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Rebuilding America – Renovation Work in Medical and WWTP Facilities

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Slide 2

Don Garvey, CIH, CSP

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- 1984 - 88 Consultant for Aires Environmental Services
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- 2006 - present 3M US Subsidiary Construction Technical Specialist

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Applicability

- This training is based on current United States federal OSHA requirements: 29 CFR 1910 and 29 CFR 1926
- US state or other country requirements may be different
- Requirements can change in the future
- These slides contain general information as of the date of the presentation and should not be relied upon to make specific decisions. Completing this program does not certify proficiency in construction safety and health. No warranties are made, as this program only presents suggested procedures that may be applicable for work in these environments.
- Information is current as of March 2016.
Health Care - 2014

The health care situation:
- Long-term continued shift to outpatient care
- Aging of the population
- Affordable Care Act uncertainty:
  - Fewer mega projects, more upgrades and additions
  - New projects slow to start but renovations appear less affected by ACA
- Projected 6% increase in health care facility construction in 2014 to $44 billion

Sources:
- FMI Forecast for 2014 in the Q3-2013 Construction Outlook Online
- Construction Issues in Health Care – A. Streifel AIHCe 2004

Renovations in Health Care Facilities

- Bid preparations
- Pre-work preparations
- Work suggestions
- Post-work suggestions

Bid Preparation

- Medical centers have high community profile. They typically will look for:
  - Management commitment to safety
  - Proof of insurance – WC, GL, Fleet
  - OSHA 300
  - Competent, trained safety staff
  - Safety programs:
    - Lockout/Tagout
    - PPE
    - HAIC
    - Fall Protection
    - Bloodborne Pathogens

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Bid Preparation

- Sophisticated facilities may check that bid has the money to do what you say you’ll do (e.g. 100% tie off at 6’)
- Infection control - one estimate:
  - 0.5% of project cost
  - $10 mil project = $50,000
- Realize some tasks may take significantly longer due to infection control procedures

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Pre-Work Preparation

- Confirm that facility has decommissioned area and it’s safe to enter:
  - Chemicals – removed
  - Radioactive materials – confirm with RSO
  - Sharps – removed
  - ACM, PCB, lead – ask for any audit reports
  - Ventilation – off and sealed from occupied areas
  - Gas lines - shut off – fuel and medical


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Pre-Work Preparation

Examples of Chemicals:

- Central Supply
  - ETO
  - Mercury
  - Glutaraldehyde
- Labs:
  - Xylene
  - Toluene
  - Formaldehyde
  - Acrylamide
- Pharmacy – drugs

Pre-Work Preparation

- Power sources:
  - De-energized
  - Consider electrically isolating work
- Communications – radios, cell phones
- Waste pipes – locate and mark

Life Safety Code Compliance

- NFPA 101 compliance critical to the facility:
  - Feds require it for Medicare payment
  - The Joint Commission requires it for accreditation
  - Health care maybe second only to nuclear plants in oversight
  - Requirements for egress, fire protection, sprinkler systems, alarms, emergency lighting, smoke barriers, and special hazard protection
- Develop interim plan with facility

Pre-Work Preparation

- Increased hazard surveillance
- No smoking policy
- Housekeeping and storage
- Safety education – staff and workers
Pre-Work Preparation

- Infection Control Committee – suggested members:
  - Start at design phase and go to commissioning
  - Nursing Staff
  - Environmental
  - Physicians
  - Physical Plant
  - Infection Control
  - Architect
  - Contractor - PM; Safety


Pre-Work Preparation

- Infection Committee should consider:
  - Extent/duration of the project
  - Location of project
  - Impact on mechanical systems
  - Areas still in use
  - Chemical and physical contamination
  - Vertical as well as horizontal locations
  - Communications – staff, patients, visitors
  - Exterior dirt work – keep facility (+) pressure to outside
  - End of project – commissioning requirements
  - Patient population
  - Microbial contamination

High Risk Patients

- Because of increased outpatient treatment – those hospitalized tend to be more serious cases:
  - Immunocompromised (AIDS, cancer, transplant)
  - Age (neonatal and infirm)
  - Dialysis – renal failure
  - Mechanical ventilation
  - Heart failure
  - Surgery
  - Burns
Infectious Agents

- **Fungi**
  - Most common source of infection
  - Aspergillus is predominant

- **Bacteria**
  - Legionella
  - Mycobacterium

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Aspergillus

- Common in soil, water, vegetation
- Early signs of Aspergillosis are nonspecific:
  - Cough
  - Ill feeling
  - Fever
- Can be fatal to immunosuppressed patient
- Prevention is critical

