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Meeting report

Inaugural nontuberculous mycobacterial lung disease education and research conference, Honolulu, Hawai'i, February 1–2, 2020

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In the age of the COVID-19 pandemic, it remains important for us to discuss, share, and teach others about additional emerging infectious disease pathogens, including nontuberculous mycobacteria (NTM). NTM are geophilic and aquaphilic bacteria intimately bound to their environmental niches [1], which are also shared with humans. In addition to being ubiquitous in the environment, a subset of NTM species are opportunistic environmental pathogens that can cause severe respiratory illness in humans [2]. Epidemiologic studies in North America [3] and other regions of the world have shown that NTM lung disease is increasing annually. However, the factors influencing this increase are not well understood. While most exposures do not result in disease, individuals with structural lung abnormalities, genetic or acquired risk factors, and high levels of environmental exposure are predisposed to NTM lung disease [2]. Yet, the specific factors facilitating their acquisition and progression to disease remain poorly characterized.

Currently, Hawai'i has the highest prevalence of NTM lung disease cases in the United States (U.S.) with 396 cases/100,000 persons among Medicare Part B beneficiaries, compared to 5–10 cases/100,000 persons in the general adult population [4,5]. We previously reported that *Mycobacterium chimaera* is the most common NTM species identified from environmental and human mycobacterial respiratory cultures among patients from Hawai'i using microbiological and genomic approaches [6]. In order to further understand the environmental, host, and microbial factors driving the emergence of NTM lung disease in Hawai'i, conference co-organizers, Jennifer Honda, Ph.D. and Michael Strong, Ph.D. established one of the largest citizen scientist projects to study environmental NTM through work funded by the National Science Foundation (NSF) Ecology and Evolution of Infectious Diseases Program (Grant #1743587). This project included an outreach network of Hawai'i high school students, undergraduates, and their mentors from 11 different schools involving more than 400 local students. Local adults and family members also participated as citizen scientists to help collect more than 2000 household and non-household environmental samples from O'ahu, Kaua'i, Hawai'i Island, and Maui. In parallel, Drs. Honda and Strong established a long-standing collaboration with local pulmonologists and infectious disease physicians in Hawai'i to obtain matched respiratory NTM isolates and environmental samples from NTM patients with the goal of better comprehending NTM biology in the Hawaiian Islands.

In order to share the results of this research and discuss key issues about NTM, the Inaugural Hawai'i NTM Lung Disease Education and Research Conference was held in Honolulu on February 1–2, 2020 at 'Iolani School's Sullivan Center for Innovation and Leadership (https://www.nationaljewish.org/calendar/2020/1st-annual-hawaii-ntm-education-and-research-workshop) **(Pictures 1–2).** The goals of this unique conference were to: 1) apprise and share research results with the students and mentors who helped procure samples, as well as to engage the Hawai'i community by providing seminars and workshops regarding the step-by-step procedures of how NTM are sampled, processed, cultured, sequenced, and analyzed at the genomic level, and 2) to demonstrate how these data relate back to what is observed clinically. Through these efforts, we aimed to showcase the tremendous scientific accomplishments that can be achieved when local communities, researchers, clinicians, and patients work together to study an emerging and under-recognized infectious disease of increasing public health importance.

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Thank you for attending
and enjoy the conference!


EXIT

This conference brought together approximately 150 local area high school, undergraduate and graduate students, mentors, scientists, NTM patients, and pulmonology and infectious disease clinicians as well as nine National Jewish Health (NJH) scientists to discuss current NTM epidemiology and treatment in addition to microbiology, genomics, and geospatial research of NTM in Hawai'i.

NJH scientists served as plenary speakers. Dr. Honda convened and moderated events and her research team members Ravleen Virdi, Stephanie Dawrs, and Grant Norton presented three vignettes showcasing NTM species diversity in the Hawai'i environment, the relationship between NTM and the Kīlauea volcano, and possible methods for mitigation of NTM exposure from tap water. Dr. Strong discussed the procedures and usefulness of whole genome sequencing of NTM. His research scientists, Elaine Epperson, Ph.D. and Nabeeh Hasan, Ph.D., emphasized the molecular protocols used in the extraction of NTM DNA and pipelines for the genomic sequencing and phylogenomic analyses of Hawai'i NTM isolates. Edward Chan, M.D. discussed the clinical significance of NTM infections and current treatments. To close, James Crooks, Ph.D. described machine-learning approaches for identifying the geological, climatologic, and sociodemographic variables positively correlated with NTM presence.

One of the most exciting sessions was devoted to high school and undergraduate student attendees in a workshop led by Yvonne Chan, Ph.D., Eric Tong, and the NJH team. This session provided participants with an authentic, hands-on research experience that included practicing microbiology and molecular laboratory techniques that culminated in the sequencing of eight Hawai'i NTM genomes using Oxford Nanopore MinION technology. This workshop was an extension of 'Iolani School's 'Āina-Informatics Network, a pioneering program designed to demystify genome science by providing private and public high school students with rare opportunities to analyze the DNA of Hawai'i organisms [7] by: 1) bringing cutting-edge genome science into local classrooms, 2) contextualizing genomic concepts in easy-to-understand, applied settings, and 3) connecting students and teachers in the generation of genomic data. In addition, a bioinformatics module introduced key connections between experimental and computational science methods, emphasizing the importance of integrated approaches to STEM education [8]. Another very popular session invited shared perspectives from students and mentors who participated on the NSF project of how participating in NTM research encouraged the development of their academic careers and school curricula. Finally, local NTM patients and clinicians graciously shared their own dynamic and poignant personal experiences with NTM disease, unforgettable stories detailing years of struggle with NTM infections.

This conference achieved the following: (i) new conversations and awareness about NTM lung disease with the local community, (ii) opened discussions about the adversities of NTM treatment, (iii) increased public awareness of this under-recognized and underdiagnosed chronic lung disease, and (iv) encouraged local Hawai'i students to pursue science and academic research. We look forward to holding future conferences to further update the community at-large on the status of NTM lung disease in Hawai'i and other Pacific Islands.

Declaration of competing interest

The authors declare no conflict of interest.

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