RESEARCH

Problem

The construction at Civista Medical Center consists of three phases; a main building addition, a vertical expansion of the existing building, and selective renovations. All three areas must establish a unique Infection Control Risk Assessment or the construction will compromise the existing structure's air quality. Many of the existing building's occupants are in need of sterile environments. An unsanitary environment may jeopardize patients' well-being.

Goal

The goal of this research is to illustrate the contents of a tactical plan that will solve the problem of infectious risk for Civista Medical Center throughout the duration and complete of construction.

Research Techniques

- Research and study ICRA subject matter to gain an in-depth understanding
- Interview industry members to gather ICRA interests, concerns, and ideas
- Determine a focused assessment to perform
- Determine governing guidelines of ICRA
- Visit Civista for a firsthand evaluation
- Perform Infection Control Risk Assessment
- Publish an ICRA report that will solve the problem of infectious risk at Civista

Expected Results

The expected result of this research topic is to provide an Infection Control Risk Assessment of Civista Medical Center. It will indicate areas of concern and propose a tactical solution to the problem (inadequate air quality).

Background

The risk of spreading infectious material during construction and renovation is a serious concern in the health care industry. The Centers for Disease Control and Prevention claim that "healthcare-associated infections account for an estimated 2 million infections, 90,000 deaths, and $4.5 billion in excess health care costs annually". Of course, these statistics are not solely attributed to poor construction practices; however, it does demonstrate the need for careful planning to eliminate any danger of introducing bacteria and microorganisms to the surrounding patient occupied facilities. An Infection Control Risk Assessment (ICRA) is a method geared towards suppressing these threats.

Infection Control Risk Assessment (ICRA) is best defined as a strategic plan intended to identify and alleviate potential risks associated with the air quality environment during the construction phase of a project. It's to be carried through from the initial design stages to the completion and turnover of the project. It's unique to the project and is intended to ensure the health safety of its respective occupants. ICRA was first introduced as a requirement for patient areas in health care related projects in the 2001 edition of the *American Institute of Architects (AIA) Guidelines for Design and Construction of Healthcare Facilities*. This requirement was later made mandatory by the *Joint Commission for Accreditation of Health Care Organizations (JCAHO)* and is now implemented on every health care related project in the country. Table 1 presents selective events of nosocomial infection associated with the dispersal of microorganisms during construction per the *Association for Professionals in Infection Control and Epidemiology's* 2000 report on *The Role of Infection Control During Construction in Health Care Facilities*. Once a strategic plan is implemented, Interim Life Safety

Measures (ILSM) are applied. ILSM are a series of actions required to be taken to temporarily compensate for hazards posed by existing *Life Safety Code* deficiencies or construction activities, allowing for safe execution of the ICRA.

Table 1. Selected events of nosocomial infection associated with the dispersal of microorganisms during construction

Year, author	Organism	Population	Epidemiologic factors
Airborne			
1976 Aisner et al[1]	Aspergillus spp	Acute leukemia	Fireproofing insulation
1982 Lentino et al[2]	Aspergillus spp	BMT; renal	Road construction; window air conditioners
1985 Krasinski et al[3]	Rhizopus; Aspergillus	Neonatal	False ceiling
1987 Streifel et al[4]	Penicillium spp	BMT	Rotted wood cabinet
1987 Weems et al[5]	Rhizopus; Mucor sp;	Hematologic BMT	Construction activity
1990 Fox et al[6]	Penicillium sp; Cladosporium sp	OR	Ventilation duct fiberglass insulation
1991 Arnow et al[7]	Aspergillus sp	Cancer-melanoma	Tiles; humidified cell incubators; air filters
1993 Flynn et al[8]	Aspergillus terreus	ICU	ICU renovation; elevators
1994 Gerson et al[9]	Aspergillus sp	General	Carpeting
1995 Alvarez et al[10]	Scedosporium prolificans (inflatum)	Neutropenic hematology	Construction, presumed environmental
1996 Pittet et al[11]	Aspergillus sp	COPD	Air filter replacement
Waterborne			
1976 Haley et al[12]	Legionella spp	Immunosuppressed	Soil; water
1980 Dondero et al[13]	Legionella spp	Adults, employees	Cooling towers
1980 Crane et al[14]	Pseudomonas paucimobilis	ICU	Potable water used to fill flush water bottles
1985 Claesson et al[15]	Group A Streptococcus	Maternity	Shower head
1993 Sniadeck et al[16]	Mycobacterium xenopi	Endoscopy-pseudo	Potable water; scopes
1997 Dearborn et al[17]	Stachybotrys atra	Infants	Water-damaged homes
1997 Fridkin et al[18]	Acremonium kiliense	Ambulatory surgery	Vent system humidifier

