Project ID: 151

SR - Biomedical/Health Sciences, and Biomedical Engineering

Aimee Barrett

Sofia Cano

Grade 12

Central Union High School, Imperial County

Advisor: Lourdes Rueda

Most Common Complications in Patients from Bariatric Surgery

Patients post operation after having bariatric surgery experience many side effects and complications, which can lead to hospitalization during their recovery. One of the most common reasons for hospitalization in the Emergency department is dehydration, which is especially difficult to avoid after such an intricate surgery. We want to determine whether dehydration is a major complication within the group of people that have had bariatric surgeries. Several studies have reported the most common complications include, and not limited to, internal hernias and gallstones formation; however, proving that dehydration is the most common complication after bariatric surgery, yet seems to be determined. Through a research project completed using subjects from a strictly bariatric surgery support group on Facebook, data successfully proved that the majority of patients experience dehydration as a complication. Dehydration is a common and serious complication for postoperative patients of bariatric surgery. More awareness will bring closer observation and protective measures for those at a higher risk and may prevent the development of postoperative dehydration. With our study, the doubts about whether or not the type of surgery held a relation with the complications experienced, were resolved.

Project ID: 152

SR - Biomedical/Health Sciences, and Biomedical Engineering

Nathan Dai
Grade 11
Canyon Crest Academy
Advisor: Ed Gerstin

Diagnosis of Mpox Using Machine Learning with a Convolutional Neural Network

This paper presents a machine learning-based method for the diagnosis of mpox (previously known as monkeypox) using convolutional neural networks (CNNs). Mpox is a rare viral disease that is similar to smallpox that was widely spread in Central and West Africa. Early diagnosis of mpox is important to prevent further spread of the disease, prompt treatment, and identify the source of the outbreak.

In this research, I propose a CNN-based approach for the diagnosis of mpox using clinical images of skin rashes associated with the disease. The CNN model was trained on a dataset of images of mpox rashes, other skin lesions such as chickenpox, smallpox, and measles, and healthy skin. I fine-tune the pre-trained model VGG-16 on the image dataset using transfer learning. VGG16 is a CNN architecture that is one of the most excellent vision model architectures till today. By leveraging a pre-trained model, I am able to achieve 84% accuracy and 86% recall with a limited training dataset.

The CNN-based diagnostic is not meant to replace physicians, but it can serve as a useful tool to help achieve early detection of the disease, especially in rural areas where a qualified physician is not easily available.

Project ID: 153

SR - Biomedical/Health Sciences, and Biomedical Engineering

Natalie Botello

Leilani Pradis

Grade 12

Central Union High School, Imperial County

Advisor: Alexander Ortiz

Automating Nutrition Administration as an Approach to Preventing Malnutrition and Dehydration in Dementia Patients

Dementia, a word to categorize a wide range of symptoms that affects one's memory, thinking and social abilities, plays a huge role when it comes to a patient experiencing malnutrition or even dehydration. Typically, to combat these issues, nutrition is delivered through hanging IV bags, and for water you have to undergo strategies and reminders to ensure that a dementia patient keeps hydrated. However, there are complications and many aimless things that make this difficult. In this engineering project, we examined and analyzed results of our test runs, then formed percentages from numbers and information. Using a peristaltic pump based device, we researched biologically then designed and programmed it virtually and crafted it from attainable resources to ensure we can safely and efficiently create our device as an approach to prevent malnutrition and dehydration. At first we engineered our first prototype which was a larger model, but then caught some changes we needed to make as a result of testing it. We then went back to redesigning it virtually, reprinting the new parts, assembling it, and testing it once more. As a result, when analyzing the results of our test runs by using the One-Sample T-Test for a population mean, it rejected both alternative hypotheses and retained both null hypotheses for the two programmed settings of Nutrition and Dehydration, proving that our data was not significant.

Project ID: 154

SR - Biomedical/Health Sciences, and Biomedical Engineering

Seleena Garcia Barbosa
Grade 12
Bonita Vista High School
Advisor: Michelle Mardahl

Does Aerobic Exercise Affect the Performance of Memorization?

I chose this study because I was interested in testing how a certain factor can either negatively or positively affect one's memory. Realizing that as we get older, our memory tends to worsen. There are many factors that cause our memory to deteriorate and such factors could be lack of sleep, or distractions. But, there are some things that can actually help us keep our memory strong, and that is exercise. So I wanted to test this hypothesis and see results through a primary lens. For this reason, I'm intrigued to find out whether aerobic exercise affects the memory of an individual when tested. Does aerobic exercise affect the performance of memorization?

