Logistics and Performance of the Operating Room

A collaborative design project between
Dr. Alex Langerman, University of Chicago, and IIT Institute of Design

Project Overview

In this project we investigated pain points and probed for unmet user needs, seeking to understand how design can add value where teams, tools and the context interact in the operating room.

THE UNIVERSITY OF CHICAGO

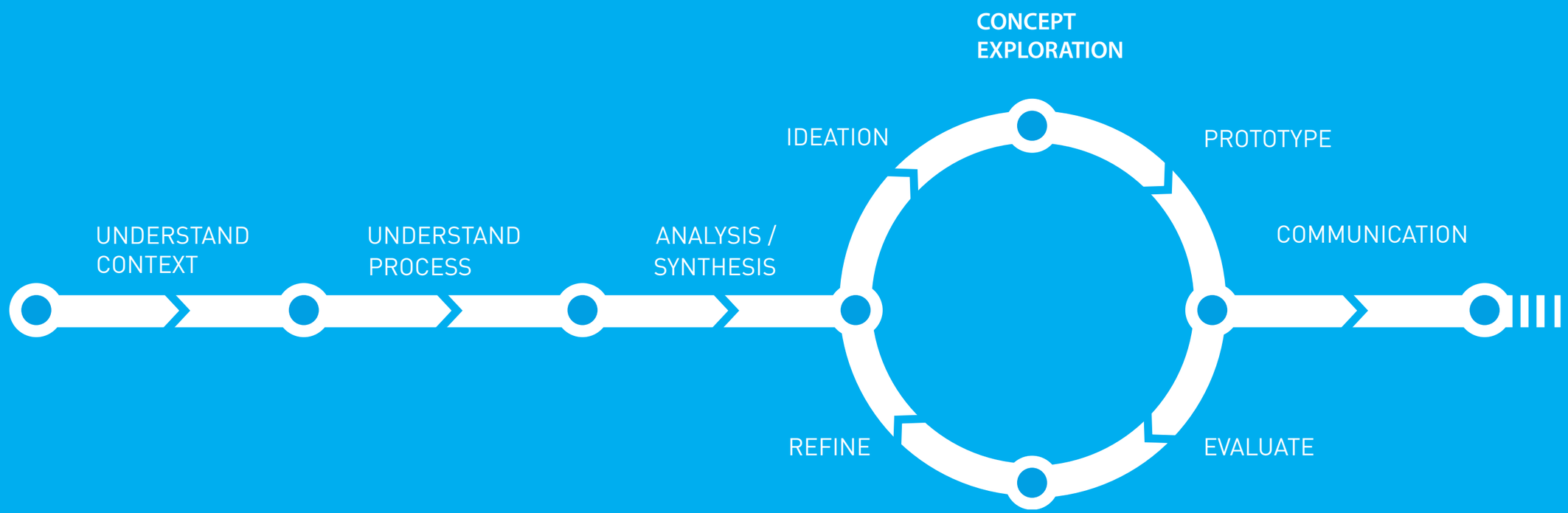
Center for Care and Discovery
State of the Art $250 million facility

Dr Alex Langerman
Chicago, Illinois

Project overview

1 Design process overview
2 Introduction to research
3 Observation
4 Analogous research
5 Guiding insights and opportunities
6 Concept exploration
7 Design concepts

Design process overview



Areas where design can contribute to healthcare

- Save money
- Help people communicate better
- Make someone's life easier
- Make the operating room safer
- Reduce complexity
- Teach better

We start with an exploration in OR

Always there

Anticipated

Back-up

Active

Always there

Research questions

What is the cycle of the surgical team?
What is the journey of supplies?
What does the OR look like with design eyes?
What does the surgical team need?
How can we improve performance?

Research activities

Observed
teams in the operating room

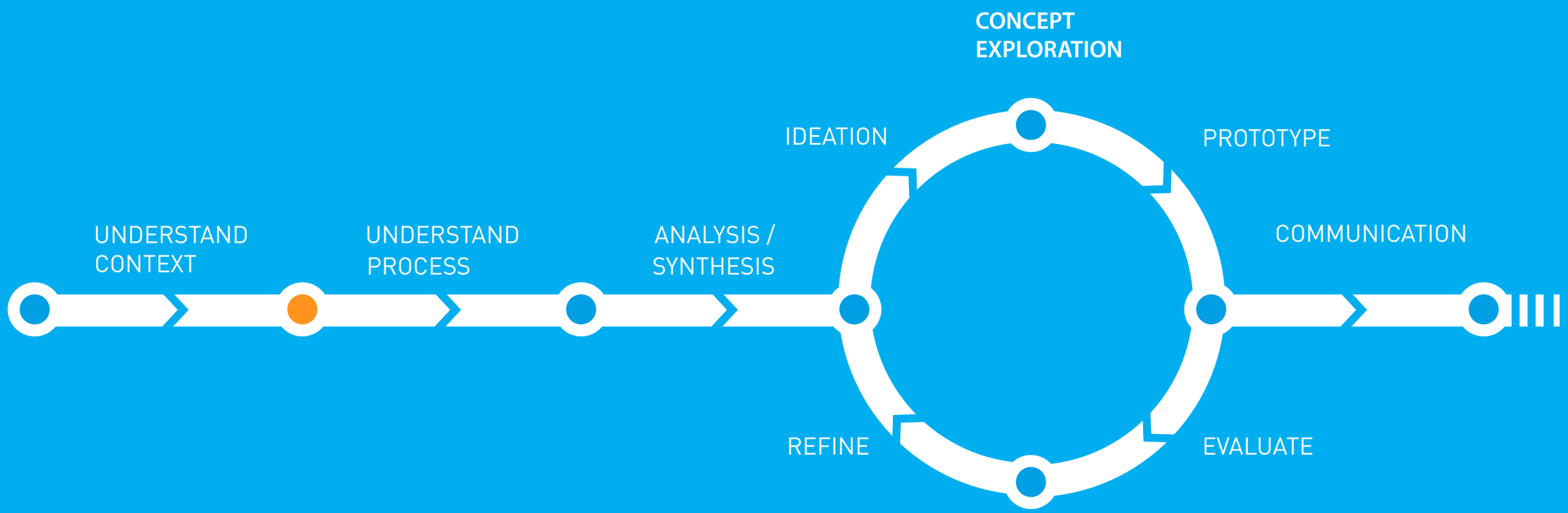
Immersed
ourselves in actual use context

Visited
analogous sites

Conducted
secondary research

Made
early prototypes

Introduction to Research



Operating room lifecycle breakdown

Room Setup

Overview:
Pre-patient, pre-doctor setup

People:
Circulator (nurse or tech)

Scrub (nurse or tech)

Specialists with equipment to set up

Engineering techs to help set up equipment

Actions:
Wipe down surfaces

Open packaging and set out most of the instruments, do all noisy setup

Inspect instruments and tools

Set up, check, and calibrate machines/ equipment, hook up screens

Scrub nurse/tech scrubs in

Set up operating table

Doctor arrives to check setup

Induction

Overview:
Get patient in and under anesthesia

People:
Surgeon

Circulator

Scrub

Anesthesiologist

Specialists

Actions:
Patient brought into room from pre-op area on hospital bed

Get patient onto the operating table

Scrub finished setting up instruments

Anesthesiologist administers anesthesia and begins monitoring patient via equipment

Positioning & Prep

Overview:
Final pre-surgery preparations

People:
Surgeon

Circulator

Scrub

Anesthesiologist

Specialists

Actions:
"Time out" to go over information about the patient and procedure with everyone in the room to ensure alignment and double-check details

Get the patient in position and perfectly arranged to ensure a smooth operation

Place drapes on the patient

Arrange the room for surgery

Opening / Exposure

Overview:
"Getting to where the surgeon needs to go inside the patient"

People:
Surgeon

Circulator

Scrub

Anesthesiologist

Specialists

Actions:
Surgeon performs first incision and gets to the site of the intervention

Scrub keeps surgeon supplied with the proper instruments, anticipate needs

Circulator replenishes supplies and handles out-of-OR needs

Specialists monitor patient and perform as needed

Anesthesiologist monitors patient and makes adjustments as needed

Intervention

Overview:
"Do the thing the patient is there for"

People:
Surgeon

Circulator

Scrub

Anesthesiologist

Specialists

Actions:
Surgeon and or specialist perform the necessary intervention

proper instruments, anticipate needs

Circulator replenishes supplies and handles out-of-OR needs

Specialists monitor patient and perform as needed

Anesthesiologist monitors patient and makes adjustments as needed

Closing

Overview:
Closing the incision and preparing the patient for removal from anesthesia

People:
Surgeon

Circulator

Scrub

Anesthesiologist

Specialists

Actions:
Remove all instruments, sponges, etc. from inside the patient

Inventory of instruments, rags, etc., X-ray to double-check

Extract tubes, suture incisions

Emergence

Overview:
Waking patient up from anesthesia

People:
Surgeon

Circulator

Scrub

Anesthesiologist

Actions:
Anesthesiologist stops administering anesthesia and continues to monitor the patient

Scrub and circulator move tables away from the patient and begin to break down instruments

Surgeon remains in room in case of patient complications'

Patient is moved to post-op area once they are awake and stable

Debrief

Overview:
"Time-out" in reverse

People:
Surgeon

Circulator

Scrub

Anesthesiologist

Specialists

Actions:
Surgeon reviews how the operation went with the people involved in the surgery and recommends follow-up and rehabilitation steps

Surgeon dictates this to the nurse's station via telephone

Breakdown

Overview:
Cleanup of surgical tools

People:
Circulator

Scrub

Anesthesia tech

Actions:
Circulator and scrub prepare all surgical implements for transport down to sterilization

