

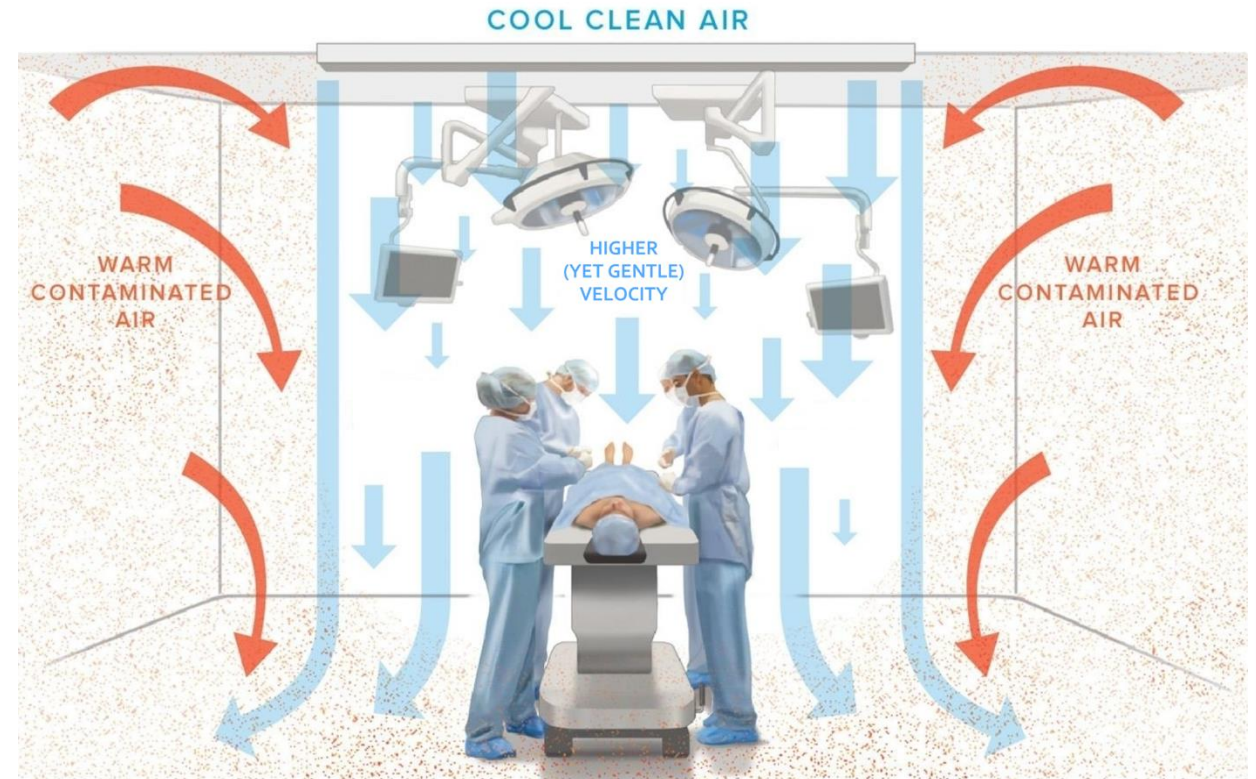
High Air Change ORs

A Whole-Building Approach to Cost,
Performance, and Patient Safety



What Are High Air Change ORs?

- 60-65 ACH vs. 20-25 ACH
- Same nominal size HEPA laminar diffuser array
- Enhanced, more stable laminar field
- Improved temperature conditions
- Less central HVAC with use of local blower coil units
 - Cleaner air >> better comfort >> improved patient outcomes



Why Are HACH ORs Often Dismissed?

Higher First-Cost Perception

Unclear ROI For Cleaner Air
& Patient Outcomes

Unclear ROI for Staff Comfort

Space & Infrastructure Concerns

Resistance to Non-Traditional Systems

Questions About Maintenance &
Operational Complexity

What Did Our Team Do Differently?

Challenged Assumption that
HACH is Cost Prohibitive

Dedicated Time for Full Evaluation

Evaluated Total Value,
Not Just First Cost

Expanded Analysis Beyond
Infection Prevention

Considered Impacts
Across Entire Building

How We Evaluated the Decision



**USE A STRUCTURED
A3 PROCESS**



**ENGAGED CLINICAL,
OPERATIONAL, & FACILITY
STAKEHOLDERS**



**CONDUCTED SITE
VISITS, MOCK-UPS
& TESTING**



**ASSESSED BENEFITS,
RISKS & LIFE CYCLE
IMPACTS**



**IDENTIFIED BUILDING-
WIDE EFFICIENCIES &
COSTS**

Operating Room A3

3	Operating Rooms					23-Aug-22
	Discipline	Sub-Discipline	Opened	Revisions	Final Decision Date	
	Interiors/MEP		21-Jul-22			
SECTION 1: BACKGROUND / CURRENT OPTIONS						
BASIS OF DESIGN (TRADITIONAL OPERATING ROOM CONSTRUCTION): Drywall walls, drywall ceilings, Resinous Flooring (check that), traditional OR ceiling systems with independent HEPA filtered laminar airflow diffusers, LED lighting, medical gases, and boom mounts. Central air handling units and ductwork systems deliver 25 air changes per hour (ACH) to each OR. All OR's are served by the same central air handling unit system. Each OR includes a supply air VAV and return air valve to control room airflow, temperature, and pressure. Low-wall filtered return air grilles in corners of the OR.						
						
ALTERNATE 1 (HIGH AIR CHANGE SYSTEM): The noteworthy change from Basis of Design is a significant increase in air volume and air changes inside the OR, which results in a significant reduction of overall particle counts within the surgical field. Studies have shown upwards of 20% lower risk of SSI when utilizing high air change systems. This system provides 60-70 air changes per hour (ACH) to each OR vs. 25 ACH with the Basis of Design system. Each OR is served by (2) dedicated fan coil units that deliver higher airflows and air change rates vs. the Basis of Design central air handling unit systems. These fan coil units are installed above the corridor ceiling, directly outside each OR and include hydronic heating and cooling coils. The local fan coil units at each OR provide a significant reduction (50%-60%) in capacity and size of the main central air handling units and ductwork systems. The primary function of the central air handling units now becomes minimum ventilation air and baseline control of humidity levels. This system includes a modular prefabricated OR ceiling plenum system with integral HEPA filtered laminar airflow diffusers and options for integral boom mounts and LED lighting. Low-wall filtered return air grilles in each OR are similar to Basis of Design. No changes to the Basis of Design room features and construction, except for the ceiling plenum system noted above.						
 						
ALTERNATE 2 (CLEAN CUBE): Clean Cube is a turn-key modular prefabricated OR solution designed and manufactured by SynergyMed. All components of the OR are designed, coordinated, and prefabricated offsite. All mechanical, electrical, and structural support systems above the OR ceiling are designed and prefabricated in modules. Structural supports are designed for future flexibility of ceiling booms. OR ceiling system is similar to Basis of Design with HEPA filtered laminar flow diffusers, LED lighting, medical gases, and boom mounts. Finished ceiling panels are PVC hygienic material. OR wall panel modules are designed and prefabricated with in-wall MEP systems and finished with Med-Glas. All hermetically sealed doors and windows are provided with the Clean Cube system. Acrylic resin hygienic flooring is installed in each OR with the Clean Cube system (Alternate materials available). OR HVAC systems are equivalent to Basis of Design, delivering 25 ACH from the central air handling unit system. HVAC systems are controlled by Clean Cube's integrated room controls, which includes user interface for surgery staff and integration with building automation system. Optional infection prevention systems include continuous 3-log dry hydrogen peroxide system or periodic 6-log vaporized hydrogen peroxide system. Additional options include integral storage cabinets, monitors, and devices.						
 						