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Legionella

- Found in cooling towers, water heaters, showers, hot water lines
- Contamination of water system when:
  - Repressurization of water line
  - Contaminated soil in lines
  - Soil/dust contaminates cooling towers
- Prevention is the key
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Pre-Work Preparation

- Non-patient - Critical - sterile - equipment and supplies
- Protect from construction dust. Don’t transport through construction zone

Source: Construction Related Nosocomial Infections in Patients in Health Care Facilities
Health Canada 2001

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Pre-Work Preparation

- Environmental monitoring – discuss this in advance:
  - Possible options:
    - Air: Aspergillus
    - Water: Legionella
    - Surrogates – total particulate
    - Pressure gauges
    - Moisture meters
    - Pre, during, and post construction samples
    - Define in advance what is acceptable
  - Guidelines for Environmental Infection Control in Health Care Facilities – DHHS (CDC) for air monitoring recommendations.
  - www.cdc.gov/ncidod/hip/enviro/guide.htm

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Pre-Work Preparation

- Mechanical systems:
  - HVAC – air flows, filters in place, pressure differential
  - Plumbing – shutoffs, re-pressure
  - Electrical – isolation
  - Elevator service

- Shrink wrap HVAC ductwork, med gas lines, plumbing lines or delay delivery until ready for use

- Do your subs, subs, sub contractors know what they are doing?
Pre-Work Preparation

- Traffic routes – avoid patient areas
- “Remote” construction locations:
  - Plumbing valves or electrical junction boxes
  - Above ceiling work permitted (e.g., dangling wires, fire protection, no leaving candy wrappers up here)
  - Silicone enclosures with HEPA
- Worker facilities – smoking, washroom, lunch
- Open windows, air vents, doors, electrical, gas, lighting, and plumbing penetrations must be sealed
- Debris removal – night? Covered containers or debris chute

Pre-Work Preparation

- Scheduling of “problem” activities:
  - Noise
  - Dust
  - Vibration – neonates may be particularly sensitive
  - Odor
- Forewarn facility staff:
  - Temporary ventilation – portable HEPA units, exhaust to exterior
  - Patients restrictions or removal for work in occupied areas
  - Safety Data Sheets
  - When will it come and when will it go
  - Communication is critical

Pre-Work Preparations

- Action plans for:
  - “Mystery” chemicals or fluids
  - Fire
  - Radiation
  - Reporting accidents
  - Emergency assistance
  - Water damage
- Who has authority to shut project down if safety is compromised?
- Who has authority to re-start project?
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Infection Control Risk Assessment (ICRA)

Extent of work
- **Type A**: Inspection and non-invasive activities
  - No dust generation - remove ceiling tile, trim work
- **Type B**: Small scale
  - Minimal dust; 1-2 rooms for 30 mins
  - Cut hole in wall, repair services
- **Type C**: Moderate activity
  - High levels of dust; Demolition several rooms, over 1 shift
  - Remove floor, new wall construction, sanding
- **Type D**: Major demolition activity – this includes buildings adjacent to occupied areas

Source:  Construction Related Nosocomial Infections in Patients in Health Care Facilities  Health Canada 2001
American Society for Health Care Engineering

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Infection Control Risk Assessment (ICRA)

Location of work
- **Group 1**: Low risk – office, public areas
- **Group 2**: Medium – Admissions, most out patient
- **Group 3**: Medium/High – ER, Labor, Labs, Peds, Minor surgery
- **Group 4**: Highest – ICU, OR, Dialysis, Transplant, Oncology

Source:  Construction Related Nosocomial Infections in Patients in Health Care Facilities  Health Canada 2001
American Society for Health Care Engineering

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During Work
- Construction worker qualifications:
  - Communicable diseases
  - Worker education – including infection control
  - Vaccinations
    - Tetanus – yes
    - Others consult with physician on need
  - Baseline testing – TB?
- Site Security:
  - Staff awareness of work zones
  - Access routes – identify and secure - positive barriers
  - Unauthorized entry reporting procedures
  - Patient signalers

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During work – HVAC and Plenums
- Entry into active plenum may be more risk to patient than workers:
  - Air pressure differentials - new flow patterns may endanger patients
  - Co-ordinate with Infection Control Committee and Facility Engineering
  - Ventilators closed and sealed
  - Proper pressurization of patient area and work area
  - HEPA filters maintained if needed
- Entry into active plenum – avoid:
  - Chemical, biological, PRCS
  - Ask facility about any past experience entering plenum