Anesthesia tech cleans, checks, and re-stocks the anesthesia machine / cart

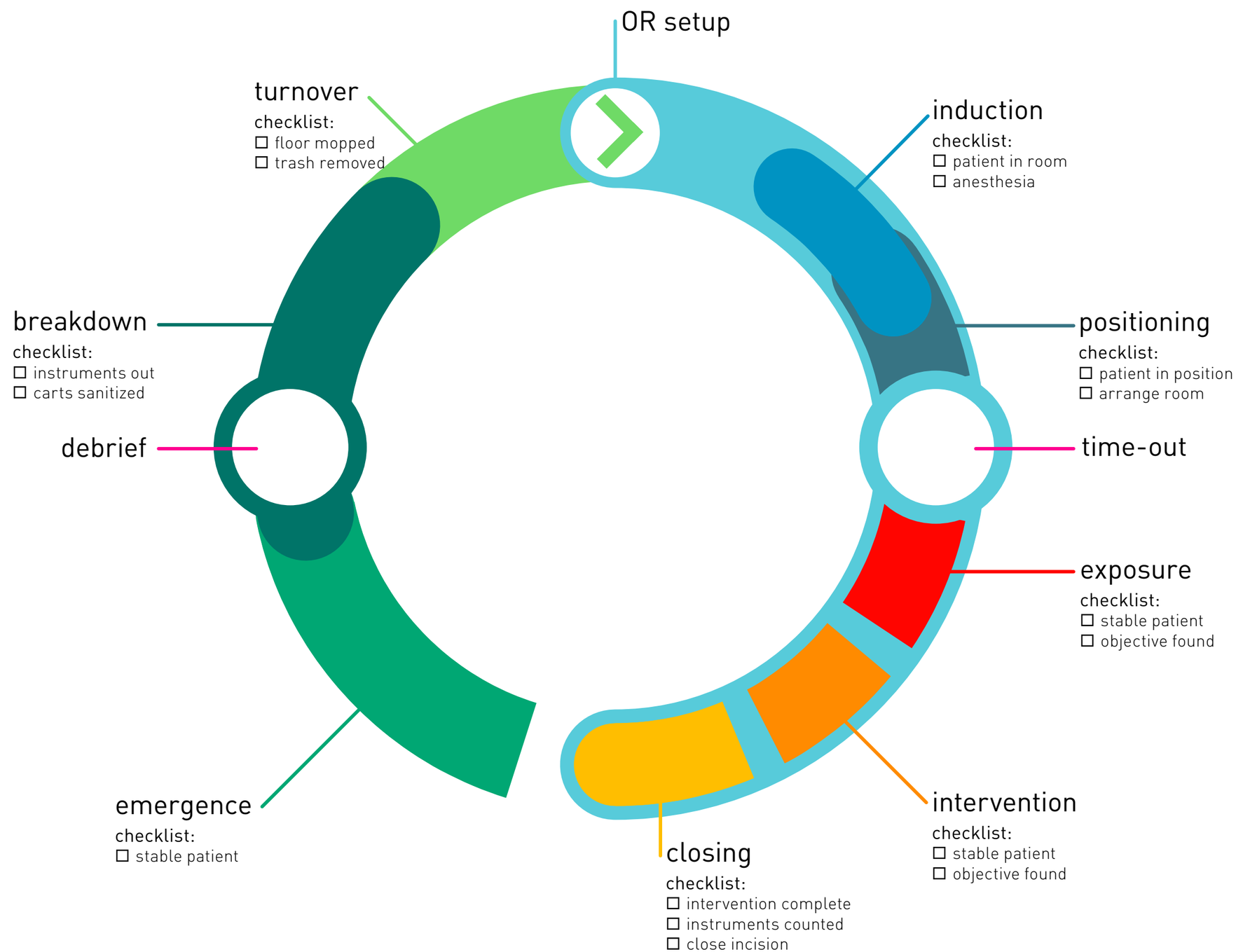
Turnover

Overview:
Getting the OR back to a blank slate

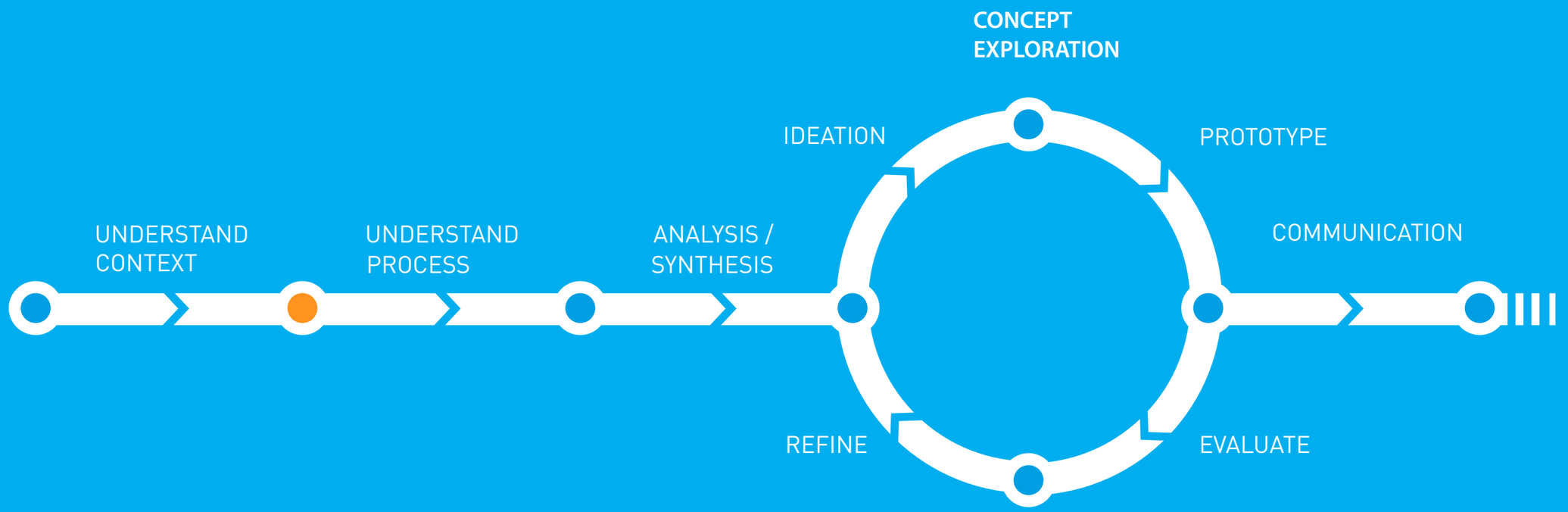
People:
Techs

Actions:
Techs mop the floor take out the trash.

Operating room lifecycle diagram



Observation



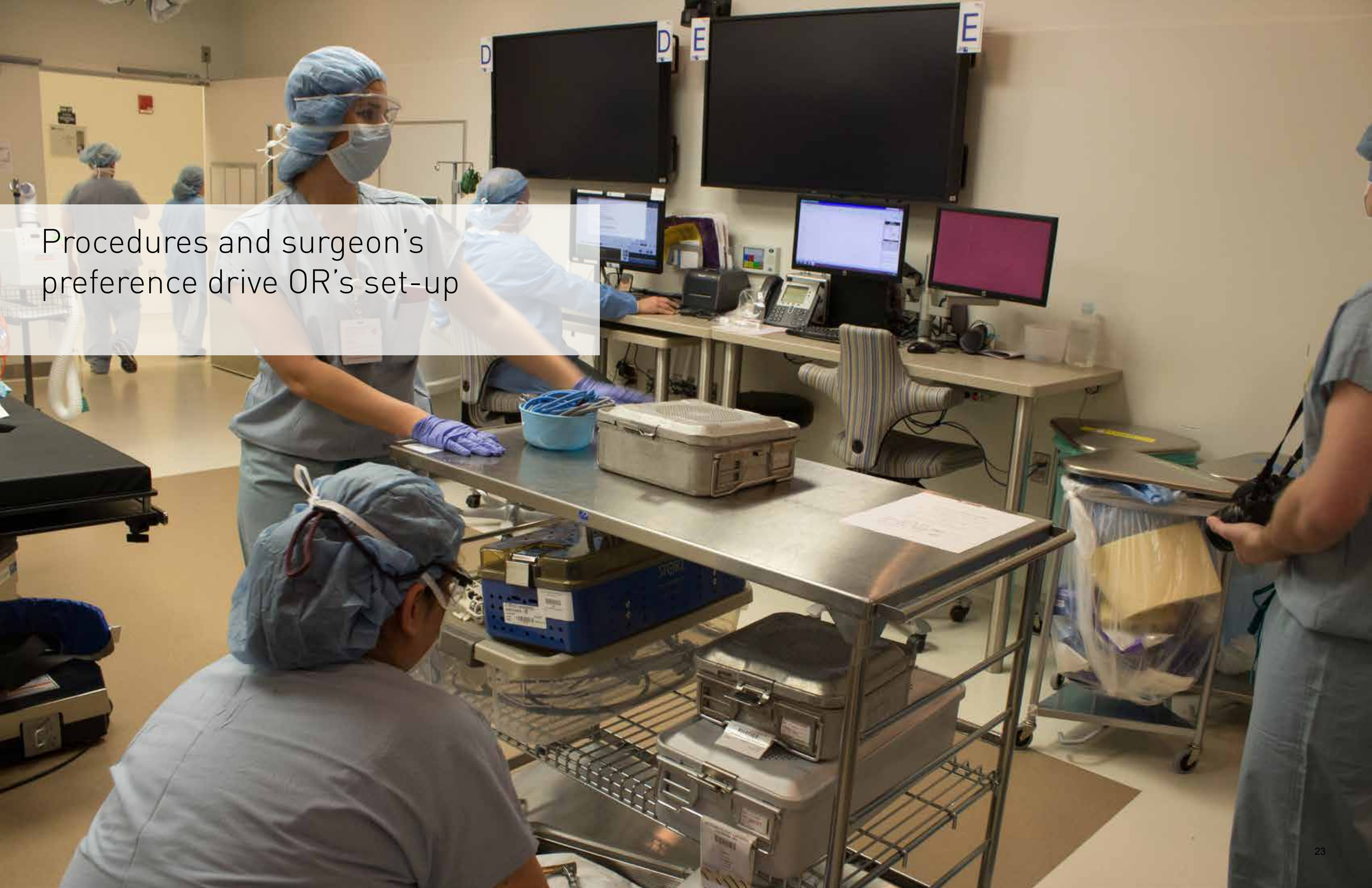
University of Chicago Hospital

100 hours observation
Center for Care and Discovery

The more customized the operation,
the more communication is needed

Complexity + Fatigue = Mistake
(missing tools, not focused)

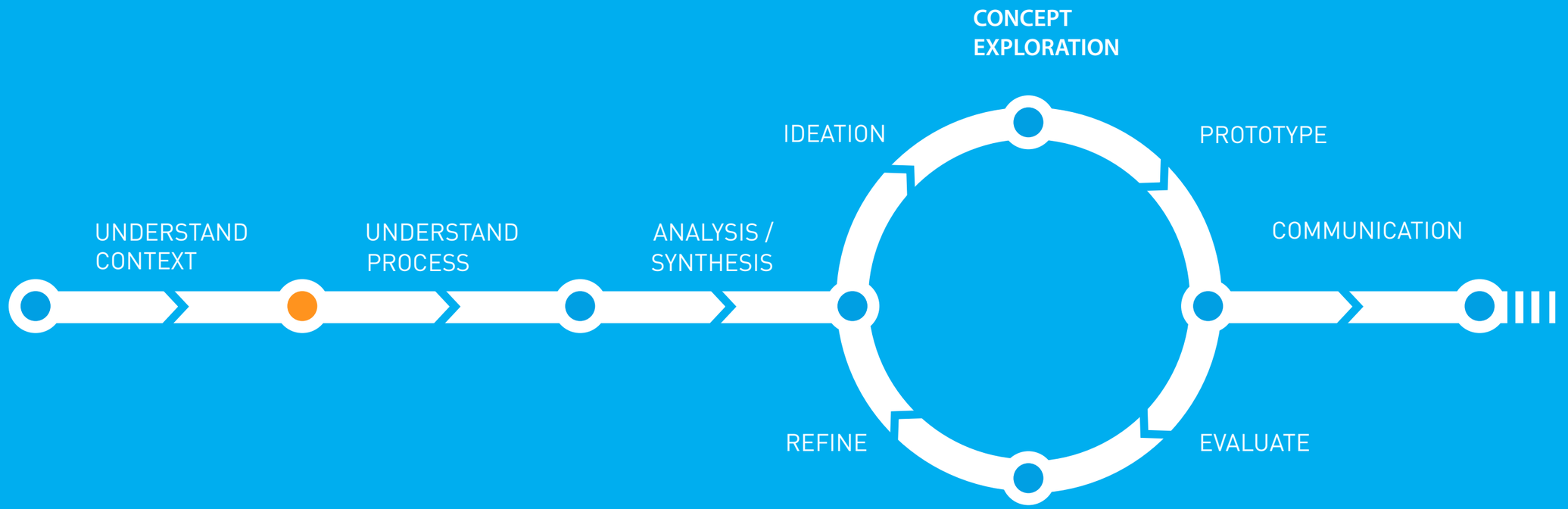
Organized OR is not a priority because surgeon and nurses do not have a sense of OR ownership



Procedures and surgeon's preference drive OR's set-up

OR accommodates equipment and supplies but not human comfort

Analogous Research



Analogous Research

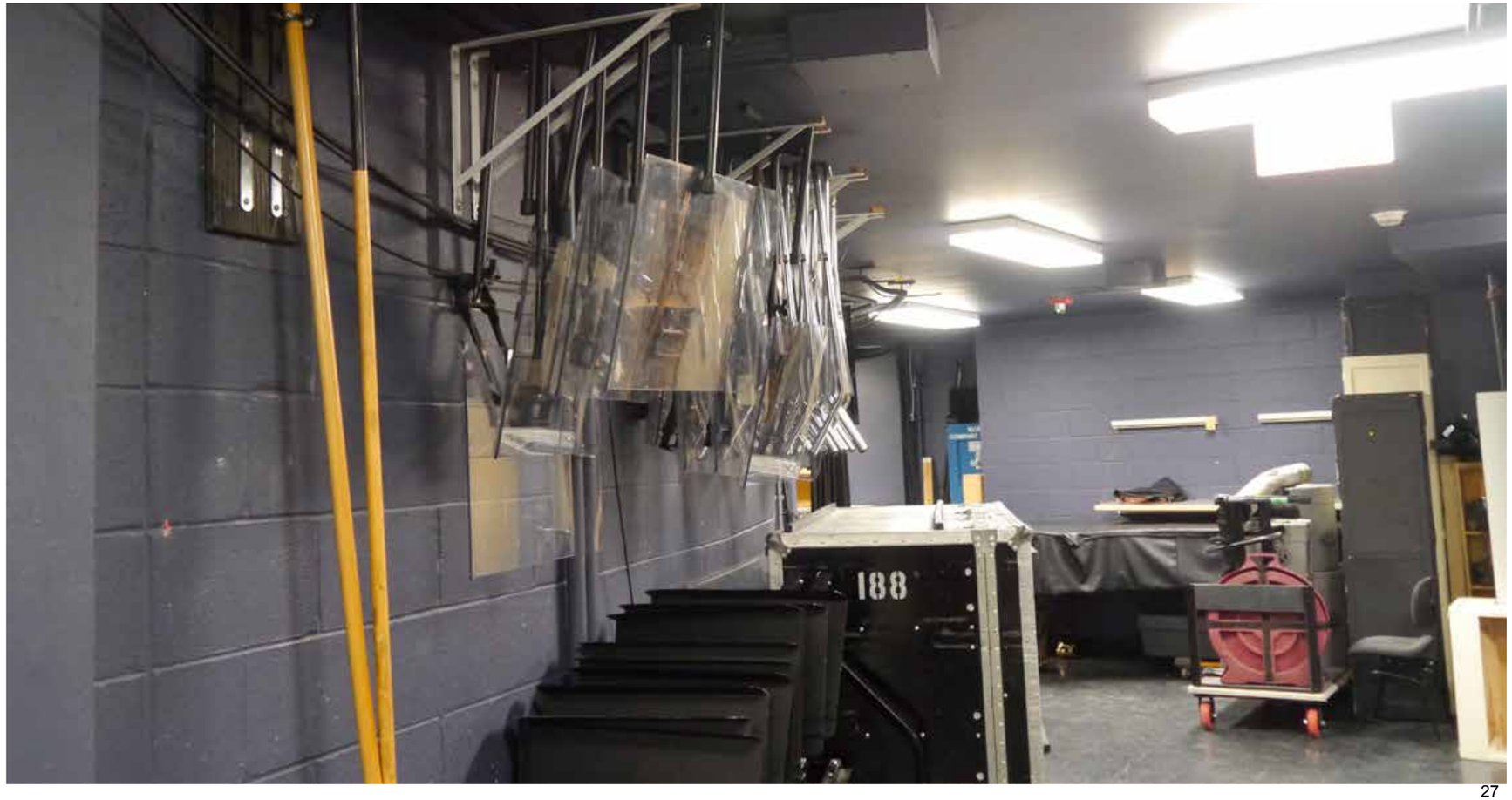
Attention to Detail
90-minute CSO Teardown / Setup