BMT, Bone marrow transplant; OR, operating room; ICU, intensive care unit; COPD, chronic obstructive pulmonary disease.

It is up to the multi-disciplinary professional team to develop infection control strategies, inspect the construction areas during all construction phases, and monitor the air quality to ensure that the plan is properly implemented and carefully executed from the design phase clear through the project completion and turnover.

Implications of ICRA

The professional team primarily concerned ICRA is the owner, construction manager, and trade contractors. Each assumes a different responsibility in infection control. The owner is responsible for the ICRA budget and its completion prior to the commencement of work. ICRA precautions may result in costly measures (barriers, negative air pressure, etc.). However, there is no avoiding the required steps. If a project is over budget, cuts have to be made elsewhere. The construction manager will be involved in preconstruction planning and implementation of the infection control measures. Furthermore, they are responsible for the monitoring, documentation, and quality control of the scope of work. It is their responsibility to lead by example and stress the importance of ICRA. Weekly meetings should address the issue and penalize subcontractors responsible for lack in effort. The trade contractors are not specialty contractors and may not always know the proper procedures to comply with ICRA. However, it is required for them to abide by the provided infection control measures. With everyone working together to successfully fulfill their obligations and each others needs, minimal problems should be encountered along the way.

Infection Control Risk Assessment Analysis of Civista Medical Center

The following assessment will be conducted for the renovation area only. The new building addition is to be completely sealed off from the existing structure throughout its construction, thus, posing no threat to its occupants. Access to the existing will not be punched out until substantial completion.

Step One: *Identify Type of Construction Project Activity (Type A-D)*

Type A	**Inspection and Non-Invasive Activities.** Includes, but is not limited to: • removal of ceiling tiles for visual inspection limited to 1 tile per 50 square feet • painting (but not sanding) • wall covering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
Type B	**Small scale, short duration activities which create minimal dust.** **Includes, but is not limited to:** • installation of telephone and computer cabling • access to chase spaces • cutting of walls or ceiling where dust migration can be controlled.
Type C	**Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies.** Includes, but is not limited to: • sanding of walls for painting or wall covering • removal of floor coverings, ceiling tiles, and casework • new wall construction • minor duct work or electrical work above ceilings • major cabling activities • any activity which cannot be completed within a single work shift.
Type D	**Major demolition and construction projects.** Includes, but is not limited to: • activities which require consecutive work shifts • requires heavy demolition or removal of a complete cabling system • new construction.

The construction at Civista is classified as **Type D** construction. The scope of work includes several items from Types A, B, and C; however, the new construction will result in the latter and place Civista in Type D.

Step 2: *Identify the Patient Risk Groups*
*** If more than one group is affected, select the group at greater risk.*

Group 1 Low Risk	Group 2 Medium Risk	Group 3 High Risk	Group 4 Highest Risk
• Office areas	• Cardiology • Echocardiology • Endoscopy • Nuclear Medicine • Physical Therapy • Radiology/MRI • Respiratory Therapy	• Emergency Room • CCU • Labor and Delivery • Outpatient Surgery • Laboratories (specimen) • Newborn Nursery • Pediatrics • Pharmacy • Post Anesthesia Care Unit • Surgical Units	• All OR's • Sterile Processing Areas • Burn Unit • All Cardiac Cath & Angiography Areas • Intensive Care Units • Medical Units • Oncology • Negative Pressure Isolation Rooms • Any area caring for immunocompromised patients.

Civista is a **Group 4: *Highest Risk*** facility. It falls under this category since a vertical expansion will house the new Intensive Care Unit.

