


Infection Control Response to Hurricane Ike

Pam Falk, MPH, Director, Healthcare Epidemiology, UTMB
A Webber Training Teleclass



Infection Control Response to Hurricane Ike


Pamela Falk MPH
Director Healthcare Epidemiology
University of Texas Medical Branch
Galveston, Texas

Hosted by Paul Webber
paul@webbertraining.com

www.webbertraining.com

Evacuation Planning

Houston Galveston Study Area Mean Sea Level




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Evacuation Planning




8.5 ft Storm Surge

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Evacuation Planning



19 ft Storm Surge




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Evacuation – 9/11/08

- 469 patients from inpatient tower, correctional hospital and behavioral health facility;
- Transported to Austin, San Antonio and Dallas-Fort Worth
- Patient evacuation completed in approximately 11 hours



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Evacuation

- > 140 by Ground Ambulance
- > 82 by Bus / Multipassenger Ground
- 23 via Helicopter Flights
- 48 via Fixed Wing Flights
- 73 discharged, transported by private vehicle
- 102 Correctional by Medical / Security Transport

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Ike Hits Galveston

17FT Seawall

Seawall Boulevard, Friday Morning, September 12, 2008

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Ike's Impact on UTMB

Plaza in front of Ashbel Smith Building, "Old Red," Friday afternoon

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1900 Storm Memorial

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The Dehumidification of UTMB

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UTMB Hospital Main Corridor

Cleaning of Moody Medical Library

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33" Interior Water Mark in office of Healthcare Epidemiology



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Temporary Kitchen and Food Tent




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Temporary Showers and Portable Toilets



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Pumping Water from Buildings



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What should we do now?

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Initial Infection Control Assessment

- I. Environmental surface contamination
 - A. Bacteria
 - B. Fungi
 - C. Nontuberculous mycobacteria
- II. Water contamination
 - A. Bacteria
 - B. Fungi
 - C. Legionella
 - D. Nontuberculous mycobacteria
- III. Air contamination
 - A. Fungi
 - B. Legionella

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Assessment of Surfaces

Question?

- Did the storm cause bacteria and fungi to grow on the environmental surfaces of the hospital that were not wet from storm water or effected by wind?



Assessment of Surfaces

- All environmental sites were first cleaned with a hospital grade disinfectant (quaternary ammonium)
- Beds, chairs, monitors, IV poles, headwalls etc were all cultured with a moistened swab
- The swabs were plated on media for bacteria and fungi.



Assessment of Surfaces

- We cultured 500 sites
- We found very few pathogenic bacteria (primarily gram negative rods) and fungi
- We concluded that the storm had little impact on the environmental surfaces in the hospital



Water Assessment

The water in the hospital plumbing remained stagnant for several weeks.

Question?

- Did the stagnant water support the growth of bacteria, fungi or legionella?
- Did a glycocalyx in the pipes support the growth of the bacteria, fungi and legionella?



Water assessment: bacteria

- Random samples of bacteria were taken from the clinical areas
- Threshold for bacteria was <50 cfu/ml
- Results: most unit based handwashing sinks and bathroom sinks had bacteria >50 cfu/ml
- Faucets were flushed (purged) for 5 to 30 minutes over several weeks and periodically cultured
- Eventually bacteria were found to be below the threshold



Water-assessment: fungi

- The same water sampled for bacteria was sampled for fungi
- The fungal growth was so infrequent that the assessment was discontinued



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Water-assessment: Legionella

- When 30% of water samples taken from outlets (faucets) of the water distribution system are culture positive for *Legionella*, patients are at risk for Legionella infection.
- 10 unique hot water samples are suggested from each water system
- Results: samples showed > 30% of water cultured from all three buildings had legionella pneumophila type 1

Water Remediation: Legionella

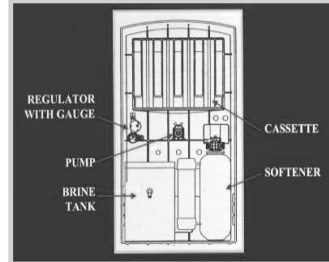
Super heating

- Bring temperature in all pipes to 60°-77°C
- Water should remain in pipes 20-30 minutes
- Take temperature at distal end of the faucet
- Dead legs can significantly effect results
- Must flush all faucets in the building after superheating
- Care should be taken not to scald patient and employees with hot water
- Process may not offer long-term remediation

Water remediation: Legionella

- *Chlorine dioxide*
- Infuse it into the system by professional
- Required to sit in system until chemical diffuses to distal end for about 1 hour
- ClO₂ test strips or spectrophotometer test to assure chemical is at distal end
- Must flush all faucets in building to eliminate residual chemical

Water Remediation: Chlorine dioxide



Chlorine dioxide (ClO₂) can be generated by an electrolytic method from sodium chlorite (NaClO₂)

Water Remediation: Chlorine dioxide

Notice / AVISO

- NOTICE
- DO NOT USE WATER
- MAINTENANCE ON THE HOT & COLD WATER SYSTEM IS OCCURRING RIGHT NOW
- MAINTENANCE WILL END WHEN THIS SIGN IS REMOVED
- Do not drink the water (Free Bottled Water is available from your dept. manager)
- Do not use the showers or turn on shower for any reason
- Do not wash hands or come in contact with water
- Do not turn off the water in the event water is running
- Flushing toilets and urinals is okay
- Please cooperate with the Technicians
- THANK YOU for Your Help!!!