SECTION 2: COST ANALYSIS			
	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Initial Cost	Basis of Design	No Change to Basis of Design	Add \$xx
Energy Cost	Basis of Design	~\$150k Savings Per Year	No Change to Basis of Design
SECTION 3: CONSTRUCTION SCHEDULE ANALYSIS			
	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Narrative	Traditional OR construction sequence and schedule. Field constructed drywall walls, ceilings, finishes, hygienic flooring. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Modular prefabricated OR ceiling plenum system will slightly improve above ceiling MEP rough-in duration, but there's additional duration to install fan coil units outside each OR. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Full modular constructed wall and ceiling systems with MEP and structure will reduce field installation duration in 3rd Floor OR suite by approx. 10 days. This activity is not on the schedule critical path, so impact to the overall project schedule is minimal to none.
Impact to Overall Construction Schedule	Baseline	No Change to Baseline	Minimal improvement

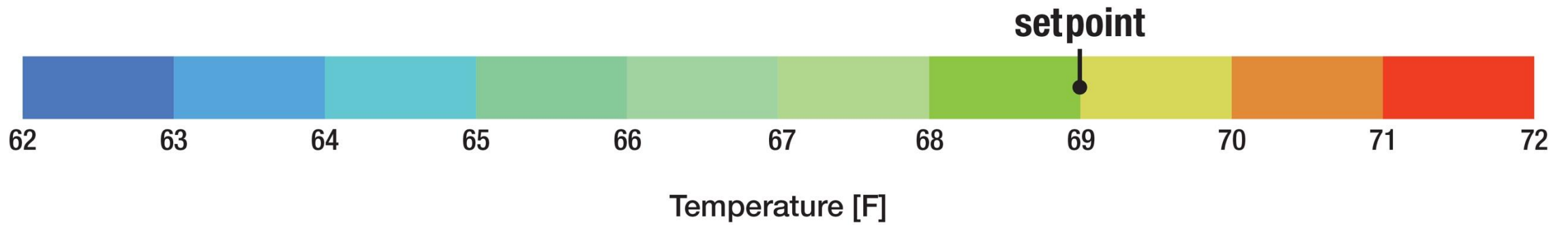
Sponsor		Collaborators	
Mortenson / HGA		Nick Ziegler, Mike Labukas, Pete Brown	
SECTION 4: ANALYSIS - ADVANTAGES / DISADVANTAGES / KEY CONSIDERATIONS			
	Basis of Design: Traditional OR Construction	Alternate 1: High Air Change System	Alternate 2: Clean Cube
Main Reasons Why We're Reviewing This Option	Although "traditional construction" sounds mundane, this option includes all features that make this a best-in-class Operating Room. The room will be 650-750 SF, include top of the line video/monitor integration and be adaptable for future needs.	Improved infection prevention due to 3 times more airflow delivered inside the OR. Improved air temps for patient and surgery staff. Smaller fans & motors are more energy efficient.	Turn-key design and modular prefabricated Operating Rooms. Improved infection prevention with optional active disinfection systems.
Room Size	Baseline (650 SF, minimum)	No Change to Baseline	Minimal decrease due to wall dimensions
Infection Prevention	Baseline	Improved during procedures (~20% lower risk of SSI). 98.99% reduction of airborne contaminants in the infection causing particle size range within the surgical field.	Improved with optional H2O2 disinfection systems
Temperature Control	Baseline	More balanced air temps (warmer for patient, cooler for surgeons & staff). FCU's dedicated to each OR improve room temp responsiveness and accuracy.	Minimal change to baseline. OR controls by Clean Cube controllers
Video/Monitor Integration	Baseline	No Change to Baseline	No Change to Baseline
Cord/Media/Service Control	Baseline	No Change to Baseline	Options for integral monitors in glass wall panels
Terminal Disinfection	Baseline	No Change to Baseline	2 Options: Continuous 3-log dry H2O2 disinfection & Periodic 6-log vaporized Dihydrogen Peroxide disinfection system
Future System Flexibility	Cutting/patching of drywall walls & perimeter ceilings required. Future OR ceiling modifications will likely require above ceiling support modifications.	Cutting/patching of drywall walls & perimeter ceilings required. Modular OR ceiling system sections can be relocated or added based on OR needs. Future boom relocation may require some above ceiling support modifications.	Above ceiling structural grid provides future flexibility for booms. Modifications to modular wall panels performed without drywall work. Need to purchase replacement panels through Clean Cube.
Future Tech Integration	Baseline	No Change to Baseline	No Change to Baseline
Mechanical Shaft & Ceiling Space Considerations	Larger AHU's in Penthouse & larger duct mains in shafts and above ceilings. Limited ceiling plenum space makes this more challenging.	Smaller AHU's in Penthouse & smaller duct mains. (2) fan coil units outside of each OR. Somewhat larger ductwork above OR ceilings	No Change to Baseline. OR ceiling plenum height is on the low-end for their ceiling plenum modules.
Maintenance	Larger AHU's in Penthouse, but overall less maintenance locations in the surgical suite. HEPA filters replaced inside the OR.	More components & maintenance locations in the surgical suite corridors. Maintenance is not frequent and likely limited to failures. HEPA filters replaced inside the OR.	No Change to Baseline
Redundancy	(2) AHU's with 70%-80% redundancy serving all OR's. Maintenance or failure of AHU's can effect multiple OR's simultaneously.	(2) FCU's serve each OR independently. Each OR can run independently for a period of time in case of central AHU failure. OR can still operate at minimum code required 25 ACH if one FCU fails.	No Change to Baseline
Energy Savings	Baseline	Upwards of 15%-20% savings	No Change to Baseline
Proven Systems	Proven as current industry standard	Hundreds of high ACH systems installed, including local installations that could be toured and reviewed.	First installation currently in progress in NY.
Cost	Basis of Design	No Change to Basis of Design	Add: \$0
SECTION 5: SAFETY			
Patient Safety & Infection Prevention is increased with either Alternate #1 or Alternate #2. Prefab ORs would increase staffworker on-site safety during construction.			
SECTION 6: QUALITY			
Basis of Design & Alternate 1 are proven systems. Alternate 2 has not been proven (first installation in progress)			
SECTION 7: UNRESOLVED ITEMS - CONSTRAINTS TO DECISION			
1. Early adopters vs. traditional systems. 2. Confirm optional "add-on" items or systems like above ceiling structure, integrated LED lighting, boom mounts, disinfection systems, etc. 3. Confirm OR corridor above ceiling space can accommodate Alternate 1 fan coil units. 4. Confirm final OR ceiling plenum heights work with modular ceiling plenum systems.			
SECTION 8: RECOMMENDATION			
Proceed with Alternate 1 High Air Change Systems			
SECTION 9: PATH FORWARD / FOLLOW-UP			
Allina Facilities and Surgery Dept Leadership teams have toured the Precision Air Showroom to review the Alternate 1 High ACH system in-person. Follow-up A3 process to compare and select High ACH System manufacturer (Precision Air or Price Industries)			



Traditional Air Change



High Air Change



Patient Outcomes

- Several studies in recent years (a lot overseas)
- "If the room temp is too cold it will increase SSI and with HACH it is safer for the patient at "normothermia" for better patient"
 - Bri Davis IP



PERIOPERATIVE MEDICINE

Effects of Forced Air Warming on Airflow around the Operating Table

Kazuhiro Shirozu, M.D., Ph.D., Tetsuya Kai, M.D., Ph.D., Hidekazu Setoguchi, M.D., Ph.D., Nobuyasu Ayagaki, M.Eng., Sumio Hoka, M.D., Ph.D.

