

Proposal

Title – Characteristics of Community and Healthcare Associated Methicillin Resistant *Staphylococcus aureus* among Liberty University Students.

Program of Study – Microbiology

Presentation Type – PowerPoint

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Category – Experimental (Basic)

Abstract: Methicillin-resistant *Staphylococcus aureus* (MRSA) emerged in 1961 and has remained a legitimate threat to people to this day (Haung, 2006). The multiple strains of antibiotic resistant *Staphylococcus aureus* are categorized into groups relating to their environment, hospital-associated MRSA (HA-MRSA), and community-associated MRSA (CA-MRSA). The purpose of this research is to investigate the different characteristics of CA-MRSA and HA-MRSA isolated from Students at Liberty University and consider whether antibiotic resistance is an indicator of increased fitness. While some believe that antibiotic resistance is an evolutionary advancement for bacteria, we investigate whether this resistance to antibacterial agents is an indication of increased fitness. On average, HA-MRSA has a larger array of genes resistant to various antibiotics than CA-MRSA. We hypothesize that due to a lighter “genetic load,” CA-MRSA will have greater fitness than HA-MRSA indicated by a faster growth rate.

My research seeks to identify the antibiotic resistance, virulence factors, and growth rate of MRSA acquired from the community and from the hospital setting. Microbiology students from Liberty University were tested for MRSA in their respective MRSA labs. Once collected, the isolates were subjected to multiple Kirby-Bauer Disk Diffusions to identify the strain’s antibiotic resistance. CA-MRSA strains were distinguished from HA-MRSA strains using ciprofloxacin.

CA-MRSA strains are sensitive to ciprofloxacin whereas HA-MRSA is resilient to the antibiotic. Once the antibiotic profiles of the MRSA strains were established, multiple growth curves were conducted. The growth curves served as an indicator of the bacteria's overall fitness. In the wild, bacteria must compete with other species to colonize an area, bacteria with fast dividing rates are able to colonize a host quicker and outcompete slower-dividing bacteria. Finally, isolates were tested for a hemolytic virulence factors found in certain MRSA over the course of 72 hours. Virulence factors provide pathogenic bacteria with a means of colonizing a host, thus the timing of virulence factor secretion has clinical implications.

To this end, current data, from multiple semesters, seems to indicate that CA-MRSA does indeed grow faster than standard HA-MRSA types in broth media. It is predicted that on average, CA-MRSA strains grow faster than HA-MRSA strains. In regards to antibiotic resistance, CA-MRSA strains were anticipated to be less resistant to an array of antibiotics than HA-MRSA. It is also predicted that CA-MRSA has more hemolytic capabilities than HA-MRSA, and are capable of secreting virulence factors quicker than their healthcare counterparts. In total, it appears that HA-MRSA isolates with an added genetic load, are less fit than their CA-MRSA counterparts. Furthermore, clinical study investigations of CA-MRSA and HA-MRSA derived from a fitness center and emergency room physician respectively demonstrate corresponding CA-MRSA/HA-MRSA growth rates and characteristics. Implications of these findings include recognizing the potential of CA-MRSA to colonize a population faster than HA-MRSA. For instance, the increase of CA-MRSA carriage nationally and at Liberty University may be explained by this growth characteristic. Further clinical implications rest on the timing of virulence factors in MRSA. As CA-MRSA strains release virulence factors quicker than HA-MRSA, CA-MRSA infections may worsen faster than HA-MRSA infections. Also, this suggests that antibiotic resistance does not necessarily indicate upward-onward evolution. Rather, genetic changes to adapt to an environment are not necessarily always a benefit to bacteria, but a cost the

strain pays to better survive in a hostile environment. In this case, HA-MRSA survives in a harmful environment by adapting antibiotic resistance at the cost of a potential decreased growth rate. Future work would include pairwise growth curves and vivo testing to investigate whether isolates demonstrate the capability to reduce their antibiotic fitness cost.

References:

Huang, H., N. M. Flynn, J. H. King, C. Monchaud, M. Morita, and S. H. Cohen. "Comparisons of Community-Associated Methicillin-Resistant Staphylococcus Aureus (MRSA) and Hospital-Associated MSRA Infections in Sacramento, California." *Journal of Clinical Microbiology* 44, no. 7 (2006): 2423-427. Accessed February 22, 2016.