MEP System Design for Infection Control

Air Entrainment

CFD Modeling/Air Dispersion Studies

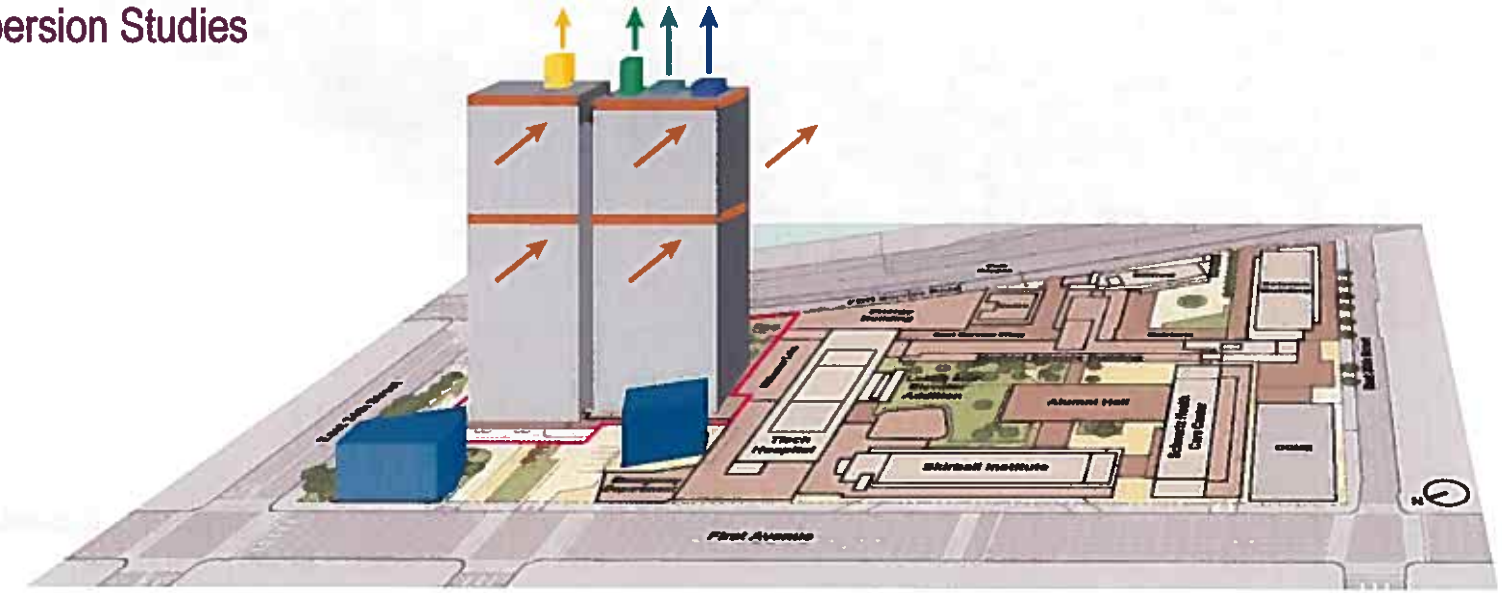
Generator Exhaust

Cooling Towers

Cogen Stack

All Exhaust Fans

Amtrak Vent Towers



MEP System Design for Infection Control

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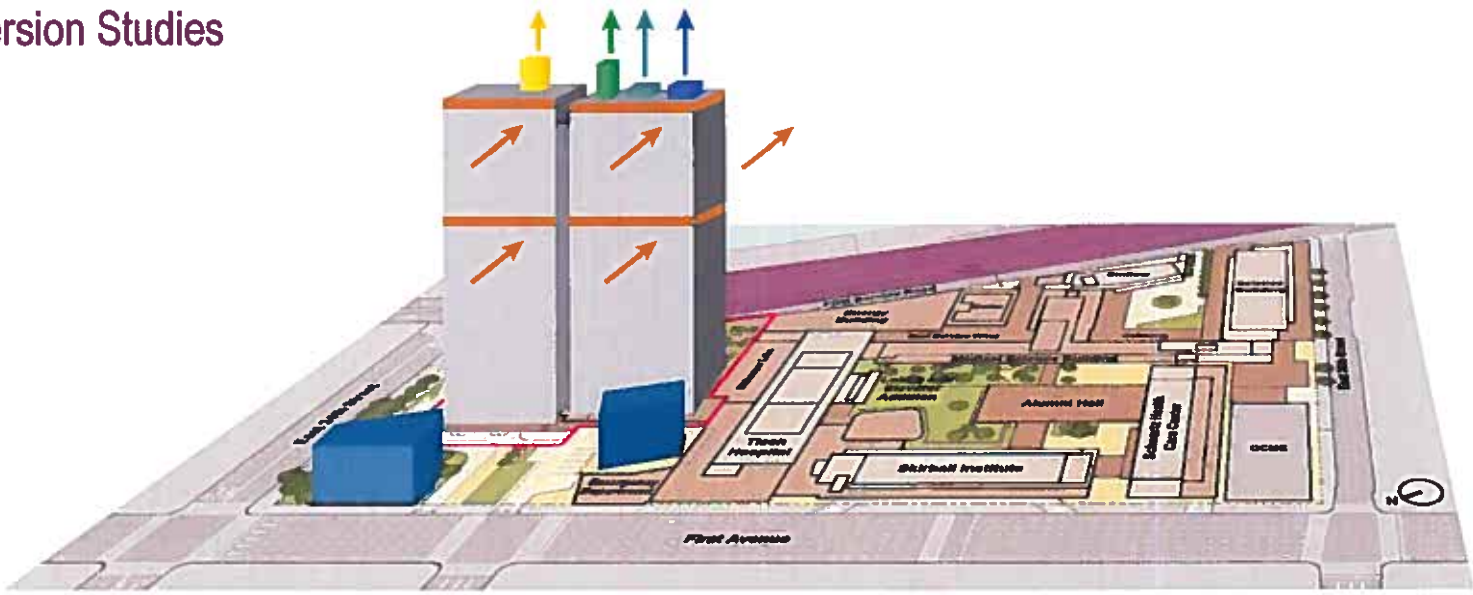

MEP System Design for Infection Control

Air Entrainment

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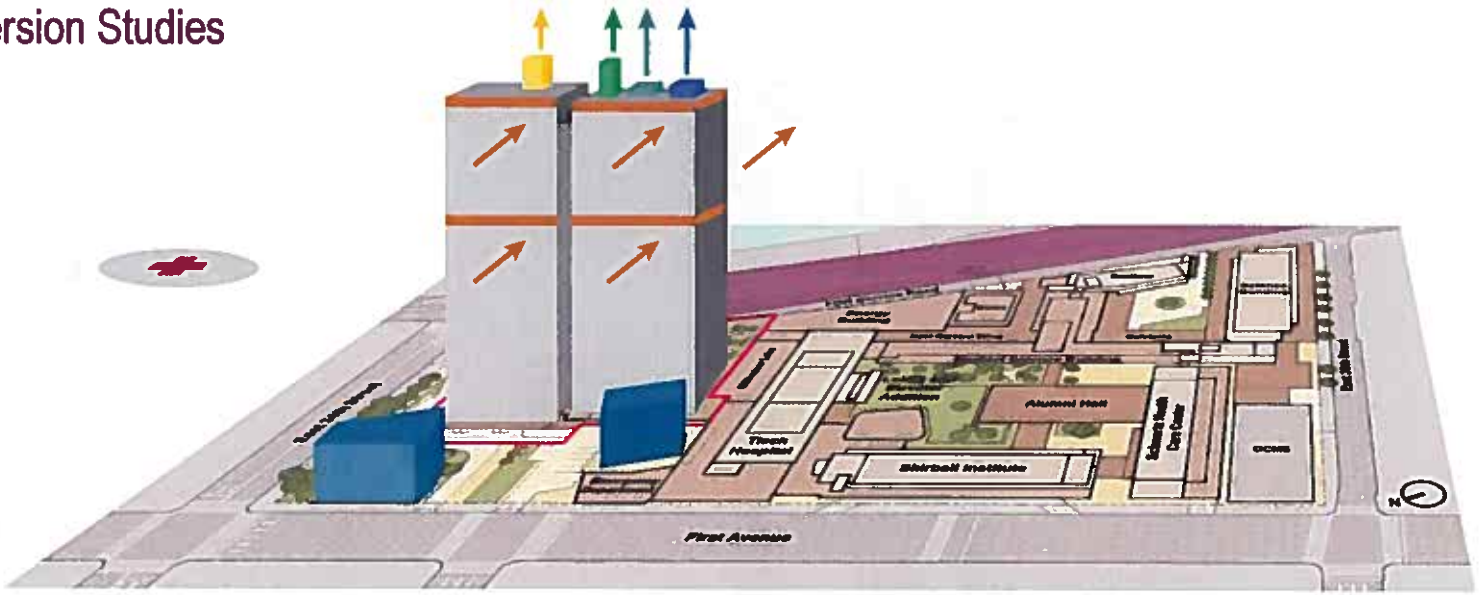