Teaching In Real-Time
Sushi Preparation Class

Flexible vs. Rigid Roles
Floriole Bakery

Attention to Detail - Chicago Symphony Orchestra

1. Storage, movement, set-up
2. Attention to detail
3. Similar but unique tasks



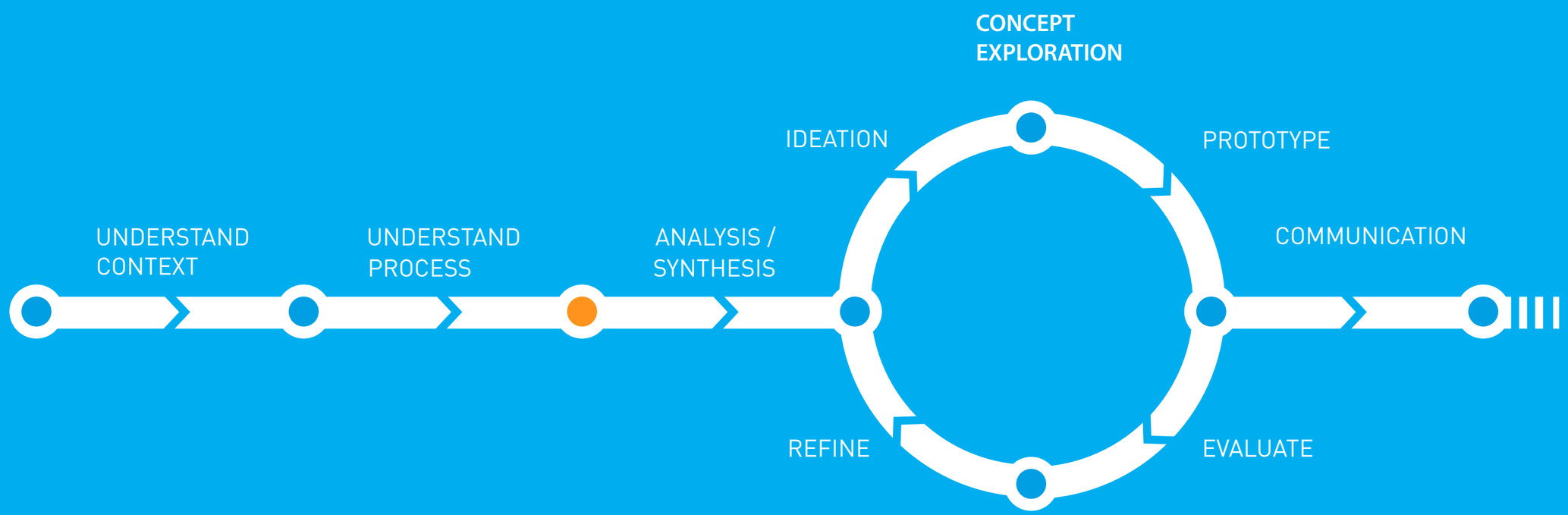
Teaching In Real Time - Sushi preparation class

1. Teaching-centric spaces
2. Assumption of prior knowledge

Flexible vs Rigid Roles - Floriole bakery

1. Monitoring overall status
2. Responsibility for debris
3. Communication strategies

Guiding Insights and Opportunities

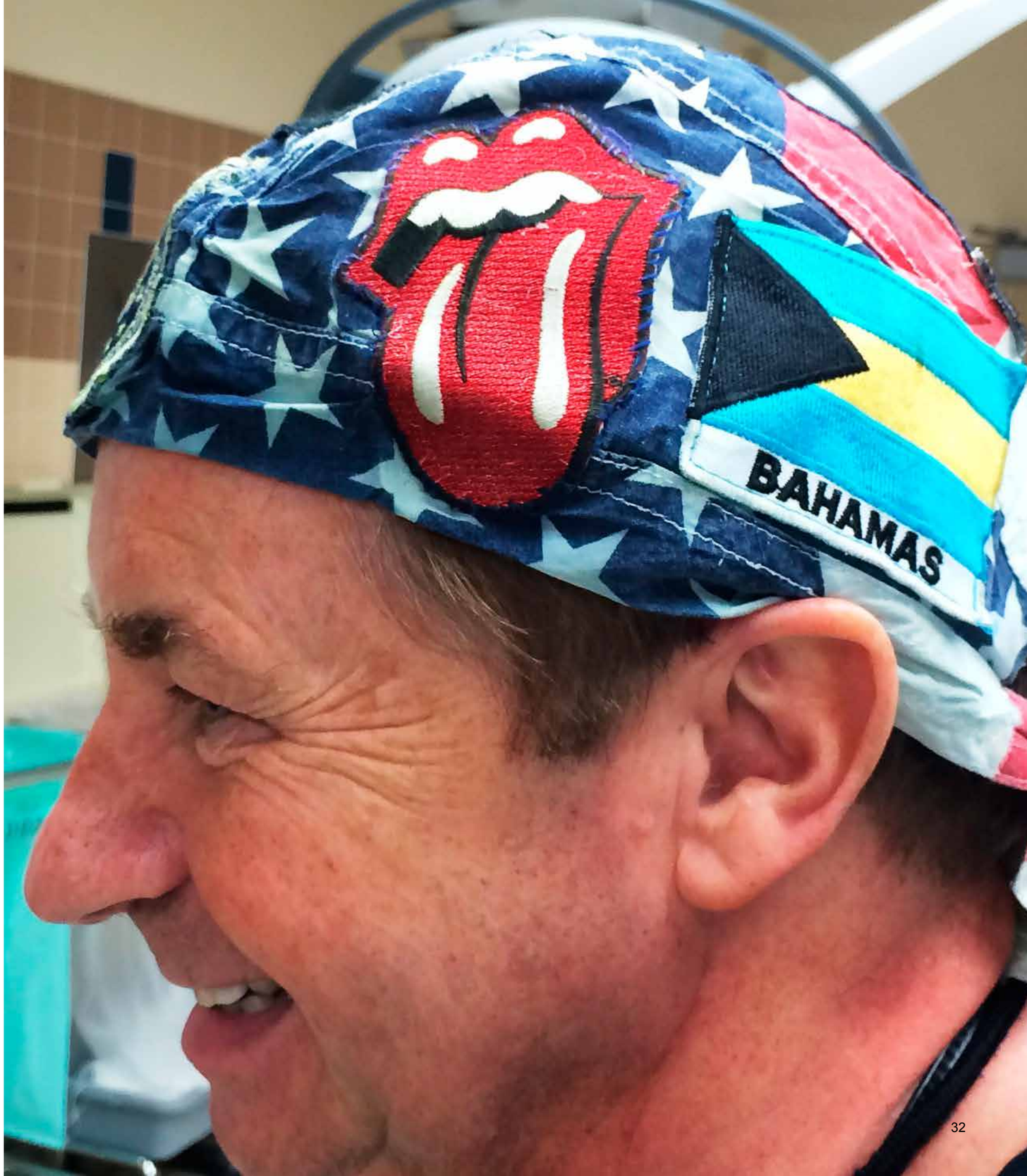


Guiding Insight 1

Visual hierarchy in tool arrangement helps nurses identify the needed item quickly. More visual hierarchy in the OR in general could reduce the cognitive load of the staff.

Guiding Insight 2

Teams enhance energy and morale by bringing human elements into the OR such as music, whiteboard drawings, etc.



Guiding Insight 3

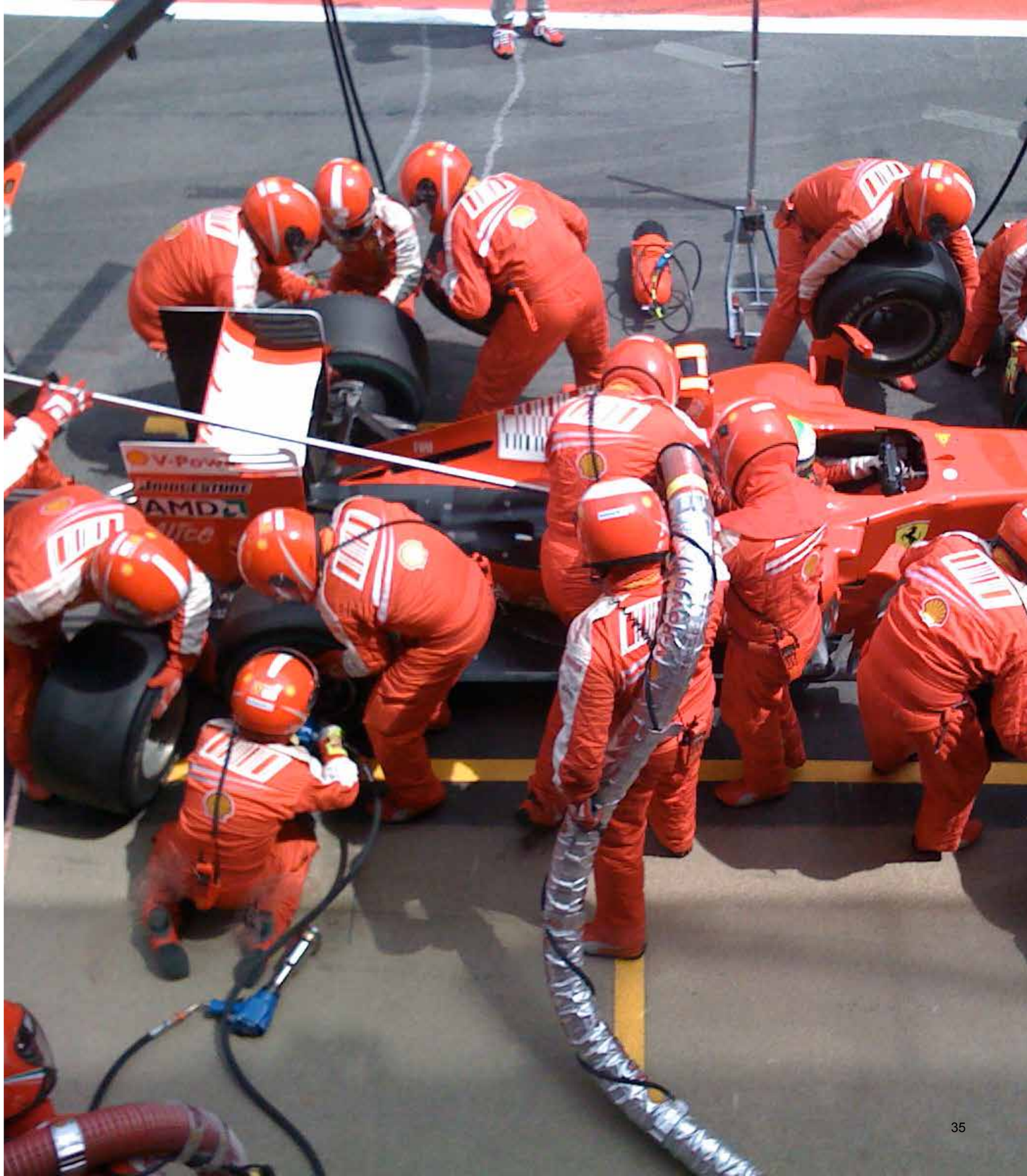
Surgery requires high situational awareness, and tools need to be laid out ahead of time so they are easily found when needed.

Guiding Insight 4

OR staff work around tools that are designed for specific surgical tasks, but not designed for the OR space.

