CHORI

35th summer research symposium 2016

a showcase for young minds in research

light a *spark*

C · H · O · R · I
Children's Hospital Oakland Research Institute

UCSF Benioff Children's Hospitals
Oakland | San Francisco

August 12, 2016

Welcome to the 35th Annual CHORI Summer Student Research Symposium! We are here to celebrate 35 years of scientific training of young investigators - the future leaders of biomedical research. We are also here to celebrate the wealth of our diversity- which is represented in spades in this years' matriculating class. We have students represented from 3 continents, with over 10 languages spoken. But most of all we are celebrating the 'spark' of scientific enquiry that has been ignited in these summer interns. This CHORI Research Program provides a short-term education and training to high school, undergraduate and post-baccalaureate students with a broad range of backgrounds and experience. Despite their diverse backgrounds, all these trainees have one common goal- they are considering careers in biomedical research and other health care fields. Today's oral and poster presentations constitute the conclusion of a nine-week long program that has featured a rigorous mentored guided research project and education curriculum.

This summer's program has been unique in that we have overcome many obstacles to achieve our goals. Some students were at placements over one hour from CHORI campus, other students and staff in the program have needed to make last minute changes due to illness, and we have lost beloved colleagues (see Memoriums page 61-62). Yet despite these challenges, these students have been incredibly resilient, a character trait that will prove invaluable in the future.

We invite you to learn about the various state-of-the-art research topics that the trainees were involved in, ranging from a prenatal test for B-thalassemia, lipoprotein and apolipoprotein metabolism, epidemiology of diabetes, methodologies to study DNA damage and repair, to visual impairment in patients with RETT syndrome. Please mingle and chat with the research scientists and physicians who served as mentors for the trainees. We feel truly privileged and honored to have the trainees in our organization and hope that their summer research experience offered a brief glimpse into the exciting world of biomedical research.

We take this opportunity to thank all of CHORI, UCSF Benioff Children's Hospital Oakland and San Francisco and UC Berkeley mentors and supervisors who are the backbone of the program. We appreciate their time, effort, and profound commitment to mentor the students. A very special note of appreciation also goes out to David Sabaria, Jennifer Cabrejas, David Lynch, Phillip Bollinger, Beate Illek, David Killilea and all CHORI and CHRCO staff, guest seminar speakers and other friends of the CHORI Summer Program for their effort and time, which made this summer's program a huge success. We acknowledge the support and funding provided by the NIH, DDCF, CIRM, the Elizabeth Nash Foundation and a number of Anonymous donors. We wish the trainees all the very best in their future endeavors and hope that they will keep in touch with us as we would like to know if the program had any impact on their academic and career decisions.

Sincerely,

Bertram H. Lubin, MD
President & Chief Executive Officer
UCSF Benioff Children's Hospital Oakland
Associate Dean of Pediatric Health, UCSF

Vasanthy Narayanaswami, PhD
Associate Scientist
Principal Investigator & Co-Director
CHORI Summer Program

Ellen B. Fung, PhD RD CCD
Associate Scientist
Principal Investigator & Co-Director
CHORI Summer Program

Support for the 2016 CHORI Summer Research Program was generously supported by the following grants and sponsors:

The National Institutes of Health (NIH), Short Term Research Education Program to Increase Diversity in Health Related Research from the National Heart, Lung and Blood Institute (NHLBI), #R25 HL125451-0

The California Institute for Regenerative Medicine (CIRM), Leveraging Investment in High School Training: Summer Program to Accelerate Regenerative medicine Knowledge: LIGHT-A-SPARK, #EDUC3-08399

The Doris Duke Charitable Foundation (DDCF) Clinical Research Experience for High School Students, #2014150

Alameda County Health Pipeline Partnership (ACHPP) Mini-Grants Program

The Elizabeth Nash Foundation

The UCSF Benioff Children's Hospital Oakland Foundation

Various Anonymous Donors

Volunteer Recognition 2016

We would like to thank the many volunteers that took time out of their busy schedules to help this program succeed:

Frans Kuypers	Abstract Reviews
Gwenn Lennox	Foundation Support
Susan Camel	Orientation Assistance
Kathy Schultz	Boot Camp & Orientation Tours
Julie Lane	Boot Camp Curriculum
Debbie Dare	Graphic Design for the Symposium
Elaine Pico	Clinical Presentation Casting Clinic
Lauren Flowers	Clinical Presentation Casting Clinic
Rosanne Dial	Clinical Presentation Casting Clinic
Dion Duncan	Clinical Presentation Casting Clinic
Willie Williams	Clinical Presentation Casting Clinic
Jennifer Cabrejas	Assisted with Grant submissions
Adam Davis	Grant Writing Assistance
Teresa Klask	Grant Submissions
Jennifer Beckstead	Tours at Orientation
Phillip Bollinger	Tours at Orientation
Sue Lyons	Badging Assistance
Margery Vanderslice	Health Clearances
Virginia Detweiler	Health Clearances
Reena Ninan	Social Activities
John McDonnell	Symposium Book
David Killilea	Symposium Co-Chair
Sarah King	Symposium Co-Chair
Anna Harleen	Student Symposium Co-Chair
Osman Shokoor	Student Symposium Co-Chair

And a very special thank you to all the 2016 Symposium Judges

2016 Program Staff

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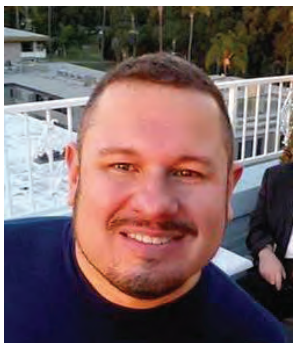

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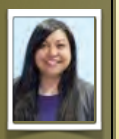
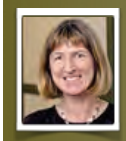
2016 CHORI SUMMER STUDENT LECTURE SERIES

Thursdays 3pm - 5:15pm CHORI Little Theater

*unless location and time specified are different
refreshments will be provided

	Mark Walters, MD Scientist, Program Director Bone Marrow Transplant Program	June 15, 2016 2:00-3:00pm August 4, 2016 5:00-6:00pm	California Institute of Regenerative medicine (CIRM) Bone Marrow Transplant: The Basics
 	Alka Kanaya, MD & Kala Mehta, DSc Epidemiology & Biostatics, UCSF	UCSF-Parnassus Library CL 221 and CL 222 June 23, 2016	Seminar: Heterogeneity of Diabetes in Asian Americans Workshop: Reading and Reviewing Scientific Articles
 	Young Kim-Parker, Program Manager, CHAMPS & Michelle Ednacot, MA-PPS CHAMPS Program	June 30, 2016	Alumni Panel Presentation: Haven Allard, Amarjit Bath, Leyna Nguyen, Jacob Amme Seminar: Stress Relief Techniques
 	Beate Illek, PhD & Steve Mack, PhD, Assistant Scientist	July 7, 2016	Student Presentations Seminar: Bio Informatic Approaches for Studying Disease Etiology and Evolution
 	Beate Illek, PhD & Dayna Long, MD Pediatrician Primary Care Dept.	July 14, 2016	Student Presentations Seminar: Pediatric Help Desk; Addressing Social and Environmental Needs in the medical Home
 	Phillip Bollinger, Senior Systems Analyst CHORI IT & Marisa W. Medina, PhD, Associate Scientist	July 21, 2016	Workshop: Effective Scientific Presentation Seminar: Is it the right drug for you? The Path Towards Personalized Medicine
 	Beate Ilek, PhD & Anne M. Marsh, MD Director, Pediatric Sickle Cell Program	July 28, 2016	Student Presentations Seminar: Sickle Cell Disease at CHO; A Unexpected Journey, A Beloved Destination
	TBA	Located at: UCSF August 3, 2016 12pm-3pm	Seminar: TBA Presentations from Medical Students Social Mixer

2016 CHORI/UCSF/UCB Summer Student Research Program Curriculum

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Full Program Orientation, June 13, 2016

All-day orientation for summer interns on Monday, June 13, 2016, from 8:30 am until 4:00 pm.
Catered continental breakfast will be served at 8:30 am, and lunch will be provided.
Agenda to include:

- Introduction and overview by Director and Co-Director
- Keynote lecture: Kirsten Bibbins-Domingo, PhD MD
- Explanation of curriculum, introduction to Scientific Mentors
- CHORI tour. Badges obtained Tuesday and Wednesday morning 6/14 & 6/15.

Safety Training, June 8th 2:00 – 5:30 pm

Mandatory Safety Training with CHORI Safety Officer, Miriam Fang.
Students are required to complete this training BEFORE beginning their projects. Coordination of this training TBD (*Make up Safety Training Date: June 23rd 9:00 – 12:30 pm*)

Meetings with Off-Site Mentors: Tuesday June 14, 2016

10:00 am Students with mentors at UC Berkeley will travel to UCB along with the Co-Director of the program in the morning to meet with their mentors. (Location: 415 Li Ka Shing Center)

1:00 pm – 3:00 pm Students with mentors at UCSF will travel to UCSF campus along with the Co-Director in the afternoon to meet with their mentors. (Location: Room 215/216 Campus Library, Parnassus)

Research Project: June 15, 2016 to August 12, 2016

The student will conduct research with assigned mentor. The details of project and research plan are left entirely to the individual mentor and each summer intern will follow the procedures, and schedule, laid out by their respective labs.

Written Research Plan: Due: June 29, 2015 (Wednesday) by 4:00 pm

Students must submit to the Program Coordinator a written Research Plan outlining their project. The Research Plan should be 3 pages long and include:

(a) Statement of hypothesis
(b) Specific aims
(c) Background
(d) Methods
(e) Anticipated outcome of project

Students will work closely with their mentor in the preparation of these reports, and mentors should review and approve the reports before submission. Figures, flow charts and schematics may be used to illustrate the research plan. The written report will be sent to: summerstudentprogram@chori.org, and must include student's name, mentor's name and the title of the project.

Weekly Seminars: Thursdays 3:00 – 5:15 pm. June 23rd – August 3rd (Last Meeting on Wed)

Students are required to attend weekly lectures delivered by CHORI, UCSF and CHRCO faculty members. The lectures will cover various scientific topics, including women's and minority's issues, career decisions, teen health issues and Responsible Conduct of Research. Curriculum will be held most weeks on **Thursdays from 3:00 – 5:15**

pm. Lectures will either be held at CHORI in the Little Theatre or at UCSF Parnassus Campus. Refreshments will be provided.

Student Photo Day: Thursday June 30th at 1:30 pm
All students must be present.

2015 CHORI Summer Student Symposium, August 12, 2016 (Location: CHORI Library)
A one-day symposium will be held on Friday, August 12, 2016 where all students are **required** to participate. The students will submit an abstract concisely summarizing their work, which will be considered for an oral or a poster session for the Symposium. Abstracts are due on Wednesday, July 20, 2016 by 4:00 pm. A committee comprised of the Co-Directors and other leading members of the CHORI scientific community will review the abstracts for the Symposium. Students will work closely with their mentors in the preparation of abstracts and presentations. Family members, teachers, lab members and friends are welcome to attend.

The Symposium will be comprised of oral presentations (10 minutes each, with 5 minute discussion), and a poster session during which the presenters will be on-hand to explain their research project. A catered breakfast and lunch will be provided for all attendees on the Symposium day. Awards will be given to the best poster and oral presentations given at the symposium. A certificate of participation in the CHORI Summer Student Research Program will be awarded to all students who successfully complete the program.

Summary of Important Dates:

June 8, 2016	**Safety Training**: 2:00 – 5:30 pm (*Required for students working in Labs only*).
June 13, 2016	**Orientation**: 8:30 A.M. – 4:00 P.M. (Required for ALL STUDENTS)
June 14, 2016	**Off Site Mentor Visits** at UCB & UCSF
June 15, 2016	**BMT Team Lecture** – *Required CIRM Students/Opportunity Other Students*
June 15/16, 2016	*Basic Science Boot Camp- High School Students (Students working in Labs only*)
June 23, 2016	Make up Safety Training: 9:00 – 12:30 pm (*Students working in Labs only*)
June 29, 2016	**Written Research Plan** due by 4:00 P.M.
June 30, 2016	**Student Photo Day** 1:30 pm (*CHORI Courtyard*): All Students must be present
July 8, 2016	**Personal Statement** for Program Guide due by 4:00 P.M.
June 27 & July 11th	**Volunteer Opportunity** Casting Clinic 8:00 A.M.-9:00 A.M. (must RSVP)
July 20, 2016	**Abstracts due** by 4:00 P.M.
August 8, 2016	**CIRM Poster Day**, Claremont Hotel (**CIRM students only**)
August 12, 2016	**Summer Student Research Symposium**, CHORI Library

***Program Seminars**: June 23, 30, July 7, 14, 21, 28, and August 3rd, 3:00 – 5:15 pm*
2 Social gatherings will be held during the summer, dates TBD

Please e-mail any additional questions and concerns to: *summerstudentprogram@chori.org*

2016 Alumni Student Speakers

Student Alumni Speakers from Left to Right:
Haven Allard, Amarjit Bath, Leyna Nguyen, Jacob Amme


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FRIDAY 08.12.16
9 A.M.–4 P.M.

Jacob Amme

After a transformative experience at CHORI last summer working with leading molecular geneticists in the Lammer Lab, I was very excited to transition to a nutrition lab, which gave me the opportunity to expand on and diversify my passion for biomedical research. This summer I have been fortunate to work in the King Lab on researching alternative biomarkers for whole-body zinc status, a micronutrient that plays a critical role in a variety of physiological and metabolic processes in the body. My research involves appraising the validity of hair zinc as a biomarker as well as investigating whether hair zinc concentration is altered in women over the course of pregnancy. I have had a very rewarding experience as a returning student researcher and as an alumni representative. I would like to thank the King Lab, especially Kathy Schultz, Dr. Swapna Shenvi, and Dr. David Killilea for their support, guidance, and invaluable advice.

Funded By: National Institutes of Health

School: Washington University, St. Louis, MO

Mentors: Kathleen Schultz, MS, David Killilea, PhD, Swapna Shenvi, PhD, Janet King, PhD

Title: Evaluation of Hair Zinc in Pregnant Women Fed a Micronutrient-rich Diet

Introduction: Both marginal and acute zinc deficiency can have profound effects on a person's short and long-term health, as zinc plays an essential role in immune system function, metabolism, DNA repair, growth and development. Zinc deficiency is exacerbated in high-risk populations such as children and pregnant women in regions where there are inadequate zinc nutritional sources. In this study, we plan to analyze 216 hair samples taken at three critical gestational timepoints from a population of 95 pregnant women in rural Vietnam, for whom corresponding plasma samples were also collected. We will assess the validity of hair as a standard zinc biomarker that can be incorporated into national nutrition surveys. Additionally, we will investigate whether hair zinc concentration is altered in women over the course of pregnancy as a precursor to designing appropriate nutritional interventions.

Objectives: To assess how hair zinc concentration compares to plasma zinc concentration, which is the gold standard biomarker for determining zinc status and to determine whether hair zinc concentration is altered in women over the course of pregnancy.

Methods: Zinc content of the hair samples will be measured by inductively coupled plasma optical emission spectroscopy (ICP) analysis to determine the zinc concentration. The pre-analysis workflow involves washing the hair to minimize external trace element contamination. Upon completion of the ICP analysis, the hair zinc concentration data will be evaluated with respect to corresponding plasma zinc concentration data. Additionally, zinc concentration data will be compared across different gestational timepoints.

Results: Preliminary hair zinc concentration results reveal shortcomings in the preanalysis workflow. For example, a small hair sample mass may not provide precise zinc content because of extraneous liquid acquired during the washing procedure. Therefore, we will use a higher mass of hair sample to perform the zinc analysis as well as adjust incubation time. However unanticipated, these challenges provide illuminating insight into the methodology required to prepare hair samples for ICP analysis and promise to ensure more robust results.

Anticipated Outcomes: We plan to appraise the validity of hair zinc as a biomarker as it compares to plasma zinc, which is the current gold standard. We also expect to clarify how hair zinc concentration changes over the course of a woman's pregnancy.

Acknowledgments: Thank you to IZiNCG, especially Jonathan Siekmann, PhD, and Lauren Smith, BS. I would also like to acknowledge Wesley Kwong and Tatiana Cheong.

Keywords: ICP-OES, plasma zinc, zinc biomarker, micronutrients

Anna Beatriz Goncalves

I am a Brazilian undergraduate student, and I am double majoring in Biomedical Science and Forensic Science. I decided to pursue these majors to connect science with justice. By combining both fields, I can give my contribution to society by researching and also helping the justice system in Brazil.
Through my previous research experiences, I have learned methods that can be applied in the forensic field. However, I never had a chance to work directly in the field because it is still in development in Brazil, and there is a shortage of researchers. This inspired me to get research experiences beyond the borders of my country, return to Brazil and contribute to change that reality. The CHORI Summer Research Program provides the experience I was looking for to get one step closer to my goal. At CHORI, I have the opportunity to learn from great scientists and perform various experiments that are relevant to the field of forensic science. I would like to thank everyone in the laboratory for teaching me valuable skills, especially for Dr. Cassandra Calloway who provided me this memorable opportunity as well her guidance and support. This enriching experience will stay with me forever.

Sponsored by: Capes and International Institute of Education (IIE)

Mentor: Cassandra Calloway, PhD.
Contributing authors: Anna B. R. Gonçalves, Rachel Gordon, Henry Erlich, Cassandra Calloway.

Title: Analysis of Mixtures by Mitochondrial DNA and Nuclear Markers for Generation of Forensic Profiles.

Introduction: Mixtures of different people's trace materials at crime scenes are commonly found, and the nuclear DNA (nDNA) analysis of these mixtures is the common approach to identify victims and suspects. However, some recovered specimens have poor nuclear genome quality and quantity due to degradation and contamination. Mitochondrial DNA (mtDNA) can be a better approach because of higher number of copies in each cell; also, each individual has only one haploid mtDNA sequence. Current methods result in a low discrimination rate among individuals. For this reason, a method that allows the analysis of both mtDNA and nDNA would be desirable to achieve a higher discrimination power needed for human identification. The goal of this study is to combine nuclear and mitochondrial DNA analysis of shed hairs and mixed DNA samples using novel probe panels in order to increase the resolution of mixtures and improve power discrimination.

Hypotheses: 1) The novel method of hybrid probe capture, followed by NGS with the Illumina MiSeq, can be used successfully to analyze nuclear SNP markers of highly fragmented DNA from shed hairs, which would typically fail conventional nuclear DNA analyses. 2) Combining mtDNA and multi-allelic nDNA SNP markers would improve the ability of resolving mixtures compared to conventional nuclear DNA methods.

Methods: Population samples were selected from among existing collections of African-American, Caucasian, Hispanic and Japanese DNA samples and two person mixtures were created to mimic forensic mixed samples. According to the similarities of the haplotypes' single sources genomes, the samples were mixed so that they had < 20 differences or > 20 differences in the mtDNA genome (comparison made by NextGene software). We anticipate that it may be more difficult to resolve the individual components of a mixture with more closely related mtDNA sequences. To investigate the sensitivity of the mtDNA and nDNA systems, the samples were mixed together in different proportions and limited in amounts (1 ng).
Shed hairs from four different people in anagen or telogen phases and with four centimeters in length were selected and their DNA was extracted. Buccal samples from the hair owners were used as controls. Both mixtures and hair samples were separately analyzed for nDNA and mtDNA by the probe capture method and the results were compared. The probe capture method consists in the use of hybridization to create a complex probe-target sequence and enrichment the target of the libraries. Because this method can be used to capture very short DNA fragments (as short as 35 bp), probe capture panels for nDNA and mtDNA markers have been demonstrated to be successful for analysis of highly fragmented DNA, while other methods would typically fail. Later, the samples were sequenced in a MiSeq Sequencing System, by Illumina.