Air Handling Systems

Operational Flexibility

- Multi-mode capability

Normal Mode

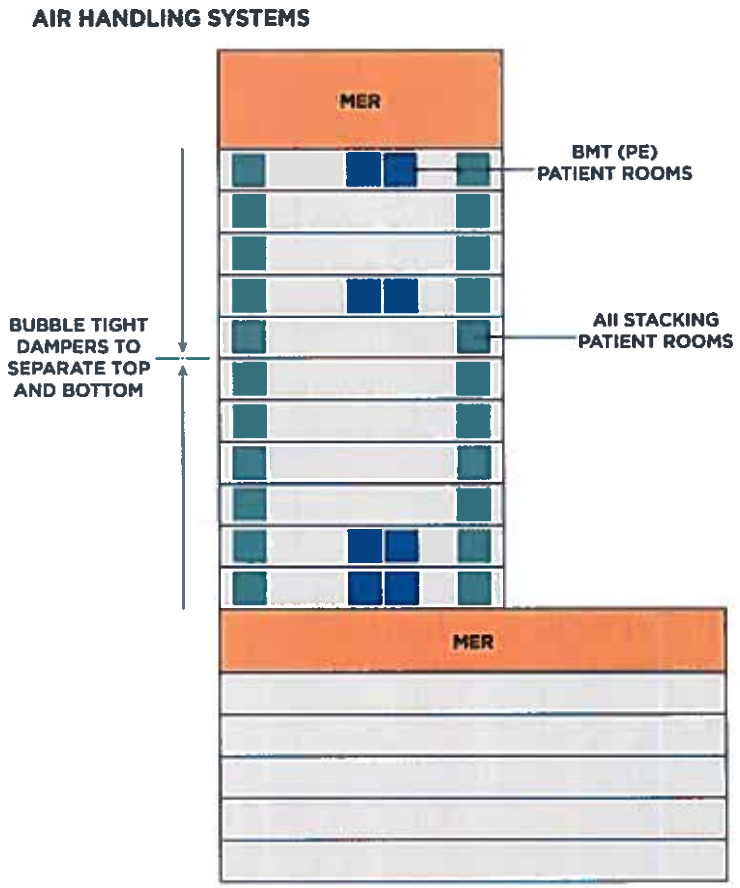
- Mixed air/ slight positive

Isolation Mode

- Full negative floors

Emergency/Triage/Outbreak Mode

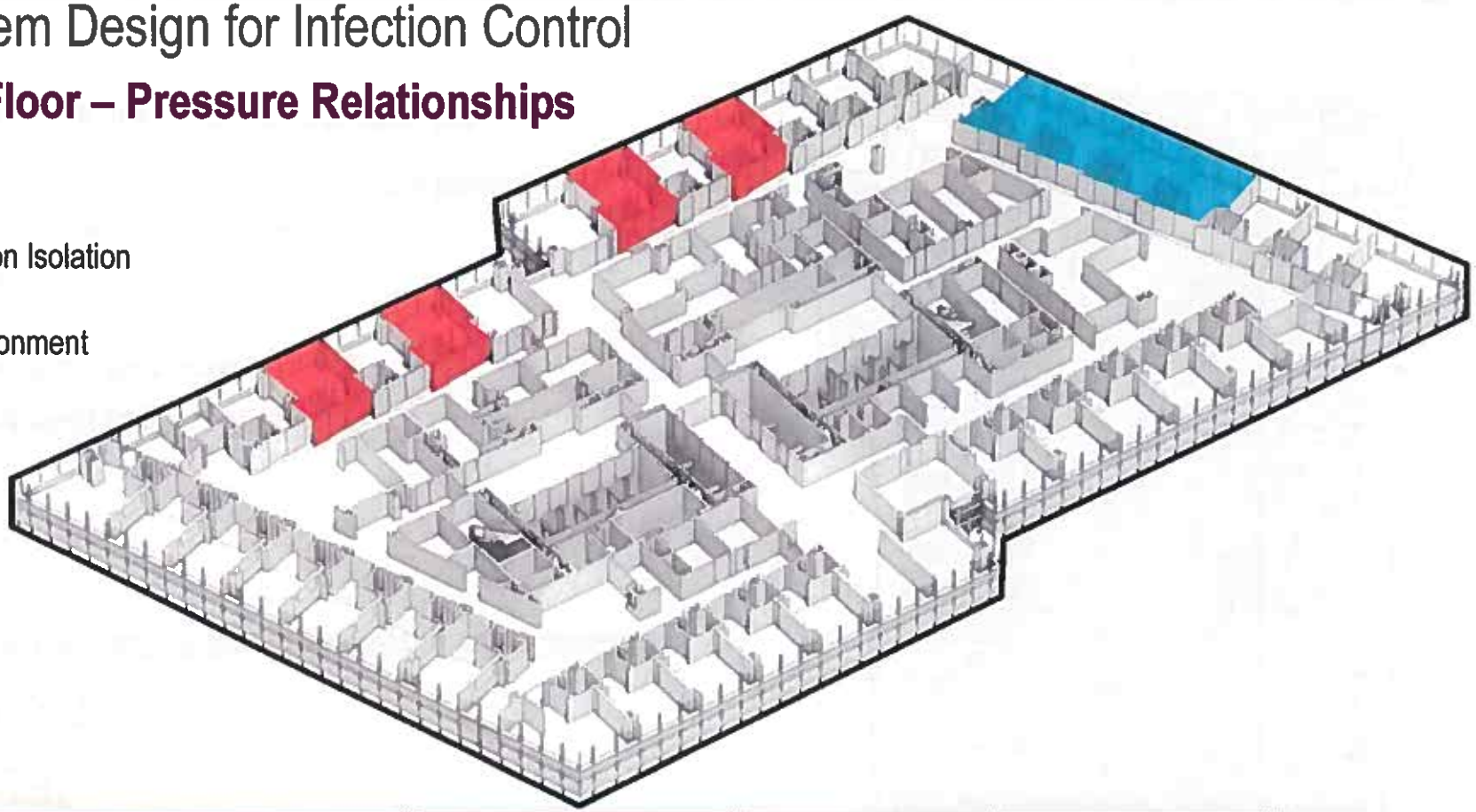
- 100% OA/ 100% exhaust



MEP System Design for Infection Control

Patient Bed Floor – Pressure Relationships

- Airborne Infection Isolation
- Protective Environment



Mechanical

Acute Care/ICU Rooms

Individual (Patient-Controlled) Room Environmental Conditions

- Temperature
- Lighting
- Shades

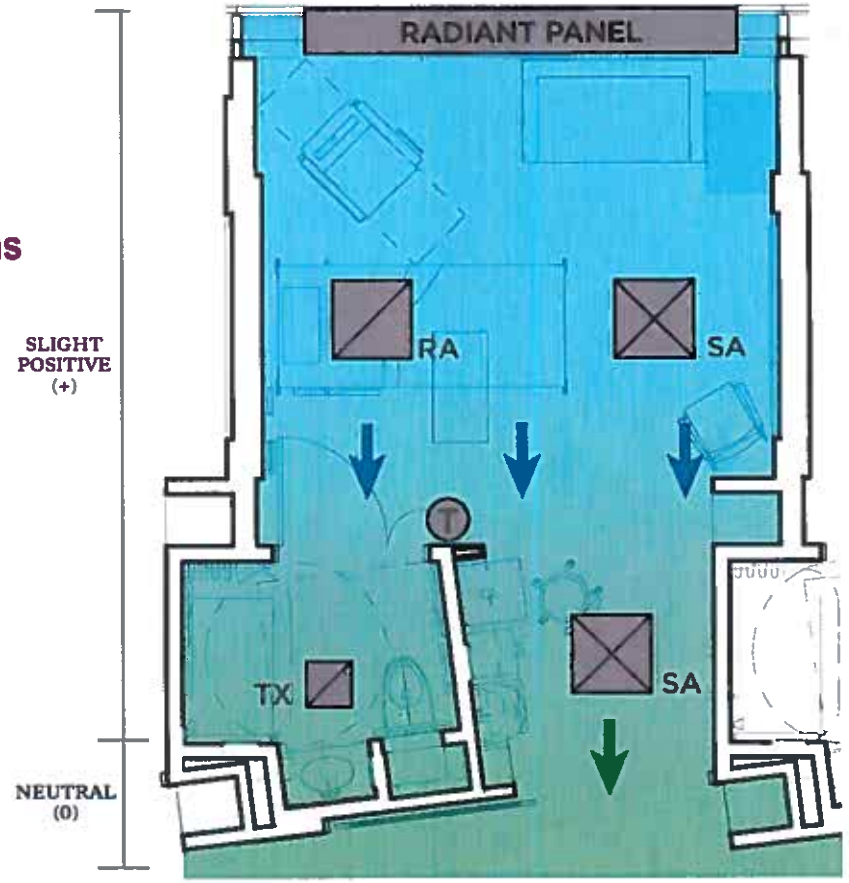
Perimeter Radiant Heat (Ceiling-Mounted)

- Continuous cleanable floor surface

VAV Tracking Pairs

- Maintain room at neutral or slight positive
- Interlocked with radiant panel – no simultaneous heating/cooling

All patient care spaces are humidified to 30% RH



ACUTE CARE PATIENT ROOM

Mechanical

Protective Environment Room

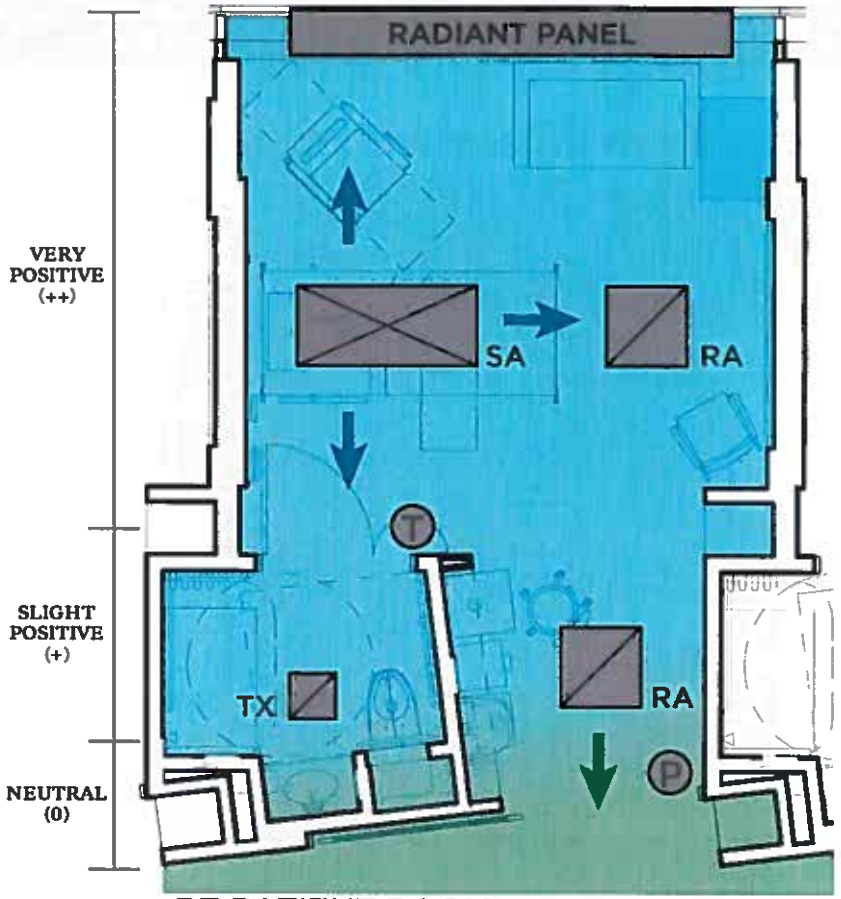
Individual room environmental controls and heating similar to acute care patient rooms

Rooms are maintained under positive pressure

- Tracks pressure monitoring through BMS
- Adjusted to maintain positive pressure to a designed set point

Supply air located over patient bed

- HEPA filter capable
- Low velocity non-aspirating



PE PATIENT ROOM

Mechanical

Airborne Infection Isolation Room

Individual room environment control and heating similar to acute care patient rooms

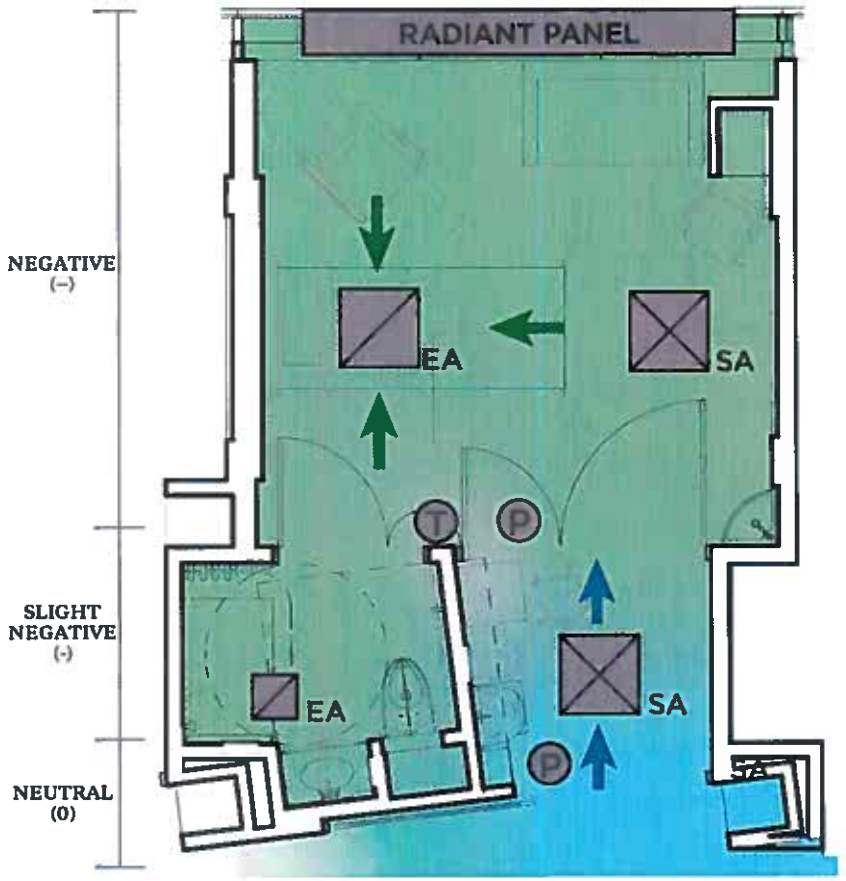
Rooms are maintained under negative pressure