Guiding Insight 5

The complexity of surgery requires the team to maintain a shared awareness of the surgery's overall status.



How Might We...

FACILITATE INSTANT TEAM BUILDING

IMPROVE SEARCH SPEED IN OR THROUGH VISUAL HIERARCHY

EMPOWER PEOPLE TO ENHANCE MORALE

INTEGRATE TOOLS INTO OR SPACE TO REDUCE FATIGUE

MAKE TOOLS WORK COHESIVELY

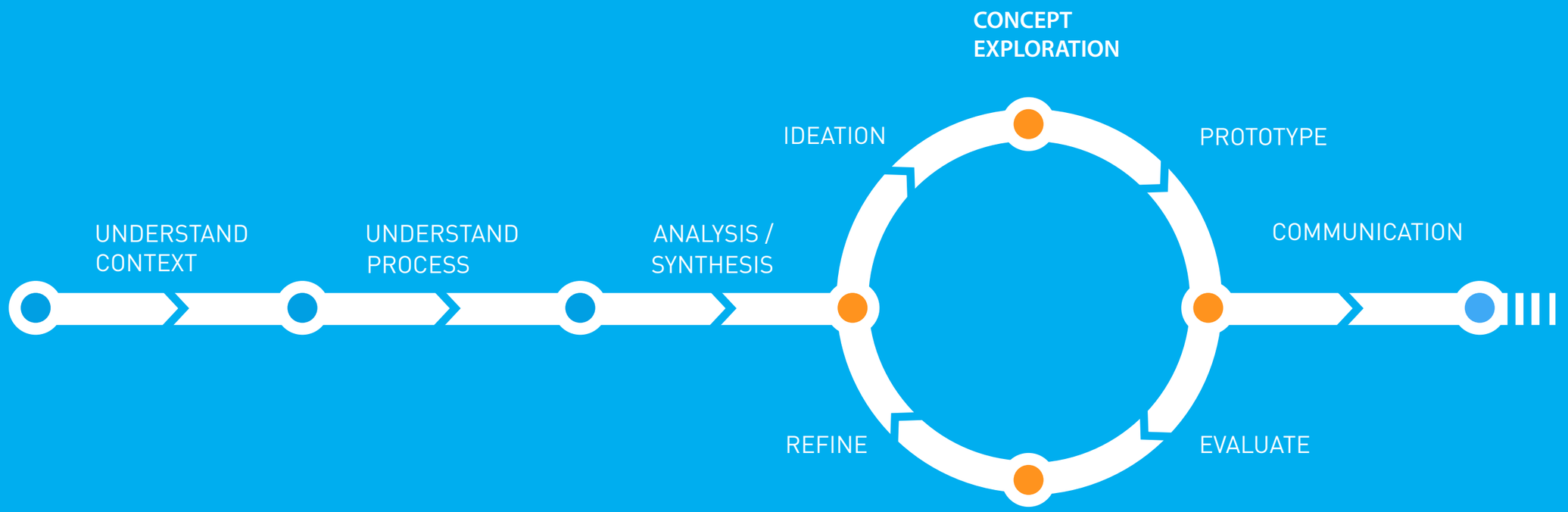
REDUCE HUMAN ERRORS WITH SIMPLIFIED STEPS

TAKE THE TASK OF SYNTHESIZING INFO IN OR OFF THE SHOULDERS OF INDIVIDUALS

DESIGN A COHESIVE LAYOUT FOR RANDOM SET UP

CREATE A LEARNING FRIENDLY OR SPACE

Concept Exploration



Concept Exploration

ID Prototype Workshop
University of Chicago Hospital Workshop

ID Workshop

First concept introduction and iteration

UC Hospital Workshop

Full day workshop in hospital
50+ surgeons, nurses, staff came and gave feedbacks

Is this realistically usable?

Would this disrupt sanitation?

How do we improve our design?

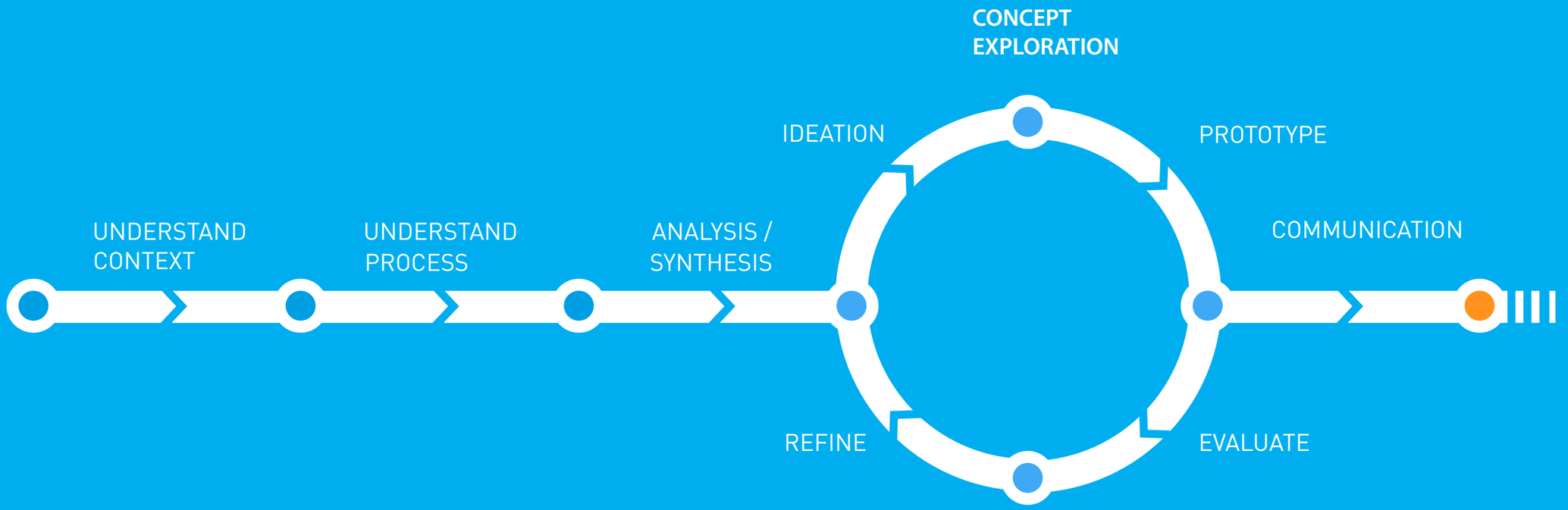
How would this change the way
you communicate ?

Learnings from workshop

Smart Table

Learnings from workshop

Design Concepts



Design Concepts

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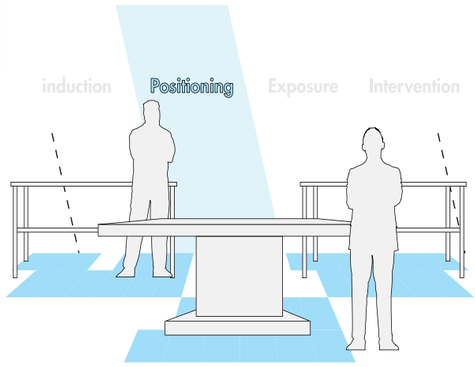

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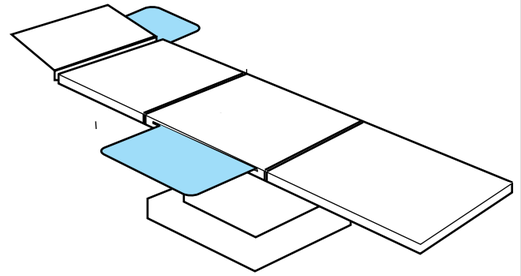

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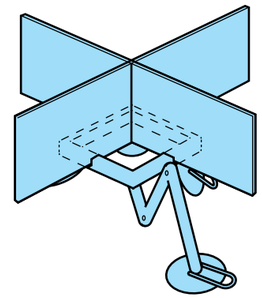

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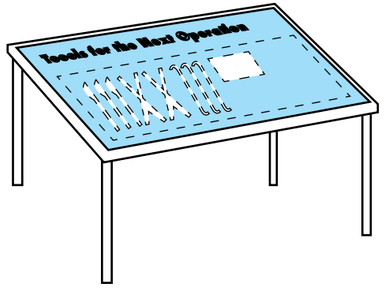

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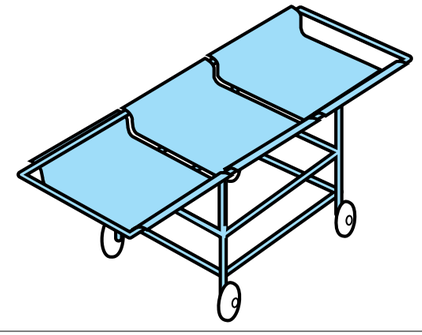

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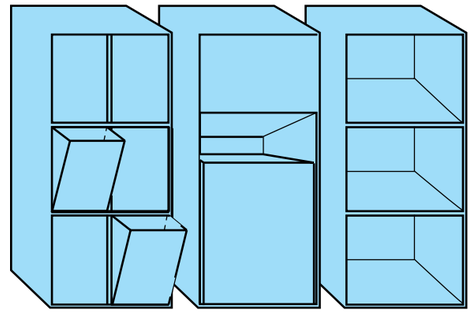
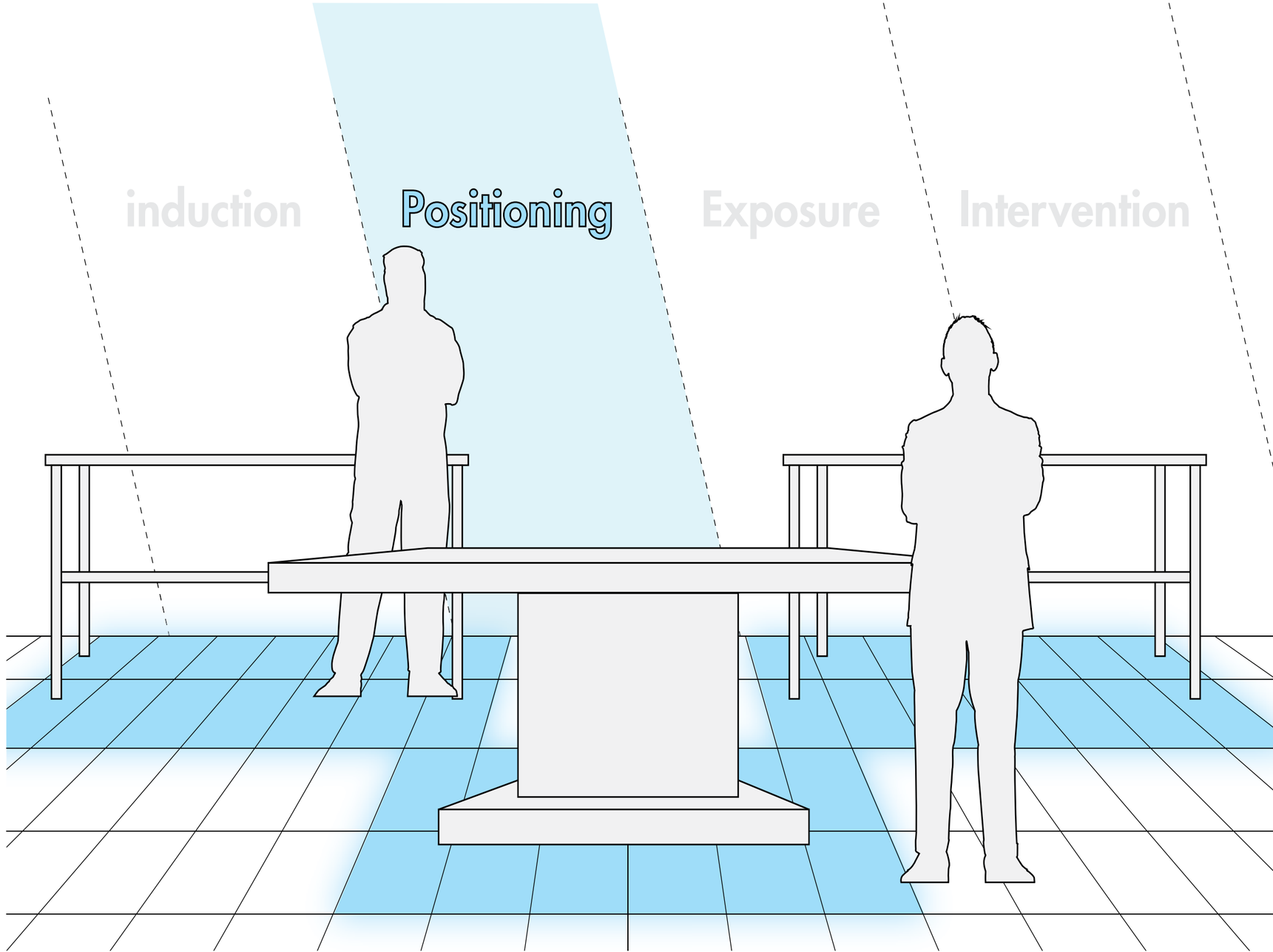