Step 3: *Match the*

Patient Risk Group *(Low, Medium, High, Highest)* with the planned…
Construction Project Type *(Type A, B, C, D)* on the following matrix, to find the…
Class of Precautions *(I, II, III, IV)* or level of infection control activities required.

Class of Precautions: Construction Project by Patient Risk

Risk Level	Construction Activity			
	Type "A"	Type "B"	Type "C"	Type "D"
Group 1	I	II	II	III/IV
Group 2	I	II	III	IV
Group 3	I	III	III/IV	IV
Group 4	III	III/IV	III/IV	**IV**

Table 2: Class of Precautions

Civista is a **Type D** project and falls under the category of Highest Risk, **Group 4**. This results in a **Class IV** Classification of Precautions. Consult the required Infection Control precautions listed on the following page. Class IV Classification requires an Infection Control approval prior to turnover.

Description of Required Infection Control Precautions by Class

Class	During Construction Project	Upon Completion of Project
Class I	1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace ceiling tile if displaced for visual inspection.	
Class II	1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area. 6. Remove or isolate HVAC system in areas where work is being performed.	1. Wipe work surfaces with disinfectant. 2. Contain construction waste before transport in tightly covered containers 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Remove isolation of HVAC system in areas where work was being performed.
Class III	1. Remove or isolate HVAC system in areas where work is being performed to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control tube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid.	1. Do not remover barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department. 2. Remove barrier materials carefully to minimize spread of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop with disinfectant. 5. Remove isolation of HVAC system in areas where work was being performed.
Class IV	1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control tube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures appropriately. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site of they can wear cloth or paper coveralls that are removed each time they leave the work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worked exits the work area. 7. Do not remover barriers from work area until completed project is inspected by the owner's Safety Department and Infection Control Department and thoroughly cleaned by the owner's Environmental Services Department.	1. Remove barrier materials carefully to minimize spread of dirt and debris associated with construction. 2. Contain construction waste before transport in tightly covered containers. 3. Cover transport receptacles or carts. Tape covering unless solid lid. 4. Vacuum work area with HEPA filtered vacuums. 5. Wet mop with disinfectant. 6. Remove isolation of HVAC system in areas where work was being performed.

Step 4: **Identify areas surrounding the project area, assessing potential impact.**

Unit Below:	High
Unit Above:	N/A
Lateral:	High
Behind:	N/A
Front:	High

Step 5: **Identify specific site of activity (e.g. patient rooms, operating rooms, etc.)**

Patient Rooms, Intensive Care, Cardiology, Operating Rooms, Physical Therapy, Offices.

Step 6: **Identify issues related to ventilation, plumbing, and electrical in terms of occurrence of probable outages.**

Must submit an outage request for any planned outages.

Step 7: **Identify containment measures, using prior assessment. Types of barriers? Will HEPA filtration be required?**

Solid wall barriers between new and existing construction.

Plastic barriers in renovation areas.

HEPA filtration.

Step 8: **Consider potential risk of water damage. Is there a risk due to compromising structural integrity?**

No.

Step 9: **Work hours: Can or will the work be done during non-patient care hours?**

No.

Step 10: **Do plans allow for adequate number of isolation/negative airflow rooms?**

Yes.

Step 11: **Do plans allow for the required number and type of hand washing sinks?**

Yes.

Step 12: **Does the infection control staff agree with the minimum number of sinks for this project?**

Yes.

Step 13: Does the infection control staff agree with the plans relative to clean and soiled utility rooms?

Yes.

Step 14: Plan to discuss the following containment issues with the project team.

Traffic Flow / Egress, Debris Removal, Housekeeping, Phasing, Construct/Deconstruct Trash Chute

Suggested Infection Control Actions

Reiterating the fact that the Civista Medical Center Project consists of new construction, renovations, and a vertical expansion, this project falls in line at a Class IV precaution level. The scope of work requires, but is not limited to, additional plumbing and sprinkler piping, HVAC ductwork, as well as electrical and telecomm cable/wiring. MEP expansions/updates require demolition and penetrations through walls, floors, and ceilings. This construction may create a poor, depressurized, air quality; hazardous to surrounding patients if not properly contained.