- Track pressure monitoring through BMS
- Pressure monitors at patient/ante and ante/corridor

Rooms stack on floor-by-floor basis

Dual (N+1) exhaust fans

- Fans located at roof
- Bag-in/bag-out HEPA filters



AII PATIENT ROOM WITH ANTEROOM

Mechanical

Airborne Infection Isolation/Protective Environment (AII/PE) Room

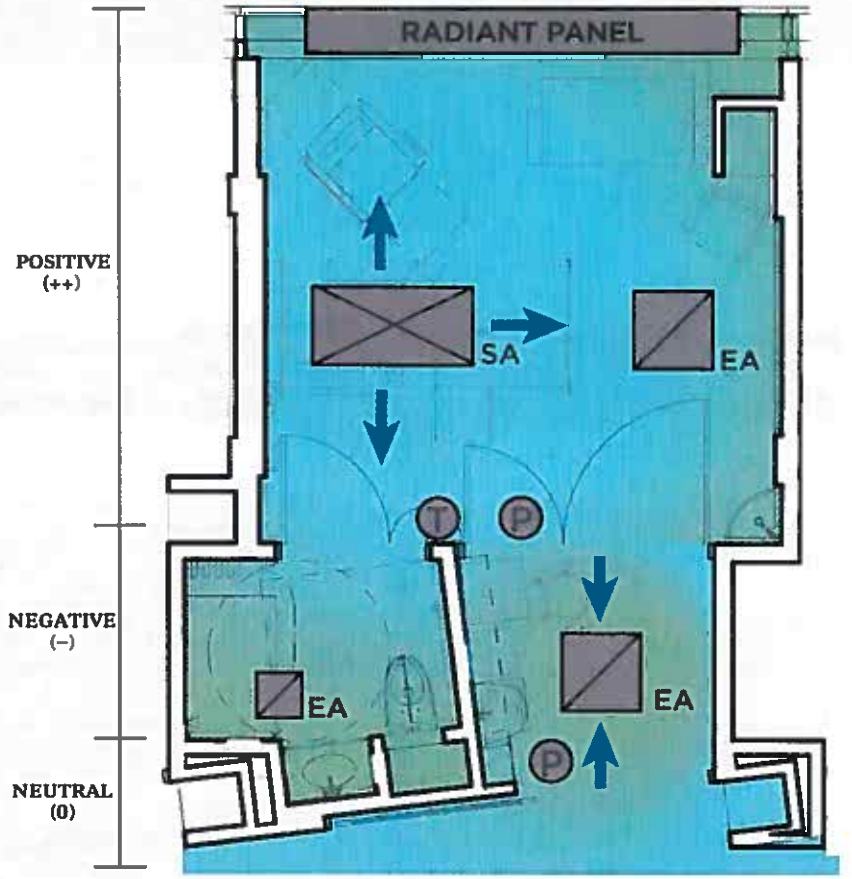
Individual room environmental control and heating similar to acute care patient rooms

Rooms are maintained under positive pressure

- Track pressure monitoring through BMS
- Pressure monitors at patient/ante and ante/corridor
- Anteroom maintained under negative pressure

Supply air located over patient bed

- HEPA filter capable
- Low velocity non-aspirating



AII/PE PATIENT ROOM WITH ANTEROOM

MEP System Design for Infection Control

Water Quality – Disinfection

- **Initial domestic water disinfection**
- **Chemical treatment for cooling towers**
- **Copper silver ionization installed on all hot water circulation systems**
  - Mitigates biofilm in the pipe system
- **Domestic Hot Water System distribution of 140°F**
  - Kills Legionella

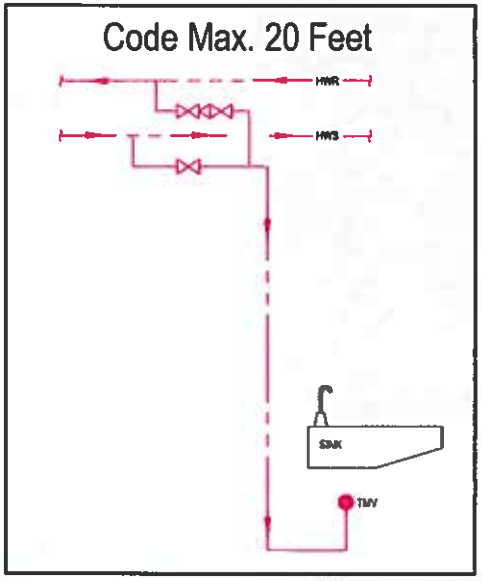
How Temperature Affects Legionella	
Above 158°F	Dies instantly
At 140°F	Dies within 32 minutes
At 131°F	Dies within 6 hours
Above 122°F	Cannot survive
Above 68°F - 113°F	Growth range
Below 68°F	Dormant

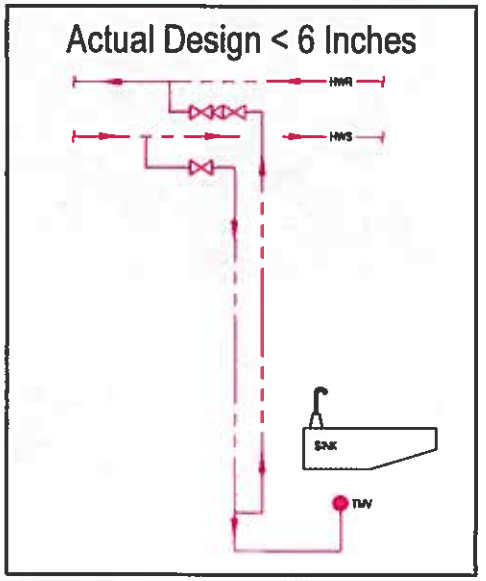
STEP 1	STEP 2	STEP 3
Water passes through the flow cell chamber	A direct current is applied across the electrodes, creating positively charged copper silver ions	The ions seek out bacteria throughout the plumbing system, providing ongoing disinfection

MEP System Design for Infection Control

Water Quality – Pipe Distribution

- **Laminar water flow at all lavatory fixtures**
  - Mixing valves to prevent scalding
  - "Hands Free" sensor-type fixtures
- **Hot water system – centralized**
  - Full recirculation (no pipe heat tracing)
- **Hot water "series" pipe distribution**
  - Limit dead legs to 6 in. maximum
  - Code maximum is 20 ft.





MEP System Design for Infection Control

Water Quality – Filtration

Storm Water Reclamation System

- Used for cooling tower makeup
- 40 micron filter pods
- Ultraviolet Disinfection
  - Inactivation of pathogens, viruses and bacteria

MEP System Design for Infection Control

MEP Systems Redundancy/Resiliency

MECHANICAL SYSTEMS

System	Redundancy	On EPS Power	Resiliency Measures
Chiller Plant	N + 1 and Export	2 Chillers	Air-cooled chillers for IT load backup
Chilled Water Pumps	N + 1 and Export	2 Pumps	–
Cooling Towers/Makeup Pumps	N + 1 and Export	2 CT's	–
Hot Water Heating Pumps	N + 1	Yes	–
Bed Floor AHU's	N +	Yes	Units are headered together
Peri OP/ Post OP AHU's	N +	Yes	Units are headered together
OR AHU's	N +	Yes	Units are headered together
All Exhaust Fans	N + 1	Yes	–

MEP System Design for Infection Control

MEP Systems Redundancy/Resiliency

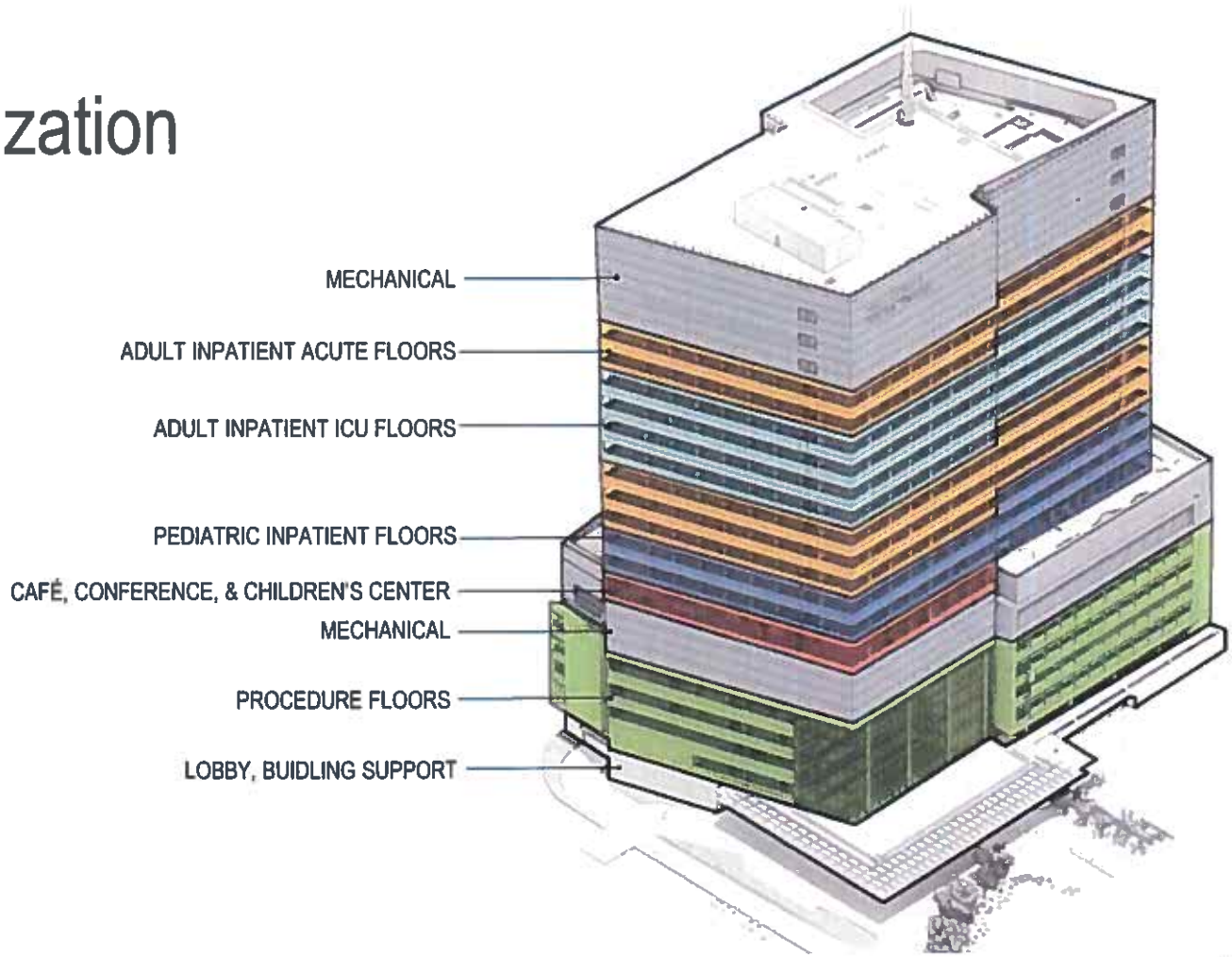
ELECTRICAL SYSTEMS

System	Redundancy	Resiliency Measures
Generators	N + 1	The (N + 1) generator can power standby loads for extended periods of loss of utility
Reciprocating Cogen	N	Ability to operate in island mode
Normal Power (Central Transformers)	N + 2	Any two transformers can be fully isolated for maintenance without affecting system operation
Normal Power (Double-Ended Substations)	2N	Each substation transformer can be isolated for system maintenance without affecting system operation
Turbine Cogen	N	Ability to operate in island mode to provide electric and steam upon loss of utilities