1

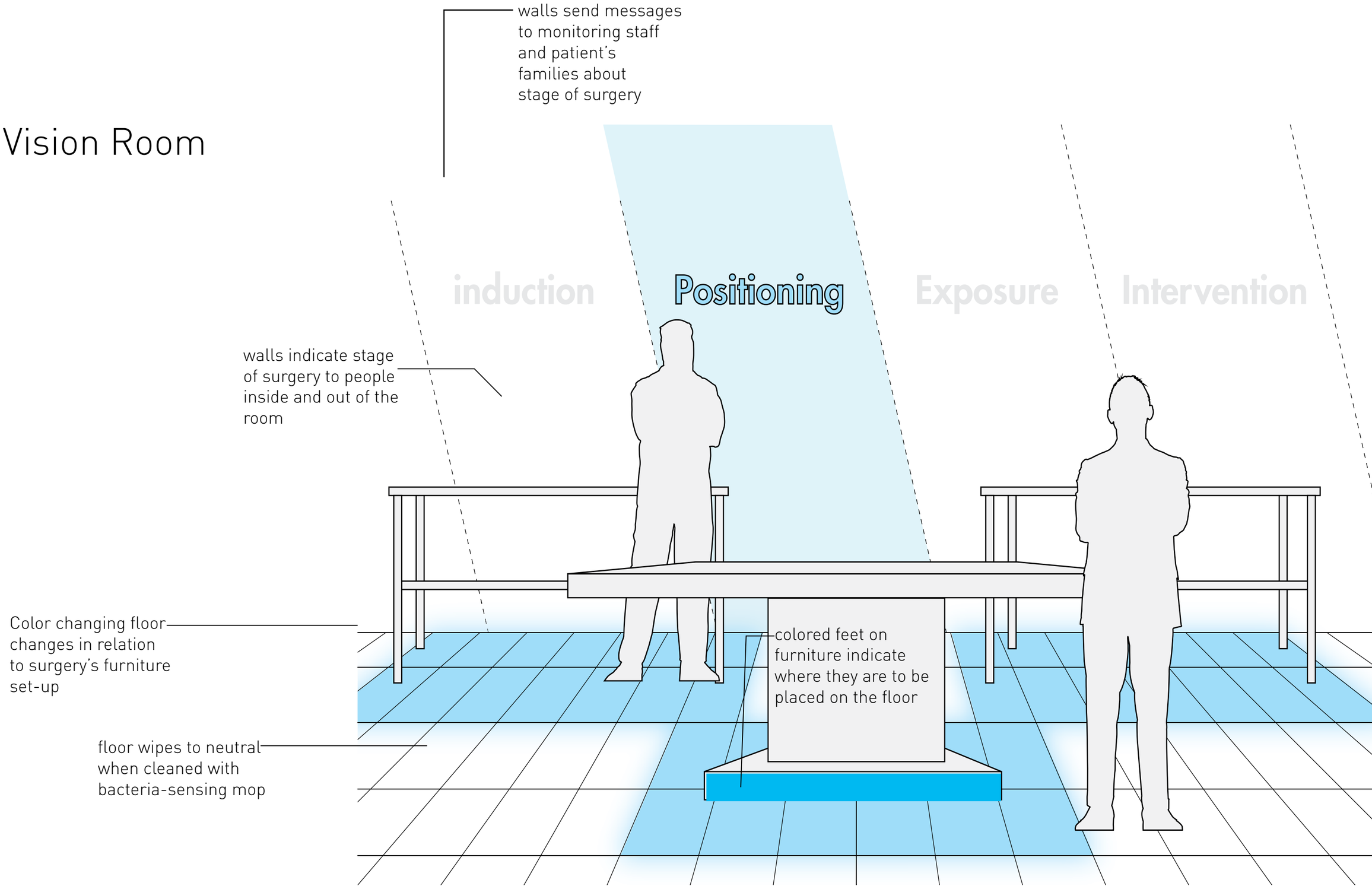
Bright Vision Room

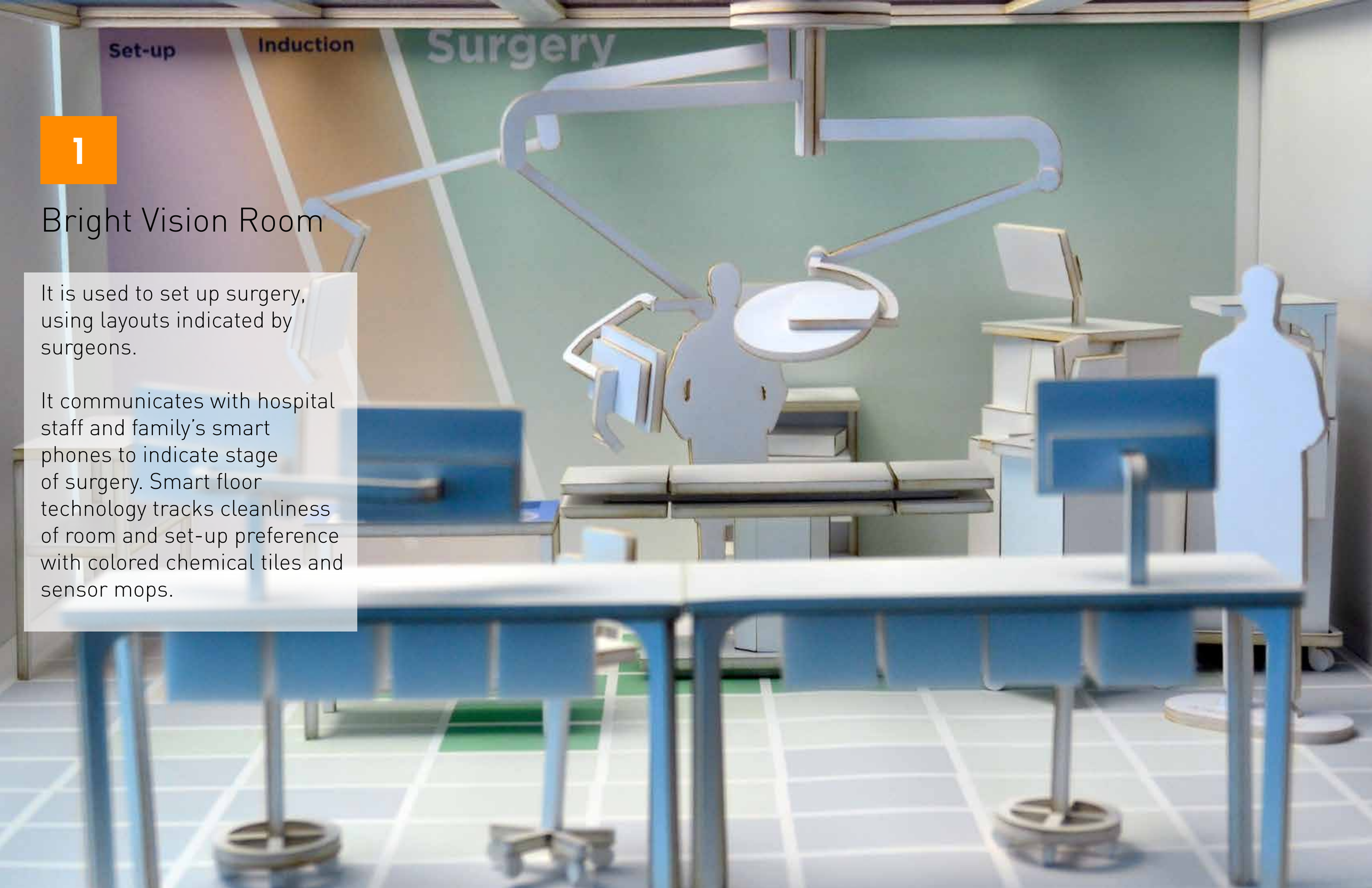
What if the operating room itself could be a checklist? The Bright Vision Room turns the operating room's floors and walls into communicators that organize the activities of the room inside and out....



1

Bright Vision Room





1

Bright Vision Room

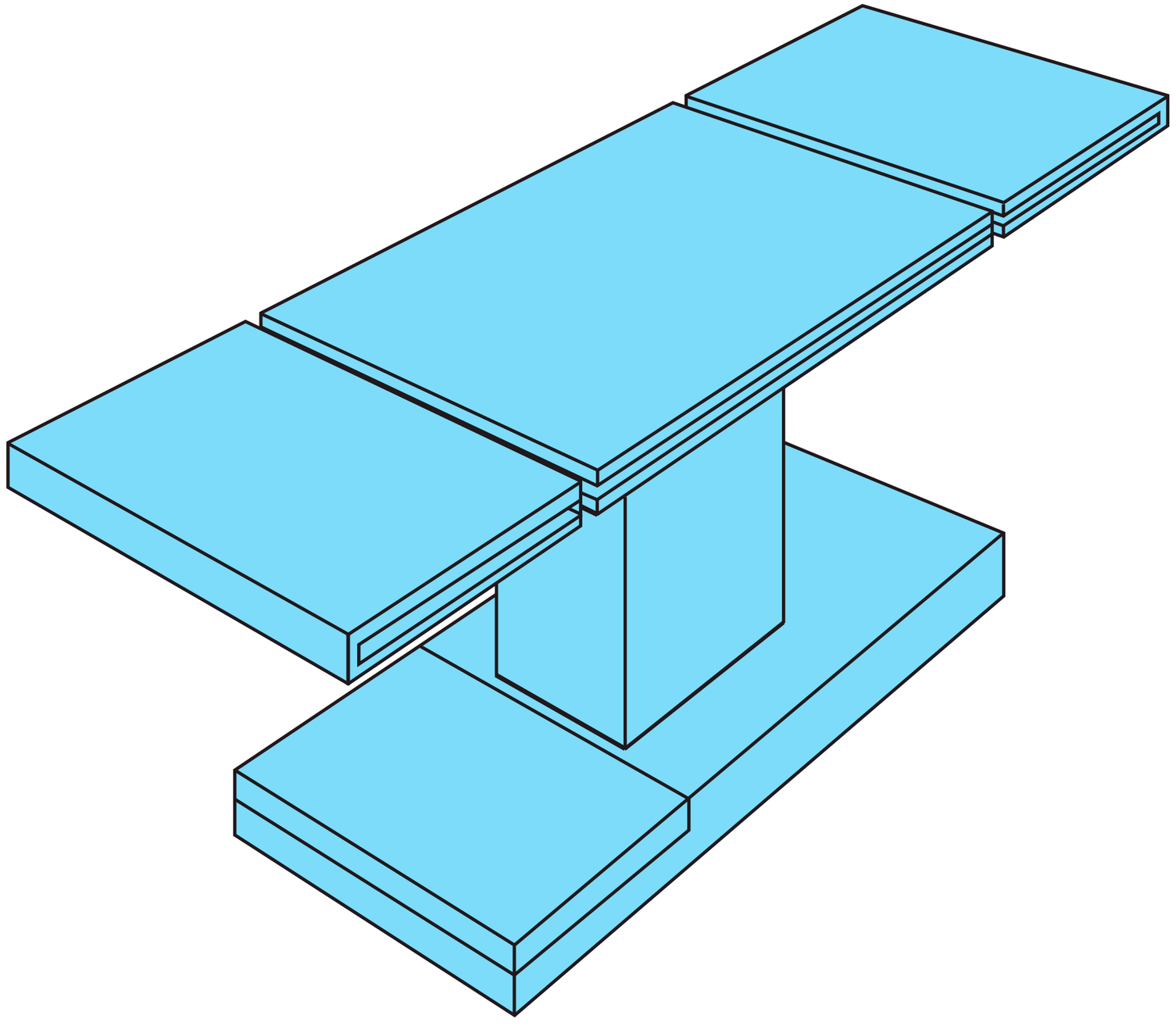
It is used to set up surgery, using layouts indicated by surgeons.

It communicates with hospital staff and family's smart phones to indicate stage of surgery. Smart floor technology tracks cleanliness of room and set-up preference with colored chemical tiles and sensor mops.

2

OR Table Platform

This bed platform is flexible. It is changeable and adaptable depends on types of operation or preferences of surgeons. It provides optimal operation environment.