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During Work - Plumbing
- Schedule interruptions during low activity
- Flush lines prior to reuse - possible superheating or hyperchlorination
- Temperature standards established
- Look for discolored water, water leaks, mold

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During work - Dust
- Seal off all portals for dust:
  - Windows
  - Doors
  - Vents
  - Plumbing penetrations
  - Electrical outlets
  - Gas portals
  - Lighting and wiring penetrations
During work - Dust

- Dust barriers:
  - 6 mil poly or drywall
  - Must go slab to slab
  - Not removed until area is clean and inspected
  - Walk off mats or shoe covers
  - Misting may be necessary
- Co-ordinate with Environmental for extra cleaning of adjacent areas

During work - Dust

- Near high risk areas:
  - Worker coveralls left in work area or HEPA vac.
  - Shoe covers left in work area
  - Negative air pressure in work area
  - High risk patients removed from area
  - Portable HEPA units in patient areas
  - Flutter strips to show air flow. Easy to see, easy to interpret

During work – Pipes and Water Damage

- Demolishing walls and floors:
  - Undocumented pipes and drains
  - Mold growth initiation – kitchens, showers, roofs. STOP and get ICC involved
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During work - Sharps
- Exposure to sharps - May be the most common hazard.
- Proper decommissioning should minimize risk.
- Check where they may accumulate:
  - Elevator shafts
  - Curb areas
  - Floor openings

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During Work – Exterior Work
- Air filters in place and tight
- May need to shut down air intakes temporarily
- Windows closed and sealed (plastic and duct tape)

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Post Construction Work
- Cleaning and disinfecting prior to occupancy:
  - Allow dust to settle prior to cleaning
  - Regular areas – TSP
  - High risk areas – copper-8-quinolinolate – discuss with facility how they want to do it
  - HEPA vacuum
  - Flush water lines and drains
- Infection Control Committee inspects prior to admitting patients.
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Post Construction Work

- HVAC system test and balance
  - Cleaning and commissioning criteria – ANSI/ASHRAE 110-2010 Management, Testing, Adjustment, and Balancing of Building HVAC Systems
  - Air filter efficiency – MERV 14 is typical
  - Third party certification?

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Other Sources of Information

- American Institute of Architects – Guidelines for Design and Construction of Hospital Health Care Facilities
- Association for Professionals in Infection Control – State of the Art Report: The State of Infection Control During Construction in Health Care Facilities
- OSHA – Framework for a Comprehensive Health and Safety Program in the Hospital Environment
- Health Canada - Construction Related Nosocomial Infections in Patients in Health Care Facilities
- National Air Duct Cleaners Association - ACR, The NADCA Standard for Assessment, Cleaning & Restoration of HVAC Systems
- CDC – Guidelines for Environmental Infection Control in Health Care Facilities

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Magnitude of the Problem

- Approximately 20,000 U.S. WWTPs handle roughly 50 trillion gallons of raw sewage daily
- Sewage collection and treatment facilities average age 33 years, with some parts over 100 years
- Between 3 and 9 billion gallons of raw sewage enter waterways annually
- Without substantial increase in investment by 2025 US waterways will lose strength load as high as 1968

Source: US EPA Report to Congress Impact and Controls of CSO and SSO - 2004
State of Minnesota

- More than 1200 projects and $4.5 billion will be needed to improve public wastewater systems in next 20 years.

Source: Drinking Water and Wastewater Infrastructure Needs in MN U of MN Water Resource Center - 2011

Focus on Biohazards

- Most contractors aware of obvious hazards:
  - Combustible gas
  - Oxygen deficiency
  - Hydrogen sulfide

- Be aware of other potential chemical exposures:
  - Ozone – gas to disinfect water prior to release
  - Chlorine – gas to disinfect water prior to release
  - Chlorine dioxide
  - Ultra-violet light
  - Heavy metals – in sludge
  - Upstream facility discharge

Wastewater Biology

- Composition will vary with:
  - Geographic location
  - Time (weekly and seasonal)
  - Location within the WWTP

- Typically:
  - Fresh – Grey; Septic – Black
  - Fresh – 'earthy' smell; Septic – Rotten eggs
  - 10-20°C (50-70°F)
  - pH between 6 and 9
Wastewater Biology

- Ingestion - Hand to mouth is primary route of exposure:
  - Eating
  - Drinking
  - Smoking
  - Wiping face

- Inhalation - less common:
  - Highest where water is agitated
  - Incoming water inlets
  - Sludge treatment areas

- Skin - unlikely unless previously damaged (e.g. burns, cuts, punctures). Eyes and nose may be portals.