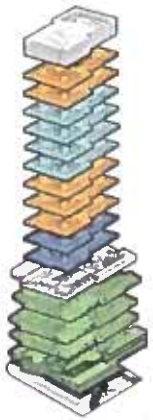
Infection Prevention & Design

Medical Planning & Interiors

Building Organization



Vertical Circulation



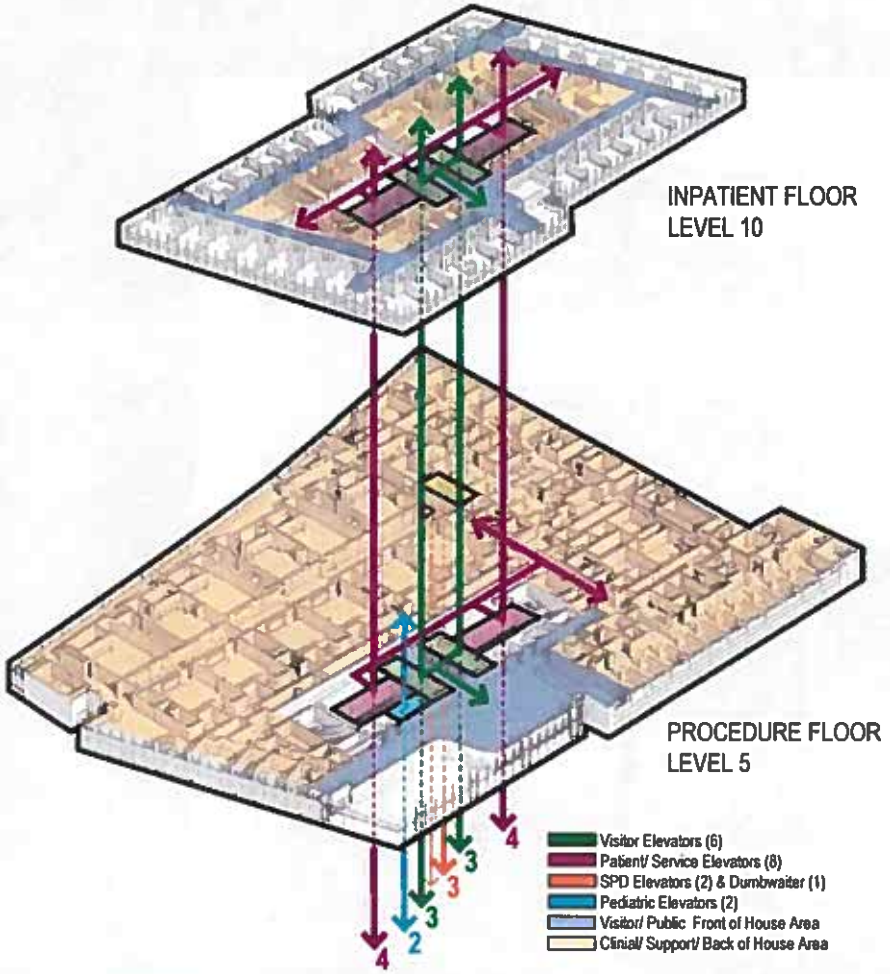
19 ELEVATORS (TOTAL)

4 VISITOR ELEVATORS
2 PEDIATRIC ELEVATORS
4 PATIENT ELEVATORS
4 SERVICE ELEVATORS
2 SPD CASE CART ELEVATORS (1 CLEAN, 1 DIRTY)
1 SPD DUMBWAITER (SPD TO CLEAN CORES)

OTHER

PNEUMATIC TUBE
- 2 PER INPATIENT FLOOR (TYPICAL)
- 3 PER PROCEDURE FLOOR (TYPICAL)

GRAVITY CHUTES
- 1 LINEN PER FLOOR
- 1 TRASH PER FLOOR



Procedure Floors

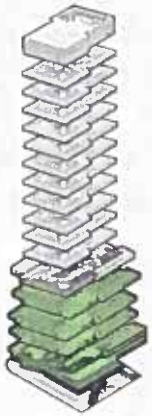
FAMILY EXPERIENCE
An expansive public lobby and atrium, overlooked by distributed surgical waiting areas, reinforces the separation of onstage (public) from offstage (clinical) areas.

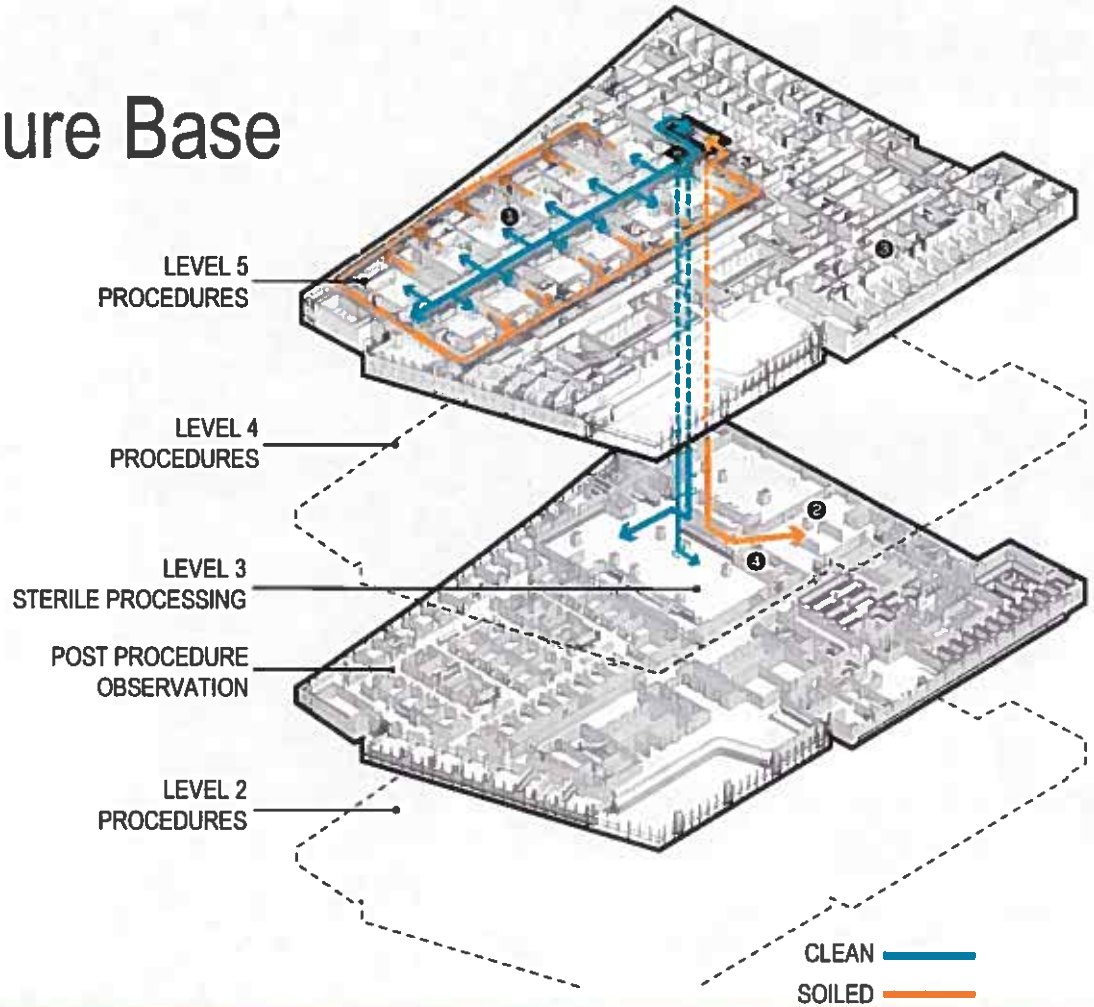
Procedure Floors

Procedure Floors: Infection Prevention Considerations

- Separation of populations - Clear public/ visitor front of house, from clinical/ service back of house
- Interventional rooms (Cath, EP) behind the red line, designed as Class 3 Imaging/Hybrid
- MRIs designed as Class 3 Imaging/Hybrid
- Continual forward flow of instruments and equipment from SPD (clean) to Clean Core to ORs, and return to SPD (decontamination)
- Clean core design with OR storage refined through Lean process
- Location of control station in the OR to best monitor adherence to IP protocol
- One centralized surgical locker rooms with interconnecting stairs
- Each peri-op unit floor has 1 specialty room (Air-borne Infection Isolation)
- Pre-fabrication of OR ceilings + headwalls

Procedure Base






atient Floor
EXIT

Inpatient Floor: Decisions

PATIENT CONTROL AND FOOTWALL
- Education opportunity
- Technology wall
- Patients individual control of their environment of care: lighting, window shades; temperature, nurse call, acoustics; room service

HOSPITAL AS CENTER FOR LEARNING
- Education / clinical research
- Training of student clinicians
- Lifetime learning of staff
- Interdisciplinary connections

STAFF FACILITIES
- Address needs for socialization, learning respite, recharging
- Address daytime & nighttime, staff needs
- Happy staff = happy patients

ON CALL FACULTY PHYSICIAN ACCOMMODATION
- 2 on call rooms
- Centralized floor on call suite

PATIENT MOVEMENT AND HANDLING
- 100% infrastructure above ceiling
- Number of rooms with ceiling lifts
- 10% to have lifts installed Day 1

EMR/TECHNOLOGY
- Epic
- Workstations on wheels vs. arms
- Development of iPads, individual devices

PATIENT ROOMS
- Ideal nursing unit 32 beds
- Single handed? Mirrored? Universal? Adaptable?
- Percentage of ICU vs. Acute
- AMCs moving to 25% ICU, 25% step down, flex ICU and SDU
- Flexibility and Adaptability
- Elimination of privacy curtains, infection control

NOURISHMENT
- Accessible to families? Encourage involvement in care
- Food preparation by families

SUPPLY MANAGEMENT
- Levels of distribution—central backup supplies, decentralized daily needs
- Inside or outside of room, par levels
- Infection control
- Avoid waste in overstocking / expiration dates
- Reduction in nurse as "hunter and gatherer"

