LABORATORY ACQUIRED INFECTIONS (LAI)

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60th Annual Biological Safety Conference
October 13 - October 18  Albuquerque, New Mexico

<table>
<thead>
<tr>
<th></th>
<th>Symptomatic</th>
<th>Asymptomatic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>1212-1226</td>
<td>142</td>
<td>1354-1368</td>
</tr>
<tr>
<td>Rickettsia</td>
<td>205</td>
<td>269</td>
<td>474</td>
</tr>
<tr>
<td>Viruses</td>
<td>764-766</td>
<td>439</td>
<td>1203-1205</td>
</tr>
<tr>
<td>Parasites</td>
<td>170</td>
<td>4</td>
<td>174</td>
</tr>
<tr>
<td>Fungi</td>
<td>25-26</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>2376-2392</td>
<td>854</td>
<td>3230-3246</td>
</tr>
</tbody>
</table>

Limitations of Literature Survey that produced the data presented today -

- Literature search of published reports, not a survey.
- International search, but for journals with English abstract – found on PubMed or Google.

WHY Do it?

- Acknowledging that LAI occur fosters change
- Develop evidence-based prevention programs
- Provide examples for training programs
### TOP TEN LAI Reported in Literature

#### 1930-1979

<table>
<thead>
<tr>
<th>Rank</th>
<th>Agent</th>
<th># LAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brucella spp.</td>
<td>426</td>
</tr>
<tr>
<td>2</td>
<td><em>Coxiella burnetti</em></td>
<td>280</td>
</tr>
<tr>
<td>3</td>
<td>Hepatitis B</td>
<td>268</td>
</tr>
<tr>
<td>4</td>
<td><em>Salmonella enterica Typhi</em></td>
<td>258</td>
</tr>
<tr>
<td>5</td>
<td><em>Francisella tularensis</em></td>
<td>225</td>
</tr>
<tr>
<td>6</td>
<td><em>M. tuberculosis</em></td>
<td>194</td>
</tr>
<tr>
<td>7</td>
<td><em>Blastomyces dermatitidis</em></td>
<td>162</td>
</tr>
<tr>
<td>8</td>
<td>VEE</td>
<td>146</td>
</tr>
<tr>
<td>9</td>
<td><em>Chlamydia psittacosis</em></td>
<td>116</td>
</tr>
<tr>
<td>10</td>
<td><em>Coccidioides immitis</em></td>
<td>93</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>2,168</strong></td>
</tr>
</tbody>
</table>

#### 1979-2015

<table>
<thead>
<tr>
<th>Rank</th>
<th>Agent</th>
<th># LAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brucella spp.</td>
<td>378</td>
</tr>
<tr>
<td>2</td>
<td><em>M. tuberculosis</em></td>
<td>255</td>
</tr>
<tr>
<td>3</td>
<td>Arboviruses</td>
<td>222</td>
</tr>
<tr>
<td>4</td>
<td><em>Salmonella spp.</em></td>
<td>212</td>
</tr>
<tr>
<td>5</td>
<td><em>Coxiella burnetii</em></td>
<td>205</td>
</tr>
<tr>
<td>6</td>
<td>Hantavirus</td>
<td>189</td>
</tr>
<tr>
<td>7</td>
<td>Hepatitis B virus</td>
<td>113</td>
</tr>
<tr>
<td>8</td>
<td><em>Shigella spp.</em></td>
<td>88</td>
</tr>
<tr>
<td>9</td>
<td>HIV</td>
<td>48</td>
</tr>
<tr>
<td>10</td>
<td><em>N. meningitidis</em></td>
<td>43</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>1,753</strong></td>
</tr>
</tbody>
</table>

### LAI in Various Types Work

<table>
<thead>
<tr>
<th>Site</th>
<th>LAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical</td>
<td>1008</td>
</tr>
<tr>
<td>Research</td>
<td>916</td>
</tr>
<tr>
<td>Industry</td>
<td>90</td>
</tr>
<tr>
<td>Teaching</td>
<td>276</td>
</tr>
<tr>
<td>Field</td>
<td>18</td>
</tr>
</tbody>
</table>

Secondary (2y) & Tertiary (3y)

<table>
<thead>
<tr>
<th></th>
<th>Bacteria</th>
<th>Viruses</th>
<th>Parasites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary</td>
<td>12</td>
<td>19</td>
<td>2</td>
</tr>
<tr>
<td>Tertiary</td>
<td>3</td>
<td>7</td>
<td>-</td>
</tr>
</tbody>
</table>

Byers, K and L. Harding. 2017. Laboratory Acquired Infections
Bacterial: 2y & 3y Infections were to Close Contacts.