- AVISO
- NO USE EL AGUA
- EL MANTENIMIENTO DEL SISTEMA DE AGUA FRÍA Y CALIENTE ESTÁ EN PROCESO AHORA
- EL MANTENIMIENTO TERMINARÁ CUANDO EL AVISO SEA REMOVIDO
- No tome agua (el agua embotellada es gratis y disponible con su gerente de departamento.)
- No use las regaderas o abra las llaves de la regadera por ninguna razón
- No se lave las manos o tenga contacto con el agua
- No cierre la llave del agua en caso de que esté abierta
- Puede jalar las palancas del inodoro o mingitorio
- Por favor coopere con los técnicos
- ¡GRACIAS por su cooperación!

Water remediation: Copper Silver Ionization

- Attach an ionizer to the hot water system
- The ionizer sends a steady stream of copper and silver ions into the water
- Copper and silver are known to have antibacterial properties
- The number of sites positive for legionella bacteria should be reduced to < 30%

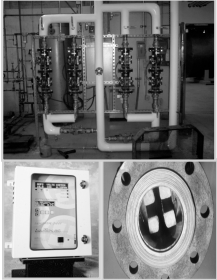
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Water Remediation: Copper-Silver Ionization

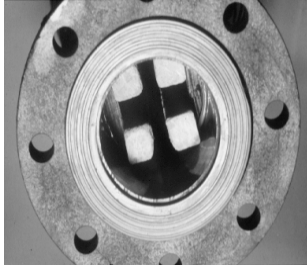
Copper and silver ions are introduced into the hot water system at a concentration of

- Copper: 0.2 ~ 0.4 mg/L
- Silver 0.02 ~ 0.04 mg/L



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Water Remediation: Copper-Silver Ionization



Flow cell houses electrodes made of copper and silver alloy

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Air Quality Assessment

Question?

- Was the air quality in the Operating rooms and other patient care areas compromised after the hurricane?

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Air Quality Assessment: Physical Plant

HVAC System

- Are the filters on the air handlers seated properly?
- Are the fan coils in good repair?
- Was the HVAC system rebalanced?
- Are the air ducts clean and dry?
- Is the insulation clean and dry?

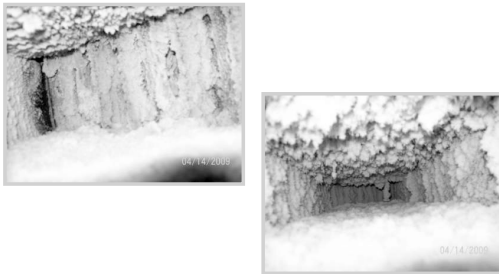
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Before Duct Cleaning



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Before Duct Cleaning



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After Duct Cleaning



Air Quality Assessment : fungi

- Air cultures were taken with an high volume air sampler called a Casella (flow rate 700 l/min)
- Air cultures were also taken with an air sampler called a SAS (flow rate 180 l/min)
- Thresholds in the OR are <math><3\text{cfu}/\text{m}^3</math> and no pathogenic fungi such as *A. fumigatus*, *A. flavus*, *A. terreus*, or *Zygomycetes* or *Fusarium*
- Thresholds in the patient care areas are <math><15\text{cfu}/\text{m}^3</math> and minimum pathogenic fungi

Air Quality: Remediation

- Air ducts were cleaned
- Turning veins were cleaned
- Fan coils were cleaned
- Condensation pans were cleaned
- Filters were replaced and gaskets changed
- Filters were upgraded
- Air systems were rebalanced

Air Quality : Epidemiology

- Air samples were taken twice a week
- Results were immediately fed back to a committee
- Experts were consulted about cleaning, filter choices and air balancing

Air Quality: Containment



Air Quality: HEPA FILTERED AIR



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Air Quality: Vacuum off people



05/21/2009

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Air Quality: Air Tubes



06/02/2009

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Air Quality: Ducts

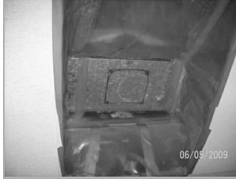


06/02/2009

Seal air return ducts


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Air Quality: Ducts



06/05/2009

Cut into duct and seal around



06/05/2009

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Air Quality: Ducts

Tape to Wall



01/08/2007

Tape to Floor



01/08/2007

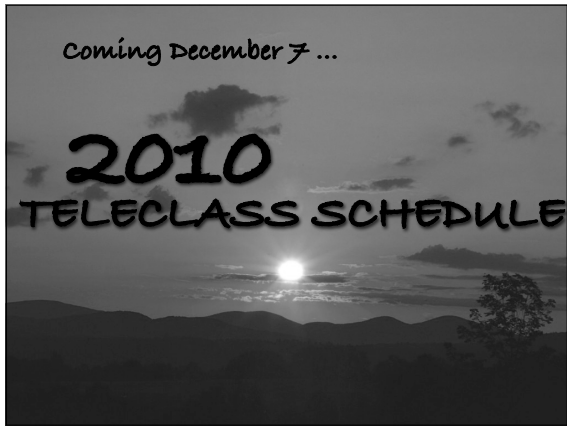
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Conclusion

- After Ike we were concerned about surface, water and air contamination.
- Surfaces were successfully cleaned with a hospital-grade disinfectant.
- Bacteria and fungi in the water were successfully removed by constant flushing of the system.
- Legionella remediation is an ongoing project (Many institutions have a constant flow of copper silver ions to decontaminate the water).
- Air quality drastically improved after the ducts were cleaned and breaches in the ventilation system were repaired.

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