Considering the previously stated ICRA recommendations and suggestions, precautions taken in preventing infectious risk are as follows:

- A dust proof plastic barrier with a door and framed will be installed to contain demo debris and dust, and protect patients
- The air vents inside the work area will be sealed with plastic sheeting
- Dust mats will be placed at the entrance and exit of work area
- Negative air pressure will be maintained within the work area utilizing HEPA equipped air filtration units
- The construction debris will be transported in tightly covered containers

- Inside work area will be completely cleaned prior to the removal of the plastic barrier
- After removal of the plastic barrier, area will be cleaned again with disinfectant
- All staff in the area is to be briefed prior to the commencement of work

In order to assure the safety of the building occupants, the following Interim Life Safety Measures are to be taken. These steps go hand-in-hand with the ICRA:

- Infection Control Risk Assessment and Interim Life Safety Measures forms submitted and approved.
- All fire door exits will be maintained for clear access at all times.
- The Hospital's existing life safety systems will not be interrupted.
- Additional fire fighting equipment will be available
- All staff in the area is to be briefed prior to the commencement of work
- Install dust proof plastic barriers to contain demo debris and protect occupants
- During demo, ensure that all loads of debris are properly covered
- Clean up interior area, enclosed by barriers
- Remove temporary barriers upon completion
- Clean and disinfect entire area upon removal of temporary barriers

Additional ICRA Provision Unique to Civista

The Civista project team follows published guidelines similar to the matrix system above. Some areas of construction require more stringent provisions than others. The new addition is completely isolated until its substantial completion. Upon its completion, the team will punch through to the existing building at each corridor. Any further interior construction of the new addition will require methods of isolation similar to the renovations. The vertical expansion requires additional plumbing and sprinkler piping to be installed above the ceiling of the existing structure and into the newly expanded levels. Installing new piping requires demolition and penetrations to the outside environment. This may create a poor, depressurized, air quality. It is important that all holes, pipes, conduits, and punctures are sealed appropriately. As for the renovated areas, the ICRA plan first studies the Decision Tree, Figure 3 on the next page. Individual rooms are sequenced – using only two rooms at a time for more localized construction and better containment. This sequencing will be examined later. To avoid the dangers associated with wall penetrations, the constructing team devised a solution. An example of a wall mount configuration used is shown, Figure 3. It minimizes the number of wall penetrations by running cable and wiring down from the ceilings instead of through the walls.

Decision Tree for Any Interior Renovation Activity:

What am I trying to do? Just investigate, or accomplish some invasive work?

Just Investigating: **(Write out the plan on ICRA)** *Invasive work:*

Pop one tile at a time, keep the tile above the ceiling, shield patients and visitors, use a disinfectant spray in ceiling.

Lay out the work plan, use containment, shield patients and visitors, use walk off dust Protection, signage as needed and cover trash for removal.

What type of containment?

< 48 Hours:	Mobile Booth
1-14 Days:	Plastic Wall
> 2 Weeks:	Hard Wall

Are you doing demolition?

If taking out an existing smoke or fire wall, part of your plan must address life situation being created.

(Write out ILSM plan also)

Are you affecting existing utilities and/or systems?

You may need a plan for an outage or work around.

(Write out an outage Request)

Plan the Work &
Work the Plan !