Anticipated Outcome: Mitochondrial DNA haploid markers as well as nuclear SNPs micro-haplotypes can be successfully applied to analyze and resolve mixtures. Further, the mtDNA and nDNA SNPs probe panels can be successfully applied to capture and sequence very limited and degraded DNA from single shed hairs.

Acknowledgment: Guillermina Almada and Shelly Shih.

Keywords: Forensic, mtDNA, NGS, Bioinformatics, Hair, Haplotypes, SNPs

Neil Patrick Buac

My name is Neil Buac, and this fall I will be a junior at California State University East Bay. I am a pre-med student majoring in Physiology. It was not until my recent time in the military where I gained an interest in the medical field. This summer, I've had the privilege to work with and learn from my mentor, Dr. Marcela Weyhmiller. She has taught me that every little detail matters in an experiment, regardless of seeming insignificant (air bubbles = not good). I've learned that the preparation of an experiment is of equal importance to its execution. These lessons of attention to detail not only apply as a student but also apply in life. I am grateful to carry these experiences with me as I pursue a career in medicine.

Funded By: National Institutes of Health

School: California State University East Bay

Contributing Authors: Ellen Fung, PhD, Roland Fischer, PhD

Title: Effects of Bone Marrow Iron on Bone Mineral Density Assessments

Introduction:
Chronically transfused patients are at risk for iron overload in various organs. Previously, our group has shown that iron density can be qualitatively assessed in DXA and high liver iron concentration can affect bone density scores when the liver overlies a portion of the lumbar vertebrae. Recently, MRI studies have shown that bone marrow of chronically transfused patients can be highly iron overloaded. Thus, DXA measurements in iron overloaded patients may overestimate bone mineral density.

Hypothesis:
Bone marrow iron affects the measurements of bone mineral density via 2-dimensional Dual Energy X-ray Absorptiometry (DXA).

Methods:
In this phantom study, we will measure the bone density of high, normal and osteoporotic spine phantoms (beef shin bone, DXA spine phantom and cuttlefish bone, respectively) overlaid with bone marrow phantoms containing various amounts of iron. Bone marrow phantoms will be made from mixtures of mayonnaise, water and various concentrations of iron dextran.
Bone mineral density (BMD) scans will be acquired on a Hologic Horizon A (Hologic Inc., Bedford, MA) software version Apex 5.6.1. Raw data of BMD will be measured via lumbar spine and forearm scans. Net average bone mineral content (BMC) will be abstracted from subregional analysis for each scan.

R2* and fat quantification will be assed from MRI scans acquired on a 1.5 T Phillips Intera software version 3.2.3.2 using gradient-echo sequences with multiple echoes. A plot of the relaxation rates vs. BMD will be produced for visualization and interpretation.

Anticipated Outcome:
This will be the first study to compare R2* with BMD measurements by DXA. We expect that this work will show a positive correlation between R2* and BMD which may help better assess bone health for iron overloaded patients.

Acknowledgments:
Kevin Lofton, Ken Martin, MD, Ames Lab

Keywords:
Bone marrow, iron, bone mineral density, MRI, phantoms, DXA, R2*

Belen Caballero

As I approach my junior year of undergraduate studies at Florida International University, I constantly get asked about my goals for the future. I have always known I wanted to go into medicine but the question still remains of what specialty or field I will want to pursue. As a CHORI intern this summer, I was exposed to Asthma patients of different backgrounds as I shadowed at the weekly Asthma clinic at the main Primary Care Clinic. I had the opportunity to engage with patients and their families, and learned more about Asthma education and prevention while conducting my own research on the social conditions that affect a family's exposure to nature and overall health. I was able to relate to these patients because of my history with Asthma and as an immigrant myself I have faced various social resource needs that have impacted my health. Working with Christine this summer has been an incredible learning experience as well as rewarding and has helped me know the importance of research.

Funded By: National Institutes of Health

School: Florida International University

Mentor: Christine Schudel / Mindy Bensen

Title: Significance of a Social Intervention and how Education Affects its Success

Introduction:
The term socioeconomic status (SES) largely refers to a person's measure of income, wealth, or education and has been recognized to have a significant effect on health. There is evidence to support that poor adult health is influenced by exposure to low socioeconomic conditions during childhood (Davey Smith, 1998). A person's education and schooling level is especially correlated with their health more so than any other SES condition, with higher educated people exhibiting greater knowledge in health behaviors. (Goodman, 2010). The Family Information and Navigation Desk (FIND) is the first randomized controlled trial that evaluates the effectiveness of a social needs intervention in a clinical setting.

Hypothesis:
Among those that participated in the FIND study, the higher the reported education level of the participant, the less likely he/she were to report an increase in their response to the question: "how often does your child visit a park or other natural space?" .

Specific aims:
To determine what effect the intervention had or did not have based on the level of education the parents reported. To find if the parent's education level has a greater influence on the child's amount of exercise and contact with nature per week and their overall health than FIND intervention.

Methods:
Data from the Family Information and Navigation Desk (FIND) study will be analyzed. During the study, a series of questions were asked to determine the need for access to health care, nature, and social services. The questions the participants answered targeted specific demographic information as well as health questions regarding their child. The question this research will focus on is the following: *"In a typical week, how often does your child visit a park or other natural space?"* I will use Analysis of Variance (ANOVA) to find the correlation coefficients, comparing the intervention and the control group to see if the intervention was successful and if so in which group. These results will then be stratified with the data received from the post survey at six weeks from the intervention to see if education level reduces the effect size.

Sharit Cardenas Lopez

Since I can recall, I have always had an interest in medicine. As I got older and began interacting with medicine in various ways I became more interested and eager to involve myself in a medical environment. I am a rising Sophomore at Wesleyan University where I will major in Cultural Anthropology and be pre-med. Unlike many people who want a career in medicine, I have decided not to major in the sciences. I belief that majoring in Cultural Anthropology will play a role and have a huge impact on the doctor I will become. I aspire to go to med school and have a career in medicine. Because of my desire to become a doctor I was and am extremely excited to participate in the CHORI program. I am certain that the experience I gain this summer will help guide me towards a medical career and give me a well rounded experience on research and broaden my knowledge on the many medicine careers available. At the end of the summer not only will I have created many more connections but I will have also deepen my knowledge in Adverse Childhood Experience (ACEs), which is a study that I worked on alongside Dr. Long and her study group, and the many factors that play into completing research.

Funded By: National Institutes of Health

School: Wesleyan University

Mentor: Dayna Long, MD

Title: The Effect of Racial Background and Social Economic Status on the Discrimination

Introduction: In 2015, UCSF Benioff Children's Hospital Oakland, University of California San Francisco Center for Genes and the Environment (UCSF), and Center for Youth Wellness (CWY) received $4.7 million to study pediatric ACEs. The aims of the pediatric ACES research are: (1) "To validate a new modified prospective ACEs screening tool," (2) "To estimate the association between pediatric ACEs and biomarkers of stress," and (3) "To evaluate whether brief and intensive primary care-based interventions for children at risk of toxic stress can lead to detectable changes in stress physiology." This new ACEs study will partake in four phases "(1) planning, (2) pilot which includes cognitive interviews and assessment of language validity and literacy level, (3) validation, and (4) implementing interventions to migitate ACES (5) biomarker collections at the time of enrollment and then at follow up (2-3). I will be focusing on phase 2 were 30 participants will partake in cognitive interviews about their comprehension and interpretation of the screening tool.

Objectives: (1) To determine how design thinking may be applied in best elicit information on discriminatory experiences among different racial/ethnic groups.
(2) To learn what characteristics are associated with reporting discriminatory experiences.
(3) To determine if people's racial/ethnic background and social economic status plays a role in their reports with discriminatory experiences

Methods: Due to the need to focus on feasibility to complete within five weeks I will only focus on one question, which in this case it will be, "Has your child experienced discrimination (for example being hassled or made feel inferior or excluded because of his/her race, ethnicity, gender identity, sexual orientation or religion)?" The participants will take the ACES questionnaire and the modified pediatric ACES questionnaire. Then meet with the study clinician to discuss the questionnaires. I will analyze the data and field notes taken when completing the cognitive questions with the clinician. I will stratify the information by racial background and SES. The racial background is below on Table 1 and the SES breakdown is on Table 2. I will compare it with one another to see if there is any relation between ethnic background and SES with the responses given by that racial/ethnic group.

Table 1- Racial Background

White/non-Hispanic	Asian
White/Hispanic	Native Hawaiian/Pacific Islander
Black/non-Hispanic	American Indian or Alaskan Native
Black/Hispanic	Other

Table 2- SES (Household Income)

0-$5,000	$5,001-$10,000	$10,001-$15,000	$15,001-$20,000	$20,0001-$25,000	$25,001-$30,000
$30,001-$35,000	$35,001-$40,000	$40,001-$50,000	$50,001-$60,000	$60,001-$70,000	$70,00 or more

Anticipated Outcome: I hope to find a correlation between race and SES to their response to my question of focus. Furthermore, I would like to better understand how discrimination may affect the participant's response to the question.

Keywords: Adverse Childhood Experience, racial background, social economic status

Melissa Cervantes

My name is Melissa Cervantes and I am a rising senior at Holy Names High School. Growing up, I have always had a great interest in science. I have loved exploring different forms of science because it satisfies my sense of curiosity and helps explain why some things in the world around us work the way they do. When I heard about the CHORI Summer Research Program, I knew it was a great opportunity. Before CHORI, I had never been involved in a real research project. This program has allowed me to engage in a project with the support of my mentor and see a new side of science I did not even realize was out there.
Although I am still not one hundred percent sure what career I want to pursue, I believe I want to have a career in the medical field. With whichever career I end up choosing, I know that I want to help others and make a difference in their lives. Being a part of CHORI has been an incredible experience; I have learned many valuable skills that I know I will use for the rest of my life.

Funded By: Doris Duke Charitable Foundation

School: Holy Names High School

Mentor: Ellen Fung, PhD, RD

Title: Assessing Bone Quality by Trabecular Bone Score (TBS) in patients with Hemoglobinopathies

Introduction:
Thalassemia is a rare, genetic disorder that prevents the body from producing a sufficient quantity of high quality blood; caused by a defect in the ability of erythroblasts to synthesize the beta chain of adult hemoglobin. Sickle cell disease (SCD), another genetic hemoglobinopathy, is caused by a single gene mutation in the hemoglobin molecule, resulting in abnormally shaped or 'sickled' red blood cells. Both patients with Thal and SCD have been shown to have lower bone mass, though bone quality and overall fracture risk is relatively unknown.

Objective:
To explore the relationship between bone mass (as assessed by DXA) and bone quality (as assessed by TBS software) in patients with Thal and SCD in comparison to healthy controls.

Methods:
A retrospective chart review was conducted in patients with Thal or SCD who had a spine bone mineral density (BMD) scan performed in the past 5 years. DXA spine scans were reanalyzed using the TBS software (TBS Insight, MediMaps v2.2, Mérignac, France). Some patients had more than one scan performed during this 5 year retrospective period; these patients were used to see how the association between BMD and TBS changed over time. Our healthy control group data was collected from subjects who completed previous research studies; these are individuals without hemoglobinopathies.

Results:
307 subjects were assessed, 39% male, 61% female, 64% >18 years; 110 Thal, 123 SCD, and 74 healthy controls. Age in the adult sub-group did not differ between Thal and SCD, though lower in controls (33 vs 28 yrs, $p<0.05$). On average, Thal adults had greater deficits in spine BMD Z-score (-2.4 ± 1.2), as compared to SCD (-1.50 ± 1.39) and Controls (-0.1 ± 0.8). TBS was significantly correlated with spine BMD Z-score ($r=0.65$, $p<0.001$), age, BMI, and liver iron concentration (all $p<0.05$). Longitudinal data analyses have yet to be analyzed.

Conclusions:
These data support the relationship between reduced bone mass and bone quality in adult patients with hemoglobinopathies. Future studies are needed to relate TBS data to fracture risk in this unique population with extremely low bone mineral density.

Acknowledgments:
I would like to thank my mentor, Ellen Fung for all of her time, support, and guidance throughout our research project.

Keywords:
Thalassemia, sickle cell disease, trabecular bone score, bone mineral density.

Charmaine Chan

Hello, my name is Charmaine Chan. I am a rising junior at Vassar College. As a child, I was diagnosed with neutropenia. Biology had no particular appeal to me when I was growing up. However, after my first biology course in high school, I grew to love biology and I've continued pursuing my love for it through college. Research is something I hold very dear to my heart not only as a curious, science-loving student but also as an individual who has had a first-hand experience with a medical condition. After college, I aim to pursue a Ph.D. in the biomedical sciences and my goal ultimately is to do research for the betterment of human health.

Having experienced this program three years ago as a high school student, I am so thrilled to once again be a part of the CHORI program with its tightly knit community and its determination to provide students from diverse backgrounds with the opportunity to obtain high-level training in the sciences. I am forever grateful for the experiences CHORI has brought me and I am excited for the experiences it will bring to future budding scientists like myself. I would like to thank Dr. Beernink for being an amazing and supportive mentor. I would also like to thank Alicia, Malik, Emma, Eddy, Monica, Kelsey, Elizabeth and Vianca for their guidance, for always making the atmosphere light in the lab, for nicknaming me giggles and typewriter, and for calling me a chipmunk after my wisdom teeth extraction.

Funded By: National Institutes of Health

School: Vassar College

Mentor: Peter Beernink, PhD

Title: Bacterial Ligands for Complement Factor H Underlie Mechanisms of Immune Evasion

Introduction:

N. meningitidis is a Gram-negative bacterium that colonizes the nasopharynx of healthy humans and can cause bloodstream infections, also known as sepsis, and meningitis, inflammation of the lining that covers the brain and spinal cord. In order to colonize humans and cause disease, *N. meningitidis* can recruit factor H (fH), a complement downregulator, to the bacterial surface, thus allowing the bacterium to resist complement-mediated bacteriolysis.

Factor H binding protein (fHbp) and Neisserial surface protein A (NspA) are the major meningococcal ligands for fH. They are proteins present on the surface of *N. meningitidis* that increase the survival of the bacterium in human blood by binding human fH. fHbp is a component of two recently released meningococcal vaccines and NspA is a vaccine candidate previously tested in humans. In addition to activating the antibody-dependent pathway of complement, antibodies directed against fH ligands can promote bacterial killing by inhibiting fH binding to the bacterial surface.

Objective:

To determine whether there is a correlation between fHbp and NspA in various strains of *N. meningitidis* in an effort to better understand the process by which *N. meningitidis* evades the complement system.

Methods:

The amount of fHbp and NspA proteins in *N. meningitidis* cells will be measured via quantitative Western blotting. A UV-Vis spectrophotometer will be used to measure the optical density (indicative of cell concentration) of the various strains of heat-killed *N. meningitidis* cells. A NanoDrop spectrophotometer will be used to quantify the protein concentration of purified fHbp control samples.

Anticipated Outcomes: We believe that there will be an inverse correlation between fHbp and NspA in strains of *N. meningitidis* since they both serve as ligands for fH and are redundant mechanisms for evasion from the complement system.

Conclusion:

If an inverse correlation between the two surface proteins is observed, we can provide information and support for future improvements of vaccines against *N. meningitidis*.

Acknowledgments:

I would like to thank Dr. Beernink for being a fantastic mentor, CHORI for providing me with a great research

Tatiana Cheong

Science has always intrigued me. It all started from the "I'm going to make things explode" idea that encouraged to explore the fields of science. My curiosity turned into passion and I knew I had to follow my passion. After hearing about CHORI through a few schoolmates, I applied in a flash. Working in the King lab, meeting amazing researchers, and conducting my own projects have intensify my love for science. This opportunity has showed me how interesting the nutrition study is and the importance of Personal Protection Equipment. I like to say that the stark white acid drops on my blue jeans are a fashion statement of 'there is always light when you are blue'. Thank you CHORI for being one of the most notable opportunities in my life and for helping me shape my future.

Funded By: Doris Duke Charitable Foundation

School: Holy Names High School

Mentor: Swapna Shenvi, PhD, Kathleen Schultz, PhD, David Killilea, PhD

Title: Impact of Blood Collection and Storage Methods on Plasma Zinc Concentrations (PZC)

Introduction:
In order to get a better understanding of the prevalence of zinc deficiency globally, it is important to obtain PZC information, especially from developing countries. The process of obtaining high quality plasma samples is a challenging task due to logistical and cost issues. The following three factors can influence PZC: multiple freeze-thaw cycles during collection, storage, and transportation, the use of trace element-free (TEF) tubes to prevent zinc contamination, and hemolysis of blood during collection and/or isolation of plasma. Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES) is an instrument used to measure elements like zinc. Using argon gas, it creates a hot plasma source, which the samples run in, resulting in the ionization of the component elements.

Hypothesis:
1. Non-TEF tubes can be used for collecting venous blood by venipuncture for PZC without detectable zinc contamination.
2. Multiple freeze-thaw cycles on plasma does not alter the PZC.
3. There is a maximum level of hemolysis that can be identified using the human eye, which could make it easier to discern whether PZC levels could be potentially compromised.

Methods:
1. Determining zinc contamination in blood collection tubes. In non-TEF blood collection tubes of various brands, nitric acid will be inserted into each tube and inverted 5 times. Then, zinc measurements are read on the ICP-OES.
2. Determining PZC in samples with multiple freeze-thaw cycles. Thawed plasma will be subjected to multiple 1 hour long freeze-thaw cycles.
3. Test with hemolysis. Different percentages of hemolyzed plasma will be analyzed for zinc.

For 2 and 3, samples are digested using nitric acid, then diluted with Omni-trace water, before inserted into the ICP-OES.

Results:
1. In a random assortment of non-TEF tubes, we found that 70% of tubes contained detectable zinc contamination that could increase average plasma zinc measurements by >10%.
2. In a controlled freeze-thaw study, we found that on average, 3 freeze-thaw cycles resulted in increased average plasma zinc measurements by >10% compared to baseline.
3. In a simulated hemolysis study, we found that substitution of 10% of clarified plasma with autologous hemolyzed plasma increased average plasma zinc measurements by >10% compared to baseline.

Acknowledgments:
Thank you Jonathan Siekmann,PhD and Lauren Smith,BS for providing me with support. Thank you to those who have donated vacutainer tubes for my project.

Keywords
Freeze-Thaw, Trace Element-Free, Hemolysis, ICP-OES

Parth Chhetri

From the Mountains of Nepal to the ocean of America, my story is the Journey of the Immigrant who came to America in search of happiness. As I contemplate writing about myself I can't help but think about those who love me as I know that I am merely a reflection of everyone that I have met. From my parents who taught me to sacrifice, to my uncle and aunt who gave me not just a house but a home when I first moved to the states, I have been shaped by everyone around me. Those wonderful days with my friends when we made makeshift sock balls and played soccer to the grandparents that always hope for my wellbeing, I am a part of them and they are a part of me.

Apart from helping those in need, medicine allows me to understand myself better. I also believe that only when we understand what it really takes to make up a human being can we understand the true value of life. I would like to thank CHORI for solidifying my dream of becoming a physician and Dr Nisha Acharya for her allowing me to live that dream over the summer.