- LAI with *S. sonnei* in clinical laboratory; 2y transmission to grandchild; 3y to 3 family members. Reference (Ref) #1.
- 4 secondary infections in children under age 4 whose parents were students in microbiology teaching laboratories in the US. Ref #2.
- 2 incidents of sexual transmission of Brucella. Ref#3, 4.
- Dinner prepared by microbiologist transmitted Salmonella to wife and son. Ref. #5.
- 2 secondary transmissions of *Bordetella pertussis* occurred. Ref. #7

2y Viral Infections were in Close Contacts.

- Zika Virus – wife of entomologist returning from mosquito study in Senegal. (Ref.#8.)
- *Macathine herpesvirus 1* – transmitted through shared tube of hydrocortisone cream. (Ref #9).
- Marburg virus - pathologist who did autopsy on LAI. (Ref #10)
- Polio virus – vaccine strain. Transmission to immunized child of staff member involved in spill cleanup. (Ref.#11) *(Note: an ABSA member states that the worker showered and was provided with a change of clothing)*
- SARS – 2 secondary, 5 tertiary. Inadequately inactivated samples removed from BSL3; 2: mother and nurse of student, 5 patients of nurse. (Ref. #12).
- Titi monkey Adenovirus – 1 attending veterinary for sick monkeys became ill; also one household member. (Ref #13)

Fatal LAIs-Bacteria

- 13 fatalities due to *N. meningitidis*. (Refs # 14-20).
- 4 aborted fetuses due to *Brucella melitensis* LAI. (Ref #21-23).
- 3 due to *Salmonella* (1 was a secondary infection-wife of clinical microbiologist). (Ref # 24,25,26).
- 1 due to *Y. pestis* (autopsy of mountain lion in a garage without precautions) (Ref #27)
- 1 due to attenuated *Y. pestis* KIMD27 (LAI had undiagnosed hereditary hemochromatosis). (Ref #28)

FATAL LAIs - VIRAL

- *Macacine herpesvirus 1* (CHV-1, Monkey B)- 5 LAI. Ref list #29 -33.
- Arboviruses – 3 (Ref# 34)
- Hantavirus 2 (refs # 35, 36)
- Hepatitis B virus 1 LAI. (ref #37)
- Hepatitis C virus 1 Ref. (ref #38)
- Ebola virus 2 LAI* Ref # (ref #39, 40)
- SARS Co-V (Ref #12)
- 1 fetal abortion due to Parvovirus LAI. (Ref #41)

*Healthcare/laboratory workers in the 2014 Ebola epidemic succumbed to occupational infections, but exact data is not available.*
DROPLET Transmission

43 cases of LAI *N. meningitidis* in literature—

- **ONLY 1** microbiologist infected in each case
- 41 worked on the open bench (catalase assays, made suspensions, etc.) 2 worked behind a plastic shield; 1 in a defective biosafety cabinet.
- None were immunized.
Brucella exposure-HIGH Risk Aerosol

HIGH:

1. Having direct personal exposure to Brucella (sniffing bacterial cultures, direct skin contact, pipetting by mouth, inoculation, or spraying into the eyes, nose, or mouth.)

2. Performing work on the open bench (outside of BL3) with an open culture plate or being in close proximity to such work (across an open bench top or within 5 feet)

3. Presence in the laboratory during any procedure on a Brucella isolate that might result in generation of aerosolized organisms and inhalational exposure (e.g. vortexing or catalase testing)

- MMWR 57(02) 39-42
Brucella Exposure-Low risk

- Present in the laboratory during workup and identification of a Brucella isolate
- From the time the culture is first isolated until all culture isolates are removed or destroyed from the laboratory.
- Not meeting criteria (1,2,3) for high-risk.
BSAT LAIs

- 2004-2010: 10,000 individuals with access to BSAT.
- 11 LAI; no fatalities, no secondary infections. 8 research labs, 3 clinical labs.


