Case Study: Infection Control on The Arroyo Grande Community Hospital Emergency Room Expansion and Remodel Project

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California hospital and healthcare projects typically involve California's Office of Statewide Health Planning and Department (OSHPD) which is governed by the state of California and the Fire Marshal. Along with OHSPD as the governing organization, healthcare and hospital projects often must incorporate infection control practices. The Arroyo Grande Community Hospital Emergency Room Expansions and Remodel project incorporated infectious control practices. Qualitative research was conducted through semi-structured interviews of the project management team along with primary and secondary sources. The tools and practices used on this project included negative air machines, temporary walls with sound barriers, zip walls with fire rated plastic, general cleaning supplies, and HEPA vacuums. This project was successful in meeting the requirements and expectations of the infection control nurse and the hospital staff. The project team emphasized teamwork, communication between involved parties, relationships with subcontractors, and problem-solving skills to the success of this project.

Key words: Healthcare projects, Construction, OSHPD, Infectious Control

Introduction

Safety for commercial, heavy civil, and residential projects are all governed by Federal Occupational Safety and Health Administration (OSHA) or through an OSHA approved state plan. These rules and regulations established by these plans are to be enforced on all projects in California, except for hospital projects that take on a more strict and heavily governed organization, OSHPD. Hospital projects do not differ much from traditional commercial projects for example, team organization, project delivery strategies, and construction practices are all similar despite having stricter structure and fire safety laws.

Often construction projects are to be executed inside an active hospital, which in addition to having OSHPD's strict and demanding regulations the project must incorporate infectious control. Infectious control is a common practice used by industry professionals that work on healthcare projects. Implementing infection control practices on a project affects almost every aspect of the construction process. Having patients on gurneys, hospital staff, and construction personnel all occupying the same space involves increased risk to any construction project. This requires every construction activity or

phase of the project to be well planned out and thought of to keep the construction project and the hospital running simultaneously.

Infectious control practices are increasingly evolving to become more efficient, but to a project manager who has not had the opportunity to mange a hospital or health care project some of these concepts and practice could seem foreign. The Arroyo Grande Community Hospital Emergency Room Expansion and Remodel built by Specialty Construction Inc. This project featured two main phases but only the second phase featured extensive infectious control practices. The second phase of this project was a remodel of the existing emergency room (ER) of the hospital. Coordinating subcontractors, patients in gurneys, and hospital staff successfully required a lot of risk management and planning.

This project was completed in the year 2020. Due to the success of the construction project, this case study will examine the infectious control practices and the project team strategies used throughout this project. Gathering and identifying these strategies will provide new knowledge for future project managers who may need some guidance on their project that incorporates infectious control.

Literature Review

Given that this paper is a case study done on the Arroyo Grande Community Hospital Emergency Room Expansion and Remodel project, the majority of the data and information used was directly from the project team. Research done during literature review was related to infectious control practices and tools.

Infectious Control

The Center for Disease Control and Prevention (CDC) defines infection control as preventing or stopping the spread of infections in healthcare settings. While hospitals must incorporate these practices to their everyday work life our construction industry may not be entirely familiar with this concept. There are three primary ways that diseases are transmitted (Taylor 2020). The first is through indirect or direct contact. Organisms and viruses can be transferred between individuals by coming into contact with the same surfaces. Enacting practices to ensure that surfaces are clean throughout the project's life is important to not only keep your subcontractors safe but hospital staff and patients as well. The second is airborne, which occurs when infectious particles travel through air currents and are inhaled. On the construction job dust control is one of the largest challenges because of all activities occurring in a relatively confined space. The third is water borne which account for a small fraction of how these diseases are transmitted, still need to be considered and thought of to ensure the safety of everyone involved on the project.

Infectious control during constructions adds a lot of risk to all parties involved. Risks associated with construction include dust and debris compromising the environment, air borne microbes journeying via air currents to infect other susceptible hosts, an unbalanced ventilation system affecting air quality, water stagnation and contamination, accumulated and multiple waste reservoirs and ineffective dustproof barriers, and managing the transportation of waste and contaminated workers, among others (Taylor 2020). With increased risk the project team must be proactive to reduce the potential of any transmission of contaminants between the construction space and the hospital.

Methodology

To acquire the best results and information for this case study primary and secondary sources by industry professionals were used. Semi structured interviews were also conducted as a part of this case study's data collection. The interviewees were a part of the Arroyo Grande Community Hospital: Emergency room Expansion project team. All Project Team members were from Specialty Construction Inc. The interview questions differed depending on the project member and their involvement with the project.

In utilizing this methodology, this case study's objectives are as follows:

- Define Infectious control
- Identify the infectious control practices that led to the success of the project.
- Provide information and recommendations for future project teams.
- Analyze infectious control practices affect on projects budget and schedule.
- Identify challenges of project and important solutions.