STAIRS
- Encouragement of collaboration throughout building
- Staff health—incorporate movement walking
- Vertical stacking of specialization acute through ICU

SEPARATION OF SERVICE CORRIDOR / FLOW FROM PATIENTS / VISITORS
- Noise / infection visual control
- Separation of service / patient flow clean / dirty

MEDICATION PREP AREAS
- Large, well lit quiet to reduce med errors
- Decentralized individualized patient medication
- Med cabinet at each room entry

VISITOR ARRIVAL ELEVATORS
- Tolerance for waiting
- Reception / greeter
- Security
- Wayfinding

VIP ROOMS
- All patients are VIPs vs. need for space for specific type of patient
- Alternative solutions: linked adjacent rooms

FAMILY ACCOMMODATION
- Need for communication, learning, respite
- FGI requirement for family lounge vs. actual practice of families within private rooms
- Multiple experiences
- Specialization, variety of spaces
- Consult rooms

CLINICAL INTEGRATION CENTERS (NEXT ITERATION OF NURSE STATIONS)
- Centralized vs. decentralized
- Support heads down / private work and collaboration
- Direct visualization vs. camera or decentralized work
- Accessibility to families vs. staff only
- Workplace design
- Drop in / flex stations

OFFICES
- Number of dedicated offices on floor
- Typical 2-3 required. Nurse Manager; Physician on duty; Hospitalist / intensivist

NATURAL LIGHT GOALS
- Depth of penetration to inner core and work areas
- Natural light on workplace, patients

ADA /BARIATRIC POPULATION
- Percentage of accommodation and weight limits established
- 100% acute ADA compliant acute rooms
- 500lb weight typical for fixtures

INTEGRATION OF TEACHING MISSION
- Spaces for rounding teams out of corridors
- Patient safety
- HIPAA compliance
- Technology availability for learning

Inpatient Floor: Metrics

INPATIENT FLOOR METRICS

FLOOR PLATE SIZE:	32,380 gsf
BEDS/FLOOR:	34
DGSF/ BED:	772 dgsf
SUPPORT SPACE:	7,520 nsf
BED NSF:	8,200 nsf
PATIENT RM:	230 nsf
TOUCHDOWN WORKSPACES PER BED:	2.15

COMPLETION DATE: 2018
BUILDING SIZE: 836,000 gsf

DISTANCE FROM NATURAL LIGHT FOR STAFF WORK:	32-36 ft
STAFF WORK STATIONS WITH ACCESS TO NATURAL LIGHT:	73
DISTANCE FROM FARTHEST PATIENT ROOM TO CLEAN SUPPLIES AND MED ROOM:	155 ft

INTEGRATE ACADEMIC & RESEARCH ACTIVITIES

BRING SERVICES TO PATIENT

- Reduce hand-offs
- Reduce trips off floor = shorten LOS
- Patient safety / satisfaction

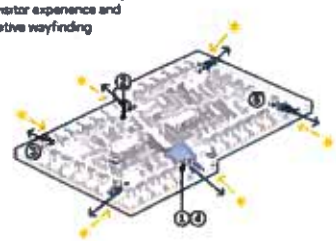
CLINICAL INTEGRATION CENTER

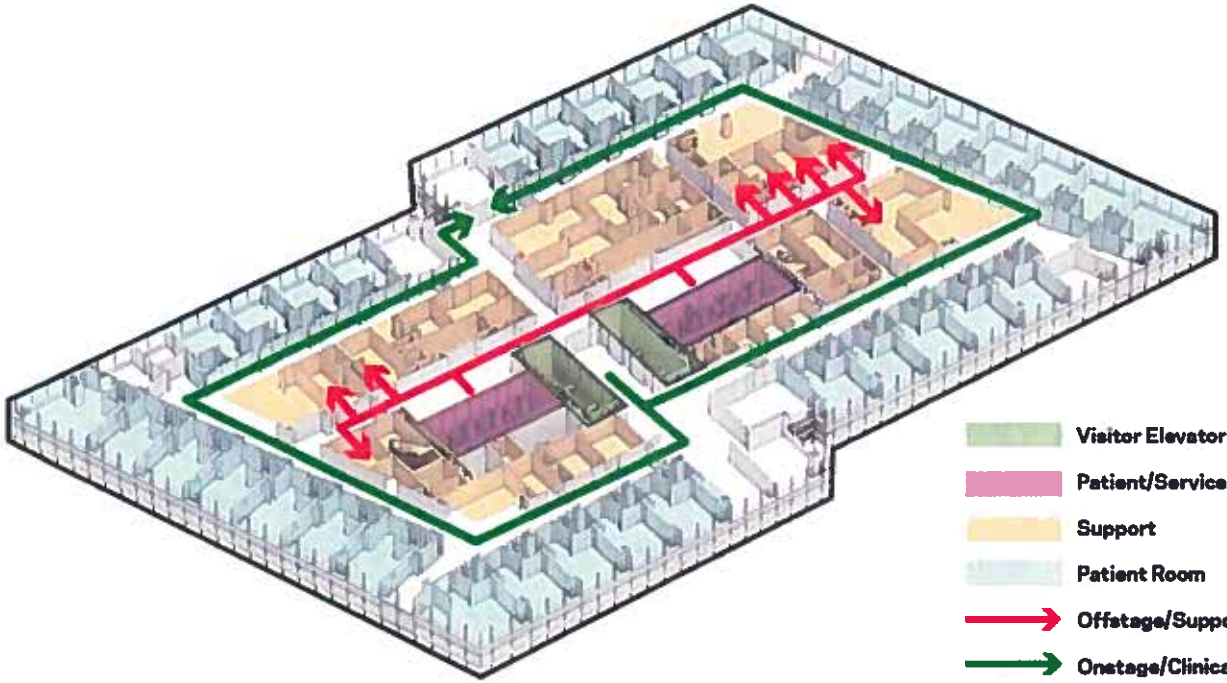
Inpatient Floors: Infection Prevention Considerations

- Clearly defined on- and off- stage areas and circulation, minimizes mixing of populations
- Duplication of clinical support programs (one per side of clean, soiled, med), reducing # of patient rooms being supported from each, ability to create 2 units per floor
- Trash and Linen chutes in within soiled rooms
- Each inpatient floor has minimum of 4 specialty rooms (Air-borne Infection Isolation), some with additional specialty rooms (Protective Environment & Combination AIIR/PE)
- AIIR & PE/AIIR rooms have full ante-rooms
- Decentralized patient supplies outside each patient room refined through Lean process
- Dialysis boxes in 100% of ICU rooms, and 10% of acute rooms

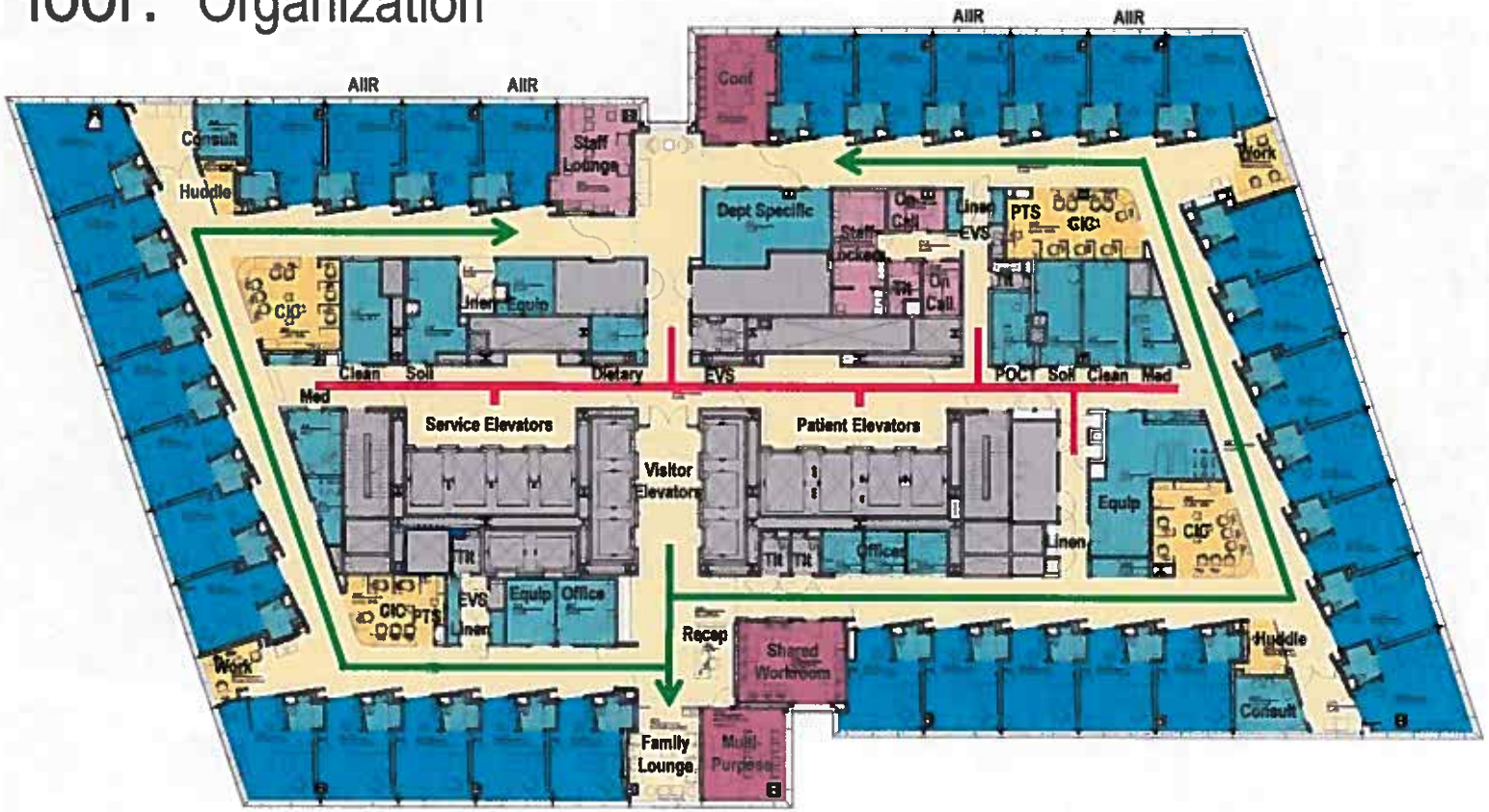
Inpatient Floor: On- stage, off- stage, flows

FAMILY EXPERIENCE
Ending corridors with views and light adds to the visitor experience and provides intuitive wayfinding



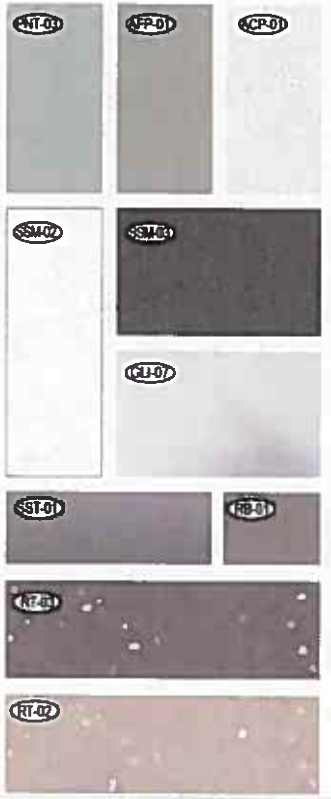


Inpatient Floor: Organization



Inpatient Floor: Clinical Integration Center

Inpatient Floor: Finishes



ACP-01	ACOUSTICAL CEILING PANEL	RB-01	RUBBER BASE	PNT-03	PAINT	SST-01	STAINLESS STEEL PLATE
AFP-01	FABRIC, XOREL	RT-02	RUBBER TILE	SSM-02	ACRYLIC		
GLI-07	INTERIOR GLASS	RT-01	RUBBER TILE	SSM-01	SOLID SURFACE		

Patient Room: Typical

Patient Room: Decisions

1 Ceiling Zone
The patient zone ceiling contains utilites and infrastructure that are fully accessible through the ceiling tiles. The ceiling tiles are specially designed for healthcare settings which are anti-microbial, cleanable, and provide high levels of acoustic absorption.