I hypothesize there is a correlation between the two variables, students who take a memory matching card test during the second trial where they have to perform an aerobic exercise as it will result in a better performance rather than them taking a memory matching card test during the first trial where they don't do an aerobic exercise.

Procedure: Test the memory of 35 students by having them take a memory matching card test, and then following with completing aerobic exercise, and then concluding again with having them do a memory matching card test. Data retrieved from timer with an uncertainty of +/-13.

Results: After the study, it's clear that aerobic exercise did affect the performance of memorization in students as there was a change in their overall time, yet it did not fully and significantly show drastic change due to the existence of outliers. This concludes that both the null hypothesis and the alternate hypothesis were in both ways correct. Average & Change: -4% Standard deviation % Change: 28% SEM: 5%.

Conclusion: The results of the study demonstrated that clear aerobic exercise did affect the performance of memorization in students as there was a change in their overall time, yet it did not fully and significantly show drastic change due to the existence of outliers. As I excluded these outliers, there was a massive change of results. This concludes that both the null hypothesis and the alternate hypothesis were in both ways correct.

Project ID: 155

SR - Biomedical/Health Sciences, and Biomedical Engineering

Anirudh Kalyanaraman
Grade 10
Mt. Carmel High School
Advisor: Amy Klingborg

Cobinamide - A Novel Antioxidant to Protect Against Polyaromatic Hydrocarbon-Induced Cardiac Cytotoxicity

Polyaromatic hydrocarbons (PAH) are a class of hazardous chemical contaminants that are released to the environment mostly from anthropogenic sources and to a lesser extent from natural sources. Several epidemiological studies have established a significant positive correlation between PAH exposure and cardiovascular complications. Based on these studies, we hypothesized that exposure to pyrene (an indicator for PAH chemicals) may have a toxic effect in mammalian cardiomyocyte cells. We further aimed to establish the toxicity profile and mechanism of pyrene toxicity with the goal of developing treatment options for cardiac toxicity induced by PAH exposure.

With the above problem in mind, experiments were performed on H9C2 rat cardiomyocyte cells using Western blotting, MTT assay and immunofluorescence staining techniques. Time course experiments indicated significant cytotoxicity at 100nM concentration at 24 hours and progressive decline in metabolic activity until 72 hours. Dose-response studies showed a significant increase in cytotoxicity and phospho-Stress Activated Protein Kinase (SAPK) levels in the H9C2 cells upon pyrene exposure at 10nM concentration. Immunofluorescence staining analysis following exposure indicated reduced cell proliferation and increased apoptosis. Finally, the results also indicated that treatment with cobinamide, a Vitamin B12 derived antioxidant, rescued the cardiomyocytes from oxidative stress induced by pyrene and protected against cytotoxicity.

This work shows for the first time that PAH (pyrene)-exposure induces oxidative stress in mammalian (rat) cardiomyocyte cells and points to cobinamide as a novel therapeutic drug to treat associated cardiovascular complications. Further in vivo experiments are needed to enhance the translational significance of this study.

Project ID: 156

SR - Biomedical/Health Sciences, and Biomedical Engineering

Jaynne Quezada
Grade 12
Bonita Vista High School
Advisor: Michelle Mardahl

To What Extent Does Gender Affect the Patellar Reflex?

I chose this project because I was intrigued by the testing of the deep tendon reflexes, as it is a common practice in the doctor's office. I was further intrigued to find they were a neurological exam to locate upper and lower motor neuron lesions (Rodriguez-Beato, 2022). Through this experiment, I want to find out if there is a difference between the upper and lower motor neurons in males and females and whether one or the other have a higher chance of suffering from lesions. To what extent does gender affect the patellar reflex? My hypothesis is there is a significant difference, with females showing a more prominent reflex.

Procedure: Test patellar reflex of 74 males and females of same age group from elevated surface utilizing Taylor hammer after obtaining informed consent. Data retrieved from distance traveled using meter stick (cm) and NINDS Scale.

Results: Females and males data not statistically significant, with males having slightly higher average distance traveled (cm) and NINDS Scale score.