Case Study

Construction

The Arroyo Grande Community Hospital was about a 5,000 square foot extension and a 5,000 square foot remodel. This project utilized a design build project delivery method which allowed the project management team to be heavily involved throughout both the design and construction phases. This project was performed in two major phases, the first being the extension and the second being the remodel. The project Management team consisted of one project manager and one field superintendent, but multiple other parties took part in the preconstruction and construction process. Preconstruction for this project started in 2015 where Specialty Construction and 19six Architects came together to begin the process of designing this project. Construction of phase one started in 2017 and construction of the final phase did not finish until 2020.

Infectious Control Practices

Negative Air Machines

The infectious control practices used on this project led to a successful project. One of the most important tools that was utilized was the negative air machine. Negative air machines use high efficiency particle air filters to prevent spreading dust or pathogens (Lee and Jeong 2020). They can create negative air inside the construction workspace to ensure all dust and pollutants are sent outside into the open air instead of being leaked to the occupied emergency room. As depicted in Figure 1 and Figure 2 these are two examples of negative air machines used on this project. Figure 3 shows how all negative air machines were connected and vent out air through the ceiling. The ducts for the machines run throughout the ceilings of the hospital hallways and had to be installed prior to any work being performed then removed when all construction activities were completed. These machines were a crucial tool throughout the construction process.

Figure 1. Negative air machine used on the project.

Figure 2. Negative air machine used on the project.

Figure 3. Shows how all negative air machines are connected and ejects air through the ceiling.

Temporary walls

Figure 4. Temporary walls used on the project.

Figure 5. Acoustical barriers used on temp walls.

The next important practice incorporated was the use of temporary walls with sound barriers on the inside. These temporary walls were placed in between the hallways and were the primary tools that separated the construction work taking place in the hospital from the patients and hospital staff in the emergency rooms. Because these walls were only temporary, they were attached to the floors with

double sided sticky tape. The only place these walls were secured to the foundation was on either side of the door. While constructing these walls duct tape was used at the top and bottom plates to ensure no dust or pollutants would leak through those small gaps. Figure 4 shows an example of how these walls were constructed. On the inside of these walls acoustical barriers were hung to reduce the amount of noise pollution in the emergency room. The temporary walls were required to be fire rated and painted with high gloss paint to avoid any organism or pathogen sticking to the exterior drywall.

Zip Walls

In addition to these temporary walls, less temporary plastic walls were used throughout the project's life. These walls are called Zip Walls. As shown in figure 6 the temporary plastic walls are constructed with extending posts and fire rated plastic. Zip walls are an efficient way to set up a contained space that is not already in the existing contained construction space. The major advantages with implementing these walls are how quickly they are constructed and how they serve as a dust barrier. The poles come with two attachments. The first is the nonslip pads that attach the fire rated plastic to the poles. The second attachment used on the project was the foam rails this also assisted in hold the plastic barriers up. Instead of holding the plastic at one point like the pads do these rails can hold a larger area of the plastic. When utilizing these poles and walls it is important to seal all edges of the plastic. On the Arroyo Grande Community Hospital, the use of 3M blue painters tape was used to seal the edges. While it is the most time-consuming process of installing these walls doing this ensured minimal to no dust leaked out of the construction workspace.

Figure 6. An example of a temporary zip wall.

Sticky Floor Mats and Dust Control

Another major practice of infectious control used on the Arroyo Grande Community Hospital was cleaning of the hallways and occupied spaces. During the remodel phase all demolition had to be carried out in carts or trash cans. This created dust and dirty hallways. One of the requirements when carrying construction debris or materials in and out of the hospital is that the materials are covered.

This project used plastic to cover the debris and materials while they were being transported. This was extremely effective in ensuring there was no exposure to the hospital patients and staff. Another common way dust and dirt migrated from the construction zone into the active emergency room was through the footsteps of the laborers. To combat leaving a trail of footprints when existing the construction zone the project team used sticky floor mats. These mats function like a giant sticker able to take away all dirt, dust, or construction material off the workers boots. These mats were extremely effective in reducing the dirt traveling into the hallways of the hospitals.

General cleaning supplies

General cleaning supplies were also an important tool used throughout this project's life. The cleaning tool that was most often used was a mop. Even with the sticky mats and covering all materials being transported dirt and dust would still be left behind. Swiffer's were used during the start of the project but as construction activities increased, they were no longer efficient. What the project team decided to use was one of the janitorial mops used by the hospital staff. Mopping the hospital floors throughout the day is what took the workers performing these practices the greatest amount of time. Other general cleaning supplies like dusters and disinfectant spray were used to clean the hospital hallways. These cleaning practice aided in ensuring that there was no transfer of infection from the patients to the construction workers and from the construction workers to the patients.