The ceiling assembly incorporates supply and return diffusers, reading and exam lights, ambient lighting, ceiling mount patient lifts.

2 Access to Natural Light
Expansive windows provide views of the city and river. Clinical studies show benefits for both patients and staff when given access to natural light.

3 Functional Headwall
High acuity demands readily accessible gases, electrical outlets, etc. These are neatly organized in a stainless steel band which is embedded in a custom laminate wood tone headboard. The headwall contains a pillow speaker and patient reading light controls for patient controllability.

4 Flexible Footwall
Designed to accommodate technology in the future, the footwall has a designated area for the markerboard, clock, room identification signage and monitor. The monitor can be used for entertainment, but also may be a place for health education, MD consult (video conference), food menu and ordering and have the ability to connect to personal devices to customize the patient room.

5 Surfaces and Details
All surfaces are non-porous, durable and easily cleanable. Cabinetry is plastic laminate and in areas where impact is concerned, solid surface (Corian) is used for cabinet fronts. All finishes reviewed for infection control.

6 Rubber Flooring
The floors are rubber tile and sheet (ICU) which provides additional under foot comfort and acoustic absorption. Rubber flooring does not require additional wax finish and has a non-porous surface.

7 Clinical Work Zone
Contains handwash sink (integrated solid surface sink with a full solid surface backsplash), trash receptacle, Workstation on Wheels, and cabinetry for clinical supplies (developed by multidisciplinary teams based on LEAN principles)

8 Mobile Clinical Workstation
Chosen by multidisciplinary teams including IT, EPIC, clinicians, pharmacists and leadership for its flexibility, ease of replacement and adaptability for future technology. The workstation can be moved from docking station to headwall, eliminating the need for a permanent workstation at the headwall. The workstation supports inclusive rounding in teaching hospitals.

9 Med/Supply Cabinet
Located outside the patient room, the cabinet can be accessed and restocked without disturbing the patient and family. Integrated into the cabinetry is a task light, work counter and digital locking mechanisms for meds and supplies.

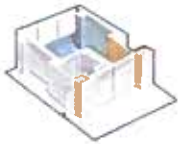
10 Sliding Doors
Sliding doors allows for a greater width door opening for ease of maneuverability of equipment and beds. Glass insert in door is designed to eliminate the need for privacy curtains in the room (translucent glass for acute, electrochromic glass for ICU).

11 Canted Room Design
By canting the entry to each patient room, a rhythm is created along the corridor that individualizes each room. It also provides a "step off" space in addition to the 8'-0" width of the corridor.

12 Access to Natural Light
Each corridor terminates at an expansive window allowing for light to permeate the corridor and clinical integration stations located in the interior of the floorplan.

Patient Room: Specific attention paid to...

- Remove unnecessary surfaces
- Reduce touch
- Remove/ reduce services that are touched by both staff and patient (cross contamination)
- Provide alternatives to touching
- Encourage hand-washing
- Select low maintenance, high resilience materials
- Use of mock ups to test decisions and materials



Patient Room: Considerations for Infection Prevention

- Elimination of privacy curtains
- Elimination of contaminated waste leaving patient room by outfitting each patient toilet room with automated bed-pan washer
- Reduce need to touch "frequently touched items" - electronic sensors, patient full control of environment at bedside through use of ipad
- Organization of entry vestibule to the patient room for best IP practices, including location of hand-washing station
- Separation of clinical and patient touch surfaces, to reduce cross contamination
- Individual medication station & supply cabinet directly outside of each patient room, reduces # of staff requiring to enter room to do their work – pharmacy, supplies
- Showers in 100% of patient toilet rooms including ICU

Patient Room: Zones

PATIENT ZONE

BED
HEADWALL
PATIENT CHAIR
EDUCATION/MEDIA SCREEN
STORAGE

FAMILY ZONE

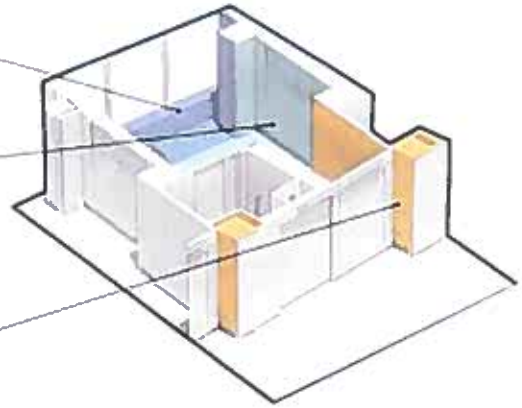
SOFA/BED
GUEST CHAIR
EDUCATION/MEDIA SCREEN
STORAGE
PERSONALIZATION SHELVES AND SURFACES
DESK

EDUCATION ZONE

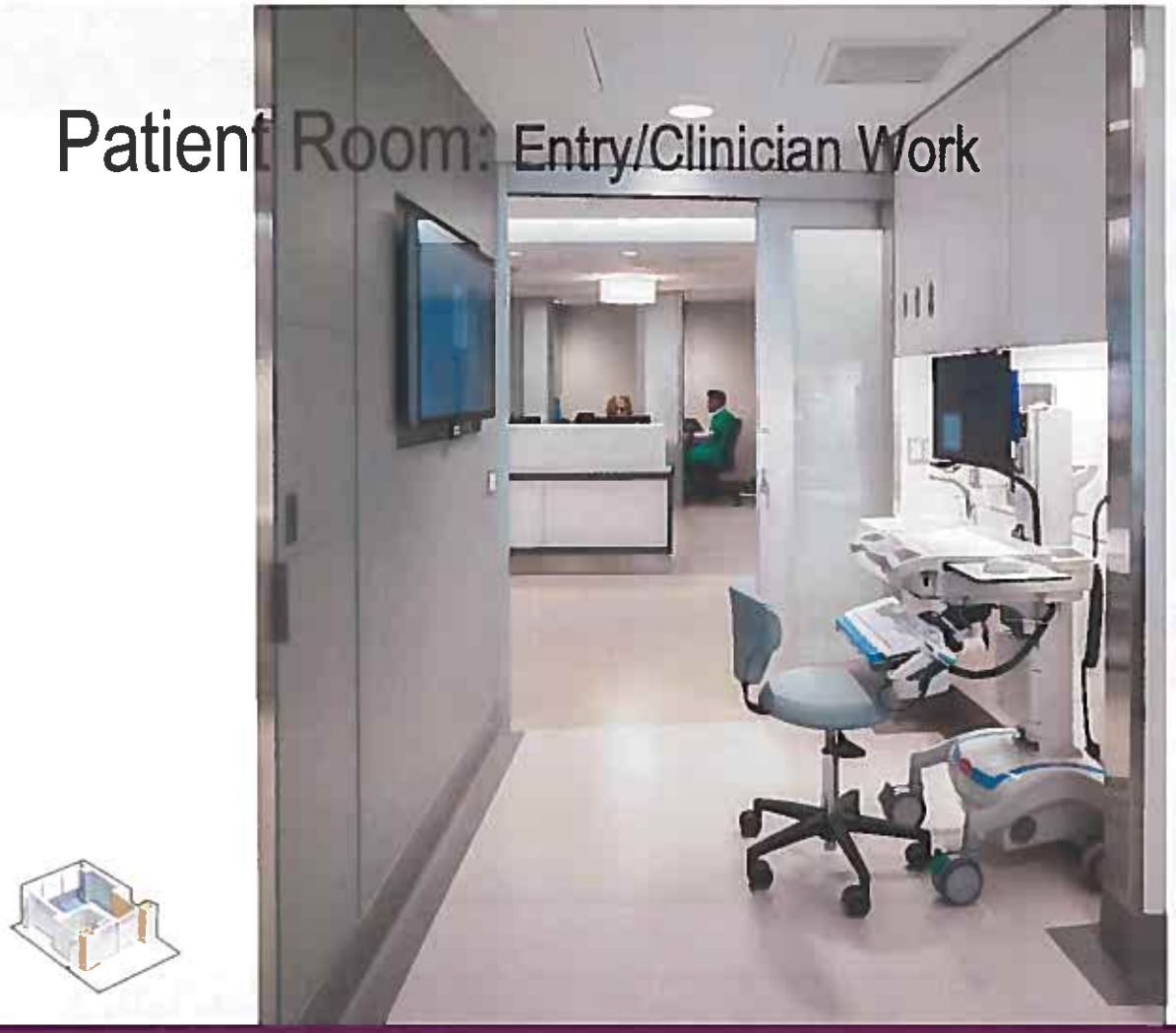
EPIC MONITOR
WHITEBOARD
SPACE FOR ROUNDING