Funded By: National Institutes of Health

School: University of California, Berkeley

Mentor: Nisha Acharya, MD

Title: Difluprednate for the Treatment of Uveitis and Macular Edema

Introduction:

Macular edema (ME), which is a vision-threatening complication of uveitis, is the most common cause of blindness and visual impairment in the uveitic population. The current first-line treatment for uveitic ME is regional corticosteroid injections. However, ocular injections are invasive and carry risks such as infection, bleeding, high ocular pressure, cataract and inadvertent damage to the lens or retina. Difluprednate (brand name Durezol) is a corticosteroid eye drop that is FDA approved for the treatment of anterior chamber inflammation. However, the drug has recently been used off-label to treat uveitic macular edema, and we are interested in learning about the efficacy of difluprednate for the treatment of macular edema. If difluprednate was shown to be effective for macular edema, it could potentially replace injections as a first-line treatment.

Hypothesis: Difluprednate, a corticosteroid eye drop, is efficacious for the management of uveitis-related macular edema but carries a risk of elevated intraocular pressure.

Objective: To determine the proportion of patients treated with difluprednate for uveitis-related macular edema who meet the definition of improvement and resolution at 30, 60, 90 and 120 days.

Methods:

Data Collection: The electronic medical records from a tertiary care uveitis referral center at UCSF was searched for any patient placed on difluprednate since its approval for use in the United States on June 23, 2008. The following information was collected at each visit: visual acuity (VA), intraocular pressure (IOP), anterior chamber (AC) cell, lens status, vitreous haze, macular central subfield thickness, and dose of topical and systemic medications including difluprednate. Summary statistics will be computed for continuous (median and interquartile range, IQR) and categorical (counts, percentages) variables. Bootstrapping will be used to create confidence intervals for categorical variables with 1,000 replicates. Mixed-effect linear and logistic regression models will be used to adjust for within-person, between-eye correlations.

Anticipated outcomes:

Based on preliminary data already collected, difluprednate is expected to improve anterior chamber inflammation and macular edema. Visual acuity should also improve in eyes with ME resolution. However, we also expect a high incidence of IOP elevation and acceleration of cataract formation. Efficacy for macular edema will be compared to historical data for ocular regional corticosteroid injections. If comparable with ocular injections, a case could be made to recommend that difluprednate be used as first-line treatment for uveitis-related macular edema.

Acknowledgment:

I would like to thank Dr Nisha Acharya for her mentorship over the summer where I got to experience the joy that comes with hard work. Miss Erica Browne for helping me see the beauty in numbers that represent data, the proctor foundation for allowing me to be part of their wonderful projects and finally CHORI for accepting me into this wonderful program.

Tadiwanashe Chirongoma

My name is Tadiwanashe Calisto Junias Chirongoma. Most people call me Tadi. I am a rising senior at Monterey Bay Academy. I was born in the Southern African country, Zimbabwe and grew up in the bordering country, South Africa. Throughout my life I have wanted to pursue a number of different careers from a race car driver to a mechanic to an engineer. Although none of the paths I switched from were very definite, one theme that came with all my choices was that they were exciting and interesting. I also picked these different careers because from an early age I knew I wanted to make a difference in other people's lives, as I grew older and wiser I realized the way I was going to enjoy my life and change other's lives was through medicine. That is why I decided to enroll in the CHORI program, which has allowed me to be exposed in the important and wonderful field of medicine. It has given me an opportunity to interact with some incredible science and amazing people. I might not remember all the information I learned, but the experience I will have for a lifetime.

Funded by: Taylor Family Foundation

School: Monterey Bay Academy

Mentors: Lynne Neumayr, MD and Kacie Smith

Introduction: Stroke occurs by the age of 20 in about 11 percent of patients with sickle cell anemia. The most frequent cause of brain infarction in these patients is blockage of the intracranial internal carotid and middle cerebral arteries. Stroke risk can be detected by Transcranial Doppler (TCD) ultrasonography because blood-flow velocity is inversely related to arterial diameter. High blood flow velocity has been correlated with stenosis on angiography, increased cerebral blood flow and stroke risk in children with sickle cell anemia. Chronic transfusion is recommended for patients with abnormal TCDs identified as at risk for stroke.

Hypothesis: Hydroxyurea (HU) as a treatment for patients with Sickle cell anemia (HbSS and HbSC) can decrease TCD velocities and may be effective in decreasing stroke risk.

Methods: We will review the Transcranial doppler(TCD) data on patients from a specific range of dates and generate descriptive summaries about central tendencies and variation comparing HbSS and HbSC patients. For patients with serial TCDs, we will compare the results within patients. For patients treated with hydroxyurea, we will compare TCD velocities before and after treatment with HU.

Anticipated Outcome: We think that after collecting all of the data it will be clear that the use of HU as a treatment for patients with HbSS will show a decrease in the mean velocities of TCDs. The data may also allow us to compare the effect of HU and chronic transfusion on TCD velocities in a select group of patients.

Significance: The significance of this study is to gather retrospective data on the effect of HU on TCD velocities and stroke risk. Chronic transfusion is more costly, time consuming for patients and families and associated with transfusion related complications that may be avoided with the use of HU.

Acknowledgments: I would like to thank Dr Lynne Neumayr and Kacie Smith for their help and guidance throughout my research. I would also like to acknowledge the Taylor Foundation for the generous funding that enabled me to participate in this program, Dr Petru for her unwavering support throughout the application process for CHORI and my parents and guardians for their constant support and encouragement.

Keywords: Sickle Cell Anemia, Stroke, TCD velocities

Ava Daniel

As I currently prepare myself for an intense transition from high school to college, there are countless unknowns in my life; but luckily, my love for science is not one of them. I have been drawn to science for as long as I can remember, but my maturation was coupled with an insatiable curiosity to learn more. The CHORI Summer Student Research Program has opened my eyes to aspects of science and medicine that I have never had the honor to see before. The caliber of research, esteem, and kindness that surrounds me on a daily basis within the Tjian Lab never cease to amaze me, and I often wonder how I managed to squeeze my way in there. Nonetheless, my knowledge and experience has only grown with the help of my mentor, peers, and administrators of this program, which will prepare me greatly for the career in medicine I plan to pursue. Although I am still unsure of what exact area of science and medicine I will choose, I know that as long as I'm helping people and the world around me, I will be happy. As I travel from the Bay Area to Yale University in the fall, I have no doubt that everything I have learned this summer as an intern for the CHORI program will help me stand out and achieve the goals I've always wanted to achieve. I'd like to thank to my mentor, Dr. Claudia Cattolgio for teaching me so much, as well as the Tjian Lab at UC Berkeley and everyone at CHORI that makes this program possible.

Funded By: California Institute for Regenerative Medicine

School: Mills High School

Mentor: Claudia Cattoglio, PhD

Contributing Authors:
Ava Daniel, Claudia Cattoglio, Aaron Friedman

Title: Role of TAF9B in Oligodendrogenesis

Introduction:
Oligodendrocytes (OLs) are the glial cells in the central nervous system (CNS) that form myelin sheaths, a vital insulation for neuronal synapses. Sequence-specific transcription factors regulating oligodendrogenesis have been identified and well studied, while the role of the basal transcription machinery remains unexplored. A previous study in the Tjian lab found that the TBP-associated factor **TAF9B** participates in motor neuron development. As of now, no studies have evaluated the role of TAF9B in the adult CNS. Preliminary results in the lab show that TAF9B transcript is elevated throughout the adult CNS, while depleted from embryonic stem cells and liver. Additionally, independent RNA-seq data of distinct neuronal cell populations show that TAF9B is enriched in the OL lineage compared to neurons and other glial cells. These data suggest a possible role for TAF9B in oligodendrogenesis, since OLs are not confined to a specific region of the brain and their developmental origin is linked to that of motor neurons.

Objective:
To perform a comprehensive survey of TAF9B transcript and protein levels in adult mouse tissues, as part of a broader effort to understand whether and how TAF9B participates in the transcriptional regulation of oligodendrogenesis.

Methods:
Tissues are dissected from *Taf9b* WT and KO male and female mice, and processed for RNA and nuclear protein extraction. TAF9B transcript and protein levels are compared between the CNS and other tissues by qRT-PCR and Western Blot.

Results:
We obtained high-quality RNA and protein from most tissues by optimizing dissection and extraction procedures. We determined that KO animal protein extracts are absolutely required to control for antibody specificity. The comparison between qRT-PCR and Western Blot results shows a good correlation between TAF9B mRNA transcript and protein levels. TAF9B expression is not confined to the CNS, but rather selectively expressed in a subset of tissues.

Conclusion:
The relatively widespread expression of TAF9B was unexpected and allows for the exploration of its role within tissues other than the CNS.

Acknowledgments:
Prof. Daniela Kaufer and Prof. Robert Tjian

Keywords:
Transcriptional regulation, gliogenesis

Saige Daniel

My name is Saige Daniel and I'm currently a rising junior at Harvard University. I'm studying human developmental and regenerative biology, but am also very interested in human evolutionary biology and a future in medicine. Although I love what I study, it has also shown me that what I really want to do extends beyond bench research. Above all, I want to help directly impact lives. I think patients and their families should always feel prioritized and cared for, and nobody should feel helpless or suffer from a preventable illness. This means medicine must focus on constant improvement as well as treatment, and is why I am so interested in translational medicine and clinical research. The CHORI summer program has given me the perfect opportunity to explore these interests with my mentor Dr. Catherine Liu. The infectious disease research we have been working on has the potential to alter current views on antibiotic usage, improve patient health, and prevent deaths. I feel so lucky to have learned from her and been a part of this great project, and I know this experience will shape my future in medicine.

Funded By: National Institutes of Health

School: Harvard University

Mentor: Catherine Liu, MD

Title: Evaluation of concordance with narrow-spectrum surgical antimicrobial prophylaxis guidelines for left ventricular assist device implantation, and assessment of efficacy compared to broad-spectrum prophylaxis

Introduction:
Left ventricular assist device (LVAD) implantation is an established treatment option for many heart failure patients, serving as bridge to transplant or destination therapy. Unfortunately, there is major risk of device-related infection and a general lack of consensus regarding the best antimicrobial regimen for surgical infection prophylaxis (SIP). The SIP regimen should effectively prevent infection, but the overuse of broad-spectrum antimicrobials can contribute to the emergence of drug resistant pathogens and increased rates of *Clostridium difficile* infection (CDI). These concerns prompted a modification of SIP from a broad-spectrum 4-drug regimen to a 2-drug narrower-spectrum regimen for patients undergoing LVAD implantation. On October 1st, 2013, UCSF Mechanical Circulatory Support Service implemented a 2-drug regimen of a single dose of vancomycin and continuous cefazolin until chest tube removal.

Objectives:
Evaluate the impact of this change in SIP, including an assessment of new protocol adherence and clinical outcomes such as LVAD infections, CDI and mortality.

Methods:
We performed a retrospective Apex chart review of 101 patients undergoing LVAD placement between January 1, 2012 and April 23, 2016 at UCSF Medical Center. The data collected pertains to patient demographics, LVAD placement, SIP, and infection.

Preliminary Results:
14 of the 101 patients (13.9%) were female, and 87 (86.1%) were male. The LVAD indication for 65 (64.4%) was bridge to transplant, versus 36 (35.6%) for destination therapy. 43 patients (42.6%) are alive with their LVAD, 33 (31.7%) are alive with a heart transplant (LVAD removed), and 25 (24.8%) have expired. Only 89 patients (88.1%) were alive at post-operative day (POD) 90. To date, 53 of the 101 total patients have been evaluated for protocol concordance. 4 of the 53 patients (7.5%) were concordant, 2 of these 4 (50%) had a positive culture(s) by POD 30 and 90, and none (0%) were positive for CDI by POD 90. Of the 49 non-concordant patients, 13 (27.5%) had a positive culture(s) by POD 30, 21 (42.9%) had a positive culture(s) by POD 90, and 5 (10.2%) were positive for CDI by POD 90. These proportions will likely change as more patients are reviewed.

Anticipated Outcome:
The outcomes of this review could help determine whether the new narrow-spectrum antimicrobial prophylactic regimen is as effective as a broader-spectrum regimen in preventing infection. If our findings suggest narrow-spectrum SIP is effective, safe, and has lower rates of adverse outcomes, this may provide data to support the use of this regimen in other LVAD centers and prompt additional research.

Jingyi Shelly Deng

I am the first to graduate high school in my family, and I am a rising freshman at Stanford University intending to major in Molecular and Cell Biology. During previous summers, I have interned at the Alameda County Public Health (ACPH) Department and job-shadowed at ACPH Laboratory. These experiences, along with the science classes in high school and community college, have confirmed my interest in the biological sciences and in pursuing a career in medicine. With my grandfather's passing in rural China after having received an under-developed drug, my deepest curiosities lie in the fields of medical and scientific research. My participation in the CHORI Summer Research Program has allowed me to explore these interests in a meaningful way. Under the mentorship of Dr. Carlberg, Dr. Calloway, as well as others in the Calloway Lab, I have immersed myself in the research experience, from writing a research proposal, planning and running experiments, and analyzing the results, to reading and citing scientific journals. Outside of lab work, they have offered me guidance with respect to my growing passion and desire to continue with medicine and research. These experiences will be invaluable as I pursue further education and as I strive to contribute to the field of medicine through research in the future.

Funded By: California Institute for Regenerative Medicine

School: Stanford University

Mentor: Sandy Calloway, PhD & Katie T. Carlberg, MD

Contributing Authors: Jingyi (Shelly) Deng, Katie Carlberg, MD; Nikhil Bose; Kenny Chen, Ashutosh Lal, MD; Henry Erlich, PhD; Cassandra Calloway, PhD

Title: Development of a Non-Invasive Prenatal Test for Beta-Thalassemia: Analysis of Contrived Mixtures that Mimic Fetal DNA in Maternal Plasma Utilizing Target-Capture Probe and Next Generation Sequencing (NGS)

Introduction: Traditional prenatal testing for beta-thalassemia, an autosomal recessive blood disorder, involves invasive chorionic villus sampling or amniocentesis, which poses some risk to the fetus. Our goal is to develop a noninvasive prenatal testing method using target-probe capture and NGS to analyze cell-free DNA (cfFDNA) in maternal plasma. Diagnosing an autosomal recessive disorder requires identification of both maternal and paternal alleles inherited by the fetus. Before applying this method to clinical samples (maternal plasma), we first carried out proof of concept by testing contrived mixtures of DNA from thalassemia patients to mimic maternal and fetal cfDNA mixtures. We created 12 DNA mixtures of various proportions from patients with known beta-globin mutations. The DNA was sheared to 150 bp to mimic cfDNA. The major contributor represents cell-free maternal DNA whereas the minor contributor represents cfFDNA.

Objective: To evaluate the sensitivity and specificity of our target capture probe and NGS in quantitatively identifying the genotypes of the major and minor contributors in the contrived DNA mixtures by comparing the observed frequencies for beta-globin mutations and SNP alleles to the expected frequencies.

Methods: The mixture samples were created in proportions from 10% down to 2.5% minor contributor in 25 ng of DNA. After fragmenting the 12 samples to 150 bp using the Covaris, the libraries were created for each sample with a unique Annealed HT Dual Matched Index Adaptor. Probe Capture Enrichment of Nuclear DNA was carried out using the custom Nimblegen SeqCap EZ Probe targeting 57 known SNPs and approximately 30 known beta-globin mutations within 945 bp of the beta-globin region as well as 451 known genomic SNPs. Libraries were sequenced using the Illumina MiSeq.

Results (Preliminary): The custom target probe capture and NGS system were able to correctly identify the genotypes of the contrived mixtures and gave accurate estimations of the minor contributor fraction as low as 2.5% using beta-globin mutations and SNPs.

Conclusion: Although further analysis is needed, current data suggest that this probe capture and NGS system can be used to identify the genotypes of the major and minor contributors by analyzing the beta-globin mutations and SNPs. The results from this experiment will prompt further investigations of new contrived mixtures that more closely resemble mixture of cfFDNA with maternal blood and, ultimately, support experiments involving maternal plasma from pregnant beta-thalassemia carriers.

Acknowledgments: I would like to thank the Calloway Lab, specifically Rachel Gordon, MS; Shelly Shih; and Guillermina Almada for laboratory assistance.

Jacqueline Diaz

Hi my name is Jackie Diaz and I am a senior at D'Evelyn High School in Denver, Colorado. Starting at a young age I was very interested in science and as I began to delve deeper into the field I became fascinated with biology and how so many small processes work together to create life. One of the best things about medicine is that there is always something new to learn because life is so beautiful and complex. Through my lab work I have learned an incredible amount about hemoglobinopathies and yet I know I have only scratched the surface. I am very grateful for the opportunity CHORI has given me to learn more about life as a researcher as well as other professions in the medical field and I am now more sure than ever that medicine is the field for me.

Funded By: California Institute for Regenerative Medicine

School: D'Evelyn Jr./Sr. High School

Mentor: Dario Boffelli, PhD, David Martin, MD

Title: Sequencing of Erythrocytes to Study Hemoglobinopathies

Introduction:
Hemoglobinopathies are genetic disorders that result in abnormality or deficiency of hemoglobin, the protein contained in red blood cells (erythrocytes) and responsible for transporting oxygen throughout the body. Hemoglobin is made up of four globin subunits; in adult hemoglobin two of the globins are a and two are b. b-thalassemia occurs when there is a deficiency of b-globin, resulting in the formation of toxic a-globin tetramers that cause cell death. Deep RNA sequencing (RNA-Seq) potentially allows determination of the type and amount of all globins present in an individual's erythrocytes in a single assay. In a patient with b-thalassemia, the relative amounts of a, b, g, and d globin are particularly important because a larger disparity between the amount of b-globin and a-globin indicates to greater disease severity. It can be difficult to obtain a precise measurement of these ratios, as current methods require multiple assays; RNA-Seq might thus be more efficient.

Hypothesis:
RNA-Seq will effectively identify the relative amounts of a, b, g, and d globin in an individual's erythrocytes, as well as mutations causing sickle cell disease and many cases of thalassemia. Methods: Two blood samples will be used for this project: one will be my own, and the other from an individual who may have b-thalassemia minor. We will isolate RNA from the erythrocytes of each sample, then construct RNA sequencing libraries for deep sequencing. Once the sequencing results are obtained, the sequences will be computationally aligned to the sequences of all the globin loci to obtain precise and internally controlled levels of a, b, g, and d globin gene expression.

Anticipated Results:
Since my own blood is presumably normal, there should be equal amounts of a- and b-like (b, g, and d) globin present. In the suspected thalassemic specimen, we should identify an alteration in these normal ratios. In addition we may identify the mutation causing the thalassemia, if the mutation changes the sequence of the mRNA and the mutant mRNA is stable enough to show up in the RNA-Seq.

Acknowledgments:
Thank you to my mentors Dr. Boffelli, Dr. Martin, and Dr. Heo for allowing me to join their lab, teaching me so much and answering my endless questions!

Key Words: Hemoglobinopathies, Thalassemia, RNA Sequencing

Stacey Dojiri

I will be a third-year undergraduate majoring in Molecular and Cell Biology at the University of California, Berkeley. I am a returning research assistant in the Dean Lab, which studies many different aspects of chlamydial infections. Since a young age, one of my primary interests has been infectious disease, which I enjoy learning about from the molecular and microscopic levels to the public health and clinical levels. The Dean Lab has given me the unique opportunity to learn about genetic recombination and pathology of chlamydia while keeping in mind the clinical significance of these findings.

I am currently working on a project that studies horizontal gene transfer between two different chlamydia species, *Chlamydia trachomatis* and *Chlamydia suis*. It is an extension of the research done in the Dean Lab by Hanna Marti, DMV, that involved studying tetracycline resistance in certain strains of *C. suis*. This research experience has undoubtedly fostered my knowledge, critical thinking skills, and work ethic, all of which I hope will help me become a better physician in the future. I am very grateful for the opportunity to learn how to more independently direct a project and would like to thank Dr. Dean and Dr. Marti for support and guidance.