HEPA Vacuums and Filters

Lastly one of the most important tools that was implemented was the use of HEPA vacuums. HEPA stands for high efficiency particulate air filter and are designed to remove and capture up to 99.97 percent of all particles. Unlike traditional vacuums the HEPA vac circulates air through filters before recirculating this air back into the occupied space. A traditional vacuum has the possibility of recirculating contaminants back into the air which is acceptable for most construction projects. Because the work performed will be inside a hospital the use of an average vacuum would circulate some viruses and bacteria into the air doing more harm than good.

These were the most important and effective infectious control practices used on the Arroyo Grande Community Hospital project. These practices were preformed by a designated subcontractor and by the general contractor's laborers.

Infectious control on a project

Implementing and coordinating these practices on a construction jobsite affects every aspect of how the project is completed. One major affect the project team had to consider was how the added processes of not only OSHPD but infectious control as well would have on the cost. Infectious control also has a significant impact on the projects budget. In fact, these measures were almost 2% of all construction costs on the Arroyo Grande Community Hospital Emergency Room Expansion and Remodel. When dealing with infectious control coordination with subcontractors, hospital staff, and patients is extremely crucial and will depend on the success of the project. There is a lot of added risk when dealing with an OSPHD project and infectious control, it is the responsibility of the project team to be able to successfully prepare, plan, and coordinate construction activities in this type of setting.

Results

Interview Results

What are the major differences from hospital projects and general construction projects?

Hospital projects are typically OSHPD which is governed by the state of California and the state fire marshal. Basically, every Piece of material, hardware, system, etc. has to be approved by the state and the fire marshal. Most importantly there can be absolutely no deviations from what is stated on the plans or construction documents.

What is your definition of Infectious control?

Infectious control is essentially creating a "bubble" that has negative air pressure within an existing working space. The most important factor of infectious control is that there is no cross contamination between construction work and the hospital.

What are the main goals of infectious control?

The main goal associated with infections control is to create a negative "bubble" that is completely sealed and will not allow cross contamination. Ongoing cleanliness is one of the largest factors in the success of infectious control.

What were the main tools and practices used to accomplish these goals?

There were many tools and practices we used throughout the project. Continuous cleaning, negative air machines with HEPA filters, HEPA filtered shop vacuums, sticky floor mats, Fire rated plastic, and ANTE rooms with controlled entry areas.

How does infectious control affect the project budget?

Infectious control is really a stand-alone function of a project which is typically an ongoing task. During the course construction through the various stages maintaining can be great at times and need maximum resources. If planned correctly during demolition or debris creating heavy activities, cost to maintain will be the highest.

How does infectious control affect the project schedule?

Infectious control is kind of the start and stop of activities. If it is a phased project the set up and take down of the project will increase the activity durations. This will need to be considered within the project schedule to account for all the added time in set up and take down. Sometimes the set up and take down will take as long or longer than the task being performed. It is up to the project team to make sure the project schedule correctly represents durations which could be hard to estimate and accomplish.

As the project manager what are the key steps you take to prepare for a project that will incorporate infectious control?

As the project manager, meetings with the facility staff and meeting with the infectious control nurse who issues this infectious control permit is key so that all their expectations are met. And to make

sure that the expectations are reflected in the budgeting and the cost of equipment, manpower, and supplies for the correct duration of the project.

In your opinion what led to the success of this project?

There was a lot that contributed to the success of this project. First, was the communication between all the subcontractors, hospital staff, and project management team. Teamwork and problem-solving skills by the project team and all parties involved were also a large contributing factor to the success of the project. Lastly the relationships between subcontractors and the project management team were crucial.

In your opinion what are the biggest challenges involved with hospital projects and dealing with infectious control?

The risk is extremely high with these types of projects. Every activity, phase, task, etc. must be thought out in preparation for the next move. Fire, life safety, and infectious control go hand in hand as the constant question must always be asked is what can go wrong and when it does go wrong, what will be our plan of attack to mitigate it. The project management team needs to be proactive throughout the whole project. Challenges with infectious control are setting up area negative to the outside room, keeping all areas of construction inside, and outside clean and ensuring there is no breach in the plastic bubble.

Conclusion

Implementing infectious control practices on an already complicated OSHPD project requires the project management team to be proactive and well prepared. On the Arroyo Grande Community Hospital Emergency Room Expansion and Remodel project the management team was able to successfully execute this project in an environmentally safe way. Relationships with subcontractors, communication, problem solving, and teamwork were the leading contributors to the success of the project. The infectious control practices and tools listed in this paper are common practices used by the industry. If correctly executed these tools and practices could be used on any construction project that requires infection control.

Future Research

In this case study the common practices and tools used on the project were stated and explained. One possible case study or research project might be to analyze how infectious control affects a project's overall schedule and budget. Although this paper touches on these topics there is still room for additional research and data on the overall financial and schedule impacts to a construction project.

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