Figure 1: Decision Tree for Any Interior Renovation Activity

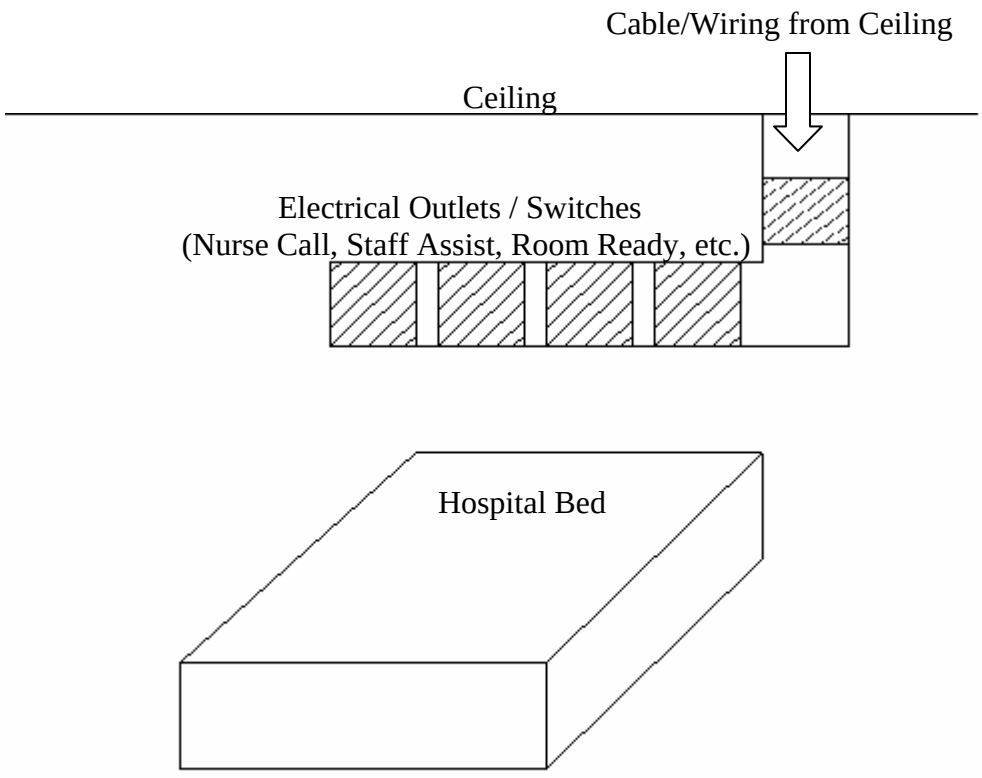

Figure 2: Wall Mount Configuration

Since existing utilities and systems will be affected, outage requests must be formulated. For example, the sheaves and belts on Air Handling Unit (AHU) #7 need replaced to upgrade the air flow and the maximum Cubic Feet per Minute (CFM) output. This activity will require a scheduled and approved system outage since it affects the occupied space being renovated. Figure 3, located on the next page, shows an outage request form that must be submitted by the contractor for proper outage coordination. Appropriate management of outages is extremely important. In this case, affected areas are isolated as much as possible since ventilation will be temporarily out of service. Highly sensitive at-risk patients may require the Civista medical staff to temporarily move them to more stable environment.

OUTAGE REQUEST

Submitted By: Trade Contractor

Description of Work to be Performed Requiring Outage:
Contractor requests an outage on AHU #7 Main Building 4th Floor Mechanical Room to replace sheaves and belts in AHU #7 to upgrade the air flow and max CFM for the addition of the ICU.

Location of Outage: 4th Floor Mechanical Room

Duration of Outage: 2 Hours (12:00 PM to 2:00 PM) 11-21-06

Affect to Tenants:
Outage will affect the 2nd floor North and East tenants, also 3rd floor North tenants

Approved: ✓ **Rejected:** _____

CM Signature (dated): _____

Owner Signature (dated): _____

Additional Comments on Procedure:
The Unit will not be shut off until the outside temperature has reached it high for the day, considering the time of year. Furthermore, affected areas are to be isolated as much as possible since ventilation will be temporary out of service.

Figure 3: Outage Request Form

ICRA – 2nd Floor East Wing Sequencing

The following is an ICRA plan for work done during the renovation phase. The work is sequenced in such a manner that only two rooms are isolated at any one time. This setup maximizes the amount of occupiable patient care space while safely and efficiently completing the scope of work.

INFECTION CONTROL RISK ASSESSMENT
Civista Medical Center Renovation and Addition Project

Date:

Location: 2nd Floor East Wing

Risk Type: A B C [D]

Patient Type: Low Risk Medium Risk
High Risk [Highest Risk]

Duration of Condition: 110 Calendar Days

Background Description:

Additional plumbing and sprinkler piping is required to be installed above the ceilings in the patient rooms of the 2nd Floor East Wing. This piping is required for the addition of the 3rd floor. The work will be accomplished in sequences by only involving two rooms at a time.