Funded By: Volunteer

School: University of California, Berkeley

Mentor: Deborah Dean, MD, MPH

Title: Horizontal transfer of tet(C)-containing cassette between *Chlamydia suis* and Chlamydia trachomatis

Introduction:
Chlamydia trachomatis is the leading cause of bacterial sexually transmitted diseases and preventable blindness, or trachoma, in the world today. C. suis, a major pathogen in pigs, has recently been associated with zoonoses including trachoma and nasal, pharyngeal, and stool infections in farmers. This is important because C. suis has naturally acquired a transposon (a tet(C)-containing cassette) that makes the organism resistant to tetracycline, one of the main antibiotics used in treating chlamydial infections.

Objective: Because C. suis is genetically similar to C. trachomatis and both can co-infect the same tissues in humans, there is concern that the cassette will be transferred to C. trachomatis. Therefore, this project studies whether the tet(C)-containing cassette can be stably transferred from C. suis to C. trachomatis under selective pressure from tetracycline.

Methods: McCoy cells were infected with the C. suis strain Rogers132 and either strain F or J of C. trachomatis. For each co-infection, there were two conditions: Condition A - no tetracycline; Condition B - sub-inhibitory concentrations of tetracycline (1/2 of transition point MIC or MICTP, as per Suchland et al. (2003) "concentration of drug in which 90% of inclusions are altered in size and morphology"); and two controls (single infections with the parental strains). After being passaged once without tetracycline and once with a high dose of tetracycline, infected cells were clonally purified using a plaque assay (PA) adapted from Somboona et al. (2008). Clones were harvested for DNA extraction and strain identification by PCR.

Results: Through PCR, each clone was tested for tet(C), polymorphic membrane protein B (pmpB) of C. trachomatis, and pmpB of Rogers 132. All clones for both mating experiments were tet(C) positive, pmpB C. trachomatis negative, and pmpB Rogers132 positive. All clones were ompA sequenced and determined to be Rogers132, not recombinants.

Conclusion: Future experiments will include different techniques, including different MOIs and co-infection times, to increase the chance of creating recombinants. This topic has important implications for public health and for further understanding gene transfer between Chlamydia sp. Future findings of this project may contribute to our ability to treat C. trachomatis infections now and in the future.

Acknowledgments:
Thank you to Dr. Dean, Dr. Hanna Marti, Tyler Morgan, and the Dean Lab for this invaluable learning experience.

Keywords: Chlamydia trachomatis, Chlamydia suis, tetracycline, antibiotic resistance, horizontal gene transfer

Awad G. Faddoul

Hello, my name is Awad G. Faddoul. I'm a rising sophomore at University of California Berkeley with an intended major of Molecular and Cell Biology. I have lived in the Bay Area my entire life and I am of Palestinian Christian descent.

I have always been interested in math and science, which has inspired me to pursue a medical career. In the past two summers I have done biological research and I am excited to be doing so again this summer with CHORI. I am working in the Dean Lab researching *Chlamydia trachomatis*. My project focuses on TARP, the Translocated Actin Recruiting Phosphoprotein responsible for entry of the pathogen into the host cell. Specifically, it focuses on a PEST sequence in the amino acid sequence which we hypothesize to affect protein degradation and virulence. I would like to thank CHORI and the Dean Lab for this great opportunity.

Funded By: National Institutes of Health

School: University of California, Berkeley

Mentor: Deborah Dean, MD, MPH

Title: When is TARP present inside the host cell cytosol and how does its PEST sequence affect its degradation once there?

Introduction:
Chlamydia trachomatis is the world's leading cause of bacterial sexually transmitted diseases and of preventable blindness. It enters its host via a Type-III Secretion System in which effector proteins are secreted. One such protein is the Translocated Actin Recruiting Phosphoprotein (TARP). The amino acid sequence of TARP contains a possible PEST sequence, which would mark a protein for degradation by the 26S proteasome.

Hypothesis:
TARP is secreted by *C. trachomatis* when EB's are present in and around the host cell. Furthermore, wild-type TARP will degrade more rapidly than the mutant TARP with a PEST sequence deletion.

Methods:
HeLa cells will be infected for 0 hour, 1 hour, 6 hours, 9 hours, 13 hours, 21 hours, 28 hours, and 36 hours with *C. trachomatis* L2. After the allotted times, samples will be collected with SDS buffer with 8M Urea and 2-Mercaptoethanol, boiled, and frozen to be ready for Western Blotting. A Western Blot was then run to quantify TARP levels using an anti-phosphotyrosine antibody. At the same time, the TARP gene was located and aligned for each of the different serovars of *C. trachomatis*. Using this information, primers were made for L2 so that the TARP gene could be isolated from the genome (three sets: a complete TARP gene; a TARP gene excluding the N-terminus up to, but not including, the PEST sequence; and a TARP gene excluding the N-terminus through the PEST sequence). The TARP genes were then ligated into a vector protein and expressed in BL21 *E. coli* cells. Next, an 18-hour TARP time course was run to measure degradation rates of the wild-type and two mutant proteins.

Anticipated Outcomes:
We predict that TARP will be present when L2 EB's are in and around the host cells. We also predict that the TARP protein without the PEST sequence will degrade much less rapidly than either the wild-type protein or the other mutant that contains the PEST sequence.

Acknowledgments:
I would like to thank the Dean Lab, especially Blake Sanders and Dr. Deborah Dean, MD, MPH, for their mentorship throughout this summer. I would also like to thank the National Institutes of Health for their funding and giving me this great opportunity. And, of course, I would like to thank the CHORI Summer Student Research Program for this great experience.

Keywords:
C. trachomatis, Type-III Secretion System, Proteasome, PEST, Obligate Intracellular pathogen, Gram-negative, Western Blot


Daily Life during BMT

Keely Fuller

Hello, I am Keely Fuller, a rising junior at Miramonte High School in Orinda, California. I applied to the Chori summer research program because my experiences with Type 1 Diabetes and Celiac disease have inspired me to pursue a career in medicine. Someday, I hope to help others with similar illnesses.

I love that I learn something new about diabetes everyday while working on my research project at Chori, even though I have lived with the disease for over three years now. Participating in this program has solidified my longstanding interest in medicine and clinical research. I am so grateful to Dr. Noble, Dr. Reed, and Dr. Keller for granting me this opportunity and guiding me through my research project. I am also thankful for the administrators who organized such an amazing summer research program!

Funded By: Volunteer

School: Miramonte High School

Mentor: Nancy Keller & Janelle Noble, PhD

Contributing authors: Alison Reed, Nancy Keller, Janelle A. Noble

Title: Investigating the Correlation Between Ethnicity and Autoantibodies Exhibited in Newly Diagnosed Diabetes Patients

Introduction: Type 1 diabetes is an autoimmune disease in which insulin and other proteins found in islet cells are targeted as "non-self" by autoantibodies. Insulin autoantibody (IAA), glutamic acid decarboxylase autoantibody (GADA), islet cell autoantibody 512 (IA-2A), and zinc transporter autoantibody (ZnT8A) are frequently found in type 1 diabetes patients. In type 2 diabetes, the presence of autoantibodies is uncommon, since type 2 diabetes is a metabolic disease. The role of ethnicity in relation to variations in the occurrence of diabetes autoantibodies is still under investigation.

Objectives

1. To survey autoantibody levels in new onset diabetes patients at UCSF Benioff Children's Hospital Oakland.
2. To look for differences in the presence and titers of autoantibodies among ethnic groups.

Subjects and Methods

Intake data from the UCSF Benioff Children's Hospital Oakland endocrinology department were abstracted for the 264 patients diagnosed with diabetes in 2015. Exclusion criteria included the following: under age two, over age eighteen, not diagnosed at UBCHO, not diagnosed in 2015, diabetes other than type 1 or type 2. After exclusion, 112 patients remained for analysis: one additional patient was excluded during analysis due to a diagnosis of maturity onset diabetes of the young (MODY).

Data collected included patient ethnicity, autoantibody titers (IAA, GADA, ZnT8, and IA-2A), diagnosis, BMI, weight, gender, age, glucose level, and C-peptide levels. Data from four ethnic groups [African American (n = 12), Asian (n=7), Hispanic (n=41), and Non-Hispanic White (n=52)] will be analyzed individually. Regression and correlation analyses will be performed using GraphPad Prism statistical analysis package. Differing presence and titers of autoantibodies will be the primary points of comparison. Additional variables to be assessed will include age of onset, gender, and presence or absence of diabetic ketoacidosis. The 2015 data will be added to information from previous years to enhance sample size and improve statistical significance. Data from future years will be added as they are collected.

Anticipated Outcome

We anticipate that titer and presence of autoantibodies in type 1 and type 2 diabetes will vary based on ethnicity.

Acknowledgments

Janelle Noble, Alison Reed, Nancy Keller

Keywords

Islet cells, autoantibodies, diabetes

Eric Garcia

My name is Eric Garcia and I'm a rising senior at Lick-Wilmerding High School in San Francisco. Science has always been of interest to me—I went to science summer camps throughout my childhood, thrived in sciences at school, and volunteered at the California Academy of Sciences in various programs. However, I was never able to pin down which medical specialty I wanted to pursue. Through CHORI, I've been able to specifically explore pediatric hematology, and I believe this was the most rewarding aspect of the CHORI program this summer. To have the opportunity to conduct a research project under the guidance of an experienced mentor has truly been an invaluable experience. I feel that I now have a strong grasp on clinical research, and how physicians and hospitals really operate. Though I focused specifically on blood transfusions in chronic transfusion therapy in patients with sickle cell disease, I've found that there's so much more for me to learn in the medical field. I hope to further my scientific curiosity in college, and would like to thank Dr. Ward Hagar, Dr. Shannon Kelly, Christine Hoehner, and the staff at the UCSF Oakland Children's Hospital for all their support.

Funded By: Doris Duke Charitable Foundation

School: Lick-Wilmerding High School

Mentor: Ward Hagar, MD

Title: Comparison of Hemoglobin S between Simple and Exchange Red Blood Cell Transfusion in Chronically Transfused Sickle Cell Disease Patients with Stroke Risk

Introduction:
Sickle cell disease (SCD) is a genetic blood disorder in which hemoglobin S (HbS) becomes abnormally shaped, drastically increasing rigidity of the red cell. Patients with severe SCD are treated with monthly transfusions (chronic transfusion therapy, CTT) to decrease the risk of primary and secondary stroke, along with decreasing symptomatic anemia and the percent of abnormal sickle hemoglobin to limit further severe complications. The blood transfusions can be given either as a simple or exchange transfusion, and are usually performed every 4 weeks. This retrospective study compares the pre-transfusion hemoglobin values between patients treated with simple or exchange transfusions to their hemoglobin S levels. In addition, ferritin will be compared between the two groups to determine the difference in iron overload.

Objective:
To determine the differences between simple and exchange transfusions in terms of pre-transfusion hemoglobin S levels, ability to control iron overload (ferritin), and ability to control pre-transfusion blood counts (white blood cells, hemoglobin, platelets, and reticulocyte counts).

Methods:
Hemoglobin S, ferritin, hematocrit, reticulocyte, white blood cell, and platelet data was retrieved from the UCSF Benioff Children's Hospital Oakland (BCHO) Meditech and EPIC databases and paper medical records for all patients chronically transfused for stroke risk for at least one year since 1998 at the Sickle Cell Center. The main outcome variable of hemoglobin S and its correlation with CTT type was analyzed by linear regression and logistic regression as appropriate, while controlling for ferritin, reticulocytes, white blood cells, hematocrit, and platelets (STATA 14.1, College Station, Texas).

Anticipated Outcomes:
Exchange transfusions will be associated with achieving a pre-transfusion hemoglobin S < 30% compared to simple transfusions.

Conclusion:
This study will better understanding of chronic transfusion therapy to improve care for patients with sickle cell disease.

Acknowledgments:
Doris Duke Charitable Foundation, Ward Hagar, MD, Shannon Kelly, MD

Keywords:
Sickle Cell Disease, Chronic Transfusion Therapy, Exchange Transfusion, Simple Transfusion, Hemoglobin S

Duc Giao

Hello, my name is Duc Giao. I am a rising second year student at UC Berkeley on the pre-medical track. I aspire to become a cardiothoracic surgeon, a profession that would allow me to directly cure those in need of critical care. I also plan to pursue the academia and research side of medicine, as I hope to pass on what I know to aspiring medical doctors while contributing to the science community by participating scientific inquiry and experimentation. I have been fascinated by Biology and medicine since young—and my experience in the CHORI-UCSF SSRP has reinforced these childhood ambitions—as I learn from the world's leading experts, collaborate with like-minded students, and surround myself in an atmosphere of creativity, curiosity, and discovery.

I would like to thank Dr. Greg Moe for being the most caring and dedicated mentor a summer research student could ask for, spending hours with me in the laboratory to teach me research techniques, guiding me through my career goals, and joking around with me during lab work. I would also like to thank everyone of the Moe, Granoff, and Beernink Lab for taking me in and providing me with a warm and fun learning environment.

Funded By: National Institutes of Health

School: University of California, Berkeley

Mentor: Greg Moe, PhD

Title: Identification of proteins modified with de-N-acetyl polysialic acid (dPSA) in SK-MEL-28 Human Melanoma Cells

Introduction:
Polysialic acid (PSA) is a polymer of >100 residues of N-acetyl neuraminic acid. Our laboratory has shown that many human cancers overexpress a derivative of PSA called de-N-acetyl polysialic acid (dPSA). Anti-dPSA mAb SEAM 2 is reactive with primary human melanoma tumors and melanoma cell lines. By confocal fluorescence microscopy, dPSA antigens recognized by SEAM 2 are located in the cell membrane, cytoplasm and the nucleus of SK-MEL-28 human melanoma cells. In addition, SEAM 2 inhibits SK-MEL-28 cell adhesion and migration, cause changes in SK-MEL-28 cell morphology, induces programmed cell death and inhibits tumor development in SK-MEL-28 xenograft models of human melanoma. However, the proteins modified by dPSA are unknown.

Hypothesis:
Proteins modified with dPSA will be a subset of PSA-modified proteins.

Specific Aims:
1. Purify the proteins modified with dPSA in SK-MEL-28 cells by immuno-co-precipitation with anti-dPSA mAb SEAM 2.
2. Identify the purified proteins by LC/MS/MS.

Methods:
1. Separate SK-MEL-28 human melanoma cells into cytosolic, membrane, nuclear, and cytoskeletal fractions.
2. Immuno-co-precipitate dPSA-modified proteins from each fraction with SEAM 2 covalently attached to beads using an irrelevant mAb as a control.
3. Elute proteins immuno-co-precipitated with a dPSA derivative, resolve by SDS-PAGE, and excise bands from the gel for LC/MS/MS for identification.

Results:
SEAM 2 specifically reacts with antigens in cytosolic, membrane and nuclear fractions prepared from SK-MEL-28 cells. Immuno-co-precipitation from the membrane fraction yielded five proteins on SDS-PAGE. LC/MS/MS identified several proteins associated with ribosomes, RNA, and microtubules. Of particular interest were Y-box binding protein 3 (YBX3) and melanoma associated antigen D2 (MAGED2). Both proteins are known to have a cellular distribution matching that of SEAM 2, regulate multiple cellular processes in cancer cells including post-transcriptional regulation, but were not known to be modified with PSA or dPSA.

Conclusion:
Identification of dPSA-modified antigens and/or proteins associated with them may lead to a better understanding of why anti-dPSA mAbs, such as SEAM 2, can affect cancer cell adhesion, migration and programed cell death, and why dPSA is overproduced in many human cancers.

Ambar Gonzalez

I am Ambar Gonzalez, and I will be entering my senior year at Fisk University this coming fall. Throughout my high school and ongoing college career, I have met and had experiences that have made me certain of wanting to take part in bettering communities and environments in which people live. I was a part of a dual enrollment program in high school that not only helped me make the dream of going to college a reality, but also taught me of health, resource, and environmental disparities that exist and pose challenges to students, families, and people seeking to move ahead and better their future outcomes. As my senior year approaches, and graduation is on the horizon, I'd like to continue my career path in researching the environmental, and resources differences experienced within communities, and seek to device modes in which to better overall health and resource outcomes within communities that require these devices most.

Working within the CHORI program this summer has given me the wonderful opportunity of seeing what that career path could look like, and has certainly helped in putting into practice research skills I know. This program has also giving me the chance to learn new skills and of many different career pathways from current working professionals. Working with Dr. Leung in her public health research, has been and experience I am truly grateful for. I've learned that organization, and determination is key in conducting social research, and these are lessons I will take with me as I continue in life and work.

Funded By: National Institutes of Health

School: Fisk University

Mentor: Cindy Leung, MD

Understanding Psychological Stress in Food Insecure Children

Introduction:
Food insecurity is the condition of having insufficient access to nutritious food due to lack of money or other resources. The quality and quantity of food consumed in food insecure households is affected. Yet, an important factor to be considered and further studied is the psychological effects of food insecurity on families. Food insecurity has been linked to anxiety about household food supply, feelings of deprivation, distress, and shame. While extensive research has been conducted concerning the psychological experiences of mothers with food insecurity, research is lacking in terms of how food insecurity affects the children of these families

Objective:
To better understand the psychological experiences of parents and their children with food insecurity. Particularly focusing on children's awareness of lack of food resources, the significance they place, or feelings they relate to those experiences.

Methods:
There will be 30 parent and child dyads, resulting in a total of at least 60 participants gathered from local emergency food providers, social service agencies, the internet, and snowball sampling. Eligibility is determined after parents answer a questionnaire provided by researchers reporting their current food situation, children must be between the ages of 7 to 14, and all participants must be able to speak fluent English. Once eligibility is verified, separate semi-structured interviews will be conducted with the parent/s by the Principal Investigator and with the child/children by Research Assistants. Participants will be asked about their current food situation and experiences they've had. Interviews will be audio recorded, then transcribed within 48 hours. Once all transcriptions are finished, qualitative research software NVivo will be used in organizing themes and examining emerging patterns.

Conclusion:
For this research we expected children to show cognitive awareness of food insecurity through knowledge of occasional unavailability of food within their household, ways in which food insecurity effects their daily routine and to express emotional awareness of food insecurity through feelings of worry, distress, or shame. Children have insofar expressed some cognitive awareness of food insecurity yet; they have not conveyed strong feelings of distress over food insecurity.

Acknowledgments:
Dr. Cindy Leung, Savannah King, Anthony Meza, CHORI summer program staff

Keywords:
Food Insecurity, Psychological, Stress, Children

Luke Greunert

I attended Oberlin College for a year and a half, and am currently taking some time off to pursue research with the end-goal of transferring. I took a gap year out of high school in 2013-2014 to work in my father's lab at UCSF. His lab focused on a variety of genetic disorders, including Cystic Fibrosis and Sickle Cell Anemia, and cancer. My father's inspired mentor-ship and guidance catalyzed my own quickly evolving love for biomedical research that has since become my desired career path. This fellowship, sponsored so generously by the Elizabeth Nash Foundation, is allowing me to build upon some very exciting projects I worked on with my father in his lab, combining cutting edge gene therapy techniques to help develop a suitable therapy for patients with Cystic Fibrosis. When not in the lab, I enjoy practicing classical piano and listening to the ocean.

Funded By: Elizabeth Nash Foundation

Mentor: Beate Illek, PhD

Title: Functional Correction of Rare Mutations Responsible for Cystic Fibrosis Transmembrane Conductance Regulator dysfunction in Patient-Derived, Conditionally-Reprogrammed Epithelial Cells using Small-Fragment Homologous Replacement.