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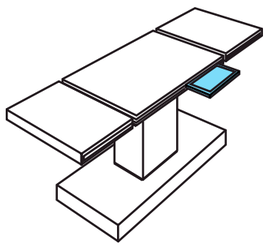
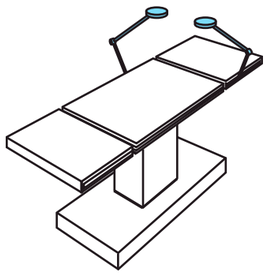
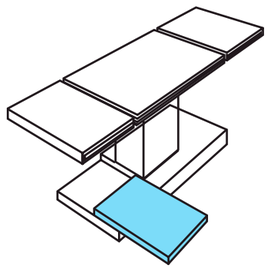
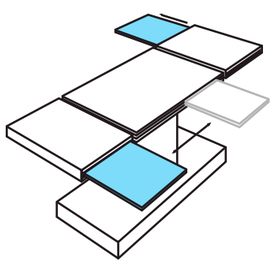
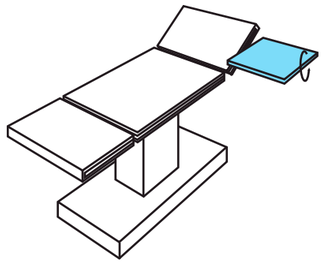
OR Table Platform

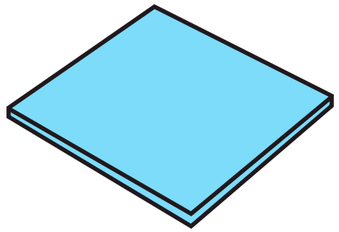




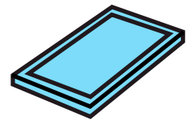




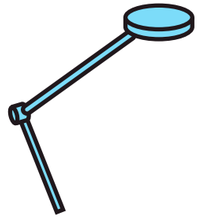




Movable Tray

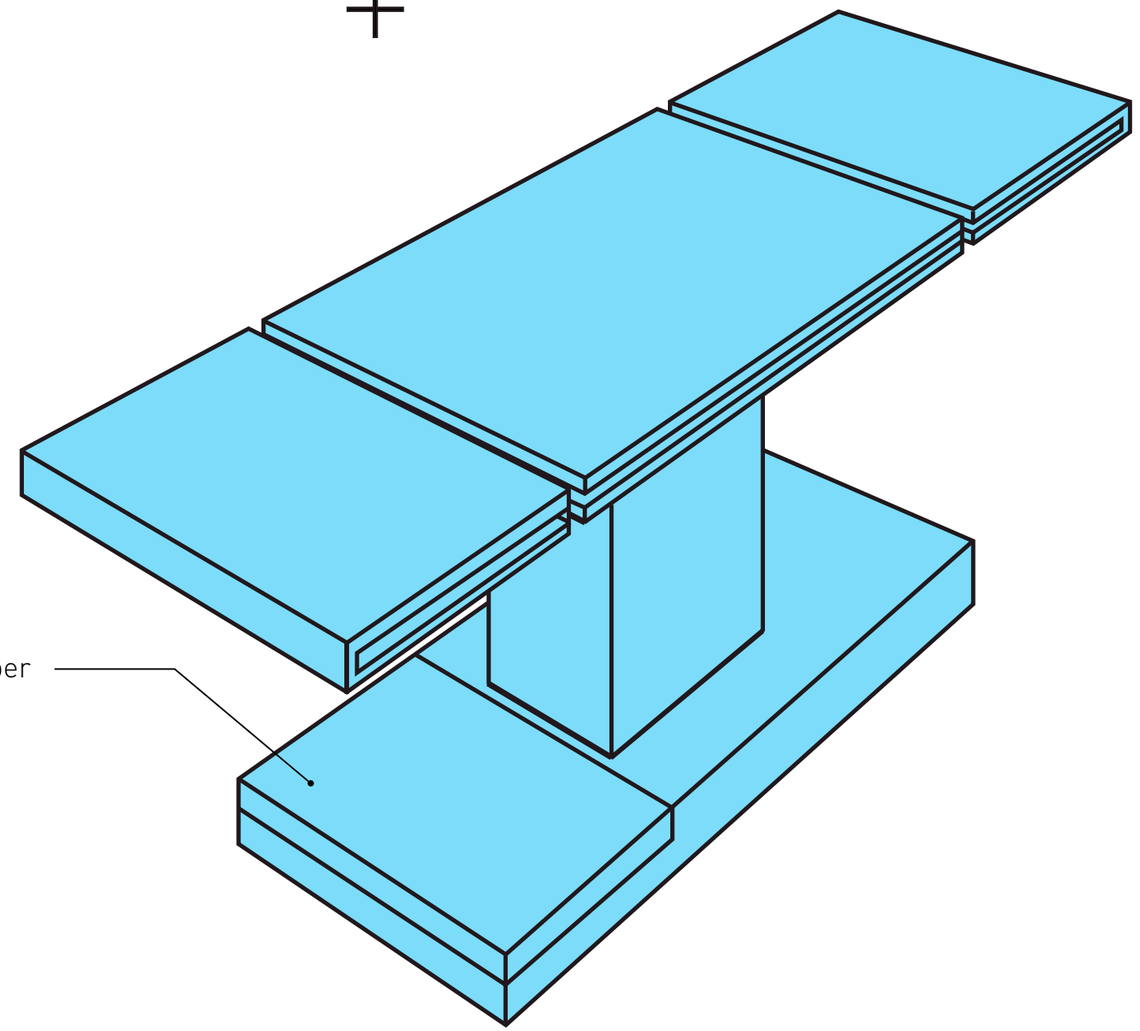


Control panel



Secondary lights

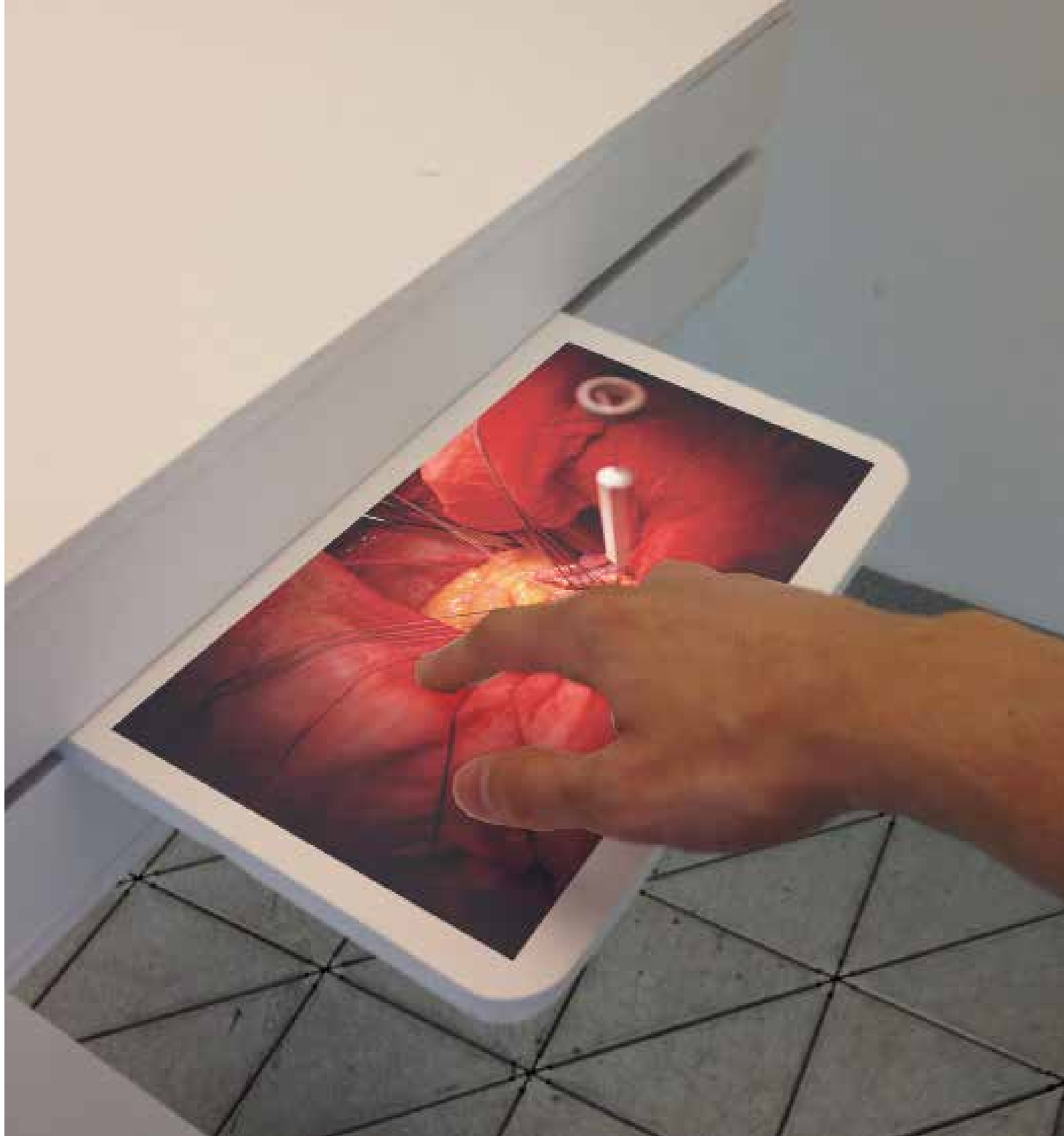
+



2

OR Table Platform

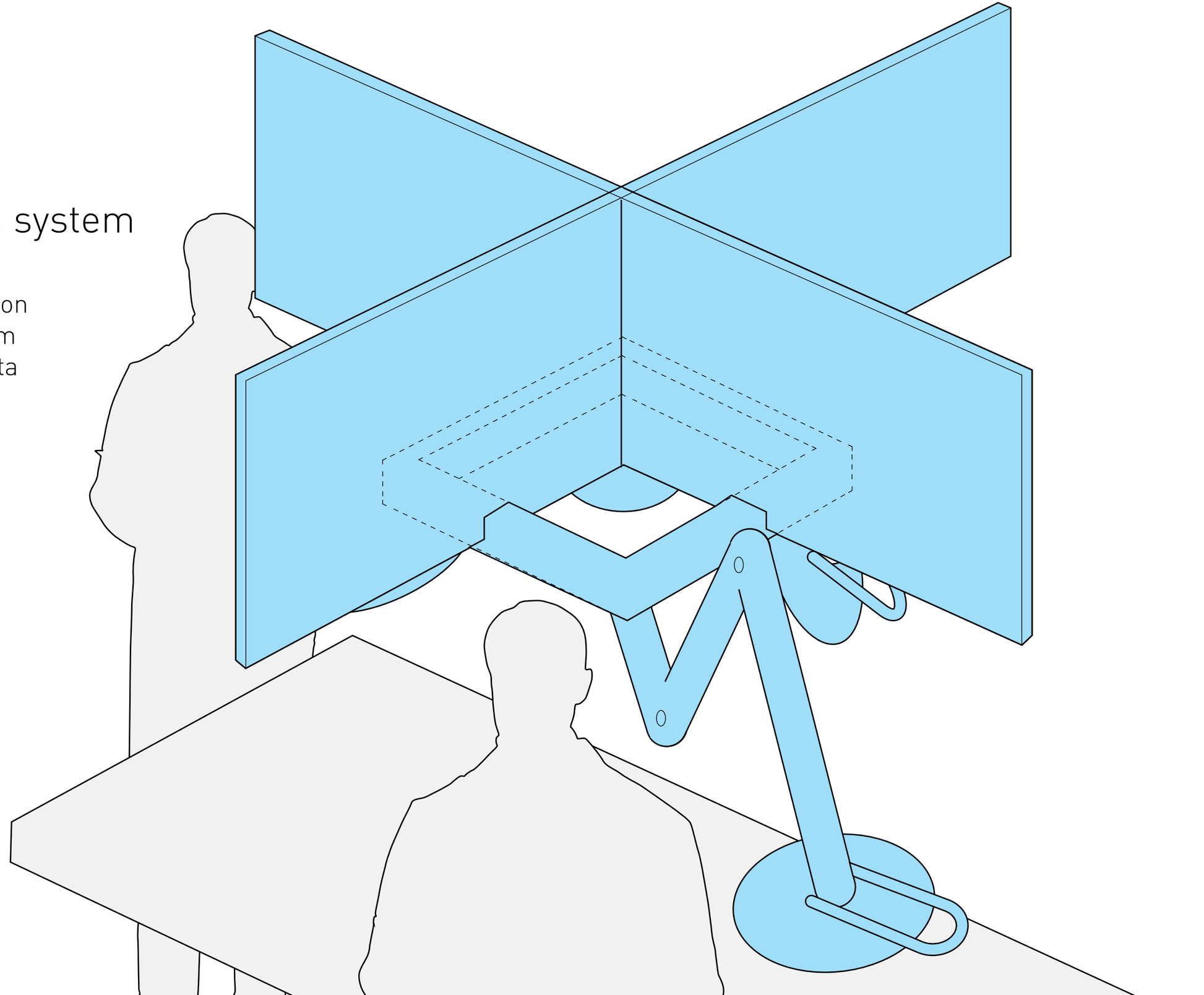
Surgeons are able to control the screens above the OR table through this control panel, so that nurses or students can see where the surgeon is indicating during a teaching moment . Also, the control panel is connect to the tool cleaning room on the basement. If surgeons ask a specific tool they need to use, through image sharing, surgeons are able to make sure the right tool is being brought up.