ABSTRACT

Background: Forced air warming systems are used to maintain body temperature during surgery. Benefits of forced air warming have been established, but the possibility that it may disturb the operating room environment and contribute to surgical site contamination is debated. The direction and speed of forced air warming airflow and the influence of laminar airflow in the operating room have not been reported.

Methods: In one institutional operating room, we examined changes in airflow speed and direction from a lower-body forced air warming device with sterile drapes mimicking abdominal surgery or total knee arthroplasty, and effects of laminar airflow, using a three-dimensional ultrasonic anemometer. Airflow from forced air warming and effects of laminar airflow were visualized using special smoke and laser light.

Results: Forced air warming caused upward airflow (39 cm/s) in the patient head area and a unidirectional convection flow (9 to 14 cm/s) along the ceiling from head to foot. No convection flows were observed around the sides of the operating table. Downward laminar airflow of approximately 40 cm/s counteracted the upward airflow caused by forced air warming and formed downward airflow at 36 to 45 cm/s. Downward airflows (34 to 56 cm/s) flowing diagonally away from the operating table were detected at operating table height in both sides.

Conclusions: Airflow caused by forced air warming is well counteracted by downward laminar airflow from the ceiling. Thus it would be less likely to cause surgical field contamination in the presence of sufficient laminar airflow. (ANESTHESIOLOGY 2017; XXX:00-00)

Effect of True Laminar Flow

- "The risk of revision due to infection after primary total hip arthroplasty (THA) performed in ORs with high volume unidirectional vertical flow was 20% lower than after THAs performed in conventional ventilation"

Journal of Hospital Infection 105 (2020) 216–224

Available online at www.sciencedirect.com



Journal of Hospital Infection

journal homepage: www.elsevier.com/locate/jhin



Operating room ventilation and the risk of revision due to infection after total hip arthroplasty: assessment of validated data in the Norwegian Arthroplasty Register

H. Langvatn^{a,b,c,*}, J.C. Schrama^a, G. Cao^d, G. Hallan^{a,c}, O. Furnes^{a,c}, E. Lingaas^a, G. Walenkamp^f, L.B. Engesaeter^{a,c}, H. Dale^{a,c}

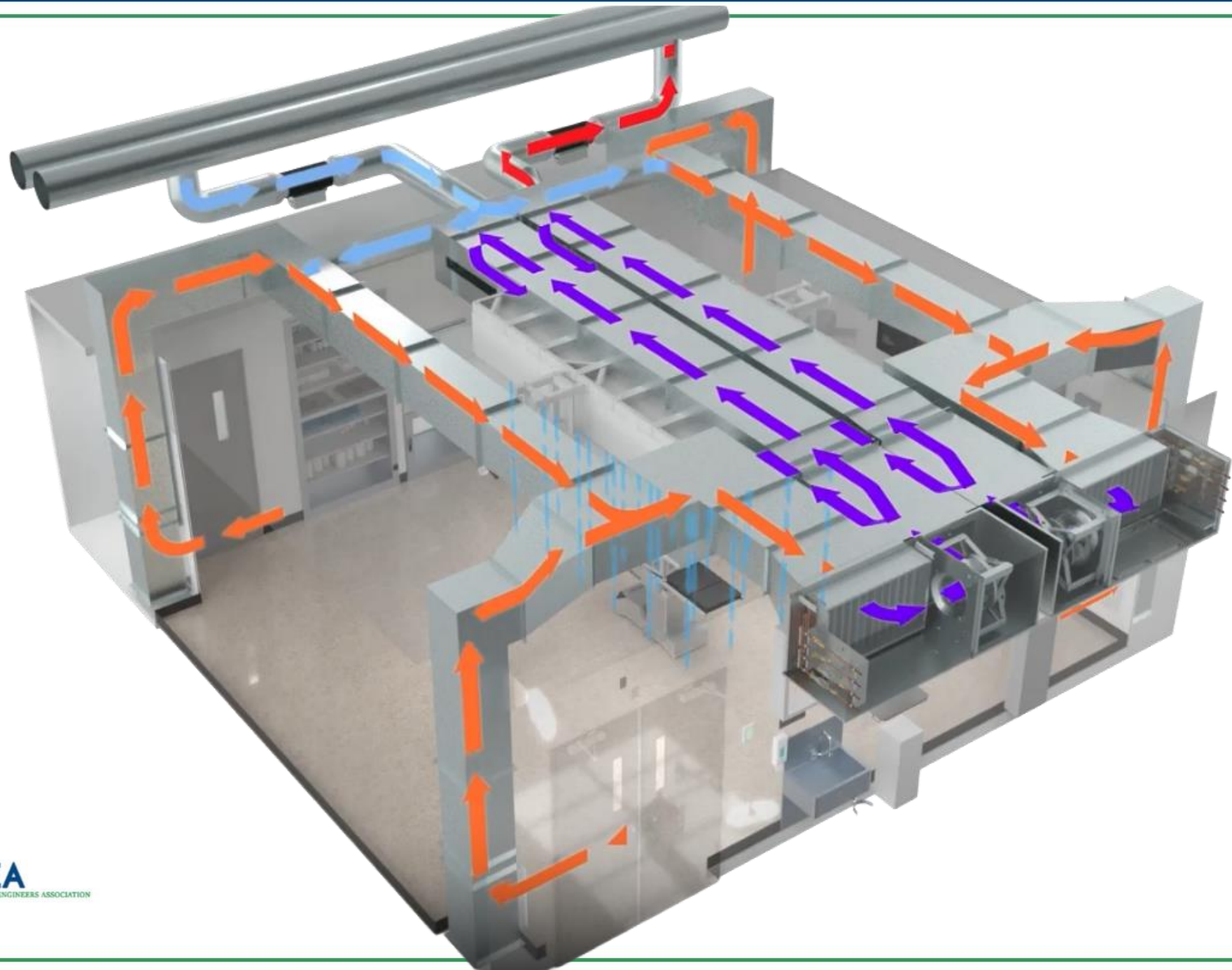
This Topic

active at maintaining body

air warming systems may
erating room, contributing
gical site

Is New

arming is well counteracted
ceiling



Energy Use

- Less cooling needed for lower temps
- Less central fan KWH needed
 - Some offset by more local fan energy
 - Net savings nonetheless
- Less reheat needed
- 20-30% energy savings

