

## **NDnano Summer Undergraduate Research**

**Jichong Lyu**

### **Work for Dr. Nallathamby**

1. Student name & home university:

Jichong Lyu, University of Notre Dame

2. ND faculty name & department:

Dr. Nallathamby, Department of Aerospace Engineering, Berthiaume Institute for Precision Health

3. Summer project title:

Nanoparticle Dox.HCl Treatments on Triple-negative Breast Cancer Cells

4. Briefly describe new skills you acquired during your summer research:

Cancer cell line culturing skills under sterile environment, cell line bring-up and freeze-down techniques, fluorescence microscopy, animal lab general training, mice injection training, dark-field microscopy, presentation skills, and group communication

5. Briefly share a practical application/end use of your research:

The possible clinical use of our Dox.HCl treatments will be treating Triple-Negative cancer with higher efficiency and less side effects.

6. 50- to 75-word abstract of your project:

Dox.HCl nanoparticle, by delivering chemotherapeutic drugs to tumor location, have been proven to increase killing efficiency on MDAMB231, a Caucasian triple-negative breast cancer cell line, and have limited side-effects [2]. My research focuses on applying Dox.HCl to breast cancer cell lines from other ethnic groups and compare the effectiveness. Our result should contribute to a more comprehensive understanding of the nanoparticle treatment and shed light on reducing medical inequality among ethnic groups.

7. References for papers, posters, or presentations of your research:

1] Waks AG, Winer EP. Breast Cancer Treatment: A Review. JAMA. 2019 Jan 22;321(3):288-300. doi: 10.1001/jama.2018.19323. PMID: 30667505.

2] Waters, M.; Hopf, J.; Tam, E.; Wallace, S.; Chang, J.; Bennett, Z.; Aquino, H.; Roeder, R.K.; Helquist, P.; Stack, M.S.; et al. Biocompatible, Multi-Mode, Fluorescent, T2 MRI Contrast Magnetolectric-Silica Nanoparticles (MagSiNs), for On-Demand Doxorubicin Delivery to Metastatic Cancer Cells.

Pharmaceuticals 2022, 15, 1216. <https://doi.org/10.3390/ph15101216>

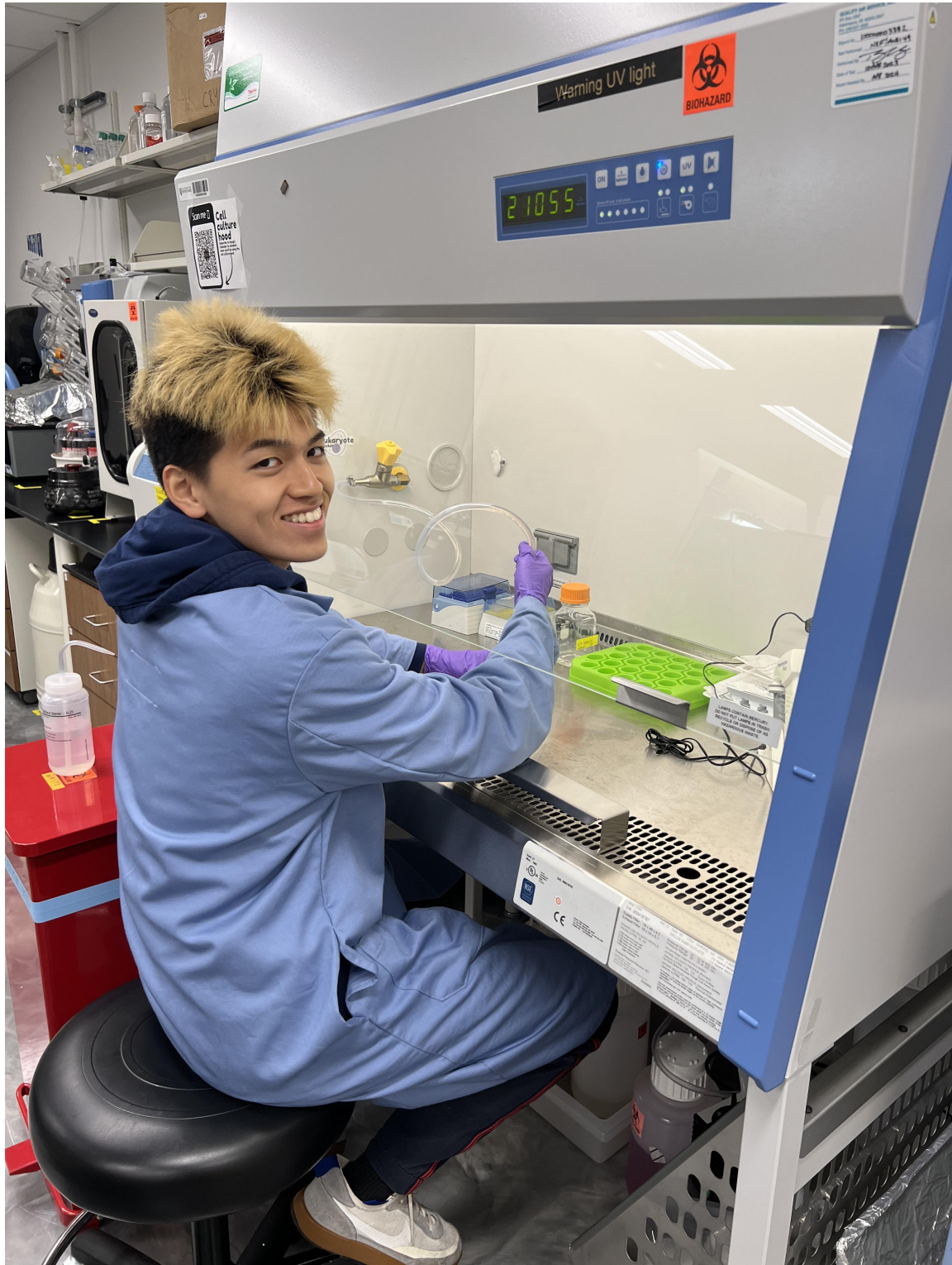
One-page project summary that describes problem, project goal and your activities / results:

**Background info:** Our research is focused on treating breast cancer with nanoparticles. Breast cancer has affected a large portion of the women population worldwide and is by far the mostly diagnosed cancer in the women population. We have developed chemotherapeutic and hormone treatments as well as surgery removal of tumors to treat breast cancer. However, a special type of breast cancer, triple-negative breast cancer, lacks the hormone receptor for hormone drugs and is more severe than other cancers, leaving chemotherapy the major treatment.

**Project goal:** There is a need to improve chemotherapy efficacy on triple-negative breast cancer and reduce harmful side effects. Our research lab has proposed the nanoparticle Dox.HCl treatment to address this issue. By incorporating the chemotherapeutic drug, Doxorubicin, to magneto-electric silica nanoparticles, we achieved better cancer-killing efficiency and developed this biocompatible MagSiN material.

**Research activities during the summer:** This summer is my first time in Dr. Nallathamby's lab. After finishing a few online trainings and reading some keystone articles during spring, I felt confident and excited to start my lab work. My summer program is from June 12th to August 18th, and this ten-week journey was a solid start for my college research. During the first few weeks, I was shadowing our lab's research assistant on cell culture, nanoparticle manufacture, and general lab maintenance. I learned so much every day and tried to write down and absorb them as much as I could. Gradually I was given the chance to practice all the lab skills. Thanks to my previous background in biology labs, I picked up the skills relatively quickly and became more independent in the lab. At the same time, I searched for related articles and shared them with our group every week. This process not only helped me a lot in understanding the most current updates in the nanoparticles/breast cancer field but also improved my communication and presentation skills. Entering July, we decided to conduct our first cancer cell injection experiment, and some of my cells were called to be used. However, an unfortunate cross-contamination from another lab's mold remnants delayed our injection by around a week. In response to that, we autoclaved all the possible sources of contamination and renovated our PPE. After that, I haven't encountered contaminations anymore. Throughout July, I've also completed a series of animal lab training to be qualified for animal experiments in Friemann Center and further polished my cell handling skills. By far, I have successfully cultivated 6 cell lines and stocked them for future uses. In August, we kept track of the animal injection experiments and started our new round of in-vitro experiments. Currently, I am working on applying different treatments to new cell lines to further improve our understanding of how Dox.HCl treatments work in cells. I have started conducting experiments with chamber slides that allow us to observe in-vitro responses to drugs and image them with fluorescent microscopy.

**Future expectations:** I will continue the research in Fall, and we are expected to perform a series of in-vitro experiments to apply multiple new treatments on multiple new cell lines. I am also excited to help continue our in-vivo experiments on metastatic and localized breast cancer developments and treatments in accordance. Overall, this summer was considered a solid preparation for the upcoming intense experiments and more exciting results.



Me working in the biosafety fume hood