3

Central Information system

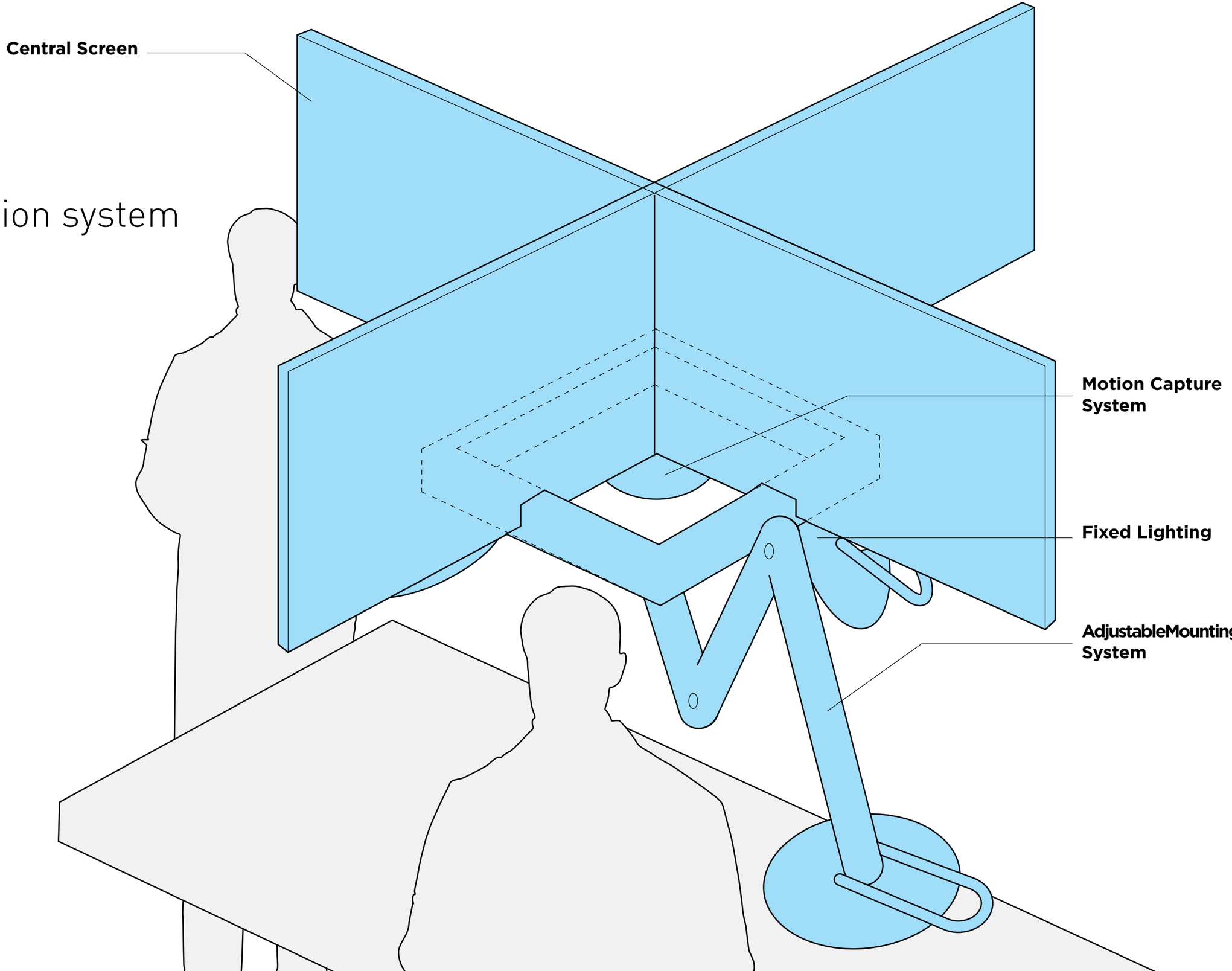
Centralizing critical information give everyone around the room a single source for shared data and is placed at the focus of activity.



3

Central Information system

Central Screen
Motion Capture System
Fixed vs. Adjustable
Mounting System



3

Central Information system

By aggregating the screen to the patient table, the OR team can focus attention to the operation instead of gazing around the room for important information.

A motion capturing “black box” records surgery for later review and teaching purposes.

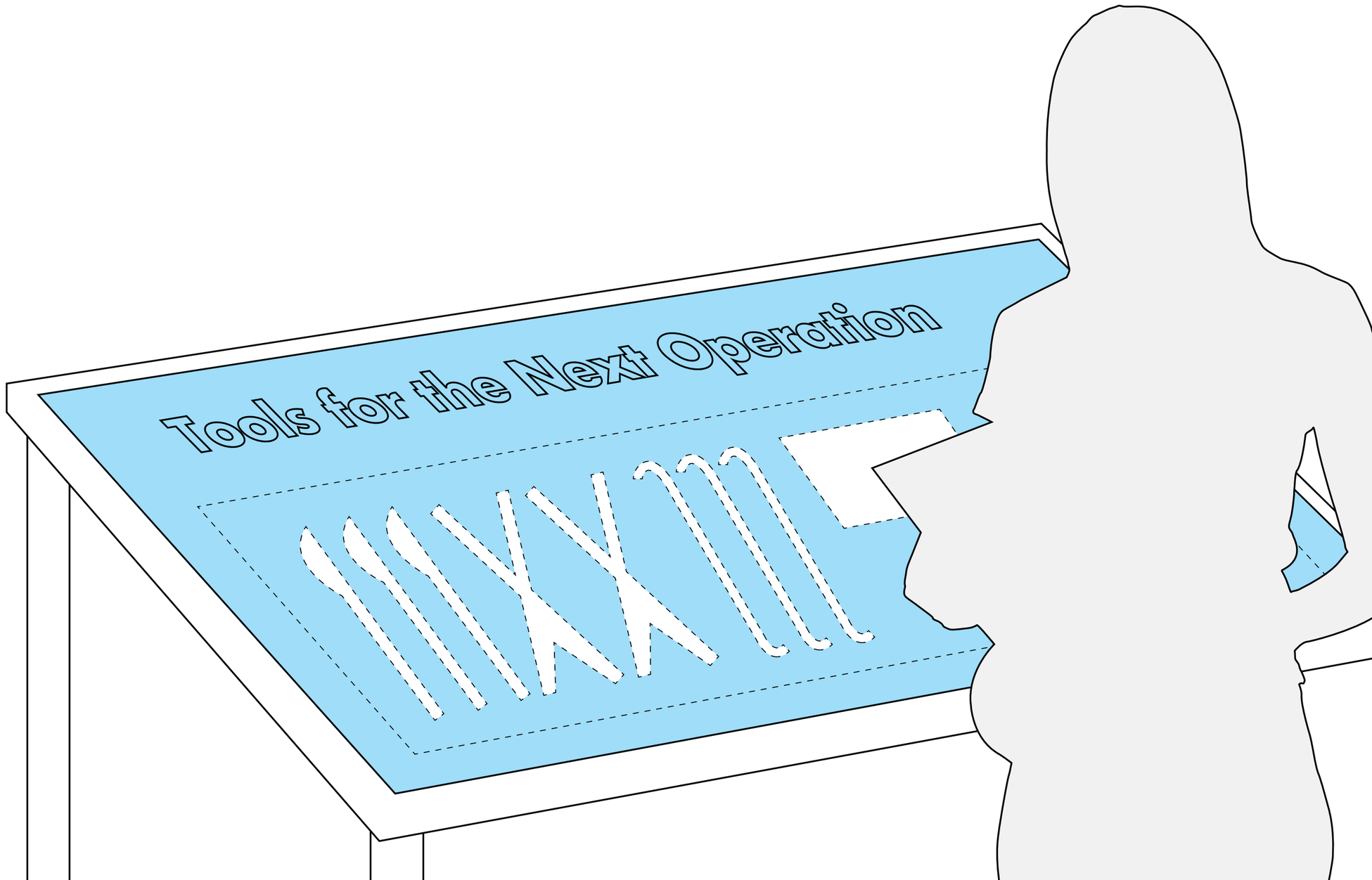
Reducing the number of adjustable lights cleans out the OR space to reduce the sense of clutter and confusion. With a modular mounting system, doctors can rerquest “plug and play” lighting and information systems for specialized surgeries.

4

Smart Table

Setting up the tools for an operation takes up valuable OR time and mastery of this process requires deep knowledge of operations and the surgeons' preferences.

We believe that the back table should go from passive furniture to active team member by aiding the scrub team throughout the operation.



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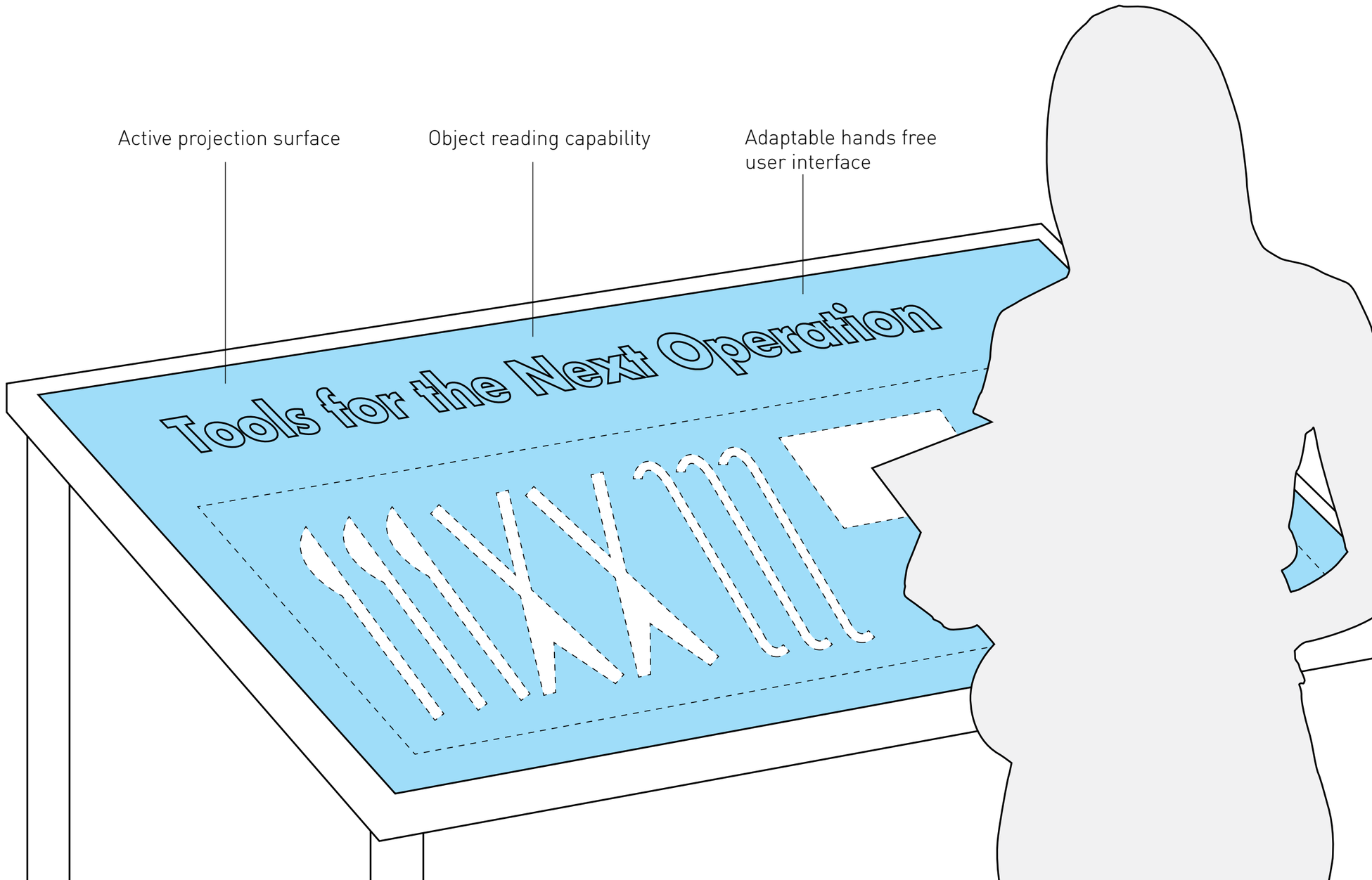
Smart Table



4

Smart Table

Active projection surface displays ideal tool layout based on operation and surgeon preference.