CLINICIAN ZONE

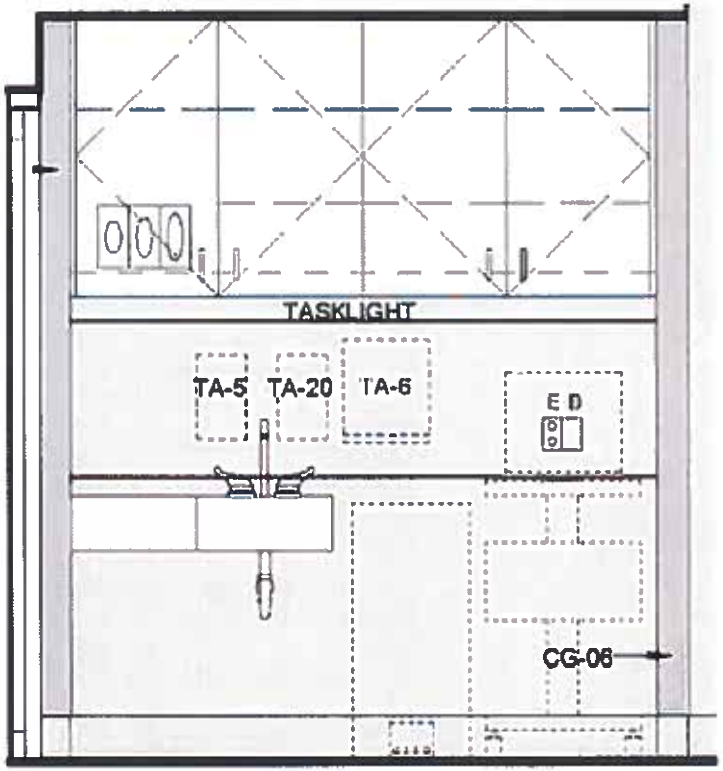
CHARTING AREA
HANDWASHING SINK
PPE
MEDS DRAWER
CLEAN SUPPLY
WASTE BIN



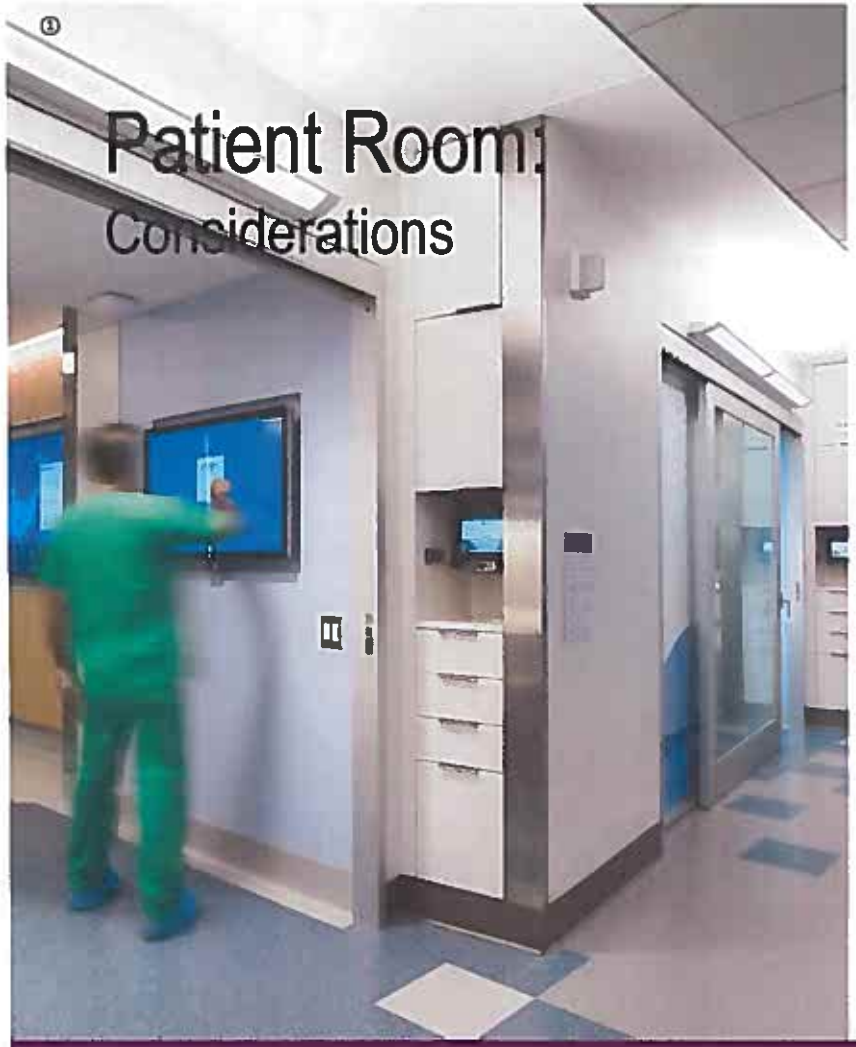
Patient Room: Entry/Clinician Work



Patient Room: Entry/Clinician Work



Patient Room Considerations



② Incorporating sliding doors with electronic glass at patient rooms, instead of privacy curtains which often harbor pathogens, is expected to reduce the rate of hospital-acquired infections

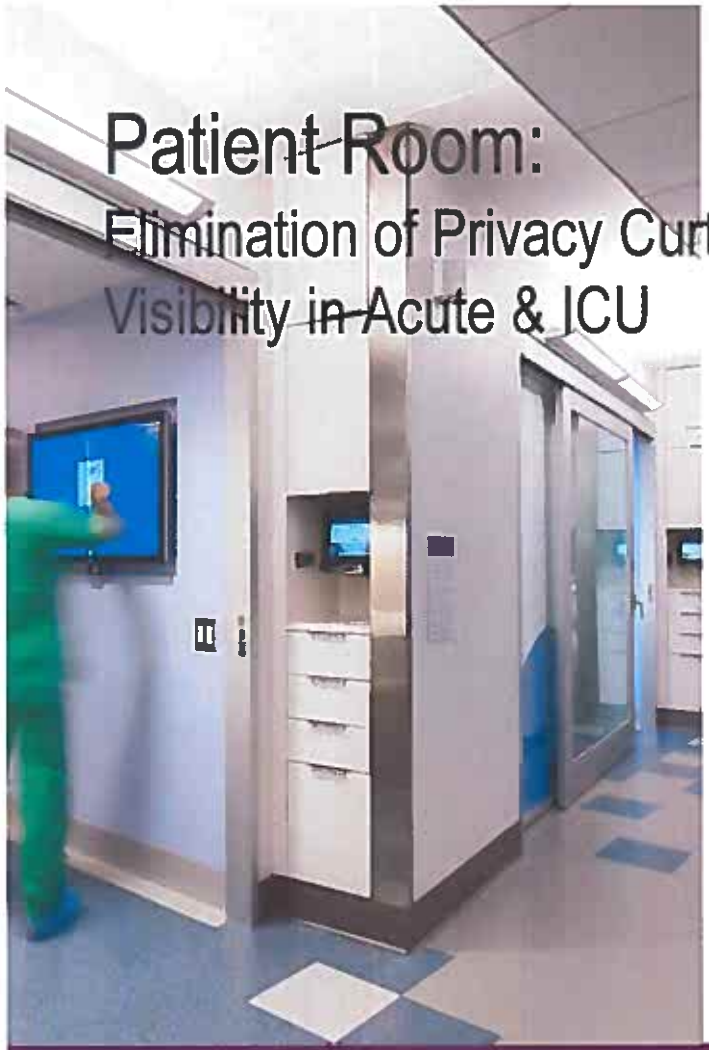
STAFF EXPERIENCE
Patient rooms are maximized for efficiency, clinical care, staff and patient safety.

④ Decentralized medication stations located outside each patient room improve efficiency and reduce medication errors, while decreasing interruptions to resting patients

Patient Room:

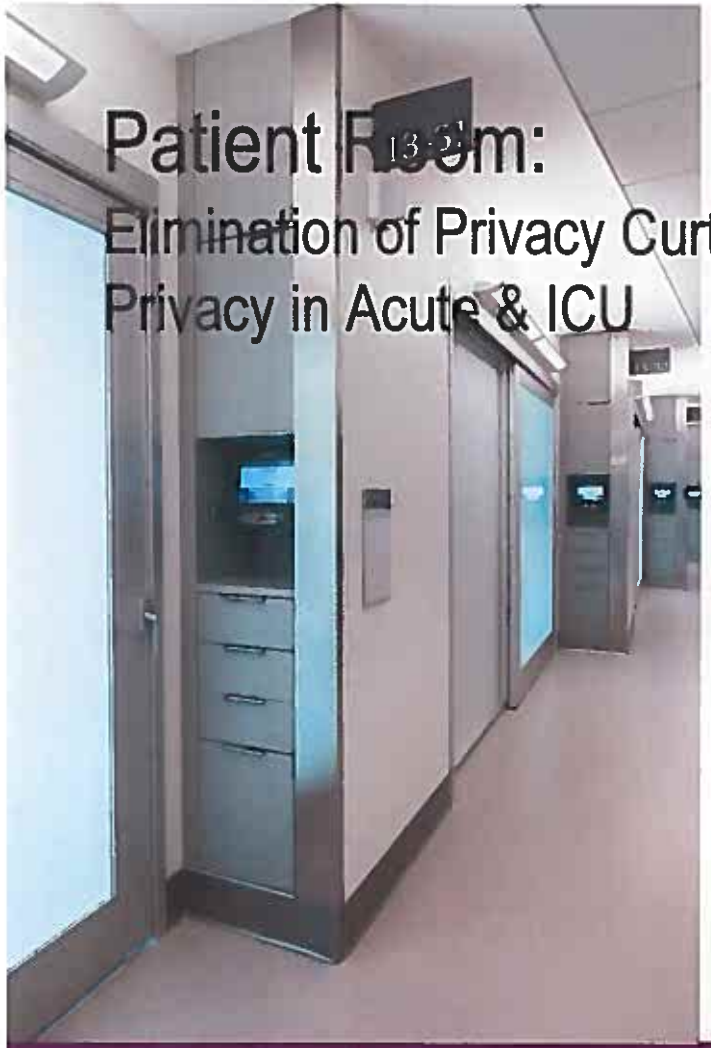
Elimination of Privacy Curtains

Visibility in Acute & ICU



Patient Room:

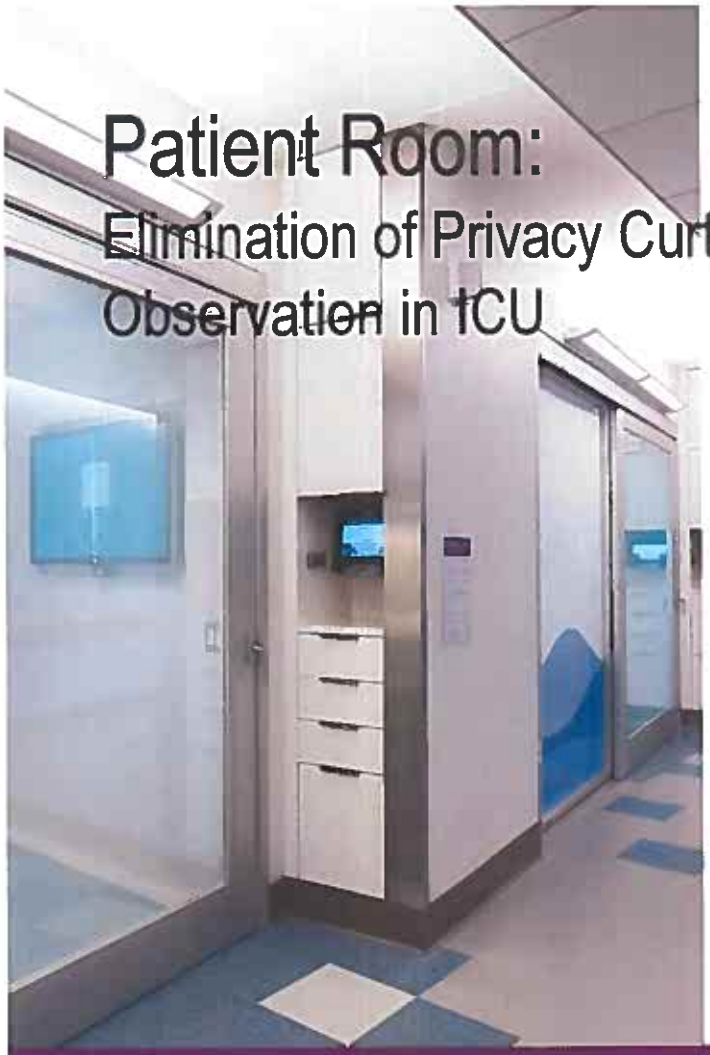
Elimination of Privacy Curtains
Privacy in Acute & ICU

