Microbiome Research in the Pre-Antibiotic Age: The Metagenomic Evaluation of Dental Calculus in the Arch Street Project's Skeletal Remains

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Collaborative Research

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Looking to the Past to Improve Our Future

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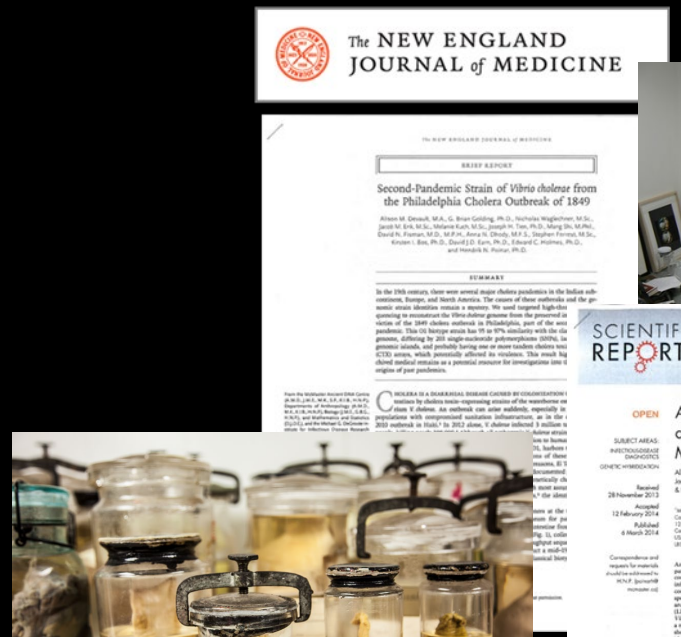
The NEW ENGLAND JOURNAL of MEDICINE

BRIEF REPORT

Second-Pandemic Strain of *Vibrio cholerae* from the Philadelphia Cholera Outbreak of 1849


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Ancient pathogen DNA in archaeological samples detected with a Microbial Detection Array

Why Calculus?

- Large sample size from Arch Street population
- Abundant calculus present
- Sampling does not damage the teeth
- Calculus preserves DNA very well
- Relatively new area of study

Methods

Analysis

- Calculus removed with sterile dental tools
- DNA prepared for Illumina shotgun sequencing
- Compared them against a database of reference prokaryotes (bacteria and viruses) and human genome to identify orgin of sequenced molecules

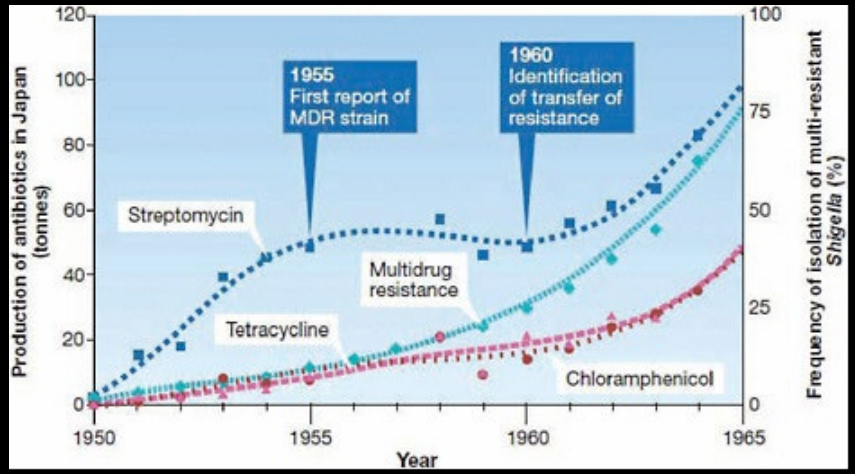
Initial Results

Note that the figure does not include all the taxa present in each sample, only examples of some of the most abundant.

- Readily distinguish the blanks from samples
- Abundant oral bacteria in calculus nearly absent in soft tissue samples
- Indication of authentic oral microbiome data

Significance

- We have a limited timeline of known AMR as well as what microbes are carrying AMR genes.
- Going back pre- 1950s is going to be important to see what genes were already being passed around in humans prior to the selective pressure of antibiotics in the late 40s and early 50s
- Our collaborators at McMaster have designed and tested a bait set for all currently known human associated resistance genes.



SOURCE: Davies (2007, 2009). Macmillan Publishers Ltd.: *EMBO Reports* Davies, Copyright 2007.

Significance

- Excellent DNA preservation in the calculus
- The metagenomic profile that is very distinct from both the soft tissue and the extraction blanks
- Less contamination in the calculus.
  - Contamination from soil, not from handling/storage of samples
  - More soil bacteria in the soft tissue samples but very little in the calculus

- Significant potential for further analysis from multiple sources:
  - Oral microbiome
  - Human host
  - Food sources
  - Soil Samples
  - Potential pathogens
- Population level analysis
- Inform about human health in the pre-antibiotic world

Next Steps

- The endogenous DNA will allow us to transition into further specific study of individual taxa/species that are present in the samples.
- Look at the soil as another point to show that the calculus has its own, unique, authentic signal.
- Develop strong research questions that will make use of this data.
- Explore funding opportunities that will allow us to conduct further analysis on additional samples.

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Images

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