Abbott Northwestern Critical Care Pavilion				
	ASHRAE 170	High ACH	Inputs	
Electrical Energy			7	Open (AM)
AHU Fan Energy (KWH/Year)	856,598	263,810	17	Close (PM)
FCU Fan Energy (KWH/Year)	n/a	435,796	0	Operating Rooms with Low temp Set point
A/C Energy (KWH/Year)	-	n/a	540	OR Load (Tons)
Central Plant Energy	Same	Same		
Energy Wheel Recovery Energy	Same	Same	35	Operating Room Usage during occupied hours (QTY)
Humidification	More	Less	41.4	98/78 enth design
HW pumping energy	More	Less	17.1	44/44 enthalpy airside economizer
Chilled Water Pump Energy	More	Less	44	Full Air side economizer
KWH/Year - Subtotal	856,598	699,606	0.11	\$/kwh
\$/year Electricity - subtotal	\$ 94,225.75	\$ 76,956.63	0.85	\$/Therm
Reheat Energy (MBTUH/year)	2,376,150.00	n/a	Assumptions: Assumed standard fan arrays with VFDs Min AHU BHP of 20 (ASHRAE 170) and 15 (High ACH) used as min sys curve pt Ancillary CFM not included in either arrangement	
Ancillary Reheat	More	Less		
\$/year Gas - subtotal	\$ 20,197.28			
Maintenance in the space	Less	More		
Xcel Custom Rebate	Less	More		
Demand Charge	More	Less		
\$/year Total	\$ 114,423.03	\$ 76,956.63		
Savings/Year		\$ 37,466.40		

Common Barriers

Too Expensive

(Teams not having willingness to challenge)

Cleaner/Safer

(Limited outcome data)

Warmer Patients

(Clinical value difficult to quantify)

Happier Staff

(Operational benefits difficult to monetize)

Won't Fit

(Can fit within typical OR footprints)

Too Different

(Resistance to change)

Maintenance Concerns

(Perceived operational complexity)

Sound Concerns

(Difficult to quantify)

Advantages/Disadvantages

SECTION 4: ANALYSIS - ADVANTAGES / DISADVANTAGES / KEY CONSIDERATIONS

	Basis of Design: Traditional OR Construction	Alternate 1: High Air Change System	Alternate 2: Clean Cube
Main Reasons Why We're Reviewing This Option	Although "traditional construction" sounds mundane, this option includes all features that make this a best-in-class Operating Room. The room will be 650-750 SF, include top of the line video/monitor integration and be adaptable for future needs.	Improved infection prevention due to 3 times more airflow delivered inside the OR. Improved air temps for patient and surgery staff. Smaller fans & motors are more energy efficient.	Turn-key design and modular prefabricated Operating Rooms. Improved infection prevention with optional active disinfection systems.
Room Size	Baseline (650 SF, minimum)	No Change to Baseline	Minimal decrease due to wall dimensions
Infection Prevention	Baseline	Improved during procedures (~20% lower risk of SSI). 99.99% reduction of airborne contaminants in the infection causing particle size range within the surgical field.	Improved with optional H202 disinfection systems
Temperature Control	Baseline	More balanced air temps (Warmer for patient, cooler for surgeons & staff). FCU's dedicated to each OR improve room temp responsiveness and accuracy.	Minimal change to baseline - OR controls by Clean Cube controllers
Video/Monitor Integration	Baseline	No Change to Baseline	Options for integral monitors in glass wall panels
Cord/MedGas/Service Control	Baseline	No Change to Baseline	No Change to Baseline
Terminal Disinfection	Baseline	No Change to Baseline	2 Options: Continuous 3-log dry H202 disinfection & Periodic 6-log vaporized Dihydrogen Peroxide disinfection system
Future System Flexibility	Cutting/patching of drywall walls & perimeter ceilings required. Future OR ceiling modifications will likely require above ceiling support modifications.	Cutting/patching of drywall walls & perimeter ceilings required. Modular OR ceiling system sections can be relocated or added based on OR needs. Future boom relocates may require some above ceiling support modifications.	Above ceiling structural grid provides future flexibility for booms. Modifications to modular wall panels performed without drywall work. Need to purchase replacement panels through Clean Cube.
Future Tech Integration	Baseline	No Change to Baseline	
Mechanical Shaft & Ceiling Space Considerations	Larger AHU's in Penthouse & larger duct mains in shafts and above ceilings. Limited ceiling plenum space makes this more challenging.	Smaller AHU's in Penthouse & smaller duct mains. (2) fan coil units outside of each OR. Somewhat larger ductwork above OR ceilings	No Change to Baseline. OR ceiling plenum height is on the low end for their ceiling plenum modules.
Maintenance	Larger AHU's in Penthouse, but overall less maintenance locations in the surgical suite. HEPA filters replaced inside the OR.	More components & maintenance locations in the surgical suite corridors. Maintenance is not frequent and likely limited to failures. HEPA filters replaced inside the OR.	No Change to Baseline
Redundancy	(2) AHU's with 70%-80% redundancy serving all OR's. Maintenance or failure of AHU's can effect multiple OR's simultaneously.	(2) FCU's serve each OR independently. Each OR can run independently for a period of time in case of central AHU failure. OR can still operate at minimum code required 25 ACH if one FCU fails.	No Change to Baseline
Energy Savings	Baseline	Upwards of 15%-20% savings	No Change to Baseline
Proven Systems	Proven as current industry standard	Hundreds of high ACH systems installed, including local installations that could be toured and reviewed.	First installation currently in-progress in NY.
Cost	Basis of Design	No Change to Basis of Design	Add: \$0

SECTION 5: SAFETY

Patient Safety & Infection Prevention is increased with either Alternate #1 or Alternate #2 Prefab ORs would increase craftworker on-site safety during construction.

SECTION 6: QUALITY

Basis of Design & Alternate 1 are proven systems. Alternate 2 has not been proven (First installation in-progress)

SECTION 7: UNRESOLVED ITEMS - CONSTRAINTS TO DECISION

1. Early adopters vs. traditional systems.
2. Confirm optional "add-on" items or systems like above ceiling structure, integrated LED lighting, boom mounts, disinfection systems, etc.
3. Confirm OR corridor above ceiling space can accommodate Alternate 1 fan coil units.
4. Confirm final OR ceiling plenum heights work with modular ceiling plenum systems.

[illegible]

Component Mock-Up (*Maintenance Review*)



Local Mock-Ups

- Particle counts
- Temperature demonstrations
- Allina Physician engagement
- Smoke tracer demonstrations



Site Specific Factory Mock-Up

- Sound
- Particle counts
- Smoke demonstrations
- Controls



Cost & Schedule Analysis

SECTION 2: COST ANALYSIS

	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Initial Cost	Basis of Design	No Change to Basis of Design	Add \$xx
Energy Cost	Basis of Design	~\$150k Savings Per Year	No Change to Basis of Design

SECTION 3: CONSTRUCTION SCHEDULE ANALYSIS

	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Narrative	Traditional OR construction sequence and schedule. Field constructed drywall walls, ceilings, finishes, hygienic flooring. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Modular prefabricated OR ceiling plenum system will slightly improve above ceiling MEP rough-in duration, but there's additional duration to install fan coil units outside each OR. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Full modular constructed wall and ceiling systems with MEP and structure will reduce field installation duration in 3rd Floor OR suite by approx. 10 days. This activity is not on the schedule critical path, so impact to the overall project schedule is minimal to none.
Impact to Overall Construction Schedule	Baseline	No Change to Baseline	Minimal Improvement