Disease Studies

- Studies did not show a higher infection rate (i.e. diagnosed disease)
- Studies did show increased risk of symptoms associated with infection (e.g. headache, G.I. tract upset, dizziness)
- Studies show subclinical infection indicators (elevated antibody levels)
- Many workers experiencing symptoms were new on the job


Disease Studies

- Study of 500 WWTP workers:
  - New employees (less than 2 years experience) – higher rate of G.I. symptoms
  - Symptoms mild and transitory

- Study of 150 WWTP - no reported cases of:
  - Polio
  - Salmonellosis
  - Leprosy
  - Shigellosis
  - Typhoid fever
  - Hepatitis A
  - Gonorrhea
  - Ancestrazia


HBV, HCV and HIV

- No cases linked to sewage exposure:
  - Would be diluted in sewage
  - Not transmitted by oral-fecal route or inhalation
  - Blood to blood contact

- Risk of contracting either disease from wastewater appears to be small

HAV, HEV and Helicobacter pylori

- HAV:
  - Stable at room temperature for up to 3 months
  - Studies indicate no increased risk or slight increased risk of HAV
  - Anti-HAV associated with shellfish consumption and age

- HEV and Helicobacter:
  - No clear increase in risk to workers
  - Unlikely to be cause of GI symptoms

Methicillin-Resistant Staphylococcus aureus (MRSA)

- Water samples from 4 WWTP in Midwest and Mid-Atlantic:
  - 50% of incoming samples had MRSA
  - Declined as treatment progressed
  - 8% after full treatment
  - 0% after chlorination

Sources:
- Venczel et al. “Prevalence of Hepatitis A Virus Infection Among Sewage Workers in Georgia” American Journal if Industrial Medicine
- Jeggli et al. “Hepatitis E, Helicobacter pylori and Peptic Ulcers in Workers Exposed to Sewage: A Prospective Cohort Study” Occupational and Environmental Medicine 66 (2009)

Source: Rosenburg Goldstein et al. “MRSA Detected in Four US WWTP” Environmental Perspectives 2012
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Suggested Precautions

- Assume all surfaces are contaminated
- Disinfect surfaces where practical
- Avoid direct contact with sewage (remote viewing?)
- Avoid aerosolizing sewage:
  - Ensure any ventilation system is active
  - Minimize time around sedimentation basin inflow, sludge treatment

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Suggested Precautions

- Wash hands and face prior to eating, drinking, smoking and at end of shift:
  - This may be the most important safeguard to take
  - 15-20 seconds for washing – soap and warm water
  - Keep hands out of eyes, nose, mouth
  - Keep finger nails short
  - Shower daily
  - Food consumption only in designated areas
  - Adequate first aid supplies – treat and report all cuts/punctures immediately

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Suggested Precautions

- Worker training:
  - Diseases
  - Entry routes into body
  - High risk areas
  - Personal hygiene
  - Need for immediate medical attention for cuts/punctures
  - Proper use of PPE per manufacturers user instructions
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PPE

- Use liquid proof gloves, boots, eye/face protection in direct contact areas.
- One study showed relationship between PPE use and decreased presence of HAV.
- Wash PPE with soap and hot (160°F) water.
- Puncture proof gloves in cut prone areas.
- Gloves especially if hands are chapped or cut.


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PPE - Respirators

- Respirators usually not necessary:
  - Dusty sludge or heavy aerosol areas
  - Always follow manufacturer user instructions
- Respirator particle filters effective against microbes. Filter does not distinguish between alive or dead particles.
- Implementation of a respirator program per 29 CFR 1910.134 and following manufacturer user instructions is critical for effective use of respirators.

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Vaccinations

- Currently no US federal OSHA vaccination requirements for construction workers.
- CDC recommendations:
  - Recommended – Tetanus-diphtheria
  - HBV, HAV – not recommended at this time, but no reason not to.
  - Foreign-born workers – don’t assume same vaccination history as native-born citizen.
Infection Investigation

- Is suspect microbe present or likely to be present in wastewater environment in significant amounts?
- Wastewater is aggressive environment
- Most bacteria are gram negative – positive would be odd
- pH, temperature, competition from other organisms
- Has microbe actually been identified in person?
- What tests were used? Were symptoms consistent with microbe?
- Was there an exposure opportunity?
- Was there an opportunity for the microbe to enter the body (e.g., puncture wound)?

Finally

A good public speaker:
- Stands up to be seen
- Speaks up to be heard
- Shuts up to be appreciated