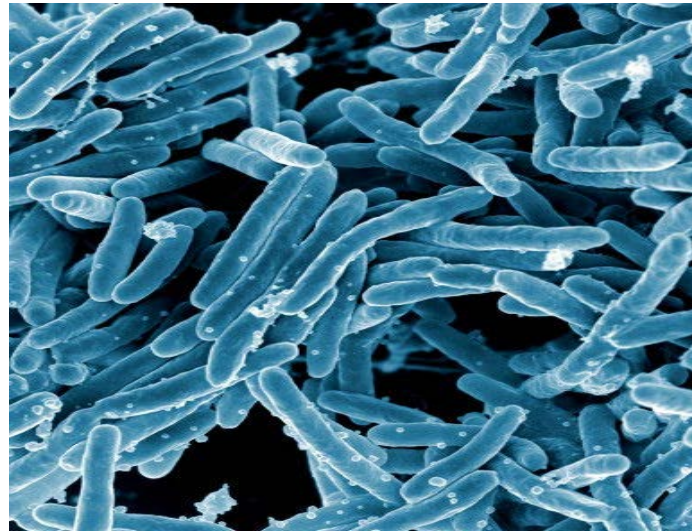




Transmission of  
*M. chimaera* and  
differentiation to  
species level of  
*M. avium complex*



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# Mycobacterium Chimaera

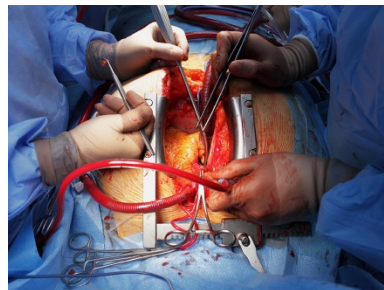
- A non-tuberculosis mycobacterium, member of the M. avium complex
  - Closely related to mycobacterium intracellulare.
- Commonly found in soil and water
- Can cause respiratory infections in Birds, pigs, and humans.
  - Rarely pathogenic in healthy individuals.
  - Pathogenic in immunocompromised hosts and after invasive procedures.
- A chimaera mythological combination of three animals.

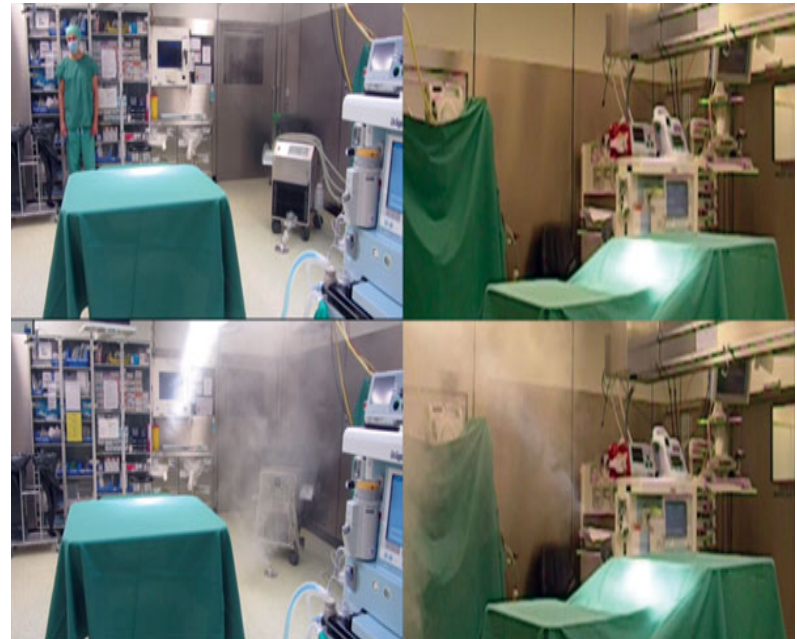
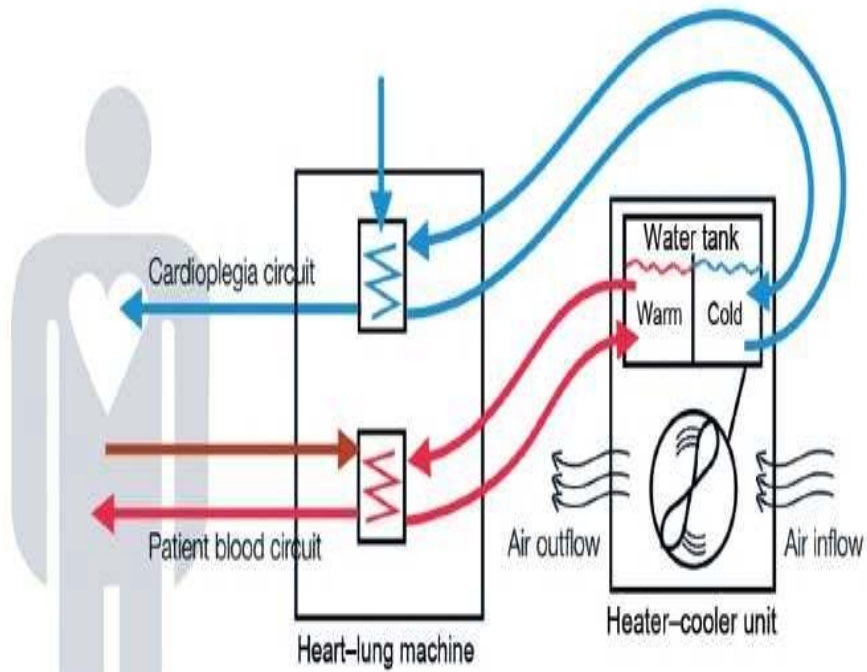




# Overview

- M. chimaera infections have been linked to contaminated Heating/cooling units necessary for cardiac surgery.
  - First reported in 2015 by German investigators and involving surgeries as far back as 2012.
  - The infections can be severe and some patients involved in the investigations have died.
  