				23-Aug-22	Sponsor Mortenson / HGA	Collaborators Nick Ziegler, Mike Labadie, Peter Brown
Sub-Objective	Comment	Revision	Final Decision Date			
23-Jul-22						
IG ROOM CONSTRUCTION: 1) Unit, Unfiltered ceiling system with independent HEPA cores, and boom rooms. 2) Air changes per hour (ACH) at OR. All ORs are A-B OR includes supply air VAV and return air to wall filtered return or grilles as controls of the OR. 23 air changes per hour (ACH) at OR. All ORs are A-B OR includes supply air VAV and return air to wall filtered return or grilles as controls of the OR.						
increase in airflow and air changes inside the OR, which results in a significant reduction of overall air shown upwards of 20% lower risk of SO when utilizing high air change systems. This system provides 60-70 air per hour of Design system. At deliver Higher airflow and air change rates vs. the Basis of Design central air handling unit systems. These fan reject outside each OR and include hydronic heating and cooling coils. The total fan/circuit units at each OR provide for the main control air handling units and ductwork systems. The primary function of the central air handling system control of humidity levels. Airlog plenum system with Integral HEPA filtered laminar airflow diffusers and options for integral-boom rooms in each OR are similar Basis of Design. of construction, except for the ceiling plenum system noted above. 						
FUTURE SYSTEM FLEXIBILITY Cutting/patching of drywall with its perimeter ceilings required. Future OR ceiling modifications will likely require above ceiling support modifications. Future Tech Integration Larger AHU's in Perimeter, larger main and mains in both and above ceilings. Limited ceiling plenum space makes this more challenging. Maintenance Larger AHU's in Perimeter, but overall less maintenance locations in the surgical suite. HEPA filters replaced inline in the OR. Redundancy 23AHUs with 70%-80% redundancy versus all OR's. Maintenance failure of AHU's can affect multiple OR's simultaneously. Energy Savings Baseline Process Systems Proven air movement standard Cost Basis of Design Alternative 1: High Air Change System Improved infection prevention due to 3 times more airflow delivered inside the OR. Improved air transfer in patient and staff areas. Smaller fans, motors and more energy efficient. No Change to Baseline Implemented during procedures 1/20% lower risk of SO, 99.99% reduction of airborne contaminants in the infection suite (particulate air) as range within the surgical field. More balanced air flows (warmer for patient, cooler for surgeons & staff), staff dedicated to each OR improve room temperature responses and accuracy. No Change to Baseline No Change to Baseline No Change to Baseline Cutting/patching of drywall with its perimeter ceilings required. Modular OR ceiling system requires same as Reheated or added based on OR needs. Future booms releases may require some above ceiling support modifications. Smaller AHU's in Perimeter, smaller main and mains, 21'x60' units outside of each OR. Some shared larger diffusers above ceilings. More components & maintenance locations in the surgical suite corridors. Maintenance is not frequent and likely limited to filter and HEPA filter replacement inside the OR. Efficiency varies off OR independently. Each OH can run independently for a period of time if central AHU failure. OR can operate at minimum capacity 25 ACH if one fails. Operative of 135% savings. Hundreds of IG-Room systems installed, including local installation could be reduced and minimized. No Change to Basis of Design Alternative 2: Clean Cube Ten-day design and modular prefabricated Operating Rooms. Improved infection prevention with optional airlock and disinfection systems. Minimal decrease due to wall dimensions Improved with optional VSD disinfection systems Options for integral modules in gull wall panels Options for integration to baseline 2 Options Continuous Flow IG-Room Disinfection & Particulate 6-log supported Drydown Period. Full disinfection system Above ceiling structural grid provides future flexibility for booms. Modifications to modular wall panels performed without drywall work. Need to purchase replacement panels through Clean Cube. No Change to Baseline. OR ceiling plenum height is on the low end for their clean cube plenum modules. No Change to Baseline No Change to Baseline First installation occurred in progress in NY. Add: \$0						



SECTION 2: COST ANALYSIS			
	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Initial Cost	Basis of Design	No Change to Basis of Design	Add \$xx
Energy Cost	Basis of Design	~\$150k Savings Per Year	No Change to Basis of Design

ACTION 3: CONSTRUCTION CODES ANALYSIS			
	Baseline	Alternative 1: High Air Change	Alternative 2: Clean Core
Impact to Overall Construction Schedule	Baseline	No Change to Baseline	Minimal Improvement

SECTION 5: SAFETY

Patient Safety & Infection Prevention is increased with either Alternate #1 or Alternate #2 Prefab OIRs would increase craftsworker on-site safety during construction.

SECTION 6: QUALITY

Basis of Design & Alternate 1 are proven systems. Alternate 2 has not been proven (first installation in progress)

SECTION 7: UNRESOLVED ITEMS + CONSTRAINTS TO DECISION

1. Early adopters vs. traditional systems.
2. Confirm optional "add-on" items or systems like above ceiling structure, integrated LED lighting, boom mounts, disinfection systems, etc.
3. Confirm OR corridor above ceiling space can accommodate Alternate 1 fan coil units.

4. Confirm final OR ceiling plenum heights work w/modular ceiling plenum systems.

SECTION 8: RECOMMENDATION	
Proceed with Alternate 1 High Air Change Systems	

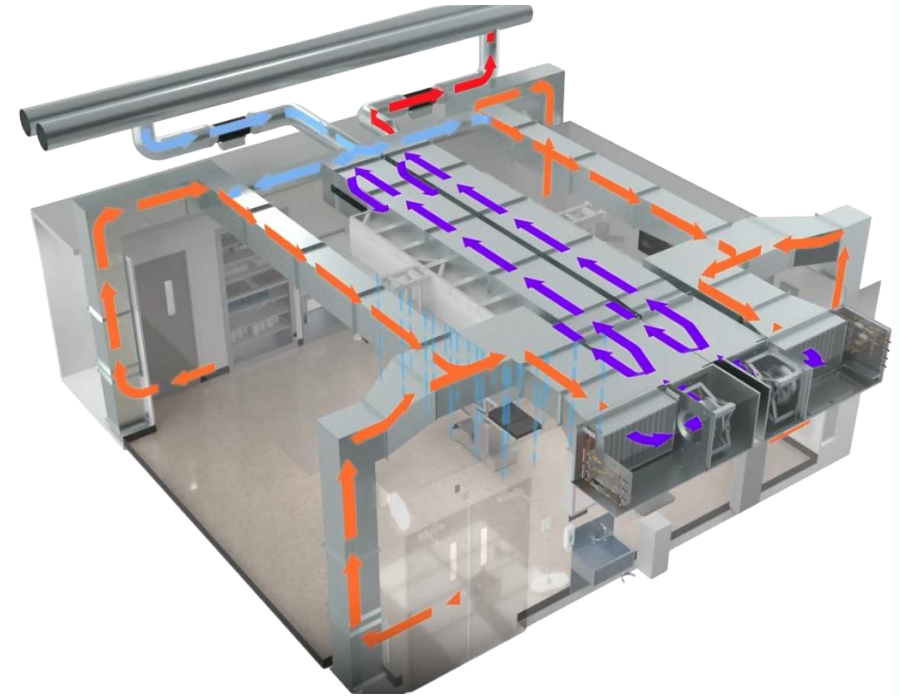
Follow-up A3 process to compare and select High ACH System manufacturer (Precision Air or Price Industries)

[illegible][illegible][illegible]



Contractor Cost Estimate

- Room Level Cost is higher for High Air Change.
- Analysis usually stops here
- We had partners pushing us to go further for full building analysis.
- We had a Team willing to go further.
- Nobody said, “No”.