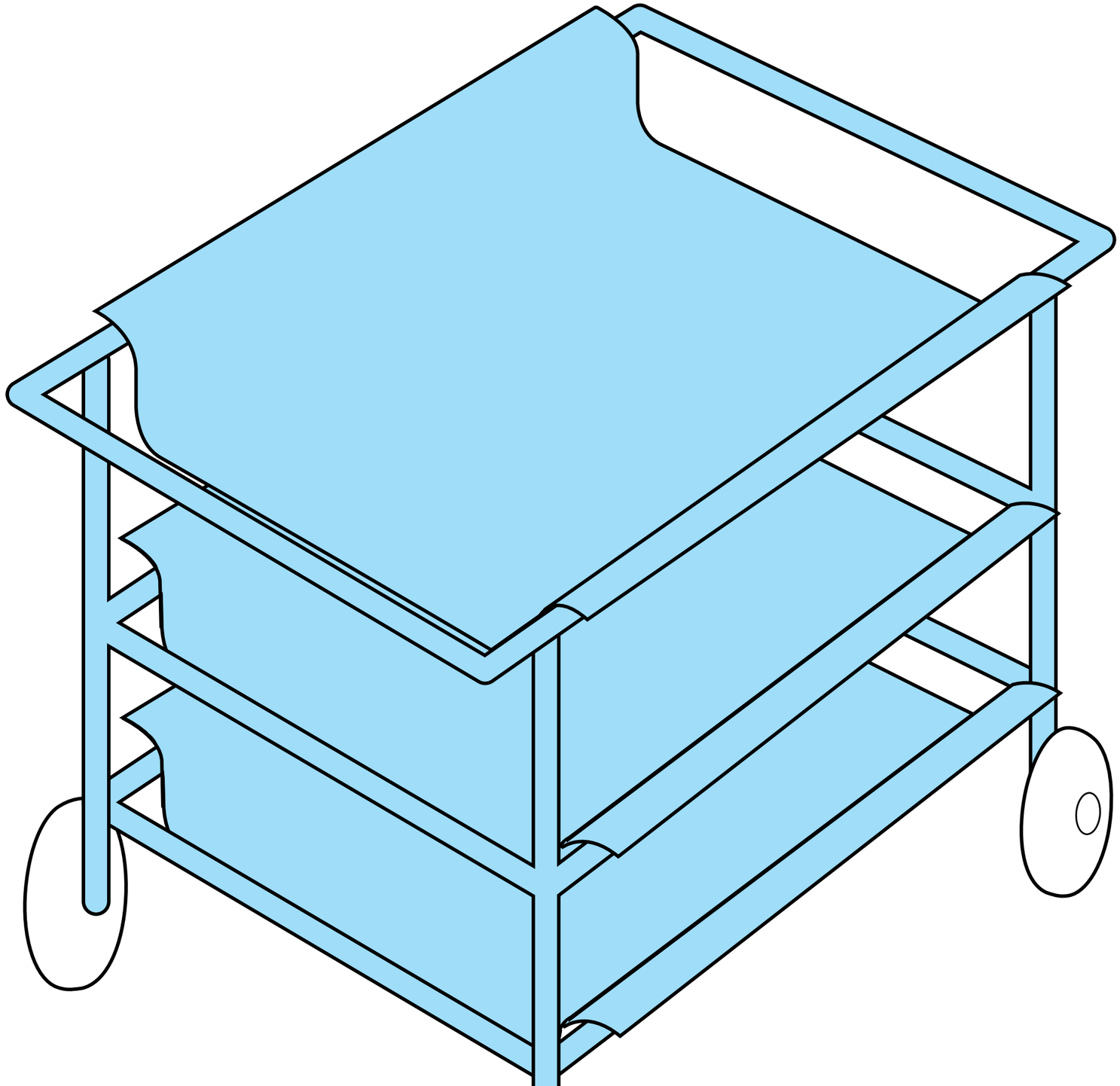
Camera provides feedback to track tools and layouts.

Tool usage and layouts will save to database for preferences and analytics.

5

Pluscart

Complex operations require more tools, ultimately bringing in more carts and adding complexity to the operating theater. By augmenting the standard cart with the ability to expand it's usable surface, we can use fewer carts for more complex operation.



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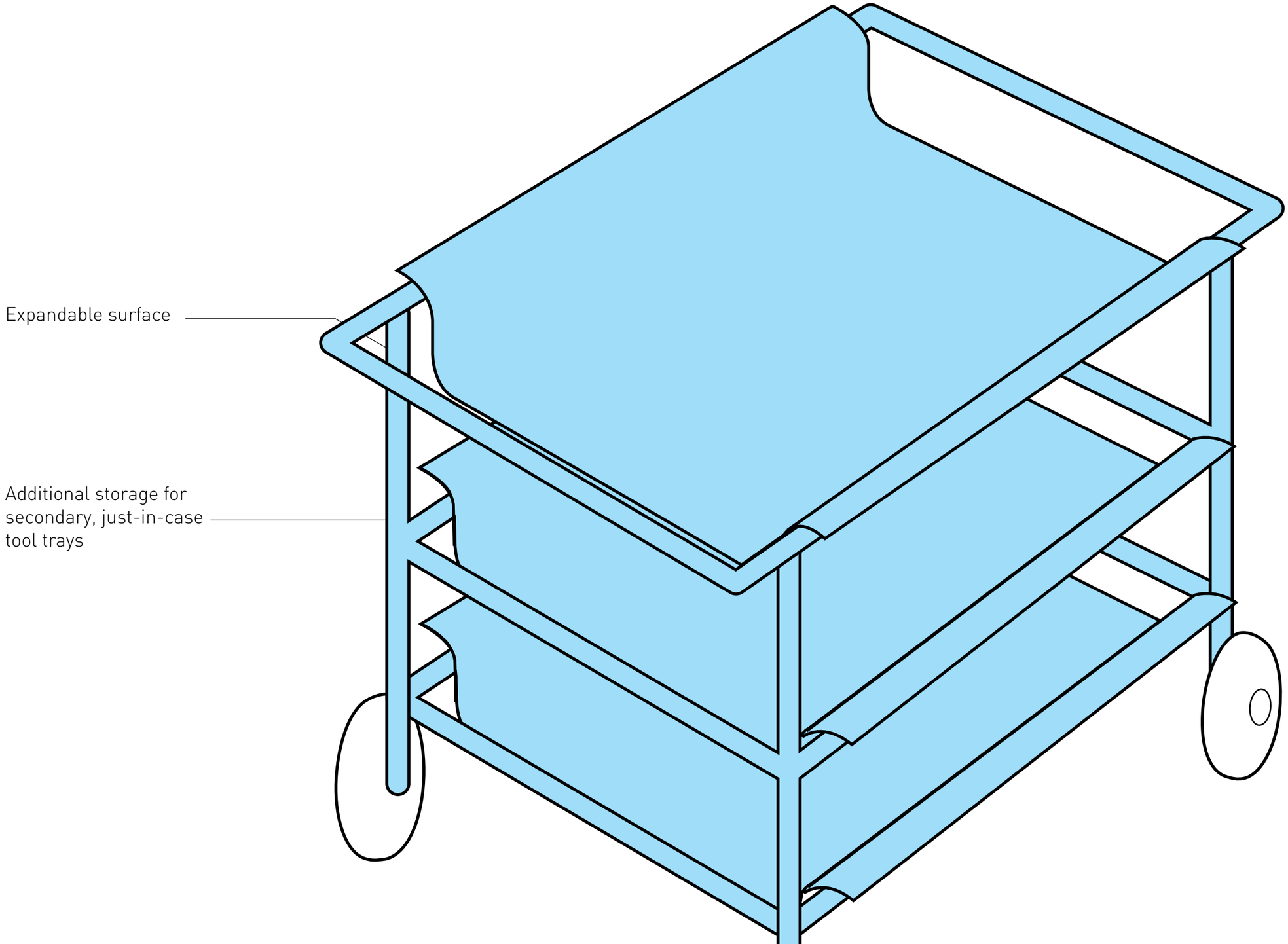
Pluscart


Expandable surface
Additional storage for secondary, just-in-case tool trays

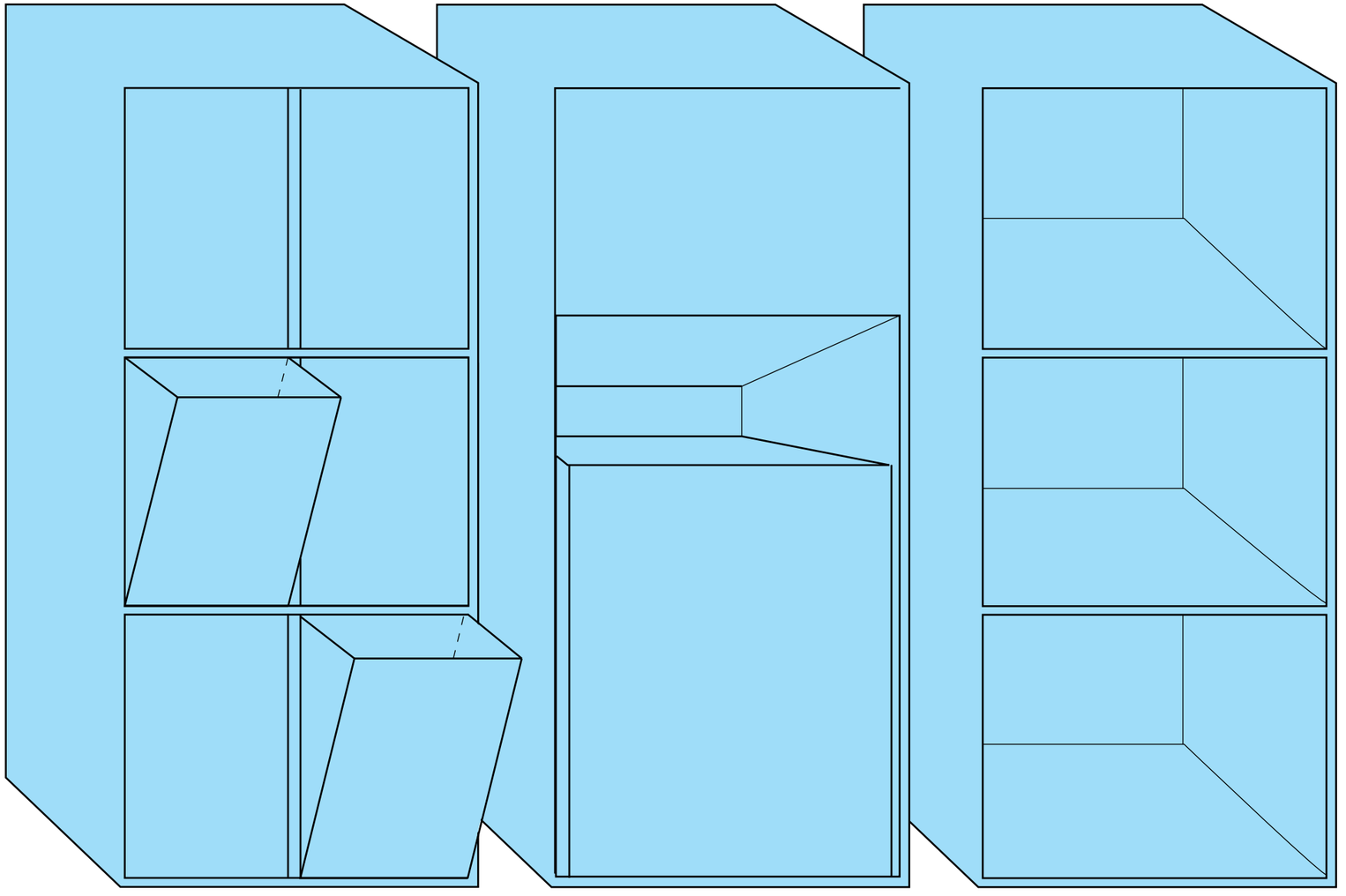
5

Pluscart

6

Backstage Elements

Taking items common to all ORs-- trash receptacles, sutures, personal storage-- and building them into a system reduces cognitive load on staff members and introduces elements of consistency to a situation in which “every surgery is unique.”



Personal Storage

Integrated phone charging
Writable whiteboard surface

Trash Receptacle

In-unit bag storage
RFID sensor detects discarded instruments

Emergency Kit Storage

Color-coded categories
Separated by nature of emergency

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Backstage Elements

Consistent visual language

Moves secondary or just-in-case items to the background

Next Step

- Review with surgeon, OR staff, hospital management
- Concept evaluation with stakeholders
- Feasibility study
- Final prototype
- Implementation plan
- Final proposal to hospital management

Thank You

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