Legionnaires Disease Case investigation – An Environmental Health Perspective

PRESENTATION TO:
Legionnaires Disease Symposium
12 May 2011
Cape Town Civic Centre
Presented by: Ian Gildenhuys
What is Legionellosis?
- Causative Agent
- What about Legionnaires Disease is of interest to EHP’s
- Known outbreaks of Legionella pneumophila
- Case Investigations within City of Cape Town 2009
- Phase 1 Investigation
- Phase Two Investigation
- Sampling Results and findings
- Outbreak prevention
- Conclusion

What is Legionnaires Disease or Legionellosis
- Primarily a respiratory illness.
- Causes a mild flu like symptoms (Pontiac Fever) or
- Severe Respiratory disease – causing acute pneumonia (Legionellosis) with possible permanent damage.
- Possible long term debilitating effects to:
  - Kidneys and other organs
  - Nervous System – Brain Damage can result.
Causative agent: Legionella pneumophila

- A Gram-negative,
- Heterotrophic,
- Aerobic
- Transitionally motile
- Rod shaped
- 1 Micrometer long and half as wide

What about Legionella pneumophila is of interest to EHP’s

- Thermo tolerant
- Grows in water temp. 20 – 60 degrees C
- 37 – 45 degrees C ideal growth range
- It is found naturally in aquatic systems
- Is known to colonize built water systems
  - HVAC cooling towers
  - Humidifiers
  - Water features/ Spa Baths
  - Building hot & cold water systems
  - Dental Lines in Dental Surgeries
About Legionella pneumophila cont..

- Parasitic
  - Grows in biofilm in water pipes,
  - parasitizing aquatic host organism ie Amoeba.
  - Can incidentally infect human phagocytic cells including Alveolar Macrophage and Alveolar Epithelial Cell
  - 48 known species of Legionella, more than half of which are known to be pathogenic to humans
  - Serotyping can assist identifying infection source

MODE OF TRANSMISSION

- It is not transmissible from person to person
- One must inhale the infected droplet nuclei from a contaminated water source
- It is entirely environmental factors that result in infections
- It is thus preventable!
Known Outbreaks of Legionellosis or Legionnaires Disease

- The first known outbreak occurred at the 1976 “American Legion” Convention, Philadelphia.
- It resulted in 221 cases and 34 deaths
- The causative agent for the outbreak was discovered by the US CDC in 1977 and named Legionella pneumophila
- Numerous well documented outbreaks have since occurred around the world.

WHO IS LIKELY TO CONTRACT LEGIONNAIRS DISEASE

- ANYONE, BUT MORE LIKELY:........
- SMOKERS;
- ALCOHOLICS;
- MALES OVER 40 yrs TWICE AS LIKELY AS FEMALES!!
- IMMUNOCOMPROMISED or
- PATIENTS ON IMMUNE SUPPRESSIVE MEDICATION – Cortico Steroids etc
- NOSOCOMIAL (HOSPITAL AQUIRED) INFECTIONS MORE COMMON
In RSA it is a listed Notifiable Medical Condition in terms of R 328/1991

The patient - 35 yr old female, Dental Receptionist – resided in Elsies River and worked in a large multi-storied Building which also happens to be a private Hospital

Established case history, in terms of Time, Place and Person

Investigated:

Possible exposures to infected droplet nuclei through:

- Aircon plant; Water Features; domestic and work building water systems – Hot & Cold

Case Investigation cont..

Phase 1 investigation

- Assemble necessary investigative expertise.
- Full facility walk through inspection,
- Noting:
  - Condition of Mech. Ventilation Plant
  - Its location in relation to fresh air inlet system
  - Whether the facility has a Legionnaires monitoring program in place? If so what are the results?
  - Are the samples representative?
Phase 1 investigation cont..

Check interior of roof
Water tanks for scale, rust & biofilm
Check buildings hot water supply infrastructure

Check water supply end point fixtures

Check Shower heads & tap splash arrestors for biofilm build-up & temperature of water
Case Investigation cont..
Phase 2 investigation

- Plan and implement sampling program:
  - We initially focused on:
  - Patients place of residence
  - The Dental Practice where the patient worked and sampled some outer lying sample points in the building.
  - Tried to identify possible sources of infection
Sampling results received 30/01/09 - of the 13 samples taken, four sample points showed the presence of Legionella

<table>
<thead>
<tr>
<th>Sample number / Point:</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients place of residence</td>
<td>Negative for Legionella</td>
</tr>
<tr>
<td>CCT/W/XXX/4 2nd Kitchen Hot Tap</td>
<td>1000 CFU/Litre Legionella pneumophila serogroup 1</td>
</tr>
<tr>
<td>CCT/W/XXX/6 Oral Hyg – Hot Tap</td>
<td>1200 CFU/Litre Legionella pneumophila serogroup 1</td>
</tr>
<tr>
<td>CCT/W/XXX/8 Dr XXXX Hot Tap</td>
<td>200 CFU/Litre Legionella pneumophila serogroup 1</td>
</tr>
<tr>
<td>CCT/W/XXX/10 Accounts Kitchen Hot Tap</td>
<td>18 000 CFU/Litre Legionella pneumophila serogroup 2 – 14</td>
</tr>
</tbody>
</table>

Further Samples were taken on 05/02/09 focusing on the remainder of the building to assess the extent of the problem.