Introduction:
Small-Fragment Homologous Replacement (SFHR) is a well-established method of gene therapy that has been used to successfully modify genomic DNA sequences in various diseased cell-types. With the development of CRISPR/Cas9 constructs that allow for specific, customizable targeting of endogenous DNA, gene editing has never been more accessible

Objective: We intend to demonstrate the versatility and efficacy of SFHR and CRISPR /Cas9 to modify endogenous DNA in new cell types in order to help push the field towards a viable, consistent therapy for CF and other genetic disorders.

Methods: Small DNA fragments (SDFs) containing the wildtype sequence at the site of G542X will be simultaneously introduced with CRISPR/Cas9 to catalyze endogenous DNA modification via Homology-Directed Repair (HDR). Clones will be screened using cell-surface antibodies and flow cytometry for CFTR expression. We will then differentiate the cells into a primary-like state and measure transmembrane ion transport using Ussing Chamber analysis.

Anticipated Outcomes:
We anticipate that successful modification will occur at comparable rates to published data showing correction in CF patient-derived Induced Pluripotent Stem Cells (iPSCs; ~1% of total population). Furthermore, we anticipate that conditionally-reprogrammed cells will maintain CFTR expression throughout the modification and isolation process and will differentiate to a primary-like state following clonal isolation of modified cells.

Acknowldgments:

Elizabeth Nash Foundation
CHORI Summer Student Program
UCSF Department of Otolaryngology
Dieter C Gruenert, PhD

Keywords:

Cystic Fibrosis; Gene Therapy; SFHR; CFTR; CRISPR; conditionally-reprogrammed epithelial cells

Anna Harleen

When I first volunteered at the San Francisco Free Clinic in high school, I was inspired by what I saw and learned. The opportunity to interact with patients, observe medical assistants and physicians, and discuss healthcare on a larger scale was wonderful. Returning to SFFC last summer only built upon my excitement for healthcare and left me curious to learn more about the work of medical professionals. Now, as a rising junior at Williams College, I am thrilled with the opportunity to further explore my interest in medicine at CHORI. I come to CHORI eager to learn about clinical work, scientific research, and where those disciplines intersect.

Clinical research under the guidance of Dr. Lal has been educational as I'm studying specific diseases but also learning about the research process more broadly. I'm also very grateful for the opportunity to shadow physicians throughout the hospital and know these experiences will be invaluable as I think about the future. Many thanks to CHORI, my mentors, and everyone who made this summer memorable.

Funded By: Volunteer

School: Williams College

Mentor: Ash Lal, MD & Tariq Ahmad, MD

Title: Comparison of oral glucose tolerance tests between obese individuals and chronically transfused beta thalassemia subjects

Introduction:
Beta thalassemia major is a recessive blood disorder in which individuals with two deficient copies of the beta globin gene are unable to properly synthesize hemoglobin. Consequently, these patients become severely anemic and require monthly blood transfusions to survive. Without adequate chelation therapy, chronic transfusions lead to progressive iron overload in which excess iron causes cell death through redox reactions and lipid peroxidation. Iron deposition in the pancreas impairs the secretion of insulin from b-cells, while resistance to insulin action also develops in the tissues. Consequently, abnormal glucose tolerance and insulin-dependent diabetes mellitus are reported in 20% and 15% of adults with thalassemia respectively. The relative contributions of insulin deficiency and insulin resistance in the pathogenesis of diabetes in thalassemia are not well understood. By contrast, insulin resistance is the primary mechanism that characterizes abnormal glucose regulation in obese individuals without thalassemia. Insulin resistance then coupled with the onset of b-cell failure progresses towards type 2 diabetes in these obese patients.

Objectives:
By comparing the patterns of response to a standard oral glucose challenge in thalassemia and obese subjects, we seek to better understand the relative contributions of reduced insulin secretion and reduced insulin sensitivity in the pathogenesis of diabetes mellitus.

Methods:
Retrospective oral glucose tolerance test (OTGG) data from beta thalassemia major patients and obese adults at UCSF Benioff Children's Hospital Oakland was obtained. Insulin resistance was calculated with the Matsuda index and HOMA-IR equations using plasma insulin and glucose data from the OGTT. The average insulin and glucose levels as well as the beta cell secretory ability were also calculated using the Insulinogenic index.

Anticipated Results:
Given the deleterious effects of iron deposition on b-cell function, we anticipate that patients with transfusion-dependent thalassemia will have markedly reduced insulin secretion during OGTTs. Additionally, we predict that these individuals will have reduced insulin resistance compared to obese subjects as calculated by the Matsuda index and HOMA-IR.

Discussion:
Better understanding the pathogenesis of diabetes in thalassemia patients has the potential to inform decisions regarding their glycemic control as well as reduce the risk of future microvascular and macrovascular complications.

Joesph Harmon

At the beginning of my summer at At the beginning of the summer, my supervisor gave me studies to read to help me better understand the foundations of the research our lab is conducting. In one study, I noticed a paragraph discussing a possible link between the same protein's role in processing signaling molecules and metabolizing cholesterol. When I asked about the details of that process, she told me that the mechanism wasn't fully understood. To me, the existence of that unknown doesn't seem daunting; it seems exciting. Along with many of the other summer students, I've shared this longstanding fascination with science. I like the jargon. I like the logic. I like the faith in new discovery. Since working at CHORI, it has helped to synthesize my appreciation for the conceptual side of science with its real world applications. For the first time, I've gone into a research process with the resources to truly accomplish something. And while lab work can be repetitive and challenging, I find it rewarding. The most minor contributions build incrementally toward more important discoveries. I'd like to thank Dr. Yuanyuan Qin and Flora Ting for their patience and support, Dr. Marisa Medina for inviting me back to her lab, and the rest of the Medina Lab for welcoming me. After I graduate from Oakland Tech this spring, I plan to pursue a degree in biochemistry and a career in research

Funded By: Volunteer

School: Oakland Technical High School

Mentor: Marisa Medina, PhD

Title: The Effect of Transmembrane Protein 55b Regulation on Cholesterol and Lipoprotein Metabolism

Introduction:
Low density lipoproteins (LDLs) and high density lipoproteins (HDLs) transport free glycerol, fatty acids, and cholesterol through the circulation. Both lipoprotein classes have been implicated in the regulation of intracellular cholesterol levels. Small dense LDL molecules can accumulate along artery walls, increasing the risk of atherosclerosis and cardiovascular disease, while HDL molecules have been observed to remove excess cholesterol from peripheral tissues. Recently, the membrane protein TMEM55B was implicated to play an important role in regulating lipid and lipoprotein metabolism. *TMEM55B* knockdown in both HepG2 and Huh7 cells reduced cell surface levels of the low density lipoprotein receptor (LDLR), impaired LDL uptake and reduced intracellular cholesterol. Consequently, inhibiting *TMEM55B* expression could block the expression of hepatic LDLR and limit cholesterol uptake.

Objectives:
Use a mouse model to determine whether *Tmem55b* knockdown increases expression of hepatic genes involved in cholesterol metabolism. To analyze the extent by which *Tmem55b* knockdown increases synthesis of hepatic apoB and apoA-I (the structural proteins of LDL and HDL, respectively) and reduces Ldlr and Srb1 (the receptors of LDL and HDL, respectively).

Methods:
We have treated 6-week old male C57BL/6J mice with an antisense oligonucleotide (ASO) against *Tmem55b* (T1 and T2) or a non-targeting control (NTC) at a dose of 25 mg/kg body weight/week. The mice were fed a Western diet (0.2% cholesterol, 42% fat) or chow diet for 4 weeks. Hepatic tissues were collected after a 4 hour fast. Hepatic mRNA from treated mice will be extracted to synthesize cDNA. Real-time PCR will be conducted to quantify the expression of cholesterol metabolism genes (*Hmgcr*, *Ldlr*, *Mvk*, *Aacs*, *Hmgcs, Pcsk9* and *Idol*). Protein expression (of apoB, apoA-I, apoE, LDLR and SR-B1) will be quantified via Western blot to compare lipoprotein synthesis and uptake.

Results:
Based on *in vitro* data, we expect to observe increased transcript levels of genes facilitating cholesterol metabolism (*Hmgcr*, *Ldlr*, *Mvk*, *Aacs*, *Hmgcs, Pcsk9* and *Idol*) in Western diet-fed mice with *Tmem55b* knockdown compared to NTCs. We also expect to see reduced protein expression of Ldlr and Srb1 and increased expression of apoB, apoA-I, indicating increased synthesis of VLDL and HDL by the liver and impaired LDL and HDL uptake.

Conclusions:
It is possible that our *Tmem55b* knockdown will not demonstrate a connection between transcriptional and translational expression of our target genes. However, this would continue to expand general understanding of the TMEM55B mechanism, which could provide the foundation for novel and effective future cardiovascular disease treatments.

Maria Carrillo Hernandez

The summer of 2015 became a season of many firsts for my sister and I: first time in Mexico, first time we lived in extreme poverty, and the first time in seven years we created a real memory of our father. On October of 2008, my father was caught by I.C.E. and was deported the following morning: No goodbyes were ever exchanged between us. My mother partially suffered the same faith as my father, but fortunately was approved a green card. My time in Mexico, however, changed my life completely; the gained experience of having the forest be our only food source or the river, a mile away, be our only water source opened my eyes to a world that could have easily been mine if both my parents had been deported. The reality that I am here writing this entrance about the CHORI program and about myself as opposed to hunting for my everyday meals will forever remain with me. Living through that experience gave my life a different meaning in that it gave me a deeper appreciation of the opportunities around me. I chose the CHORI program because I knew this great opportunity in exposing myself to the scientific community and potentially a life that can possibly become my own will make my parent's sacrifice worthwhile. My time spent at CHORI enhanced my vision in becoming a scientist, a better student and overall a better person because all the hard work I witnessed from other scientists and students to make the world a better place for everyone gave me a new perspective in life: True triumph is met through both failures and success, but importantly if it helps those in need. I carried this perspective all throughout my research project trying to provide other scientists a new insight in the occurrence of neutropenia in Barth Syndrome victims, but I could have not done it without the guidance of my mentor, Dr. Ryan, and Nick Ikon. They have truly made this an unforgettable summer.

Funded by: California Institute for Regenerative Medicine

School: Berkeley High School

Mentor: Robert Ryan, PhD

Title: Cardiolipin Mediated Apoptosis of Myeloid Progenitor Cells: Mechanistic Insight

Introduction: Barth Syndrome (BTHS), is a rare X-linked disorder found mostly in young males. Patients who suffer from BTHS cannot produce sufficient amounts of energy and struggle to fight off infections due to mutations in the tafazzin (TAZ) gene locus. The tafazzin protein is a phospholipid transacylase that remodels the mitochondria specific phospholipid, cardiolipin, in order to generate a single molecular species, "tetralinoleoylcardiolipin". Patients with BTHS oftentimes present with neutropenia: the presence of reduced levels of neutrophils in the patient's circulating blood stream.

Hypothesis: I hypothesize that the cardiolipin rich mitochondrial membranes are compromised in BTHS, permitting entry of calcium to the inner membrane space. Calcium binding to cardiolipin induces a transition from a bilayer to non-bilayer state. This disruption of inner membrane structure allows cytochrome-c to escape and induce apoptosis. When this reaction occurs in neutrophil progenitors, neutropenia occurs. Research suggests that cytochrome-c interacts with cardiolipin in the inner membrane and I propose that calcium influx induces cytochrome c release.

Methods: I propose to use an artificial miniature membrane composed of apolipoprotein A-I and cardiolipin, termed nanodisk (CL-ND) as a model of the inner membrane. When CL-ND were incubated with calcium a transition of cardiolipin from bilayer to non-bilayer state was observed. In continuation, I will use the calcium chelator, EDTA, to investigate the reversibility of this transition reaction. I will also test various other parameters including the effect of replacing calcium with other divalent cations, the effect of calcium addition to CL-ND plus cytochrome-c, and the effect of cardiolipin molecular species composition on the calcium induced bilayer to non-bilayer transition.

Anticipated Outcomes: I expect my results to show that calcium-induced cardiolipin transition from a bilayer to non-bilayer state will result in the release of cytochrome-c, providing new insight into mitochondria-induced apoptosis of neutrophils, as well as a possible explanation of neutropenia in BTHS.

Acknowledgments: I personally want to thank my mentors, Dr. R.O Ryan, and Nick Ikon for guiding me throughout my research. I greatly appreciate all the hard work the Ryan Lab staff are doing to better this world for many generations to come. One day, I I to work alongside bright scientists and be a part of a lab similar to the Ryan Lab.

Keywords: Barth Syndrome, Mitochondria, Cytochrome-c, Cardiolipin-nanodisk, Calcium, Bilayer, Non-bilayer, Inner Membrane, Apoptosis, Neutropenia

Rahul Jayaram

My name is Rahul Jayaram and I am a rising senior at Dougherty Valley High School. As a young child, I had little idea of what I was going to do with my life, other than becoming a professional basketball player in the NBA. But a few years later, as I learned more and more about how our bodies operate, my bewilderment, and sometimes fright, of how complex life is continuously grew. Since then, I have always had a passion for the way the world around us functions and what we can do to better fathom the processes that govern our surroundings. This curiosity has fueled my passion towards medical science to this day, especially in the fields of genetics and neurology. Working in clinical research has allowed me to truly understand how fundamental scientific principles can be applied to make a significant impact in the lives of others. The CHORI program has helped me solidify my decisions about entering the medical field by providing many opportunities to interact with healthcare professionals and experience their work on a first hand basis. It has been an amazing experience working with Dr. Mary Jones and Dr. Elaine Pico to understand the relationship between Cortical Visual Impairment and Rett Syndrome by analyzing a broad set of data, interviewing medical specialists, and conducting clinical trials to assess visual acuity in Rett patients. The experience of applying my knowledge to a clinical setting has allowed me to see the importance of staying curious in our ever changing world.

Funded By: Volunteer
School: Dougherty Valley High School
Mentor: Mary Jones, MD & Elaine Pico, MD

Introduction: Rett Syndrome (RTT) is a neurodevelopmental disorder found primarily in girls with a prevalence of 0.44 per 10,000 aged 2 to 18, occurring in all ethnic groups at about the same frequency. Most cases result from a mutation in the MECP2 gene, located on the X chromosome, specifically mapped to Xq28. After an interval of initially normal development, affected individuals face numerous problems, including loss of speech and purposeful hand use, stereotypic hand movements, and gait abnormalities. Deficient levels of MeCP2 protein in the brain have been shown to be correlated to visual cortex regression, indicating Cortical Visual Impairment (CVI) in patients with RTT. Since children with RTT lack the ability to communicate or speak, the standard methods of office based vision assessment requiring interaction, activity, and communication, become very difficult and challenging.

Hypothesis: CVI may be a clinical manifestation in RTT. The prevalence of CVI in children with RTT remains largely undetected because of the lack of a good assessment tool and the complex clinical presentation seen in RTT.

Objectives: Our goal is to develop an office based screening tool for detecting early signs of CVI in patients with RTT. We also aim to understand if CVI is one of the clinical manifestations in patients with RTT.

Methods: We identified 5 patients with RTT for our study. The patients' families were interviewed at office visits and were each asked a series of 7 questions relating to their experiences at home, some of the challenges they faced, and about the patients' visual acuity. These children were then evaluated by UC Berkeley School of Optometry to examine both visual pathway and look for any cortical impairments. The data gathered from the visual examinations and the initial patient surveys was analyzed to look for any relationship between these findings and CVI.

Results: Of the 5 families that we interviewed, 3 of them had patients with some degree of visual impairment that might be indicative of CVI. One of these patients with visual impairment, as suggested by the initial patient survey, demonstrated normal afferent visual pathway on optometric examination.

Discussion and Anticipated Outcome: Based on our results, it is very important to have a good office based tool to screen for visual impairment in RTT. One of the patients who had symptoms suggestive of visual impairment based on parent survey had normal afferent visual pathway on optometric examination. This may suggest that visual impairment seen in RTT may not entirely be due to abnormal afferent visual pathway but may also be due to abnormal processing at the level of the cortex, as seen in CVI. Further tests will be needed to understand this better. We expect to find some relationship between the patient survey responses and the results from optometric examinations. This will allow us to develop a better office based screening tool for physicians to detect the presence of visual impairment in patients with RTT. These patients could have then referred for appropriate optometric examinations to look for findings indicative of CVI. By establishing clinical connections between UCB School of Optometry and Katie's Clinic, we hope to ensure proper diagnosis of CVI in patients with Rett Syndrome.

Alexandra Keir

My desire to be a part of medical research comes from my own experiences in witnessing doctors, nurses, and medical staff strive to care for patients. Today, I am a three-time cancer survivor who was treated at the UCSF Benioff Children's Hospital Oakland. My experiences as a patient have been my inspiration for pursuing a career in medicine. As a rising junior at the University of California, Los Angeles, I am studying Molecular, Cell, and Developmental Biology with a minor in English Literature. My intention is to pursue a career as a physician. Taking part in research this summer has reaffirmed my aspirations and has enabled me to contribute to a project which will impact clinical care. Working with Dr. Michlitsch on this project has given me a new perspective on oncology and has shown me how much I want to continue to learn. As a patient, I saw what medicine could do for my life. As a researcher, I see what I can do for the lives of others.

To all of the doctors and nurses in Hematology and Oncology who are the reason I am here today: thank you. It means a great deal to me that I have now been able to work at an institution alongside the people who have offered me so much. I hope that my research this summer and all that I continue to do in the future will give to others in the same ways you have given to me.

Funded By: National Institutes of Health

School: University of California, Los Angeles

Mentor: Jennifer Michlitsch, MD

Contributing Authors: Jennifer Michlitsch, M.D.; James Feusner, M.D.; Anurag Agrawal, M.D.

Title: Surveillance for Wilms Tumor and Hepatoblastoma in Patients Diagnosed with Hemihypertrophy

Introduction:
Hemihypertrophy is a genetic disorder characterized by excessive growth in one side or region of the body. When this condition occurs with other characteristics, hemihypertrophy may be consistent with an overgrowth syndrome (OGS). The relevant feature of hemihypertrophy and such OGS is the increased risk of childhood cancer, particularly Wilms tumor and hepatoblastoma. While an increased risk of cancer is known, the recommendation for any particular type and duration of surveillance is unclear.

Objectives:
1. Determine the incidence and timing of Wilms tumor and hepatoblastoma in children referred to oncology and orthopedic departments at CHRCO with isolated hemihypertrophy and OGS, respectively.
2. Determine the incidence and timing of OGS in children followed at CHRCO with Wilms tumor and hepatoblastoma.

Methods:
Patients previously diagnosed with OGS, Wilms tumor, or hepatoblastoma from January 1996 through May 2016 were identified by a query of billing codes in the current and predecessor medical records (EPIC and Meditech). Data regarding diagnosis types, dates, and surveillance methods was extracted. Spreadsheets of patients eligible for review were generated and analyzed. This project was approved by the CHRCO institutional review board.

Anticipated Outcome:
I believe that this study will help determine the incidence and timing of Wilms tumor and hepatoblastoma in patients with OGS. We may find that children diagnosed with OGS are being over-surveilled for these cancers.

Conclusion:
Typical surveillance for Wilms tumor and hepatoblastoma includes abdominal ultrasounds, CT or MRI scans, measurement of serum alpha-fetoprotein levels, and routine clinic follow-ups. However, little evidence exists in current medical literature or in our institutional experience regarding the benefit of surveillance. This has resulted in inconsistent and case-specific surveillance. This project is significant because it aims to help develop evidence-based practice that may reduce medical costs and radiation exposure for these children.