Traditional vs. High Air Change

Contractor Cost Estimate

- Traditional OR design required two large penthouses to serve the ORs.
- Increased building cost
- Decreased green roof amenities



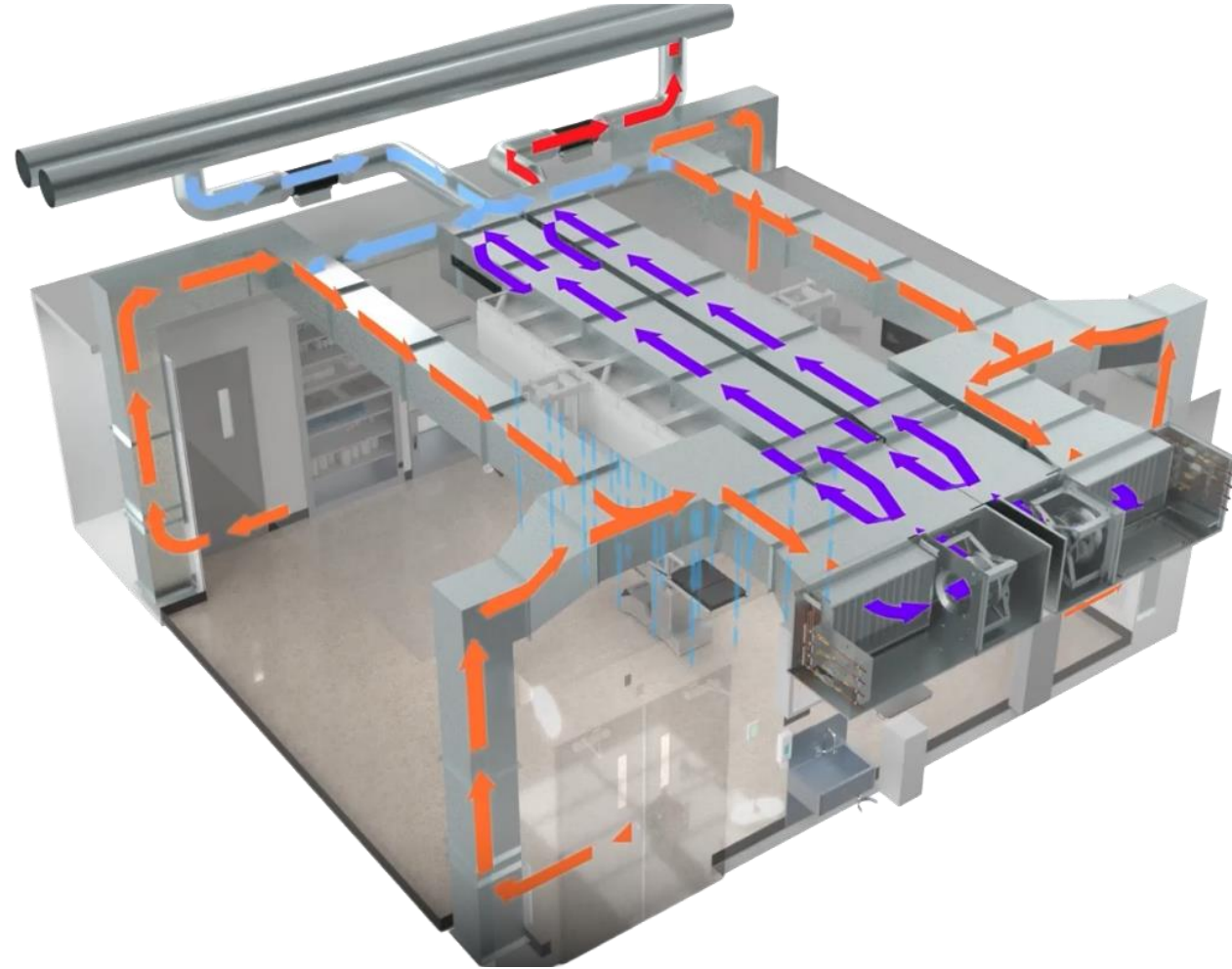
Contractor Cost Estimate

- High Air Change OR design requires one penthouse due to reduction in AHU capacity.
- Smaller ductwork, smaller shafts.



Contractor Cost Estimate

- Overall, we had one High ACH vendor slightly above and one vendor slightly below the budget for traditional ORs .
- We concluded zero cost impact.
- If we stopped at the room level, we would likely not have accepted this option due to decisions based on incomplete data.



Patient Safety & Quality Installation

SECTION 5: SAFETY

Patient Safety & Infection Prevention is increased with either Alternate #1 or Alternate #2
Prefab ORs would increase craftworker on-site safety during construction.

SECTION 6: QUALITY

Basis of Design & Alternate 1 are proven systems. Alternate 2 has not been proven (First installation in-progress)



SECTION 2: COST ANALYSIS			
	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Initial Cost	Basis of Design	No Change to Basis of Design	Add Box
Energy Cost	Basis of Design	~\$100k Savings Per Year	No Change to Basis of Design

SECTION 3: CONSTRUCTION SCHEDULE ANALYSIS			
	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Narrative	Traditional OR construction sequence and schedule. Field constructed drywall walls, ceilings, finishes, hygiene flooring. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Modular prefabricated OR ceiling plenum system will slightly improve above ceiling MEP rough-in duration, but there's additional duration to install fan coil units outside each OR. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Full modular constructed wall and ceiling systems with MEP and structure will reduce field installation duration in 3rd floor OR suite by approx. 10 days. This activity is not on the schedule critical path, so impact to the overall project schedule is minimal to none.
Impact to Overall Construction Schedule	Baseline	No Change to Baseline	Minimal improvement

Main Reason Why We're Reviewing This Option			
Room Size	Baseline (3000 sq. foot minimum)	No Change to Baseline	Minimal decrease due to wall dimensions
Infection Prevention	Baseline	Improved during procedures (72% lower risk of SS), 95-99% reduction of airborne contaminants in the infection causing particle range within the surgical field.	Improved with optional #202 disinfection systems
Temperature Control	Baseline	More balanced air temps (Warmer for patients, cooler for surgeons & staff, FCUs dedicated to each OR improve room temp responsiveness and accuracy)	Minimal change to Baseline - OR controls by Clean Cube controllers
Video/Monitor Integration	Baseline	No Change to Baseline	Options for integral monitors in glass wall panels
Cord/Utility/Service Control	Baseline	No Change to Baseline	No Change to Baseline
Terminal Disinfection	Baseline	No Change to Baseline	2 Options: Continuous (log the #202) disinfection & Periodic 6-ling vaporized Dihydrogen Peroxide disinfection system
Future System Flexibility	Cutting/patching of drywall walls & perimeter ceilings required. Future OR ceiling modifications will likely require above ceiling support modifications.	Cutting/patching of drywall walls & perimeter ceilings required. Modular OR ceiling system sections can be relocated or added based on OR needs. Future boom relocation may require some above ceiling support modifications.	Above ceiling structural grid provides future flexibility for booms. Modifications to modular wall panels performed without drywall work. Need to purchase replacement panels through Clean Cube.
Future Tech Integration	Baseline	No Change to Baseline	No Change to Baseline
Mechanical Shaft & Ceiling Space Considerations	Larger AHU's in Penthouse & larger duct mains in shafts and above ceilings. Limited ceiling plenum space makes this more challenging.	Smaller AHU's in Penthouse & smaller duct mains. (2) fan coil units outside of each OR. Somewhat larger ductwork above OR ceiling.	No Change to Baseline. OR ceiling plenum height is on the low end for their ceiling plenum modules.
Maintenance	Larger AHU's in Penthouse, but overall less maintenance locations in the surgical suite. HEPA filters replaced inside the OR.	More components & maintenance locations in the surgical suite corridors. Maintenance is not frequent and likely limited to failures. HEPA filters replaced inside the OR.	No Change to Baseline
Redundancy	(2) AHU's with 70%-80% redundancy serving all OR's. Maintenance or failure of AHU's can effect multiple OR's simultaneously.	(2) FCUs serve each OR independently. Each OR can run independently for a period of time in case of central AHU failure. OR can still operate at minimum code required 25 ACH if one FCU fails.	No Change to Baseline
Energy Savings	Baseline	Overall of 25%-30% savings	No Change to Baseline
Proven Systems	Proven as current industry standard	Thousands of high ACH systems installed, including local installations that could be toured and reviewed.	First installation currently in progress in WI.