Average Left Knee Males: 14 cm (Distance Leg Traveled) and 2.459459 (NINDS)
Average Left Knee Females: 13.783783 cm (Distance Leg Traveled) 2.324324 (NINDS)
Average Right Knee Males: 14.121621 cm (Distance Leg Traveled) 2.567567 (NINDS)
Average Right Knee Females: 14.081081 cm (Distance Leg Traveled) 2.486486 (NINDS)
Males Standard Deviation: 5.981954 cm (Left Leg) 0.720157 (NINDS Left Leg) 6.450859 cm (Right Leg) 0.754823 (NINDS Right)
Females Standard Deviation: 13.783783 cm (Left Leg) 2.324324 (NINDS Left Leg) 14.081081 (Right Leg) 2.486486 (NINDS Right)
Males & Females T-Test: 0.873328 cm (Left Knee) 0.475692 (Left Knee NINDS) 0.979537 cm (Right Knee) 0.658033 cm (Right Knee NINDS)

Conclusion: The results of the experiment demonstrated there wasn't a significant difference in the patellar reflexes of males and females, demonstrated through the results of the t-test surpassing the 0.05 limit. The differences in average were also insignificant, like males average right knee reflex being 0.041cm more than females. The standard deviations were also high, demonstrating a chance of error in the collection of the data.

Project ID: 157

SR - Biomedical/Health Sciences, and Biomedical Engineering

Maya Krishnan
Grade 11
La Jolla Country Day School
Advisor: Diana Valji

Effect of Human Dermal Fibroblast Cells on Lipopolysaccharide (LPS)-Induced Neuroinflammation

Background: Neuroinflammation is the primary cause of neurodegenerative diseases such as Alzheimer's Disease, Parkinson's Disease and Multiple Sclerosis. Mesenchymal stem cell (MSC) therapies, often derived from the bone marrow or umbilical cord, promise reduction in neuroinflammation. According to recent studies, MSCs and fibroblast cells exhibit similar immunomodulatory patterns. In this study, it was hypothesized that human dermal fibroblasts will reduce neuroinflammatory markers.

Methods: Ten C57BL/6J mice were intraperitoneally injected with 1 mg/kg of Lipopolysaccharide (LPS) of the serotype O55:B5 to induce acute neuroinflammation. After one hour, mice were injected through the eye with 0.1 mL of human dermal fibroblasts (5*105). Blood collection occurred before LPS administration, between LPS and fibroblast administration, and two hours post fibroblast administration. The Novel Object Recognition Test (NORT) and Enzyme-Linked Immunosorbent Assay (ELISA) tested for changes in memory and Interleukin-1Beta levels, respectively (IL-1Î²).

Results: Preliminary behavioral tests and blood tests tested for recognition memory and levels of IL-1Î². The mice on average spent more time with the novel object during the NORT sessions. Optical density readings from an ELISA showed an increase in IL-1Î² one hour post-LPS administration and a decrease in IL-1Î² post-fibroblast administration. Mice on average mimicked the wild-type NORT expectation of spending significantly more time with the novel object.

Conclusion: Fibroblasts decrease neuroinflammation, decrease IL-1Î² cytokine levels and normalize Novel Object Recognition Test (NORT) memory. Future steps include more cohorts, different behavioral tests, and various cytokine analyses, including MultiPlex analyses of more inflammatory markers.

Project ID: 159

SR - Biomedical/Health Sciences, and Biomedical Engineering

Mikha Alcantara
Grade 12
Bonita Vista High School
Advisor: Michelle Mardahl

How Does Classical Music Compare to Horror Music in Manipulating Heart Rate

My motivation behind pursuing this research question lies in my personal values of prioritizing mental health and I am fascinated with exploring different methods that can combat stress and the leading cause of death in the nation, cardiovascular diseases. Acknowledging mental health is important because patients who are left partially or fully paralyzed due to complications after stokes may become depressed and unmotivated to seek further aid. Music therapy could stand as a cheap treatment for health risks because the relaxing nature of classical music has the ability to reduce anxiety and heart rate. 26 participants were chosen at random to assess the effect of music on heart rate in which they wore noise-canceling headphones displaying Mozart's *Symphony No. 40* in g minor and Micheal Abel's *Pas De Deux*. Differences in Beats Per Minute will be measured and compared to an initial heart rate reading without the influence of music on the Oximeter. Heart rate and well-being will be monitored to ensure a participant's psychological and physical safety. In between each audio, participants conducted deep breaths in order to mimic their original heart rate. Heart rate readings will happen before and after each audio in order to investigate the legitimacy of Music Therapy and determine if sound can alter the physiological mind and the physical body. In the experiment, horror music had a greater effect on heart rate than classical music. Though Classic Music did have an impact in lowering heart rate overall, the strength of the response typically varied.