Keywords:
Overgrowth syndromes, hemihypertrophy, hemihyperplasia, embryonal tumor, Wilms tumor, hepatoblastoma, predisposition, orthopedics, oncology, genetics, pediatrics, cancer surveillance.

Wesley Kwong

Finishing my first year of college, I already knew what I wanted to do with my life: become a clinical research scientist. The only problem with my grand plan was that I didn't know what the research live entailed. Under the guidance of Dr. David Killilea, I was introduced to nutrition – an area of science that I felt wasn't very exciting. But I'm glad I was wrong. Meeting with my fellow scientists in the King's Lab every week, I realized that I was a part of a global effort working towards finding solutions to help people suffering from zinc deficiency. At CHORI, I learned more than just doing research; I learned how to use research discoveries outside the lab.

Funded By: Volunteer

School: Berkeley City College

Mentor: David Killilea, PhD

Title: Comparison of Elemental Content in Kidney Stones from Animal Models of Urolithiasis

Introduction:
Every year, half a million people in the US suffer from urolithiasis (kidney stone disease). Small fragments can aggregate into a large urolith (kidney stone), resulting in severe pain at the lower back and groin area, blood in urine, and impaired kidney function. Kidney stones are classified based on their predominant composition, which includes calcium, urate, struvite, and cysteine stones. One major issue preventing insight into the formation of kidney stones is the lack of a mammalian animal model. Additionally, research from our lab and around the world has shown that trace metals, especially zinc, play an important role in urolithiasis.

Hypothesis:
The composition and relationships of zinc and other trace elements within urate and struvite uroliths from dogs and cats are chemically similar to human urate and struvite uroliths.

Methods
Randomly selected canine and feline kidney stone samples were provided by the G. V. Ling Urinary Stone Analysis Laboratory at UC Davis. The samples were then cataloged, weighed, and dissolved in nitric acid. Finally, inductively-coupled plasma optical emission spectrometry (ICP-OES) was used to quantify 34 constituent elements.

Results:
We processed 26 struvite and 29 urate feline samples. A color spectrum was used to categorize the color on the outer layer of the stones. There was no discernable correlation between the color and the element. Preliminary analysis of the urate stones illustrates that the feline stones have a similar pattern of trace metal distribution compared to humans. Interestingly, the total content of feline stones higher than humans for all elements except for zinc. Analysis of canine samples and additional correlation discovery are in progress.

Conclusions Suggested:
Companion animals naturally form kidney stones, and thus can serve as reliable animal models for future research in urolithiasis. Since their diet and environmental factors can be precisely controlled, future studies of potential therapeutics for both pets and humans are feasible.

Keywords
Urolithiasis, Kidney Stones, Animal Model, ICP-OES, Elemental Content

Leyna Nguyen

My name is Leyna Nguyen and I will be entering my junior year at UC Berkeley with a major in public health and a minor in nutritional science! I feel honored to have the privilege of participating in the CHORI Summer Research Program for a second year. Working in clinical nutrition has reinforced both my desire to pursue a degree in public health and my future goal of going to nursing school. As a first generation Vietnamese-American, I hope to take the knowledge and experiences that I have gained and bring it back to my community. I would like to thank my mentor, Dr. Mary Lesser, for making my summer experiences possible and providing me with unending support! I would also like to thank Dr. David Killilea and Kathleen Schultz for sharing their time with me and welcoming me to the King Lab.

Funded By: National Institutes of Health

School: University of California, Berkeley

Mentor: Mary Henderson, PhD RD

Title: Retrospective Analysis on the Effect of Vitamin D Supplementation on Bone Mineral Density in Pediatric Leukemia Patients who underwent Allogeneic Bone Marrow Transplantation

Introduction:
Children treated for leukemia with bone marrow transplant (BMT) are exposed to multiple risk factors that have shown to have direct or secondary effects on vitamin D serum levels and subsequently, bone mineral density (BMD). Some of these factors include immunosuppressive therapies, graft versus host disease (GVHD), reduced sunlight exposure, and restricted dietary intake. Vitamin D insufficiency/deficiency has been associated with low bone mass and increased fracture rates in both adult and pediatric BMT recipients. However, the influence that vitamin D dietary and supplement intake have on reducing BMD deficits in this specific patient population remains unclear. Having the opportunity to retrospectively analyze electronic medical record (EMR) and hard copy data from a population of leukemia survivors who have undergone BMT over the span of three years post transplantation, will allow researchers to track vitamin D intake and identify other factors and patterns that impact long-term bone health. If a positive relationship is detected between patients who have the greatest vitamin D intake (including supplementation) and patients who have a normal or improving BMD over time status post BMT, then it may be plausible to incite a more structured vitamin D supplementation/intake protocol for this patient population, with previously identified risk factors for bone heath impairment.

Objective or Hypothesis: Patients treated for leukemia with BMT that have higher vitamin D intakes through supplementation or diet, will have greater gains in bone mineral density, three years post transplantation.

Methods:
This study will collect retrospective data (5/31/16 on back) via EMR and paper medical records to accumulate approximately three years worth of information for the long term follow up of sixteen patients, who were diagnosed with leukemia between the ages of six months and 25 years, who underwent BMT as part of the treatment for leukemia at UCSF Benioff's Children's Hospital, Oakland.

Anticipated Outcomes:
I predict that patients who regularly consumed dietary sources of and were prescribed supplements of vitamin D will likely have improved BMD following three years post BMT.

Conclusion:
The results from this study may suggest that more strict vitamin D supplementation should be included in both pre and post BMT therapy, especially in those individuals with identified risk factors for compromised bone health.

Acknowledgments:
Drs. Mary Lesser and Ellen Fung, The Hematology/Oncology/BMT teams, Dr. Barbara Sutherland and Dr. Ron Krauss' Laboratory for dietary analysis guidance, and Dr. Virginia Gildengorin for statistical guidance

Keywords:
leukemia, bone marrow transplant (BMT), vitamin D, bone mineral density (BMD)

Gabriela Nuñez

My name is Gabriela Nunez and I am a rising senior at Holy Names High School. By participating in the CHORI Research Program, I have been able to get an insight of how vast and unknown the field of science is. It's exciting for me to realize how many people have a similar passion for science that I do, and that I can discuss and learn from so many knowledgeable people. I also get to experience how research is conducted in the medical field and figure if it is something I would like to continue as a career. Furthermore, CHORI gives me the chance to practice my public speaking skills as well as networking, which are skills I will need in any sort of field I wish to pursue. I know I will continue to work in the science field and I am thankful to have the experience that CHORI gives me this summer.

Funded By: Doris Duke Charitable Foundation

School: Holy Names High School

Mentor: Tariq Ahmad, MD

Title: Thalassemia, Diabetes and Iron Overload

Introduction:
Thalassemia is a genetic disease that is characterized by reduced circulating hemoglobin. A common treatment of this disease is chronic blood transfusions. This can prevent most of the serious growth, neurological, and skeletal complications caused by chronic anemia. However, since the body has no effective way to expel the excess amount of iron, iron overload occurs in the individual. This overload can deposit excess iron in the pancreas and lead to diabetes.

Objectives:

This project hopes to elucidate the deterioration of beta cell function over time and look for other contributing factors such as BMI, ferritin levels, and family history

Methods:

We will collect retrospective data from a database in the thalassemia clinic at UCSF Benioff Children's Hospital Oakland. We will quantify insulin resistance over time for each subject using the values from the Oral Glucose Tolerance Test and using the Matsuda Index and HOMA-IR equation. These are validated equations that quantify insulin resistance. Additionally, the average insulin and glucose levels will be calculated as well as the change in insulin to glucose levels over the first 30 minutes as a way to quantify beta cell secretory ability. Once we quantify insulin resistance and beta cell secretory ability we can statistically account for BMI, ferritin levels, and family history.

Anticipated Outcomes:

We predict that insulin resistance levels will increase and beta cell secretion will decrease independently of the ferritin levels and body mass index over time. We also predict that insulin resistance will occur first, and then beta cell secretion will diminish providing a model for the evolution of diabetes among those with transfusion dependent thalassemia.

Blessing Ojeh

I have had many possible career choices over my eighteen years, ranging from law enforcement to healthcare to social work. Though they all stem from very different fields, each has the opportunity to help people in some form. With two parents as nurses, health has always been important in my life. I loved being able to talk to my parents about the work they do and how they play a part in improving another person's quality of life. CHORI has not only provided me with a research opportunity unlike any I have had, but has also helped me clarify my career plans. I was doubtful about pursuing a career in science or medicine, because I wasn't a science person. I love to read and write, but medicine and health have always been a part of my life that I cannot ignore. My experiences with CHORI have helped me develop more confidence as a student and as a scientist. I am a rising sophomore at Columbia University with a double major in biology and sociology. My work with Dr. Treadwell and Michael Rowland at UCSF Benioff Children's Hospital Oakland has been challenging, yet extremely rewarding. These weeks have been eye opening, and I admire the strength and heart put into their work every day. I thank them for welcoming me onto their team and helping me grow, both as a student and a scientist.

Funded By: National Institutes of Health

School: Columbia University

Mentor: Marsha Treadwell, PhD, Mike Rowland MPH

Social Determinants of Health and Barriers to Hydroxyurea Use for Patients with Sickle Cell Disease

Introduction: Sickle cell disease (SCD) is characterized by painful episodes and life-threatening complications. While evidence based treatments for managing SCD complications are available, SCD care in the U.S. has been characterized by disparities. Hydroxyurea is an evidence-based treatment for SCD that can reduce the frequency of pain and hospitalizations and can improve health-related quality of life, but it has been found to be under-prescribed. The present study examines the relation between social determinants of health that are associated with disparities for other populations and reported barriers to hydroxyurea uptake.

Hypothesis: Adults with SCD and parents of children with SCD will report increased barriers to hydroxyurea use as they evidence more negative social determinants of health, including low income and lower education of head of household.

Methods: Adults with SCD and parents of children with SCD were enrolled in the Pacific Sickle Cell Regional Collaborative Minimum Data Collection project. They provided demographic and clinical information, and reported on hydroxyurea status via a questionnaire.

Results: Participants were 113 patients: 51% female; age range infant to 61 years; primarily Hb-SS and Hb-Sβ0 thalassemia (92%); and 89% Black/African-American race. Heads of household had a median education of some college, ranging from 9th grade to college degree/postgraduate. Half of participants reported an annual household income of less than $20,000 (n = 40, 48%). Sixty-eight percent (n = 76) reported they had been prescribed hydroxyurea, and the majority reported no or one barrier to hydroxyurea uptake (71%, n = 80). Fewer total barriers were reported for male versus female patients, and older patients reported more barriers compared with younger ($p < .05$). Lower head of household education predicted more total barriers controlling for income and gender for adult and pediatric patients, while income was not an independent predictor of barriers.

Conclusion: In this select sample, the majority of patients with SCD had been prescribed hydroxyurea. Nevertheless, lower head of household education predicted more total barriers to hydroxyurea for all patients. Findings are consistent with the literature on social determinants of health. Broader sampling of patients with SCD drawn from throughout our state and region is planned.

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Abibat Oshiobugie

My name is Abibat Oshiobugie-Suleiman and I am a rising junior at University of California, Davis. I came to the united states from Nigeria 31/2 years ago in pursuit of my future goal as a medical doctor. I come from a country were the health care system is underdeveloped and I have had some person encounters with this problem. I have a mission to give back to my community and help to alleviate the health care system. I have been exposed to several health care settings through some volunteer work at Kaiser and my internship at Stanford last summer. However, CHORI has really put me in the front line of research this summer. I have been exposed to the world of research and how I can impact my community as well as advocate for a better health care system, while reducing health care disparities. It has been such an honor to work with Dr Courtney Lyles as she does her research from the public health sector, trying to reduce health care disparities which is a goal of mine. I want to thank CHORI for this great opportunity.

Funded By: National Institutes of Health

School: San Jose City College

Mentor: Courtney Lyles, MD

Title: Engaging diverse patients in health technology to improve their information access

Introduction
Digital literacy is becoming more important as technology in our world advances. However, one cannot reap the benefits of this advancement if one is not digitally literate. The Zuckerberg San Francisco General Hospital (ZSFG) serves the underrepresented community and has seen a great reason to provide an opportunity to its patients to be digitally literate. Patient portals, websites where patients can access their health information, have the potential to reduce health care disparities that exist in this population of patients, but could also exacerbate them if patients lack the digital skills necessary to access a portal. Patients with chronic diseases have more doctors' visits and test results to keep track of and may benefit the most from being able to access their medical records online. By giving an online training to patients with chronic diseases to help them navigate through their medical records online, we hope to test the usefulness of online training for patient portal use.

Objective / Specific aims:
The purpose of this study is to offer patients of the Zuckerberg San Francisco General Hospital (ZSFG) who have chronic diseases a training on how to use a new online portal (called MYSFHEALTH) to access their medical information via a secured website at any time. In this study, we are testing for different ways of giving patients more education about how to navigate this website through an online training. Specifically, we want to see if it is better to provide the tools and have them go through the training by themselves at their convenience versus completing the online training with one-on-one assistance/tutoring from research assistants at ZSFG.

Methods:
Patients are screened to make sure they can understand and read in English, because the website is only currently available in English. The patient is then scheduled for an initial in- person session at our office for a portal training session, which could last from thirty (30) minutes to two (2) hours. Participants are asked to read a consent form and HIPAA waiver before participating. The patient then takes a baseline survey. At completion of the survey, we proceed to the training. We are using a one-sided blinded form of randomization in which the
patient is randomized to receiving the training with us in person versus being sent home with the training materials to review on their own. We will then follow up with them three months post- intervention to see what their experience was like and to verify if they have used the online patient portal MYSFHEALTH, including what features they are using on this site.

Anticipated outcome of the project:
At the conclusion of this study, we will be able to determine whether the trainings were effective in increasing portal enrollment and use. We will also be able to determine if use of MYSFHEALTH was associated with patient perceptions of improved care or confidence in their ability to manage their healthcare conditions. Finally, we will be able to examine which type of patients appeared to benefit the most from ceiving the trainings, to be able better disseminate this program throughout our healthcare system.

Acknowledgment:
Courtney Lyles, Ph.D; Lina Tieu, MPH; Blanca Chavez.
Keywords: Health technology, health record, health disparities, MYSFHEALTH, digital literacy

Armen Phelps

My name is Armen Phelps, and I am a rising Junior at Encinal High School in Alameda, CA. This summer at CHORI has been truly life changing for me. I have always been fascinated with science, but could never decide on what science field to go into, until this program. Going into it, I didn't know how much the field of research had to offer, but I found it to be both extremely interesting and exciting. My study was on cholesterol and the way it interacts with protein in the bloodstream, and I learned so much this summer about not only cholesterol, but many other topics in physiology and medicine. I could never have imagined the level of complexity involved in scientific research, and really found it to fit well with my love for science. I can't express my gratitude for being able to work in a real research setting alongside practicing scientists in the matters concerning health and our world today. This was really an invaluable experience for me and my career interests, and I am seriously considering research as a possible career path. The mentors were all very friendly and continued to support me through my experience with scientific research. I would like to thank the CHORI staff, the DDCF foundation, and the Oda lab for opening up this wonderful opportunity to high school students and for making this summer such a memorable experience.

F**unded By**: Doris Duke Charitable Foundation

School: Encinal High School

Mentors: Mike Oda, PhD, Mark Borja, PhD

Title: The Effect of HDL Particle Size on ApoA-I Absorption and Desorption

Introduction:
High-density lipoprotein (HDL) promotes efflux of cholesterol from the artery wall, a process thought to be atheroprotective. Critical to the functionality of HDL in performing reverse cholesterol transport (RCT) is the exchange between the lipid-free and lipid-bound states of its primary protein component, apolipoprotein A-I (apoA-I). ApoA-I must be desorbed from the HDL particle in order to promote ABCA1-mediated cholesterol efflux within arterial walls (lipid-free apoA-I is the preferred substrate of ABCA1-mediated cholesterol efflux) and form nascent HDL. It has recently been proven that the apoA-I absorption (binding) rate has a strong positive correlation with HDL particle size, and that larger particles participate more in ApoA-I absorption, but the relationship between particle size and desorption (release) rates remains unclear.

Objective:
To measure the rates of lipid-free apoA-I absorption and desorption from reconstituted HDL particles of various sizes, and examine the relationship between HDL particle size and apoA-I exchange.

Methods:
ApoA-I modified with a single cysteine mutation at one location was recombinantly expressed in E. coli bacteria and then fluorescently labeled with either Alexa 647 or Alexa 488 fluorophores. ApoA-$I_{Alexa647}$ was used to synthesize reconstituted HDL (rHDL) particles of varying sizes with phosphatidylcholine (POPC) and cholesterol. Five different sizes of rHDL (17.0 nm, 12.2 nm, 9.6 nm, 8.4 nm, and 7.8 nm) were isolated using size exclusion chromatography. These particles were incubated with the lipid-free apoA-$I_{Alexa488}$ to promote exchange of apoA-I. Exchange of apoA-I was monitored using NDGGE, to separate HDL particles from lipid-free apoA-I. Gels were imaged using wavelengths of light specific to Alexa 488 and Alexa 647 fluorophores. The extent of absorption and desorption of apoA-I was quantified using densitometry.

Anticipated Outcomes:
It is currently known that the rate of ApoA-I absorption onto HDL particles has a positive correlation with particle size. It is anticipated that the rate of apoA-I desorption will have a similar correlation, thus implying that for every apoA-I protein that binds to HDL, one is released.

Acknowledgements:
I would like to thank Mark Borja, Ph.D, and Michael Oda, Ph.D for their guidance and support.

Keywords:
HDL (High Density Lipoprotein), ApoA-I (Apolipoprotein A-I), HDL subclasses

Netsay Ramos

Currently, I am the CHORI Summer Program's Analyst and Marketing Intern, which grants me the opportunity to work with Dr. Fung to do research concerning the effectiveness of the CHORI summer research program and to promote this program in hopes of reaching prospective participants and potential philanthropists. I found a unique correlation between this position's purpose and the transparent meaning behind my personal experiences with non-profit organizations that have made it possible for me to be a first-generation college student at such a prestigious university.

I've been fortunate enough to have received STEM exposure through an external summer program that shares values with the CHORI summer program in that they both aim to level the playing field and eventually diversify STEM careers but the majority of the children in my neighborhood and family members will not have this experience. In promoting and marketing this program, I hope to give back to my community by reaching both donors that are willing to invest in providing opportunities like these to under-represented scholars and minority students that are interested in reaching higher education in the STEM field.

F**unded By**: National Institutes of Health

School: University of California, Berkeley

Mentor: Ellen Fung, PhD RD

Title: Longitudinal Assessment of Participants in the CHORI Summer Research Program

Contributing Authors: Ellen B. Fung, PhD RD & Gino Galvez, PhD

Introduction:
The CHORI Summer Research Program's mission is to foster generations of under-represented students into STEM careers by providing research opportunities for high achieving high school and college students. Ultimately, the program strives to diversify the STEM field, thus altering the national statistics. To assess how effective the program has been in achieving its' mission, we sought feedback from alumni through a cross-sectional survey.

Objective:
To evaluate the long term effectiveness of the CHORI summer program with reference to alumni's persistence in STEM focused careers.

Methods:
An on-line survey was developed to give alumni the opportunity to share their experiences from the program in a convenient user-friendly format. Questions focused on: education level, major, career and the program's impact on career choice (if any). The voluntary survey was distributed to 1994-2015 cohorts who are ≥18 years of age and alumni given 2 week deadline. Basic demographic data (gender, ethnicity) were collected for statistical interpretation and comparison of the CHORI alumni population to national data on pursuit of STEM careers (US Census Bureau Statistics 2015). Alumni were incentivized to complete the survey through a raffle for gift cards.