- 3T heater-cooler devices made by LivaNova PLC, which hold a 60% world market share.
  - Used to maintain patients circulating blood at a stable temperature during surgery
  - The site of contamination is believed to be water tanks contained within the machines.
  - Although this water does not directly contact patients it has the potential to be aerosolize bacteria into the surgery environment via exhaust vents.
  - Issue may originate from a point source contamination at the manufacturing sight, according to a 2016 study<sup>1</sup>.







# Overview

- Because *M. chimaera* is a slowly growing organism. Signs and symptoms of infection may develop until months or years after initial exposure.
- Non-specific symptoms makes diagnosing difficult.
  - Muscle aches, fever, fatigue, ect..
- CDC recommends continuing to monitor all patients potentially exposed during a surgical procedure.
- FDA recommends being watchful of contamination in all 3T machines made before September 2014, and continuing to follow manufacturer cleaning/disinfecting methods.



# Scope of the problem

- There have been around 30 cases identified at hospitals in Iowa, Michigan and Pennsylvania; as well as cases identified in Europe.
- There are roughly 2,000 susceptible devices in the U.S. Used in 60% of the 250,000 heart bypass surgeries performed annually.
- CDC estimates the risk of infection to be between 1:100 and 1:1000 patients, in hospitals where at least one infection has been identified.



# CDC Interim practical guidance

<http://www.cdc.gov/hai/pdfs/outbreaks/Guide-for-Case-Finding.pdf>

[https://www.cdc.gov/mmwr/volumes/65/wr/mm6540a6.htm?s\\_cid=mm6540a6\\_w](https://www.cdc.gov/mmwr/volumes/65/wr/mm6540a6.htm?s_cid=mm6540a6_w)

<https://www.cdc.gov/hai/outbreaks/heater-cooler.html>



# Identification at WSLH

## MAC PCR

- Detects all members of the complex including: *M. avium*, *M. avium* subsp. *avium*, *M. avium* subsp. *paratuberculosis*, *M. intracellulare*, *M. chimaera*, *M. arosiense*, *M. colombiense*, *M. marseillense*, *M. bouchedurhonense*, and *M. timonense*.
- Gives a positive or negative result for MAC and does not differentiate between members.

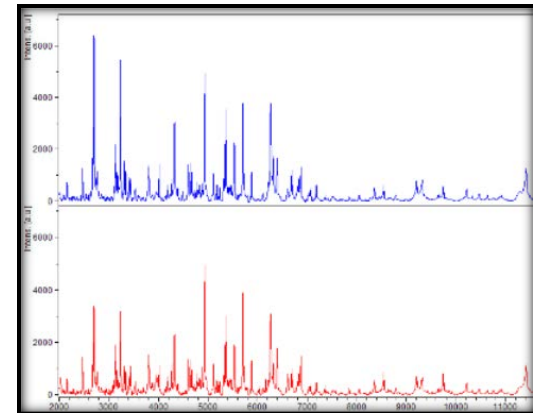




# Identification at WSLH

## MALDI(Library version 3)

- Is able to identify some members of the MAC to species: *M. avium*, *M. arosiense*, *M. colombiense*, *M. marseillense*.
  - Lumps *M. intracellulare* and *M. chimaera* together as *M. Chimaera/intracellulare* group.
- New Library(version4) will give and *m. chimaera* or *m. intracellulare* result to species, along with other additions and improvements.





# Identification at WSLH

## 16S and *rpoB* sequencing

- Uses PCR to amplify a target partial gene. 16S(540bp) and *rpoB*(750bp)
- The tests are performed when necessary for identification and evaluated on a case by case basis.
- According to literature these single genetic targets are likely insufficient to separate *M. intracellulare* and *M. chimaera*.
  - “There is only a single nucleotide difference in 16s rDNA (base pair difference between *M. intracellulare* T450C and *M. chimaera*).”<sup>2</sup>
- We have not been able to confidently assign a species ID.



# Case Study

- In summer of 2016 We received 4 environmental isolates for identification.
  - Clear, smooth colonies on 7H11 plates
  - Specimen sources listed as Sorin water, cardioplegia and Sorin water, PT heater.
  - From the problematic 3T heater-cooler devices.
- PCR was performed and isolates were Identified as MAC.
- MALDI was performed in attempt to further speciate
  - Result was “*M. chimaera/M.intracellulare group*”



# Case Study

- Performed *rpoB* and 16s sequencing on 2/4 isolates.
  - **rpoB**: gave equivalent results of *M. chimaera*, *M. Intracellulare*, and *M. yongonense*.
  - **16S**: Returned a top result of *M. chimaera*.
    - The scores were not sufficient to confidently assign a species ID.
    - Sequencing is not used as a standalone test at the WSLH.



# Case Study

- Isolates were sent to an additional reference lab by the initial submitter and identified as *M. chimaera* by MALDI.
  - Using library version 4?
  
- Additional methods used to distinguish between *M. Chimaera* and *M. intracellulare* include internal transcribed spacer (ITS) or whole genome sequencing (WGS)
  - Not performed at WSLH



## WSLH Statement

“If your laboratory is contacted by a clinician inquiring about testing for *M. chimaera*, please notify the WSLH. We are not able to perform definitive testing for *M. chimaera* at the WSLH. However, if the patient meets the parameters of a suspect case, we will work with your laboratory to submit an isolate to the CDC for definitive identification.”



# Reference Laboratories

- National Jewish Health Mycobacteriology Laboratory
- University of Texas Health Northeast  
Mycobacteria/Nocardia Laboratory

-According to APHL guide on testing for *M. chimaera*



**Thank you**