SECTION 5: SAFETY
Patient Safety & Infection Prevention is increased with either Alternate #1 or Alternate #2
Prefab ORs would increase craftworker on-site safety during construction.

SECTION 6: QUALITY
Basis of Design & Alternate 1 are proven systems. Alternate 2 has not been proven (First installation in-progress)

- Early workshop/visual review.
- Confirm optional "add on" items or systems like above ceiling structure, integrated LED lighting, boom mounts, disinfection systems, etc.
- Confirm OR corridor above ceiling space can accommodate Alternate 1 fan coil units.
- Confirm final OR ceiling plenum heights work with modular ceiling plenum systems.

SECTION 8: RECOMMENDATION
Proceed with Alternate 1 High Air Change Systems

SECTION 9: PATH FORWARD / FOLLOW-UP
Active Facilities and Surgery Dept Leadership teams have toured the Precision Air Showroom to review the Alternate 1 High ACH system in-person
Follow up AS process to compare and select High ACH System manufacturer (Precision Air or Prior Industries)

Quality



Constraints

SECTION 7: UNRESOLVED ITEMS - CONSTRAINTS TO DECISION

1. Early adopters vs. traditional systems.
2. Confirm optional "add-on" items or systems like above ceiling structure, integrated LED lighting, boom mounts, disinfection systems, etc.
3. Confirm OR corridor above ceiling space can accommodate Alternate 1 fan coil units.
4. Confirm final OR ceiling plenum heights work with modular ceiling plenum systems.

SECTION 5: BACKGROUND / CURRENT OPTIONS

BASIS OF DESIGN (TRADITIONAL OPERATING ROOM CONSTRUCTION):

Drywall walls, drywall ceilings, recessed fluorescent linear light, traditional OR ceiling systems with independent HEPA filtered laminar airflow diffusers, LED lighting, medical gases, and boom mounts.

Central air handling units and ductwork systems deliver 25 air changes per hour (ACH) to each OR. All ORs are served by the same central air handling unit system. Each OR includes supply air VAV and return air valve to control room airflow, temperature, and pressure. Low-wall filtered return air grilles in corners of the OR.



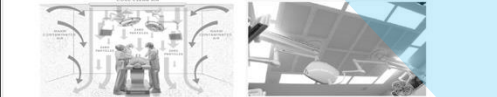
ALTERNATE 1 (HIGH AIR CHANGE SYSTEM):

The noteworthy change from Basis of Design is a significant increase in air volume and air changes inside the OR, which results in a significant reduction of overall particle counts within the surgical field. Studies have shown upwards of 20% lower risk of SS when utilizing high air change systems. This system provides 60-70 air changes per hour (ACH) to each OR vs. 25 ACH with the Basis of Design system.

Each OR is served by (2) dedicated fan coil units that deliver higher airflows and air change rates vs. the Basis of Design central air handling unit systems. These fan coil units are installed above the corridor ceiling, directly outside each OR and include hydronic heating and cooling coils. The local fan coil units at each OR provide a significant reduction (50%-60%) in capacity and size of the main central air handling units and ductwork systems. The primary function of the central air handling units now becomes minimum ventilation air and baseline control of humidity levels.

This system includes a modular prefabricated OR ceiling plenum system with integral HEPA filtered laminar airflow diffusers and options for integral boom mounts and LED lighting. Low-wall filtered return air grilles in each OR are similar to Basis of Design.

No changes to the Basis of Design room features and construction, except for the ceiling plenum system noted above.



ALTERNATE 2 (CLEAN CUBE):

Clean Cube is a turn-key modular prefabricated OR solution designed and manufactured by SpragueMed. All components of the OR are designed, coordinated, and prefabricated off-site. All mechanical, electrical, and structural support systems above the OR ceiling are designed and prefabricated in modules. Structural supports are designed for future flexibility of ceiling booms. OR ceiling system is similar to Basis of Design with HEPA filtered laminar flow diffusers, LED lighting, medical gases, and boom mounts. Finished ceiling panels are PVC hygienic material.

OR wall panel modules are designed and prefabricated with in-wall MEP systems and finished with Med-Glax. All hermetically sealed doors and windows are provided with the Clean Cube system. Acrylic resin hygienic flooring is installed in each OR with the Clean Cube system (Alternate materials available).

OR HVAC systems are equivalent to Basis of Design, delivering 25 ACH from the central air handling unit system. HVAC systems are controlled by Clean Cube's integrated room controls, which includes user interface for surgery staff and integration with building automation system. Optional infection prevention systems include continuous 3-lug dry hydrogen peroxide system or periodic 6-lug vaporized hydrogen peroxide system. Additional options include integral storage cabinets, monitors, and devices.



SECTION 2: COST ANALYSIS

	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Initial Cost	Basis of Design	No Change to Basis of Design	Add \$xx
Energy Cost	Basis of Design	~\$100k Savings Per Year	No Change to Basis of Design

SECTION 3: CONSTRUCTION SCHEDULE ANALYSIS

	BOD: Traditional Construction	Alternate 1: High Air Change	Alternate 2: Clean Cube
Narrative	Traditional OR construction sequence and schedule. Field constructed drywall walls, ceilings, finishes, hygienic flooring. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Modular prefabricated OR ceiling plenum system will slightly improve above ceiling MEP rough-in duration, but there's additional duration to install fan coil units outside each OR. Above ceiling MEP systems will be prefabricated. Potential for modular prefabricated walls and ceiling plenum with MEP.	Full modular constructed wall and ceiling systems with MEP and structure will reduce field installation duration in 3rd floor OR suite by approx. 10 days. This activity is not on the schedule critical path, so impact to the overall project schedule is minimal to none.
Impact to Overall Construction Schedule	Baseline	No Change to Baseline	Minimal improvement