Results:
A total of 378 surveys were distributed, of which 90 emails were returned due to address error (23.8% of students). Thirteen additional surveys were distributed to alumni through their LinkedIn profiles, as opposed to email addresses. Therefore, the survey was successfully distributed to 36% of the total 805 of eligible alumni from the 1994-2015 cohorts. After one week of data collection, 41 have responded to the survey (14.5% response rate). Survey results are pending.

Significance:
Feedback gathered from the collection of surveys will allow us to quantify how effective the CHORI Summer Research Program is in influencing its participants to pursue a STEM focused career. Data that reflects that the program is effective in fostering generations of students into STEM majors and careers can be used as a marketing strategy to appeal to prospective participants and potential donors. Data that reflects that the program's curriculum is lacking value and impact can be used to make the necessary improvements.

Keywords:
CHORI summer program, alumni, survey, STEM

Raymundo Sanchez

My name is Raymundo Sanchez and I am a first generation college student. I will be starting my freshman year of college at UC Santa Barbara this fall. I am planning to double major in biology and psychology and eventually pursue a career in medicine. Ever since I was young I have been fascinated with how the human body functions and the complexity of life. Many of my family members have struggled with diabetes and cardiovascular diseases, which engendered my interest in medicine. I have shadowed physicians at the Stanford Hospital and performed microbiology research at the Joint BioEnergy Institute. These experiences reinforced my interest in the biological sciences, specifically health and medicine. Completing CHORI will allow me to gain experience in research and help me evaluate my career interest in patient care versus medical research. I am excited to be working with my mentor and to be surrounded by other scientists who are passionate about their work.

Funded By: California Institute for Regenerative Medicine

School: Concord High School

Mentor: Ryo Higuchi, PhD

Title: The actin cytoskeleton and mitochondria are critical components of an organism and exhibit functional decline during aging.

Introduction:
Aging is a complex process common to all organisms and generally involves two phases: 1) a process responsible for growth, development, and maturation and 2) a loss of cellular homeostasis notable with physical and mental decline. Understanding and dissecting the phenomenon of aging is of great interest to the scientific community as it is the leading cause and contributor to many diseases. Increasing molecular and cellular understanding of aging is crucial to identify novel targets for therapeutic intervention against age-related diseases. Most cellular components are subject to dysregulation and dysfunction, and the actin cytoskeleton and mitochondria are no exception. Mitochondria are the cell's primary energy source and the actin cytoskeleton is a dynamic structure that is integral to maintenance of cellular structure and organization. More recent research has brought to light a strong connection between mitochondria and the actin cytoskeleton. In this proposal, we aim to further characterize actin and mitochondrial quality during aging, and map out the components involved in their interaction.

Hypothesis:
1. We hypothesize that actin and mitochondria will lose structure and organization with age. Beyond this, we can determine whether both structures lose integrity simultaneously or independently.
2. We also hypothesize that when either mitochondrial or actin cytoskeletal function are compromised, the other will also be disrupted.

Methods:
We performed our studies in the nematode model organism, C. elegans. Here we used a microscopic technique employing two strategies: 1) green fluorescent protein (GFP) fused to a mitochondrial localization sequence to allow robust visualization of mitochondria and 2) mRuby fused to LifeAct to visualize the actin cytoskeleton without disrupting function.
To visualize mitochondria and actin cytoskeletal organization as a function of age, we synchronized populations of C. elegans by arresting them at larval stage 1. We then visualized the actin cytoskeleton and mitochondria during various stages of adulthood: Day 1, D4, D7, and D10. Furthermore, we measured the profile of lipid droplets and their interaction with mitochondria in adult worms during the aging process. Lipid droplets are lipid-filled vesicles that accumulate during stress and are a hallmark of aging. Therefore, we used this as another indicator for the aging process.
Finally, we characterized the interaction of mitochondria and actin by knocking down essential mitochondrial-regulatory genes to study their effects on the actin cytoskeleton and vice versa.

Results:
Our experiments have shown that there is in fact a decline in both actin cytoskeletal and mitochondrial structure and integrity during advanced aging in the muscle cells of C. elegans. Moreover, there is an accumulation of lipid droplets, which are tightly associated with mitochondria during aging. Unfortunately, we did not see a strong

Laura Schaffer

As an undergrad senior student of Psychology and more recently also Pedagogy at UC Berkeley, I am deeply interested in research fields related to pediatrics and healthcare associated to socioeconomic status (SES) factors. I believe that having grown up experiencing the consequences of Brazil's developing societal reality while having juvenile diabetes plays a significant influence on what has developed into the focus of my academic career by far. I am mostly concerned with the consequences of low socioeconomic status (SES) factors potentially interfering with treatment affordability and proper healthcare practices for chronically ill children's mental, emotional and physical health.
Although I have had the chance to acquire some fundamental research-enabling skills through involvement as an RA at the UC Berkeley Emotion and Social Interaction Laboratory and also from participating in an honors' thesis developing program through her University's department of pedagogy, I believe that participating in CHORI's Summer Research Program has further my training and exposure to principles underlying conducts of research. My experience at CHORI has also strengthened my interest in conducting research that will potentially serve to advocate for underprivileged communities seeking and related to medical care. I have been honored by and grateful for the opportunity to work with my mentors at UCSF: Polina Ilieva and Dr. Brian Dolan in a project that aims to assist with the digitization and creation of metadata for the historical patient data from the 1920's to 1960's. Through this project we hope to reveal relevant information that will contextualize the different ways the hospital provided service to underprivileged patients and ideally, use our findings as reference for current and future health care providing related discussions.

Funded By: National Institutes of Health

School: University of California, Berkeley

Mentor: Polina Ilieva, PhD, Brian Dolan, PhD

UCSF Teaching Hospital's Patients' Socioeconomic Status (SES) Profile Indicated from 1940s' Historical Patient Health Information (HPHI)

Background: Throughout the last century, health care affordability has been a matter of concern and discussion among medical societies. The question of affordability has been especially relevant among health care providers involved with teaching hospital institutions' commitment with serving the public. The provision of care to the public has historically defined the role of such hospitals and raises discussion of providing service to financially disadvantaged communities. Existing literature on the topic of health care affordability and the origin of insurance schemes is often lacking in specific data about the socioeconomic status of particular patient populations.
Objective: Suspecting that this is partially attributed to early, non-standardized, multiple and irregular medical record collecting systems, this project focuses on digitizing and analyzing socioeconomic data from the University of California, San Francisco's historical patient health information (HPHI) records from the 1940s.
Methods: The data being analyzed for this project forms part of a HPHI collection from the 1940s that are preserved in the UCSF Archives and Special Collections Department. The data is being made available and accessed through a current digitization process which is part of the "UC Initiative for the Ethics and Practicalities of Historical Patient Data" project.
Anticipated Outcome of Project: We expect the data to indicate that UCSF's primarily served public was made up of financially disadvantaged patients, the definition of which may shift when compared across other decades, revealing demographic shifts in the provision of primary healthcare services.
Conclusion: Based on the revelations allowed from the digitizing of the concerned data, we hope to contextualize the different ways the hospital provided service to underprivileged patients, ideally using this assessment of how health insurance plans impacted care in the communities served by UCSF as a reference for current and future health care providing related discussions.
Acknowledgements: I have only been able to invest in this research due to both my mentors' Mrs.llieva and Dr. Dolan appreciated involvement, assistance, supervision, enlightenment, patience, willingness and belief on its potential relevance. I'd like to thank both of my mentors not only for providing their expertise, experience and knowledge throughout this research, but also for all their encouragement, help, interest, availability, time and investment.

Keywords: Teaching Hospital; Health Insurance; Medical Records; Private Health Care; Public Hospital; Public Health Care; University of California, San Francisco

Priya Shah

I love immersion. Whether it be getting my hands dirty in the kitchen and fully experiencing the textures, aromas, and flavors of food or vacationing in a rural area and getting to know the history of the town or interacting with families at the hospital, I seek experiences that allow and encourage me to delve into the depths of an activity. This summer, I learned how to apply the theoretical knowledge from my undergraduate courses at UC Berkeley to the real world. I joined the outpatient hematology clinic in the UCSF Benioff Children's Hospital in Oakland and collected quality of life data from patients with sickle cell disease. My mentor Dr. Neumayr, the hematology staff, and the patients themselves taught me so much about the disease, symptoms, and treatments. I cemented my interest in pursuing an MD through over 125 hours of shadowing and a summer internship in clinical anatomy, and through the CHORI summer research program, I have developed an interest in performing clinical research during my schooling and career as a physician.

Funded By: Volunteer

School: University of California, Berkeley

Mentor: Lynne Neumayr, MD

Title: Living with Sickle Cell Disease: Quality of Life Data for Patient-Centered Outcomes

Introduction:
Sickle cell disease (SCD) is a heritable, recessive genetic condition that is caused by a mutation in the hemoglobin protein in red blood cells (RBCs). This causes normally disk-shaped RBCs to 'sickle' in shape and polymerize into clots at branch points in blood vessels. Symptoms include anemia, pain crises (due to blockages in blood flow), swelling, and susceptibility to infection. Hydroxyurea (HU) is an approved oral medication that is prescribed to reduce the frequency and intensity of pain crises. Peds 7+2 is a shorter version of the original PedsQL™ quality of life (QOL) survey that has been validated for use in SCD.

Hypothesis:
We hypothesize that sickle cell patients taking HU will have a higher average QOL score than those who are not. Further, we hypothesize that a higher frequency of severe pain episodes will correlate with a lower QOL score.

Methods:
Eligible patients (8+ years of age who have SCD) will be approached in the waiting area or the exam rooms of the outpatient clinic. The survey will be explained and patients that are interested in participating will sign their written consent. The patient will fill out the Peds 7+2 survey and after their visit, the clinician will enter their responses into their electronic health record in Epic. Once a minimum sample size of 30 is reached, the data will be analyzed by calculating the means, medians, standard deviations, t-scores, and a Pearson correlation coefficient. Previously collected measures of patient-reported severe pain frequency will be used for this analysis.

Anticipated Outcomes:
As proof of principle, we aim to demonstrate that it is sustainable for clinicians to enter QOL data into Epic along with their post-appointment patient notes. We predict that patients who are currently taking HU will have a higher average QOL score, and anticipate the QOL scores to be inversely correlated to the frequency of severe pain episodes. We will adjust for other mediators, such as age and gender, as necessary.

Acknowledgments:
Thank you to Kacie Smith, the PCRC, and the Hematology/Oncology clinic staff for welcoming me so warmly into their workspace.

Keywords:
Sickle cell disease, quality of life, hydroxyurea

Anna Victoria Serbin

Spending my summer interning at CHORI was unforgettable. I learned so much in such a brief period of time, an experience that I will bring with me in my academic career and beyond. I was able to extend my knowledge with the guidance of experienced mentors, as well as with access to tools I had never encountered before. I am thankful for the instruction of Dr. Kuypers and Sandra Larkin, MS, and for their infinite patience in answering my infinite questions. We tested the effect of potential anti-sickling drug compounds in both normal and sickled human and mice hemoglobin to observe shifts in oxygen affinity, as well as changes in the red blood cells. I also enjoyed attending lectures on Thursdays, writing letters to a "pen pal," and even posting pictures of my progress in my CIRM Instagram account. Looking back at what I learned, I can confidently say that I see myself in the science field, seeking fulfillment by helping others attain better health.

Funded By: California Institute for Regenerative Medicine

School: St Joseph Notre Dame High School

Mentor: Frans Kuypers, PhD

Title: Potential Anti-Sickling Compounds and Increasing Oxygen Affinity

Introduction:
Sickle Cell Disease (SCD) is an inherited disease. In SCD, abnormal beta-globin in hemoglobin S causes polymerization in lower oxygen conditions. Absence of oxygen bound to hemoglobin triggers polymerization and changes RBC morphology. Lengthy polymers touch the RBC membrane, causing RBCs to sickle. Sickled cells can clog vessels, damage tissues, and cause vaso-occlusive episodes (VOE).

Objective:
This study will determine the ability of different concentrations of a potential anti-sickling compound to shift the oxygen affinity curve of human or mouse RBCs. If the compound causes the oxygen affinity curve to shift left, then it is inferred that the compound increases oxygen affinity. If shifting occurs without damaging RBCs, and with efficient oxygen offloading, then the compound may be an effective anti-sickling drug.
Methods

Both normal and sickle blood is collected from mice and humans. RBCs are incubated with the potential anti-sickling agent and tested by Advia 120 analysis and EKTA-cytometry for RBC vitality and deformability. The TCS Hemox-Analyzer measures oxygen affinity shifts. Sickling rate will be measured using a custom build sickling incubator and an image flowcytometer.

Anticipated Outcomes:
An effective anti-sickling agent increases oxygen affinity, and allows release of oxygen to tissues while preserving RBC health.

Results:
Our results show that compound ABDNAZ shifts oxygen affinity. Figure1 is a typical result. The ratio of ABDNAZ/RBC was changed by incubating RBCs in 5 mM ABDNAZ at 40% or 2% hematocrit. As shown, increasing ABDNAZ modification will increase oxygen affinity. Higher drug concentrations led to hemolysis (not shown).

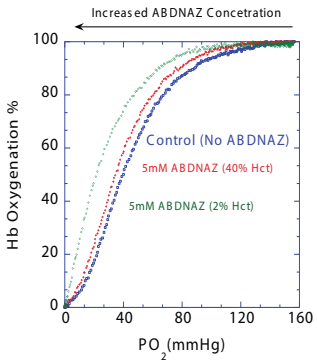

Figure1.
Shift in oxygen affinity by ABDNAZ added to RBCs at different hematocrits at 37°C. Left shift indicates higher oxygen affinity.

Conclusion:
Our preliminary data show that ABDNAZ can shift oxygen affinity without damaging the RBC, if the concentration is not too high. Ongoing studies are on the way to set the optimal treatment of RBCs to increase oxygen affinity, decrease

Osman Shokoor

I am a rising senior at UC Berkeley studying public health and global poverty. Throughout the course of my college education thus far, I have learned to deconstruction complex public health issues, gain different perspectives through a sociological imagination, and problematize the status quo in several courses and in a variety of topics. By undergoing these experiences, I have gained a curiosity in different subject areas and have raised questions that interest me. However, I had not yet learned how to properly and professionally answer these questions or go about addressing issues that interest me. As the first person in my immediate and extended family to pursue a career in the health and research field, I did not have a firm understanding of how to use formal scientific research to answer questions and gain a better understanding of critical issues until I was given the great opportunity of participating in the CHORI program and working as a research assistant at the Nutrition Policy Institute under the mentor-ship and guidance of Dr. Lorrene Ritchie. The Summer Research Program has equipped me with the tools to advance my academic passions and to contribute to the research community; for this ability to inspire and empower, I am greatly thankful.

Funded By: National Institutes of Health

School: University of California, Berkeley

Mentor: Suzanna Martinez, PhD, Lorrene Ritchie, PhD RD

Title: Validation of a Survey Instrument to Assess Food and Beverage Provision in Infant and Child Care Settings

Introduction:
About one-fourth of the young children in the United States are obese or overweight before entering kindergarten. Even in childhood, overweight status is associated with a variety of deleterious health outcomes that can include Type II diabetes, hypertension, asthma and many other conditions. This status is likely to adversely affect social and academic development and is likely to persist as children progress into adolescence and adulthood. Prevention of obesity is best early in life when chronic obesity may still be prevented and while food habits and preferences are being established. Child care sites are an excellent setting for an obesity-prevention intervention, with seven million children enrolled in formal child care every work day. Recent guidelines have been established regarding nutrition in child care sites, and it is important to understand the current state of nutrition in child care to form a baseline in order to later compare the state of nutrition after nutrition guidelines are implemented.

Objective:
Create, pilot test, and validate a survey instrument that is intended to assess the foods and beverages offered in infant (0-to-12 months old) and child (1-to-5 years old) care sites.

Methods:
Five child care sites will participate in pilot test that includes child care providers completing the nutrition survey and answering questions regarding clarity and comprehension of the survey.
For the validation, food provision during one meal time and one snack time will be directly observed at multiple child care sites in the Bay Area. A paper observation tool that matches the same questions from the survey will be used to track the various foods and beverages provided to infants and children. Survey will be completed by each participating child care provider and comparisons will be made between the providers' survey responses and the observations made on site using statistical analysis.

Anticipated Outcome:
We expect that the observations made onsite will largely match the survey responses from the child care providers, indicating a validated survey instrument that can be confidently used in childcare nutrition research. This validated survey will be immediately put into use for a state-wide study to assess food provision in licensed child care sites before implementation of the new CACFP nutrition guidelines and thereby establish a baseline for comparison with a post-implementation assessment.

Acknowledgments:
Thank you to Lorrene Ritchie, Suzanna Martinez, Gemma DiMatteo, Nutrition Policy Institute, National Institute of Health

Keywords:
child care, nutrition, validation

Julia Smith

My name is Julia Smith, and I am a rising junior at Carleton College in Minnesota. When I got to college, I had absolutely no idea what I wanted to do, except that I liked biology and working with people. As I continued through college, I began to explore potential fields of study and grew an immense interest in health. I am still undecided as to what specific area of health I would like to pursue, and I am grateful to be part of the CHORI program for giving me the chance to explore. This summer, I worked with Dr. Barbara Laraia's research team on a large-scale longitudinal public health study that focused on the health of women and girls. I gained valuable experience with the inner workings of public health research and learned so much about working with an academic team doing research in general. Public health research is now definitely on my radar and I can't wait to see what is next.

Funded By: Volunteer

School: Carlton College

Mentor: Barbara Laraia, PhD MPH RD

Title: Associations of adolescent physical activity, diet, and TV viewing habits with adult BMI in women

Introduction:
The National Health, Lung, and Blood Institute Growth and Health Survey (NGHS) was a ten-year study conducted from 1987-1997 of 1213 black girls and 1166 white girls, ages 9-10 at baseline and 18-19 at the conclusion of the study. One cohort of participants originated in Richmond, CA. The study followed up with participants yearly, and a variety of data was collected, including information on the girls' diet, physical activity, and TV viewing habits. Dr. Laraia's team is currently following up with the original Richmond group, who are around 38 years old today. A variety of data are being collected, including current height and weight, stress levels, and eating patterns.

Hypothesis:
Participants with higher fast food intake, higher TV watching, and lower physical activity levels at Year 10 of the original study will have a greater BMI as adults.

Methods:
My project aims to analyze a subset of the data using both the original NGHS study and the current one. I am looking at data on physical activity, diet, and TV viewing habits of 67 participants from Year 10 of the original NGHS study when participants were 18-19 years old. Participants self-reported the number of times they ate fast food per week, as well as how many hours of television they watched a day. Each participant also reported the amount of time they spent engaging in leisure-time physical activity. In the present-day study, height and weight were measured by centrally trained examiners and were used to calculate BMI.

Anticipated Outcomes:
Existing literature suggests that higher fast food intake and TV watching, as well as lower physical activity levels, will each be predictors of a higher adult BMI.

Acknowledgments:
I would like to thank my mentor, Dr. Laraia, as well as Dr. Tashara Leak, the study staff of the current NGHS study, and my fellow interns for the summer.