All other sample points came back negative for Legionella. Pointing to the Mezzanine Floor as the problem area.
CASE INVESTIGATION – OUTBREAK PREVENTION

- An urgent meeting between City Health and the Hospitals Management Team – GM; Maintenance Manager & Infection Control Sr.
- Obtained specialist input from Dr Neil Cameron
- We resolved on action plan & way forward included:
  - Heat shock treatment of the Hot Water System
  - Hospitals boiler temp was gradually raised to 65 degrees then to 70 degrees C and maintained as such for approximately 12hrs.

CASE INVESTIGATION – OUTBREAK PREVENTION Cont…

- Special precautions were taken to:
  - Communicated to all section heads/ Nursing Staff
  - Prevent Patient scalding by steam
  - Protect Maintenance crew from Occupational hazards. PPE were worn – N95 Respirator masks, Gloves and disinfectant was sprayed, Alcohol disinfectant hand rub etc
  - Every tap aerator/ shower head in the hospital and dental surgery was then removed, cleaned, disinfected with Hibitane
  - Then hot flushing each point at above 60 degrees C for 25 minutes
  - Then reassembled.
Follow-up Sampling received 23/02/09 - of the 14 samples taken, two sample points showed the presence of Legionella – Serious head scratching followed!!

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<tr>
<th>Sample number / Point</th>
<th>Result:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCT/W/XXX/8 Dr XXXX Cold Tap</td>
<td>400 CFU/Litre Legionella pneumophila serogroup 1</td>
</tr>
<tr>
<td>CCT/W/XXX/10 Accounts Kitchen Hot Tap</td>
<td>8 800 CFU/Litre Legionella pneumophila serogroup 2 – 14</td>
</tr>
</tbody>
</table>

The hospital subsequently called in their National Head of Technical Services who flew down from JHB.
Root Cause Analysis was conducted.
Which included full tracing of all Hot water supply lines to the Mezzanine floor, in roof spaces etc.
Doing ten second interval temperature measurements at hot water taps (Found to be at 46 – 47 degrees C)
Assessing temperature of cold water lines (found to be at 24 degrees C)
CASE INVESTIGATION – Findings:

- Fault findings included:
  - Faulty temperature thermostat at Hot Water Boiler,
  - Faulty temperature gauge to Boiler,
  - Faulty non-return valves,
  - Faulty hot water return pumps for Boiler
  - Cold water supply lines in roof space lacked insulation lagging

- All these findings contributed to reducing the hot water supply temperature to fixtures and increasing the cold water supply temperatures to within Legionella spp. ideal growth range.
- Immediate actions were taken to address shortcomings.

Follow-up Sampling results received 20/05/09 - of the 5 samples taken........

All came back negative for Legionella

Persistence Pays!!
ONUS OF PREVENTION

- Legionellosis is an entirely preventable disease
- It is a listed Class Two Hazardous Biological Agent in the Hazardous Biological Agents regulations R 1390/2001 promulgated in terms of the OHS Act.
- This implies a duty of care on every self-employed person or employer to take steps to prevent its spread.
- Prevention is best ensured through:
  - Either the use of WHO Water Safety Plan approach or
  - HACCP

STANDARDS FOR LEGIONELLA

- IN RSA THERE ARE NO PUBLISHED STANDARDS
- INTERNATIONALLY STANDARDS VARY
- THE DOSE RESPONSE RELATIONSHIP IS NOT WELL UNDERSTOOD
- GUIDELINES:
  - US DEPT. OF LABOUR OHSA Technical Manual SUGGESTS:
  - CFU Legionella / ml

<table>
<thead>
<tr>
<th>Action</th>
<th>Cooling Tower</th>
<th>Domestic Water</th>
<th>Humidifier</th>
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<tbody>
<tr>
<td>Level 1</td>
<td>100/ml</td>
<td>10/ml</td>
<td>1/ml</td>
</tr>
<tr>
<td>Level 2</td>
<td>1000/ml</td>
<td>100/ml</td>
<td>10/ml</td>
</tr>
</tbody>
</table>
STANDARDS Cont...

- Action Levels:
  - Level 1 – Prompt cleaning and or Biocide treatment of system
  - Level 2 – Immediate cleaning and or biocide treatment. Take steps to prevent employee exposure.
  - Note: These standards are based on a number of assumption
  - The ideal standard to strive for is zero Legionella/ml

CONCLUSION

- Legionella organisms are known to have caused major outbreaks of Legionellosis worldwide.
- The organism is capable causing severe illness, disability and death
- A cooperative, multi-skilled team effort is essential to prevent major outbreaks
- All parties need to bring their A game to the table when large communal building infrastructure is involved.
- Good communication is essential
- Persistence pays off more often than not!
- RSA standards are needed.
- Preventative policy direction is needed from the authorities and building managers
LADIES AND GENTLEMEN

THANK YOU

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