Project ID: 160

SR - Biomedical/Health Sciences, and Biomedical Engineering

Sam Fries
Grade 11
St. Augustine High School
Advisor: Tom Fries

Compression: Performance Enhancing or Not

In the midst of an increase in the popularity of compression products in sports, this project aims to determine the most effective method of athletic compression for enhancing athletic performance and maximizing blood flow. Over the course of the trial, compression bands, compression wraps and taping, and the complete absence of compression will all be compared to determine which one has the greatest effect on an athletes circulation. The subject will go on several runs, each of which will be followed by collecting feedback that will be used to evaluate the comfort and effectiveness of each compression method. The results of the study will provide valuable insight into the best method of athletic compression and inform athletes and trainers about the optimal approach for maximizing athletic performance.

Project ID: 161

SR - Biomedical/Health Sciences, and Biomedical Engineering

Daanya Hussain
Grade 11
Bright Horizons Academy
Advisor: Najwan Naserelddin

Sugars vs Sweeteners: Detrimental Effects on Bodily Functions

What is healthier- natural or artificial sugars? The goal of this project is to explore the detrimental effects, if any, of different types of sugars on the gut microbiome and on the stem cell system. The probiotic Lactobacillus acidophilus and the flatworm Planaria, were used as models of gut bacteria and stem cell systems, respectively. It is hypothesized that the sweetener saccharin will have detrimental effects by decreasing planaria growth and promoting exponential growth in L. acidophilus.

L. acidophilus and planaria were cultured in different sugar solutions, and their effects measured by optical density and size, respectively. The bacterial growth pattern were different with each treatment. Aspartame treatment showed highest growth at 6 hours. Saccharin treatment showed slow growth initially but by 24 hours, grew exponentially. Interestingly, the glucose treatment resulted in more growth than aspartame but less than saccharin. These results show that both natural and artificial sugars cause an overgrowth of gut bacteria.

The sugar solutions had an opposing effect on planaria. At 24 hours, the saccharin treated group showed the greatest decrease in length as compared to the untreated group. This result shows that sugars inhibit growth and differentiation of stem cells in the body.
In conclusion, these results support our hypothesis that sugars have detrimental effects on healthy gut bacteria and the stem cell system. This could potentially have detrimental effects on human health by shifting the balance between healthy and harmful gut bacteria, and hinder our ability to fight disease as stem cell viability decreases.

Project ID: 162

SR - Biomedical/Health Sciences, and Biomedical Engineering

Andrew Day
Grade 11
Torrey Pines High School
Advisor: Brinn Belyea

Gasping for Air? Blame Neanderthals.

This year's Nobel Prize was awarded for decoding the Neanderthal genome1-2. Some Neanderthal variants are in modern humans and associated with human diseases. Due to a family history of asthma, I investigated if abnormal cell adhesion in the mouse lung airway could be a genetic cause of asthma. I hypothesize that some genetic causes could be due to Neanderthal variants.

Procedure: I was provided single cell RNA sequencing data from mutant and control mouse lungs; the mutation was in Cadherin 1 (Cdh1), which encodes the key cell-cell adhesion protein3. Using bioinformatic algorithms on these data, I identified differential expressed genes between mutant and control lungs, and cross referenced these to a list of human genes already implicated in asthma4. From the subset of common genes, I identified Neanderthal specific variants.

Results: The Cdh1 mouse mutant airways show a gene expression signature that resembles that of the human asthmatic airway5. Specifically, four of these genes, IL33, AKAP6, LPP and GSDMA are also implicated in human asthma based on genome wide association studies4. In IL33, AKAP6 and LPP, I found variants shared between modern human and Neanderthal, but not African genomes. At least one of these candidate Neanderthal variants has independently been shown to cause symptoms of asthma6-7.

Conclusion: The mouse mutant supports a conclusion that a loss of E-Cadherin, a key cell-cell junction factor may lead to asthma8. The identification of shared asthma-associated variants in humans and Neanderthals suggest that Neanderthal variants could have contributed to asthma in modern humans.