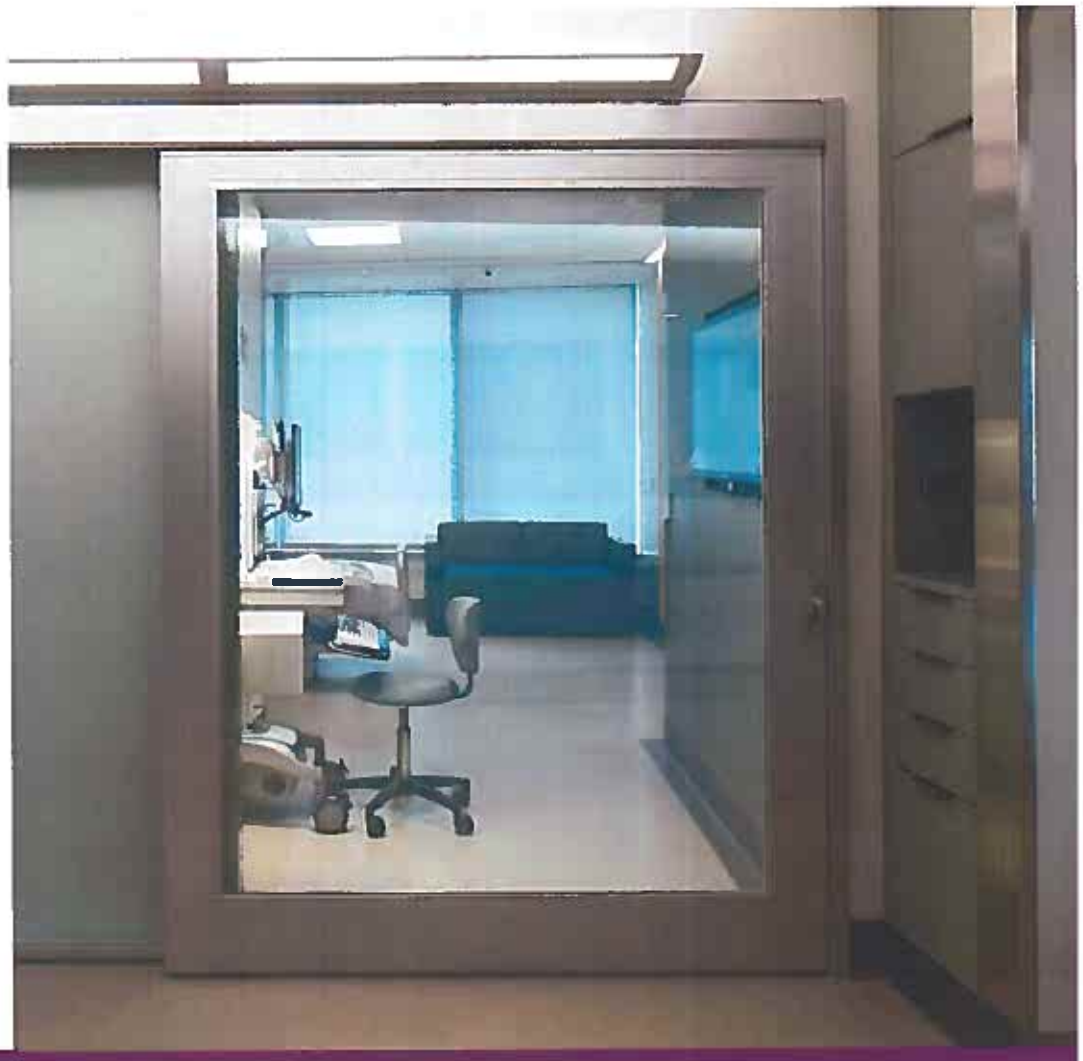


Patient Room:

Elimination of Privacy Curtains

Observation in ICU





Patient Room:

Reduction in staff entering room

Medication Station & Supplies

Patient Room: Reduce touched surfaces

PATIENT EXPERIENCE

Comfort, amenities, and the ability to control the environment are all part of the patient experience and healing process

Overbed Table Ipad - Patient Controls

Infection Prevention & Design

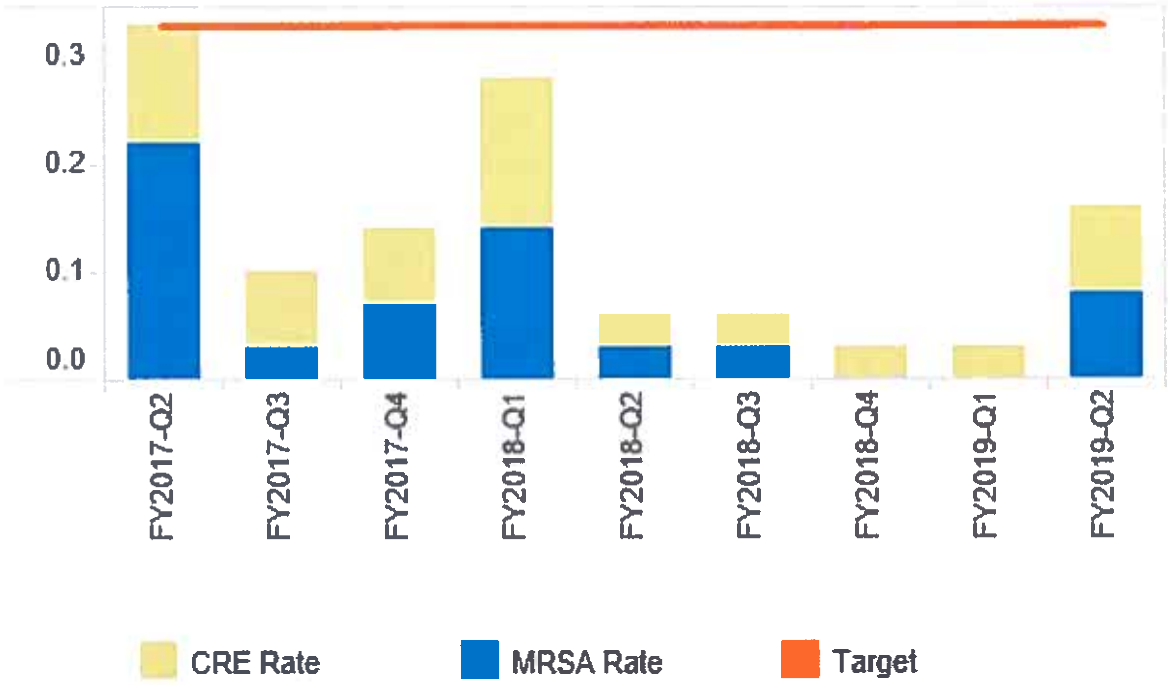
Outcomes & Findings

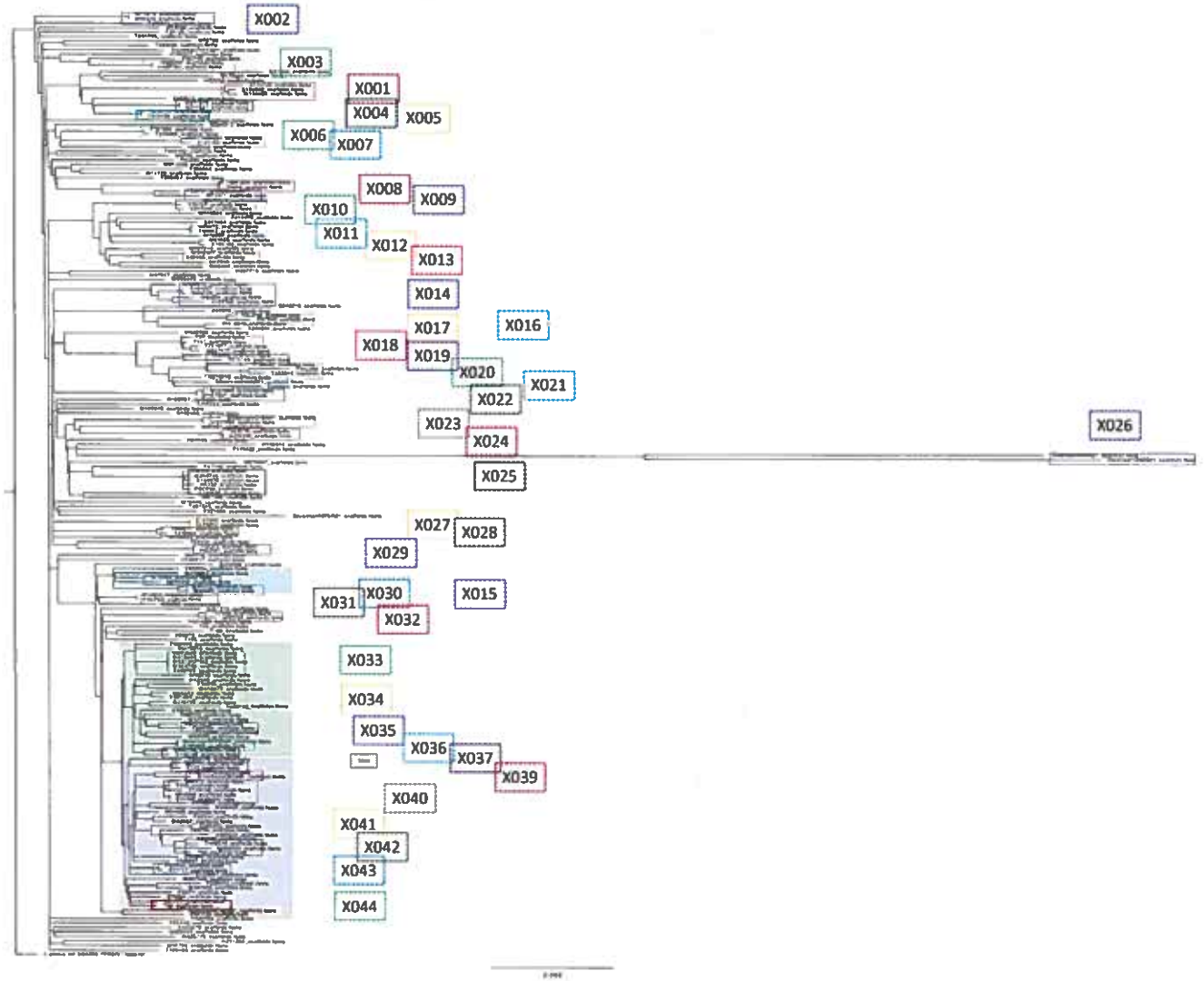
Multi-Drug Resistant Organisms (MDRO) per 1000 patient days

Select Metric: MDRO

Onset: Hospita...

0.11

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X044

HA Event	#Event	Room	Unit	Hospitalization	Provider	Procedure	Surgery
1	4		rehab		two		
2	2			concurrent			
3	2	gen med					
4	2			concurrent			
5	2	ED			multiple		
6	2			within 1 month			
7	2			concurrent	multiple		
8	2			concurrent	multiple	TTE	
9	3	heme/onc (2pts)	heme/onc (2pts)		multiple	CPAP	
10	3		heme/onc (2pts)		multiple		
11	2			concurrent	multiple		
12	2		rehab			balloon pump	foot debride
13	2	heme/onc			multiple	bronch	
14	2			concurrent			
15	2		gen med		multiple	ET tube	PEG
16	2			concurrent			
17	2			concurrent	one	CVC	
18	2			concurrent	multiple		
19	3	ICU			multiple		
20	2			within 1 month			
		25%	**25%**	**55%**	**60%**	**30%**	**10%**

NYU Langone MEDICAL CENTER

Thank you

Questions

This concludes The American Institute of Architects Continuing Education Systems Course