2015 Annual Report on Federal Select Agent Program
- 199 potential exposure incidents resulting in monitoring
- 0 LAI

Case study example: Could a researcher in a hurry do this at your institution?

Follow SOP for filtering virus: remove capped needle from syringe, use syringe to draw up virus, filter. Then... because the syringe did not fit in the bottom of the tube... the needle was re-attached to draw the virus into the syringe. The needle had to be removed in order to replace the filter, and the researcher sustained a needlestick at that point.

The technician did self-testing; symptoms of dengue infection presented on day 9; the assay was positive on day 10.

The authors published images simulating the exposure incident, and recommended stronger language in the WHO advice on the use of needles.

After recovery, the technician was assigned to a different laboratory to prevent exposure to other serotypes of dengue.

Lessons learned about PPE for Field Studies

    died 1 week after conducting necropsy in his garage of plague-infected mountain lion.
    no PPE used.

Fatal infection of graduate student:
    interview of 2 other students on the same project – ambitious student collecting samples from wild rodents: many bites, no PPE, no handwashing, even before eating.

References:
http://cid.oxfordjournals.org/content/49/3/e33.full
National Park Service Response

- Biosafety guidelines

- Survey of staff points out the need for PPE availability, portability, and feasibility under field conditions.

- Found staff that were trained by supervisor more likely to use PPE.

References

References

References- Fatalities from Viral LAI

- 31) MMWR 47: 1073-6, 1083.
- 39) ProMed mail archive #20040522.1337.
FOR MORE INFORMATION ON LAI
Open-access, searchable database of LAI published references

Development description:


As of 10/8/2017: 258 references added. Amazing volunteers!
Database entry – sample.

<table>
<thead>
<tr>
<th>Date(s) of LAI / exposure: <strong>2008-07-31</strong></th>
<th>Location where LAI / exposure occurred: <strong>Wisconsin, USA</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupation(s) of affected personnel: <strong>University laboratory researcher</strong></td>
<td>Age(s) of affected personnel: <strong>Unknown</strong></td>
</tr>
<tr>
<td>Agent(s) involved: <strong>Brucella melitensis</strong></td>
<td></td>
</tr>
<tr>
<td>Biological Safety Level (BSL) for work being performed?:</td>
<td>Setting in which LAI / exposure occurred: <strong>University research laboratory</strong></td>
</tr>
<tr>
<td>Device or equipment involved: <strong>Goggles</strong></td>
<td>Procedure being performed: <strong>Removing safety goggles</strong></td>
</tr>
<tr>
<td>How LAI / exposure occurred: <strong>Goggles had been removed for cleaning while the individual was working with the bacterium a few months before the illness began. The researcher had undulating fever, weakness, and arthralgia in back and ankle for 10 weeks.</strong></td>
<td></td>
</tr>
<tr>
<td>PPE worn at the time of LAI / exposure: <strong>Safety glasses</strong></td>
<td></td>
</tr>
<tr>
<td>Engineering controls used at the time of the LAI / exposure: <strong>Unknown</strong></td>
<td></td>
</tr>
<tr>
<td>Follow-up procedures taken: <strong>Laboratory procedures were reviewed, and recommendations were made to improve respiratory protection, disinfection, sharps management, training, and emergency planning. Baseline serum had been collected on all 12 lab members. Symptom surveillance was conducted for 24 weeks; Serological monitoring occurred at weeks 2, 4, 6, and 24 weeks after the diagnosis. Symptom monitoring occurred weekly; there were no additional seroconversions in the other 11 researchers.</strong></td>
<td></td>
</tr>
<tr>
<td>Reference:</td>
<td></td>
</tr>
</tbody>
</table>
Literature surveys to answer specific questions- some open-access examples.


Recent Survey: Belgium 2007-2012

Belgian Biosafety Server

Method: 2 anonymous, secure, online surveys
Survey 1: biosafety, occupational health, prevention officers of 206 Institutions: 26 LAI
Survey 2: 873 personnel from 26 relevant institutions surveyed. 68 LAI.
Official occupational health records for workplace infections: 25.

Results: When insufficient detail was provided to determine whether both surveys referred to the same, or an additional LAI, this was reflected in the reported numbers.