Project ID: 163

SR - Biomedical/Health Sciences, and Biomedical Engineering

Justin Chen
Grade 12
Torrey Pines High School
Advisor: Brinn Belyea

Using Artificial Intelligence to Track Cellular Changes After Laser-Induced-Shockwave as a Model of Traumatic Brain Injury

Traumatic Brain Injury (TBI) are forms of injury that affect how the brain works. As one of the major causes of death in the US, there are only therapeutic methods of treatment with no treatments capable of reversing brain damage. Blast-Induced Traumatic Brain Injuries (bTBI) are one of the types of TBI, caused by explosions and the pressure waves generated by it. Affecting primarily soldiers in recent years, despite body armor being able to protect internal organs from major damage, there is commonly still major neurological damage in the brain. Specific cellular mechanisms behind the damage are not well understood and need to be explored further to develop better treatments.

Using Laser Induced Shockwaves (LIS), TBI can be studied with cells in-vitro. Using a short femtosecond laser, shockwaves similar to those in bTBI can be delivered to cells, allowing cell transient levels of biological competition to be studied. The cells in my experiment were stained using biosensors to study the effects of LIS of Lysosomes and DNA. As Lysosomes are a key component in cell â€œclean up,â€ their vitality is essential for cell health. The rupture and degradation of Lysosomes results in toxins it cleans up being leaked out. This study aims at studying the specific effects of TBI on Lysosomal degradation in order to study how certain drugs might potentially increase cell durability and resistance to TBI, leading to the research question, How does TBI affect cell Lysosomal degradation and how can drugs be used to reduce degradation?

Image analysis was previously done completely manually, using ImageJ. Stacks of images took hours to be analyzed. To increase the efficiency, I developed a MATLAB app to analyze the images, increasing efficiency and accuracy. The app uses a marker-based watershed transform approach to segment the cells and uses GPU acceleration to ensure efficient calculation time.

Project ID: 165

SR - Biomedical/Health Sciences, and Biomedical Engineering

Cynthia Garcia Barbosa
Grade 12
Bonita Vista High School
Advisor: Michelle Mardahl

To What Extent Does Standing from a Supine Position Affect Heart Rate and Blood Pressure?

Testing heart rate and blood pressure is a vital component in understanding and knowing one's health. I was intrigued in learning the relationship between heart rate and blood pressure through a change in body position. To what extent does standing from a supine position affect heart rate and blood pressure?

Procedure: Take and gather data of the blood pressure and heart rate of each adolescent participant (n=20) utilizing a wristwatch style heart rate and blood pressure monitor after obtaining informed consent.

Results: Blood pressure and heart rate data are statistically different, with higher average percent changes when from supine to standing compared to a negative percent change after 3 minutes of standing compared to standing up immediately after lying down.

Average Systolic Blood Pressure (mm Hg) from supine to standing: 10.8%
Average Systolic Blood Pressure (mm Hg) after 3 minutes of standing compared to standing up immediately: -3.20%
Average Diastolic Blood Pressure (mm Hg) from supine to standing: 10.76%
Average Diastolic Blood Pressure (mm Hg) after 3 minutes of standing compared to standing up immediately: -3.20%
Average Heart Rate (bpm) from supine to standing: 30%
Average Heart Rate (bpm) after 3 minutes of standing compared to standing up immediately: -1%

Conclusion: Results demonstrate that my alternative hypothesis was correct as there is a significant difference in blood pressure and heart rate when standing from supine position and standing for 3 minutes after immediately standing compared to the blood pressure and heart rate from supine position.

