I would like to conduct a study on the level of bacterial transmission for various modes of vocalization to determine if certain events will: 1) exceed the previously established three feet social distancing guideline, or 2) significantly increase or decrease the level of bacterial transmission.

My research topic was inspired by the recent and ongoing COVID19 pandemic. I noticed that social distancing guidelines vary by country and health organization. For instance, the World Health Organization (WHO) recommends at least one meter (3.3 ft) while the Centers for Disease Control and Prevention (CDC) recommend six feet. Other countries such as Germany and Australia recommend at least 1.5 meters (4.9 feet). The disparity between social distancing guidelines led me to question how such guidelines originated.

Due to my inability to conduct experiments involving the virus itself, I thought that studying bacterial transmission might give insight to how various types of activities affect virus transmission in COVID19. While bacteria are certainly larger than viruses and thus will not travel the same distances when expelled from the human respiratory tract, recognizing how different modes of vocalization impact the level of bacterial transmission may add to my understanding of COVID19 transmission.

There are two relevant modes of respiratory transmission: droplet transmission and airborne transmission (also known as aerosol transmission). While droplet transmission concerns the passage of microbes through large droplets generated by close expiratory activities that directly deposit into a person’s susceptible mucous membranes, airborne transmission refers to the easily inhalable particles containing microorganisms that remain suspended in air due to their small size [1].

During human expiratory events, droplets with diameters ranging from 0.6 µm to over 1000 µm are expelled at high velocities [1]. It is a known fact that respiratory droplets are responsible for the airborne transport of microbes and can serve as vehicles of transmission despite their size. Bacteria and viruses alike are released in different amounts depending on the type of expiratory activity, which can affect the level of transmission.

Evidence in past events point towards certain activities in particular having a significant influence on transmission. For instance, a two and a half hour choir practice in Washington, March 2020 that displayed high COVID-19 attack rates revealed that singing could potentially increase the risk of transmission [2].

Research conducted before the COVID-19 pandemic also explored the effects of different variables on transmission. Two studies administered by the same researchers each examined a particular variable. The first of the studies by Asadi et al. (2019) evaluated the impact of the amplitude of vocalization on aerosol emission [3]. They used an aerodynamic particle sizer to calculate the number and size distribution of particles during various expiratory activities and found that the rate of particle emission was positively correlated with volume during speech. The second study (a continuation of the first) created an experiment to analyze the effects of phones (units of sound in speech) on particle emission and discovered that airborne transmission could be influenced by language characteristics [4].

My study will explore the effects of different modes of vocalization on the level of droplet transmission of bacteria in an indoor setting. Common vocalizations such as speaking at 60 dB, speaking at 75 dB, singing at 60 dB, and coughing will be used to confirm the CDC social distancing guidelines for bacterial transmission. Additionally, a collection of activities involving speaking while jogging, blowing raspberries, sneezing, speaking up/down, speaking at a higher altitude, and speaking at a higher temperature will be investigated.

My general hypothesis is that, as previous research suggests, general vocalizations will not transmit bacteria beyond three feet. However, by modifying the mode of vocalization, this distance and the level of bacterial transmission may vary. I also have two sub hypotheses:

1) For general vocalizations (speaking at 60 dB, speaking at 75 dB, singing at 60 dB, and coughing), bacterial transmission will not exceed three feet as established in social distancing guidelines. In addition, as distance increases, the level of bacterial transmission decreases.
2) Depending on the type of activity, the level of bacterial transmission may significantly increase or decrease, or potentially exceed the three feet guideline.

I expect singing to display a greater level of droplet transmission than normal speech. According to background literature, singing has been shown to release up to 6 times more droplets than normal speech and is approximately equivalent to coughing; however, the amplitude of vocalization likely has an even more significant impact on the level of bacterial transmission [3]. While it may be true that the amplitude of vocalization has a higher rate of particle emission, no previous research has presented solid evidence that vocalizing loudly exceeds the three feet guideline. As a result, speaking at 60 dB, speaking at 75 dB, singing at 60 dB, and coughing will not transmit bacteria beyond three feet.

While a number of studies target the aerodynamic effects on transmission introduced by running [5], to the best of my knowledge, no previous research has focused on the level of transmission when speaking while jogging. I expect speaking while jogging to transmit more bacteria because a physically taxing activity would cause the speaker to exhale large breaths of air. In turn, this would likely produce a higher level of droplet transmission of bacteria. As a result, speaking while jogging is likely to exceed the three feet guideline. Additionally, I expect raspberries to exceed the three foot guideline. Since the act of blowing a raspberry involves rapidly expelling short puffs of air, raspberries likely eject large quantities of droplets at high rates. Therefore, raspberries are likely to project farther than the other types of activities. I also expect sneezing to transmit bacteria beyond the three feet guideline, since sneezing produces respiratory droplets in great quantity and size that travel at velocities significantly larger than coughing, breathing, or normal speech [3]. I expect that talking up versus talking down as in a scenario with a mother and child will demonstrate a significant difference in the level of bacterial transmission. The person speaking down is likely to receive less bacteria than the person speaking up because droplets will be affected by gravity. Lastly, I expect that speaking at a higher altitude (5,000 feet) will produce a higher level of droplet transmission. This is due to the effect of altitude on air density, which decreases as altitude increases. Thinner air will exert less drag; therefore, at a higher altitude, droplets will fly farther. Likewise, I expect speaking at a higher temperature to transmit droplets farther since a higher temperature correlates to lower air density [6].

By investigating the effects of different modes of vocalization on the level of droplet transmission of bacteria, I hope to gain a clearer understanding of COVID19 transmission and the science behind social distancing guidelines. Also worthy of investigation in future research are the effects of different languages (e.g. Swahili vs. English) and food types (e.g. apple vs. garlic) on droplet transmission.

References