SECTION 4: ANALYSIS / ADVANTAGES / DISADVANTAGES / KEY CONSIDERATIONS

	Basis of Design: Traditional OR Construction	Alternate 1: High Air Change System	Alternate 2: Clean Cube
Main Reasons Why We're Reviewing This Option	Although "traditional construction" would maintain, this option includes all features that make this a best in class Operating Room. The room will be ISO 730-32, includes top of the line video/monitor integration and be adaptable for future needs.	Improved infection prevention due to 3 times more airflow delivered inside the OR. Improved air temps for patient and surgery staff. Smaller fans & motors are more energy efficient.	Turn-key design and modular prefabricated Operating Rooms. Improved infection prevention with optional active disinfection systems.
Room Size	Baseline (ISO 30' x minimum)	No Change to Baseline	Minimal decrease due to wall dimensions
Infection Prevention	Baseline	Improved during procedures (~20% lower risk of SS), 95-99% reduction of airborne contaminants in the infection causing particle air range within the surgical field.	Improved with optional H2O2 disinfection systems
Temperature Control	Baseline	More balanced air temps (Warmer for patient, cooler for surgeons & staff). FCUs dedicated to each OR improve room temp responsiveness and accuracy.	Minimal change to baseline - OR controls by Clean Cube controllers
Video/Monitor Integration	Baseline	No Change to Baseline	Options for integral monitors in glass wall panels
Cord/Media/Service Control	Baseline	No Change to Baseline	No Change to Baseline
Terminal Disinfection	Baseline	No Change to Baseline	3 Options: Continuous 3-lug dry H2O2 disinfection & Periodic 6-lug vaporized Hydrogen Peroxide disinfection system
Future System Flexibility	Cutting/patching of drywall walls & perimeter ceilings required. Future OR ceiling modifications will likely require above ceiling support modifications.	Cutting/patching of drywall walls & perimeter ceilings required. Modular OR ceiling system sections can be relocated or added based on OR needs. Future boom relocation may require some above ceiling support modifications.	Above ceiling structural grid provides future flexibility for booms. Modifications to modular wall panels performed without drywall work. Need to purchase replacement panels through Clean Cube.
Future Tech Integration	Baseline	No Change to Baseline	No Change to Baseline
Mechanical Shaft & Ceiling Space Considerations	Larger AHU's in Penthouse & larger duct mains in shafts and above ceilings. Limited ceiling plenum space makes this more challenging.	Smaller AHU's in Penthouse & smaller duct mains. (2) fan coil units outside of each OR. Somewhat larger ductwork above OR ceiling.	No Change to Baseline. OR ceiling plenum height is on the low end for their ceiling plenum modules.
Maintenance	Larger AHU's in Penthouse, but overall less maintenance locations in the surgical suite. HEPA filters replaced inside the OR.	More components & maintenance locations in the surgical suite corridors. Maintenance is not frequent and likely limited to failure. HEPA filters replaced inside the OR.	No Change to Baseline
Redundancy	(2) AHU's with 70%-80% redundancy serving all OR's. Maintenance or failure of AHU's can effect multiple OR's simultaneously.	(2) FCUs serve each OR independently. Each OR can run independently for a period of time in case of central AHU failure. OR can still operate at minimum code required 25 ACH if one FCU fails.	No Change to Baseline
Energy Savings	Baseline	Overall of 25%-30% savings	No Change to Baseline
Proven Systems	Proven as current industry standard	Hundreds of high ACH systems installed, including local installations that could be toured and reviewed.	First installation currently in progress in NY.
Cost	Basis of Design	No Change to Basis of Design	Add \$6

SECTION 5: SAFETY

Patient Safety & Infection Prevention is increased with either Alternate #1 or Alternate #2.

Profit City would increase craftsworker on-site safety during construction.

SECTION 6: QUALITY

Basis of Design & Alternate 1 are proven systems. Alternate 2 has not been proven (first installation in progress).

SECTION 7: UNRESOLVED ITEMS - CONSTRAINTS TO DECISION

1. Early adopters vs. traditional systems.
2. Confirm optional "add-on" items or systems like above ceiling structure, integrated LED lighting, boom mounts, disinfection systems, etc.
3. Confirm OR corridor above ceiling space can accommodate Alternate 1 fan coil units.
4. Confirm final OR ceiling plenum heights work with modular ceiling plenum systems.

Proceed with Alternate 1 High Air Change Systems

SECTION 9: PATH FORWARD / FOLLOW-UP

Active Facilities and Surgery Dept. Leadership teams have toured the Precision Air Showroom to review the Alternate 1 High ACH system in-person.

Follow-up AI3 process to compare and select High ACH System manufacturer (Precision Air or Prior Industries).



Recommendation & Path Forward

SECTION 8: RECOMMENDATION

Proceed with Alternate 1 High Air Change Systems

SECTION 9: PATH FORWARD / FOLLOW-UP

Allina Facilities and Surgery Dept Leadership teams have toured the Precision Air Showroom to review the Alternate 1 High ACH system in-person
Follow-up A3 process to compare and select High ACH System manufacturer (Precision Air or Price Industries)

Integrated room controls, which includes user interface for surgery staff and integration with building automation system. Optional infection prevention systems include continuous 3-log dry hydrogen peroxide system or periodic 6-log vaporized hydrogen peroxide system. Additional options include integral storage cabinets, monitors, and devices.



From the above information, the following is recommended:

SECTION 8: RECOMMENDATION

Proceed with Alternate 1 High Air Change Systems

SECTION 9: PATH FORWARD / FOLLOW-UP

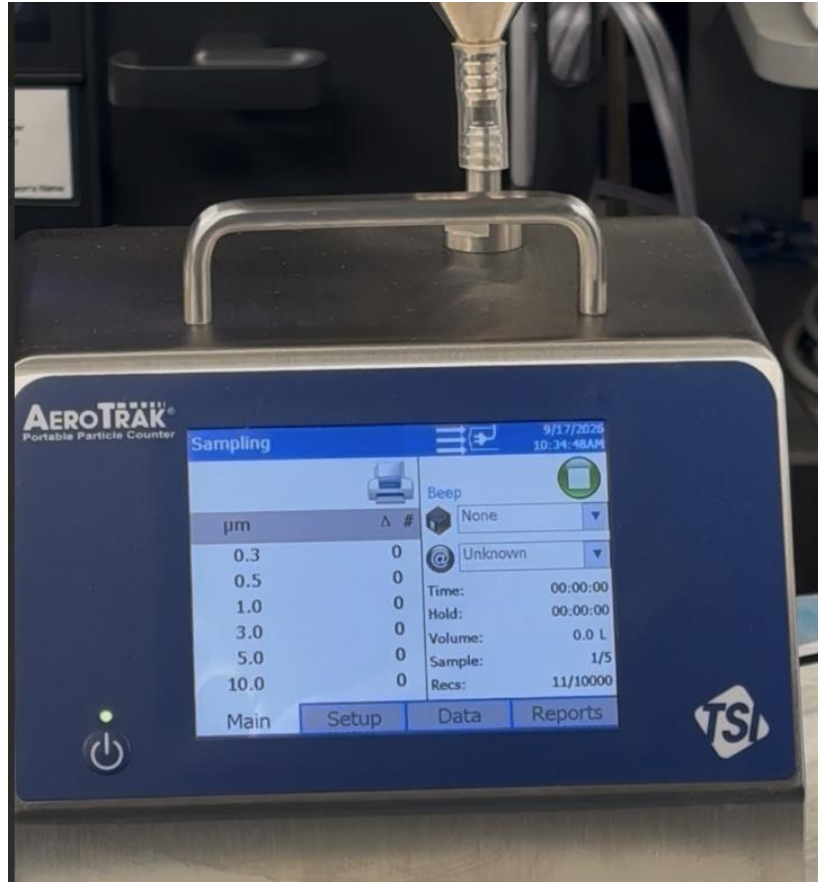
Allina Facilities and Surgery Dept Leadership teams have toured the Precision Air Showroom to review the Alternate 1 High ACH system in-person
Follow-up A3 process to compare and select High ACH System manufacturer (Precision Air or Price Industries)

Early Outcomes

- First patient date August 28th
- Early feedback
- Observed promising particle-count comparisons
- Generating strong interest through tours
- The system is being discussed as a standard for future projects



Early Outcomes



How to Apply to Your Project



- Engage the right partners and voices early
- Stay neutral with structured evaluation
- Evaluate how system affects the entire building
- Separate first cost from total value
- Build stakeholder confidence and keep them engaged and listen to them

QUESTION & ANSWER

THANK YOU



HGA