Project ID: 166

SR - Biomedical/Health Sciences, and Biomedical Engineering

Zinia Khattar
Grade 10
Del Norte High School
Advisor: Juli Cheskaty

Discovery of Stress Pathways Targets to Map Gene Function on Regulatory Networks

Our bodies are continuously faced with a variety of genetic and developmental stress and use stress-responsive signaling pathways to safeguard cells from these insults. These pathways thereafter activate signaling cascades to promote protective remodeling of the proteome, providing a nonstop response to external conditions to lessen impairment of the stress. The insults, however, can result in the pathogenesis of diseases. By defining the tissue-specific changes due to disease, regions of endogenous pathways that can be therapeutically targeted to improve the ramifications of disorders can be determined. To assess stress response activation in cells, stress response signaling gene sets in different tissues can be categorized. In this study, bioinformatics methods were used to correlate canonical genes from the Unfolded Protein Response consisting of ATF6, IRE1, and PERK stress pathways, and the Heat Shock Response with each other. These pathways correlated significantly across tissues, indicating that tissue-specific gene sets can be used to assess pathway activation. Analyzing correlations amongst genes in different stress pathways can establish principal pathways that cellular physiology depends on, by identifying biomarkers, and delineating the necessity to activate certain pathways in spite of certain diseases. Based on k-means clustering and pairwise correlations, target genes like HSPA5, HERPUD1, DNAJB11, MANF, PDIA6, and CALR from the UPR were found. With knowledge of such definitive biomarkers, gene functions were mapped onto regulatory networks using Gene Ontology methods. In this project, based on defined gene activity post-perturbation, target genes were entered into GO methods to output gene function. The ATF6 pathway regulates N-linked glycosylation and cell metabolism, PERK is involved in translation, ribosomal and mitochondrial processes, and XBP1s/IRE1 genes facilitate protein transport and localization. Based on such perturbation impact results, novel therapeutic methods can be developed to modulate stress proteostasis pathways without reliance on cell stress.

Project ID: 167

SR - Biomedical/Health Sciences, and Biomedical Engineering

Vibha Yadav Ganji
Grade 9
Del Norte High School
Advisor: Nagamalleswara Rao Ganji

Deep Learning Based Approach for Detection of Epileptogenic Zone Using HFO Events

Manual analysis of EEG data followed by signal-processing methods has been used for seizure detection. With advances in deep learning and related fields in the past decade, applications to detection of seizures in EEG recordings-have yielded accurate results in diagnosis of epilepsy. Our experiment sought to implement and compare the efficiency of various machine learning algorithms.

Localization of the seizure onset zone has also been a challenging obstacle present to researchers when studying potential treatments for drug-resistant epilepsy patients (resection surgery of the SOZ is generally considered the most efficient). For resection surgery to be done, the SOZ has had to be localized through iEEG methods. Recent research in the past decade on high-frequency oscillations events as potential predictors of seizure events has been conducted and incorporated into the detection of the SOZ. Our experiment compared physiological and pathological HFO event data in control and epilepsy patient groups followed by a clustering analysis of the patient EEG data.

We hypothesized that EEG data based mechanisms of seizure detection and SOZ localization would function as â€œcoarseâ€ detection mechanism due to their high efficiency in both tasks. Our results validated the hypothesis through high performance of the machine learning algorithms used for seizure detection in the EEG recordings and through efficient localization of the clusters formed through analysis of the patient EEG data. Our experiment concluded that due to the high cost and invasive barriers present in the use of iEEG data, an EEG-based approach could function as a possible precursory stage.

Project ID: 168

SR - Biomedical/Health Sciences, and Biomedical Engineering

Leanne Fan
Grade 9
Westview High School
Advisor: Scott Halander

Detecting and Treating Mid-Ear Infections Using Acoustic Reflectometry and Blue Light

Every year, there are 700 million cases of mid-ear infections (Otitis Media, OM) and nearly 21,000 deaths occur worldwide because of complications arising from OM (Worrall, 2007). The method of ear infection diagnosis hasn't changed since German Otologist Wilhelm Kramer invented the otoscope in the 19th century. So, I am proposing a low cost, machine learning (ML) driven diagnosis using echoes from the ear canal converted into spectrograms to provide an instant diagnostic of mid-ear infections. I was inspired by Dr. Neil Finsen, who invented light phototherapy to treat skin diseases a century ago. I integrated a 405nm blue LED to headphones to control mid-ear infections by killing bacteria within the ear canal.
I combined a miniature speaker and microphone along with a blue LED into noise canceling headphones which I call Finsen headphones. The total cost of materials was $70, compared to the cost of traditional detection and treatment which may cost up to 360 dollars without insurance. A Cloud-based machine learning service built on Tensorflow.js that was used to train my mid-ear infection classification model with spectrograms taken from chirps echoing through a middle ear canal model. It uses transfer learning, an ML technique, to find patterns and trends within the images. The ML model can achieve 80% accuracy. For the blue LED phototherapy, I performed antibacterial property tests to prove the effectiveness of blue light treatment. The results showed that 405nm blue light can kill E.coli bacteria on the surface starting at 45 minutes, and most effectively at 75 minutes. Blue light treatment and machine learning show great promise in the future of medicine, especially due to the rising problem of antibiotic resistant bacteria and the shortage of healthcare professionals in certain areas.