Required Precautions:

- A dust proof plastic barrier with a door and frame will be installed to contain demo debris and dust and protect patients.
- The air vents inside the work area will be sealed with plastic sheeting.
- Dust mats will be placed at the entrance and exit of work area.
- Negative air pressure will be maintained within the work area utilizing HEPA equipped are filtration units.
- The construction debris will be transported in tightly covered containers.
- Inside work are will be completely cleaned prior to the removal of the plastic barrier.
- After removal of the plastic barrier, area will be cleaned again and tile areas will be wet mopped with disinfectant.
- All staff in area will be notified and briefed on what work will take place.

Submitted By: _____
Approved By: _____

INTERIM LIFE SAFETY MEASURES
Civista Medical Center Renovation and Addition Project

Date:

Location: 2nd Floor East Wing

Deficiency:

The areas included in the construction may involve temporarily blocking fire exits/corridor.

Background Description:

Additional plumbing and sprinkler piping is required to be installed above the ceilings in the patient rooms of the 2nd Floor East Wing. This piping is required for the addition of the 3rd floor. The work will be accomplished in sequences by only involving two rooms at a time.

Duration of Deficiency: 110 Calendar Days

Interim Life Safety Measures Taken:

- Infection Control Risk Assessment and Interim Life Safety Measures forms submitted and Approved
- All staff in area will be notified and briefed on what work will take place.
- All fire door exits will be maintained for clear access at all times
- Civista's existing life safety systems will not be interrupted.
- Additional fire fighting equipment will be available.
- Install dust proof plastic barrier to contain demo debris and protect patients.
- During removal, ensure all debris is properly covered.
- Clean up interior area.
- Remove temporary barrier upon completion
- Clean entire area. Coordinate with Engineer to replace furniture.

Submitted By: _____
Approved By: _____

Since areas are sequenced by two rooms at a time, there is a total of 8 sequences. Each sequence is to be completed in 10 working days. The following outlines the scope of work.

Sequence 1, 2, 3, 6, 7, 8

General Trades

- Remove furniture
- Construct plastic dust barrier
- Install floor protection
- Install HEPA filters in both rooms
- Cut drywall for tie-ins
- Lay out piping on ceilings
- Cut drywall ceiling for piping
- Cut drywall ceiling in toilet room for sprinkler piping and head
- Remove drywall debris

Plumbing Contractor

- Lay out piping on ceilings
- Core drill roof
- Install hangers and piping
- Perform pipe testing

Sprinkler Contractor

- Install hangers and piping
- Install sprinkler heads

General Trades

- Patch drywall walls and ceilings
- Finish paint
- Clean entire rooms
- Remove plastic dust barrier
- Clean area

Sequence 4 and 5

*** Can be accomplished after normal working hours without disruption to the hospital staff.*

General Trades

- Remove supplies from the supply room
- Construct plastic dust barrier
- Install floor protection
- Install HEPA filters in both rooms
- Demo drywall ceiling in the supply room
- Remove drywall debris
- Install plastic covering on the walls and floors in rooms to be worked that night
- Remove ceiling tiles as required

Plumbing Contractor

- Lay out piping on ceilings
- Core drill roof
- Install hangers and piping
- Perform pipe testing

Sprinkler Contractor

- Install hangers and piping
- Install sprinkler heads

General Trades

- Patch drywall walls and ceilings
- Finish paint
- Re-install all ceiling tiles
- Remove plastic covering from walls and floors
- Remove plastic dust barrier
- Clean area

***** Refer to Appendix E for Sequencing Drawings***

Conclusion

Infection control is a vital aspect to all health care construction projects. There are several resources available to aid in the development of a plan that is unique and effective to the project in question. Following an Infection Control Risk Assessment of the renovation phase of Civista, several specific methods for minimizing infection risk were identified. Furthermore, provisions taken that were unique to the project were identified and discussed. Finally, after reviewing several different case studies, a sequencing plan was devised for the 2nd Floor East Wing area. This sequencing plan is intended to maximize the amount of occupiable patient care space while safely and efficiently completing the scope of work.