Keywords:
BMI, overweight, physical activity, television, dietary factors, fast food

Jeffrey Q. Taylor II

As a recent graduate of Oakwood University, with a Bachelor's of Science in Biomedical Sciences, I am a person that continually seeks find solutions to the difficult questions. My name is Jeffrey Q. Taylor II and I will be entering the Harvard School of Dental Medicine in the fall of 2016. Throughout my college experience, I have only participated in basic science research. However, I had been looking for a different type of research experience that would directly apply to my future profession. So when I found out about the CHORI program I just had to apply. As a participant in the CHORI program, I was granted the opportunity to participate in dental clinical research with Dr. Joel White. Through this experience, I found that clinical research is an exciting, fun, and a challenging field of work to go into. Our particular project dealt with a Dental Quality Metric for caries risk assessments done with periodic or comprehensive oral examinations at UCSF. Dental caries is an issue that is not only prevalent in San Francisco but the world. So, as a future dental healthcare professional I jumped at the opportunity and hit the ground running.
Looking toward the future, I see myself being involved in clinical research in one form or another. The world is wide open with opportunities. There are so many needs to be met out there and because of this I want to make sure I pick the one problem which I can do to serve humanity for the best.

Funded By: National Institutes of Health

School: Oakwood University

Mentor: Joel White, MD

Contributors: Ram Vaderhobli, DDS MS, Bienvenido Espiritu, jr., MS, Suhasini Bangar

Title: Development of a Dental Quality Metric for Caries Risk.

Introductions:
Dentists could all agree that the practice of dentistry is not perfect. As it pertains to measuring the quality of care there are limited ways to assess it. The main focus of this study is to develop an accurate dental quality metric (DQM) of caries risk.

Hypothesis:
An accurate dental quality metric can be developed utilizing the electronic health record which will determine the percentage of patients receiving a caries risk assessment (CRA) at a periodic oral exam (POE) or comprehensive oral exam (COE) within a defined interval.

Methods:
The DQM query was developed and ran through the electronic health records (EHR) system at UCSF and collected data from 2013 to 2015. The query was designed to pick up the subject only if the patient received a POE or COE. The query recorded the caries risk status. Manual review of the subjects' electronic health record occurred and compared to the DQM query. The query was reviewed; analyzed and suggested improvements were made.

Results:
The UCSF EHR system DQM Caries Risk query picked up a total of 26,350 subjects, 18,330 of which were given a caries risk status.326 were manually reviewed. From the query 230 patients were given a caries status with 243 verified by the manual review. This gave the query a sensitivity of 0.95. The query had a positive predictive value (PPV) 1. The specificity and the negative predictive value (NPV) of the query were 1 and 0.86respectively. According to the query, 70% of the patients that received a POE or COE received a CRA, and the manual chart reviews (over the smaller sample size of 326) showed that 75% of the patients received a CRA.

Conclusions:
The DQM CRA query gave a percentage of subjects with a CRA at a POE or COE comparable to the manual review. The DQM CRA query is quick and easy to utilize as a quality metric. To improve the query in the future, additional sources of risk assessment from the electronic health record were identified and will be added to query (script). The DQM Caries Risk Assessment query is effective.

Acknowledgments:
This work conducted as part of NIH/NIDCR 1R01DE024166, UCSF School of Dentistry and the CHORI summer research program.

Keywords:
Dental quality metric, caries risk assessment, caries risk status, periodic oral exam and comprehensive oral exam

Maria Vides

My name is María José Vides and I was born in El Salvador. I'm a Junior at Pomona College in Claremont, CA where I will be majoring in Public Health with a double in emphasis in Epidemiology and Community Health. After Pomona, I plan to pursue a joint degree in Medicine and Public Health and ultimately work with under-served communities.

My interest in Medicine and Community Health has been shaped by life experiences, scientific interest, and understanding of Medicine as a restorative tool for social justice and empowerment. I first became interested in Medicine when my younger brother was diagnosed with leukemia at the age of two. In 2007, my family immigrated to the United States seeking better medical care for my brother's condition. Although he passed away, my family's experience with the disease exposed me to the medical field and allowed me to gain a different perspective and commitment to humanizing medicine.

Growing up in the immigrant community as a low-income scholar, I also developed an interest for public health and commitment for social justice. By virtue of research and medicine being fields that are meant to relieve humanity and provide a better quality of life, I also consider the active investigation of disease and pharmaceutical development a tool for social justice and equity.

This summer, CHORI in conjunction with the NIH have granted me the wonderful opportunity to work with Dr. Lenny Lopez on a research project addressing social determinants of health in the Latino community in regards to Diabetes. We have analyzed data collected from national cohort studies and examined the role of stress and acculturation in Type 2 Diabetes risk and glycemic control in Latinos living in the United States. We hope to contribute to existing literature on the topic and increase awareness on the social determinants of health in the Latino community and eventually the addressing of these issues from a community health perspective.

Funded By: National Institutes of Health

School: Pomona College

Mentor: Lenny Lopez, MD

Title: Association of Acculturation and Hyperglycemia Among Latino Adults: Results from the National and Nutrition Examination Survey 1999-2010.

Introduction: Acculturation is of special interest, due to the Latino population's heterogeneity in relation to racial, ethnic, national, and socioeconomic background. Acculturation is measured using proxy markers that include English fluency, nationality, length of time residing in the United States, and language spoken. Despite the objectivity of the proxy markers used, acculturation is a complex multidimensional process with both positive and negative effects on lifestyle behaviors that may explain the disproportionate health burden of hyperglycemia and other cardiometabolic risk factors among Latinos.

Objective/Hypothesis: Our objective is to assess the association between acculturation and prevalence, awareness and treatment of hyperglycemia in Latino adults participating in the National Health and Nutrition Examination Survey (NHANES) from 1988- 1994 and 1999-2010. We hypothesize that lower acculturation in Latinos is associated with lower awareness of diagnosis of diabetes, and ultimately with lower rates of diabetes control.

Methods: We utilized chi-squared analyses and linear and logistic regression models to examine the association between acculturation and undiagnosed diabetes, diabetes, and hyperglycemic control among 11,627 Latinos adults participating in the National Health and Nutrition Examination Survey (NHANES) from 1999-2010.

Results: Overall higher acculturation in Latinos, measured using the Short Acculturation Scale for Hispanics, is associated with higher risk of diabetes. On the other hand, undiagnosed diabetes and lower rates of hyperglycemia control are more prevalent in less acculturated Latinos.

Conclusions: Diabetes outcomes in Latinos are associated with complex aspects of acculturation that must be addressed through institutional, community, and individual practices and behaviors.

Acknowledgments: this project was made possible through the guidance of Dr. Lenny Lopez, and support provided by the National Institute of Health, Children's Hospital Oakland Research Institute, University of California San Francisco, and Veteran's Affairs Medical Center.

Keywords: hyperglycemia, diabetes, Latinos, acculturation, hyperglycemic control.

Jia Yang

As a first generation college student who developed an interest in the medical field, I was constantly reaching out to experienced students and professors trying to get a glance at the medical field. Their words and experiences really put into perspective on how large and diverse the field is; the countless subfields within the medical industry made it seem daunting but fascinating at the same time. I knew I needed to get more exposure to explore my interests, therefore, I decided to apply and was thrilled that I was accepted into the CHORI summer program. Through CHORI, not only did I get to network with a group of students who share the same interests and experiences, but also the mentorship was something I could not have gotten anywhere else. I had a memorable and rewarding experience with Dr.Bachrach. Through her guidance, I had the chance to learn and explore beyond the classroom setting with hands-on experience. Overall, I am grateful for the opportunities that CHORI has opened up for me and I will forever cherish the connections I have made in this program.

Funded By: National Institutes of Health

School: University of California, San Diego

Mentor: Lela Bachrach, MD

Title: Workplace learning: Is scribing a Win-Win?

Introduction:
The adoption of electronic health records (EHR) has brought numerous challenges and opportunities for many health professionals. It can be daunting to try to communicate effectively with patients while entering data into a computer at the same time. In addition, the time burden of inefficient computer workflows can adversely impact job satisfaction, as well as decrease productivity. Studies have shown that when EHR scribes, who help enter data into the EHR, are a part of the care team, patient satisfaction scores increase often dramatically. Prior research asked patients and their families if they would be open to a scribe assisting their physician and over 75% said they would be fine with a scribe in the room during their clinical encounter.

Objective:
The purpose of this study is to assess if medical students find it educational to serve as scribes. We will also assess if the supervising physicians and/or residents they work with find their service helpful, or if the students' relative inexperience adversely impacts patient flow.

Methods:
Surveys will be conducted to assess how physicians and residents feel about the EHR and its impact on communication with patients and potential contribution to physician burn-out. We will survey those providers that worked with a student scribe to find out if it was helpful to them and how it impacted their ability to provide quality patient care. In addition, the students who served as scribes will be surveyed to find out if they felt like it was an educational experience to serve as a scribe and how to optimize the experience for future student scribes.

Anticipated outcome:
We expect that medical students will find it educational to serve as scribes in terms of learning about the electronic health record. We also anticipate that the attending physicians and residents who have the help of scribes will have less charting burden, more natural communication with patients and therefore increased job satisfaction. We also anticipate that they will enjoy teaching medical student scribes.

Cammie Young

Hello, my name is Cammie Young, and I am a rising senior at the Alameda Science and Technology Institute (ASTI). Over the course of this summer, I was given the opportunity to further develop my interest in medicine. Walking in on the first day of the program, I really didn't know what it had in stored for me. I always had a knack for science and even dreamed about becoming a pediatrician, so that I could be surrounded by smiling children everyday. But, being able to spend my summer in the surgery department of UCSF's Benioff Children's Hospital Oakland was something that I never dreamed of even doing. This program reassured me that I want to pursue a career in medicine, so that I can make a difference in the world. From all the informative seminars to the volunteer opportunities that CHORI offered, it opened a new door for me to see the medical world in another perspective. I have acquired a number of skills and tools that would help me accomplish my dreams and aspirations. I hope to use the knowledge that I acquire to hopefully change the lives of others and to help those in need. This research opportunity marks my first step in the process of pursuing my ambitions and to begin changing the world. Overall, the summer has been extremely memorable, and I would like to express my gratitude for the staff at CHORI and the surgery department for being so friendly and helpful. I would also like to thank my mentor, Dr. Wendy Su, for sacrificing some of her time to meet with me despite her busy schedule. It has been truly rewarding to be working aside a pediatric surgeon, and I would not trade this experience for anything!

Funded By: Doris Duke Charitable Foundation

School: Alameda Science and Technology Institute

Mentor: Wendy Su, MD

Title: The Epidemiology, Management, and Outcome of Pediatric Thyroid Diseases

Hypothesis:
Thyroid nodules in children are more likely to be malignant in kids than adults, but overall, the treatment outcomes of pediatric thyroid diseases are favorable.

Introduction:
The main functions of the thyroid, a butterfly shape gland of the endocrine system, is to regulate metabolism and produce hormones to help regulate heart rates, blood pressure, and body temperature. With more than 50% of the population having a nodule in their thyroid, it is important to determine whether it is benign or malignant. In adults, the risk of a thyroid nodule being malignant is 5-15%. However, the risk of a thyroid nodule in children being malignant is higher and equals about 20-26%.The treatment for malignant thyroid nodules is usually surgical.

Methods:
A retrospective chart review of anonymous patients afflicted with thyroid nodules at UCSF BCHO for the past 10 was conducted. Data was collected on the gender, age, diagnosis, malignancy, treatments, surgical findings, and long term follow up.

Anticipated Outcomes:
Preliminary data from medical literature suggest that there is a high probability of thyroid nodules in children to be cancerous as compared to adults.

Results:
Between the years of 2008-2016, 42 patients with thyroid nodules were identified. 32 of them were females while 10 of them were males. Ranging from ages 1 to 19, the average age is 13. 8 patients were afflicted with Grave's Disease during their diagnosis.
Of the 42 patients that were identified, there were 23 benign thyroid nodule cases, 12 malignant thyroid nodule cases, and 7 cases concerning other thyroid problems. From the malignant cases, 10 of them had papillary carcinoma, 1 had medullary carcinoma, and 1 had follicular carcinoma. All 12 patients with malignant nodules underwent total thyroidectomy with a survival rate of 100%. Other than the case of discovering another thyroid nodule after surgery, no recurrences were noted.

Conclusions:
29% of the thyroid nodules from children patients at BCHO are malignant. 100% of those patients underwent total thyroidectomy with 100% survival rate.

Acknowledgments:
I would like to thank mentor Dr. Wendy Su for guiding me through the research process. I would also like to thank the Doris Duke Charitable Foundation for funding me and

National Institutes of Health (NIH)

This group of undergraduate students was funded by the National Institutes of Health, Short Term Research Education Program to Increase Diversity in Health Related Research. The students were selected from a competitive pool of over 200 applications to join the program this year.

Back Row (From left to right) these students include: Jeffrey Taylor, Jacob Amme, Saige Daniel, Abibat Oshiobugie, Osman Shokoor, Neil Patrick Buac, Awad Faddoul, Parth Chhetri, Wesley Kwong
Front row (left to right) Sharit Cardenas Lopez, Netsay Ramos, Jia Yang, Alexandra Keir, Charmaine Chan, Leyna Nguyen, Ambar Gonzalez, Duc Giao, Belen Caballero, Laura Shaffer.
(not pictured: Maria Vides & Blessing Ojeh)

California Institute for Regenerative Medicine (CIRM)

This group of students was funded by CIRM's Leveraging Investment in High School Training: Summer Program to Accelerate Regenerative medicine Knowledge: LIGHT-A-SPARK. Their summer research projects' focused primarily on stem cell or progenitor cell research. In addition, they engaged in patient focused activities such writing letters to patients who had experienced a bone marrow transplant, Blogging about their research and educating Families of patients with Sickle Cell Disease about the merits of Bone Marrow Transplant. They also volunteered at various fundraising activities for the Hospital including the Bone Marrow Transplant program's St. Baldricks Campaign in March of this year.

From left to right, these students include: Jacqueline Diaz, Maria Sophia Hernandez, Ava Daniel, Jingyi (Shelly) Deng, Anna Victoria Serbin, and Raymundo Sanchez.

Doris Duke Charitable Foundation

These students were funded by the Doris Duke Charitable Foundations, which focuses on funding high school students interested in pursing future careers in the clinical health care field. In addition to the CHORI Summer Program, these students also completed separate evaluations for their program and created a detailed individual development plan with the assistance of their mentor. The IDP, serves as a 5-10 year career plan which can encourage the students as they continue to pursue their dreams.

From left to right these students include:
Tatiana Cheong, Armen Phelps, Cammie Young, Eric Garcia, Gabriela Nunez, Melissa Cervantes

Elizabeth Nash Foundation

The objective of the Elizabeth Nash Foundation Cystic Fibrosis Summer Research Award is to provide short-term research training opportunities in the specific area of Cystic Fibrosis at the Children's Hospital & Research Center Oakland. The program is open to high school seniors and undergraduate students. The goal is to identify students who have a strong interest in pursuing research in Cystic Fibrosis. The program provides the students with a research training experience to stimulate interest in biomedical and/or clinical research in a friendly and nurturing environment. This year, the awardee, Luke Greunert, was paired with Dr. Beate Illek, a scientist involved in cystic fibrosis research who provided mentorship for his research project. Similar to the other CHORI programs, the NASH award is based on a structured curriculum, including participation in weekly seminars and a one-day Research Symposium.

Luke Greunert

Remembering Alex Lucas, PhD

Alexander Hume Lucas, born September 15, 1949 was raised deeply rooted in Southern tradition with majority of his childhood spent in South Carolina and Florida. His family history was profoundly rich; the American lineage dating back to the country's founding. Tucked away in Charleston County, the Lucas family plantation known as "the Wedge" still stands today. The estate was built by rice farmer William Lucas in 1826 after inheriting the land from his father Jonathan, inventor of the rice pounding mill. It remained in the family for the next hundred years, eventually being purchased by the University of South Carolina.

Fiercely independent and bright, Alex left home at the pristine age of 18 to study marine biology at the University of Miami. At the time, he worked at the Biological Field Station in Bimini, Bahamas also known as the "Shark Lab". Lucas truly embraced the island lifestyle and Bimini will always be host to some of his fondest years.

In the early 1970's with an itch to go West, Alex took the long drive to Northern California to feed his intellectual curiosities. He worked at UC Berkeley with immunologist Bob Mishell and then joined the Bruce Lyon lab at Children's Hospital Oakland as a lab tech in 1974. Alex would go on to earn both his BA in Biology and his PhD in Immunology from the University of California, Berkeley.

After a six year stint in San Diego, working as a postdoc at UCSD and a Senior Research Associate at Scripps, Alex would return to CHORI in 1988 where he would stay until retiring in 2014. Lucas fervently and tirelessly dedicated his life to his research and the institute.

Both professionally and personally, Alex lived in color. He exuded energy and passion, shining his light on even those he met once, relating to all walks of life. A true renaissance man, Lucas was a magnificent intellectual, superb chef, meticulous carpenter, and accomplished musician. He enjoyed hiking at Point Reyes and Sunday afternoons spent reading the New York Times with his beloved cats, Bobo and Wallace. A pseudo Bay Area native at heart, nothing made Alex happier than a foggy morning spent tending to his garden. An animated story teller, lively dancer, and bourbon aficionado; Alex was always the life of the party. He was a romantic, writer of poetry, and loving father to his three children Nick, Michael, and Amy. He will be greatly missed.

Ed Lammer, MD In Memoriam

On February 20, 2016, the birth defects community lost one of its finest, Dr. Ed Lammer, a physician-scientist in the truest sense of the words. Those of us who were fortunate enough to work closely with Ed, or interact with him at scientific conferences, know Ed for his kind smile that was hidden under a bushy mustache/beard, a warm, engaging personality, and his passionate advocacy for children affected with genetic and congenital anomalies. There was no end for the compassion Ed held for the children and their families whom he cared for in clinic. He wanted all of his patients to have their best shot at a good life- a life as good as the one he and his loved ones enjoyed. And Ed truly had a life well lived.

The son of an Iowa schoolteacher and milkman, Ed was a gifted athlete who received his undergraduate education at Washington University in Saint Louis and his medical training at the University of Iowa. Following his pediatric residency in Iowa City, Dr. Lammer was an Epidemic Intelligence Service Officer at the Centers for Disease Control in Atlanta, GA prior to pursuing a medical genetics fellowship with Dr. Lewis B. Holmes at the Mass-General in Boston, MA. Ed received additional postdoctoral training at UCSF Medical School prior to establishing a brilliant career at the California Birth Defects Monitoring Program, a new investigator NIH award working at Stanford University, and then at Children's Hospital Oakland Research Institute (now known as Benioff Children's Hospital Research Institute of the University of California, San Francisco) from which he retired in January.

As a pediatric geneticist and teratologist, Ed was an expert at the diagnosis of children with malformation complexes, and his keen understanding of genetics, epidemiology and teratology enabled him to make seminal contributions to literature, most notably about the risks involved to women of reproductive age being treated for cystic acne with the drug Accutane (Hoffmann-La Roche). His 1985 landmark paper in the New England Journal of Medicine describe his evaluation of 150 Accutane compromised pregnancies and described the most serious human teratogen since Thalidomide in the 1960s. In recent years as the Principal Investigator of multiple National Institutes of Health grants, Ed directed a research program focused on gene-environment interactions that compromised heart and craniofacial development. He collaborated widely with colleagues at Stanford University School of Medicine, UC-Berkeley, UCSF, and the University of Texas, who valued his impeccable intellectual honesty and his no bullshit high standards, as much as his unusual generosity. First and foremost, Ed was always incredibly generous with his time. As someone who lived well into the 21st century without a cell phone-using only his trusted 'soul pilot' (index card in chest pocket) to monitor his time and whereabouts, Ed could always make time to chat, discuss a case, hear out an idea for a grant or provide valued input to a nascent manuscript. Ed was tremendously patient to teaching and mentoring students who would do a summer or semester stint in his lab. His mentoring of so many young minds will serve as an enduring testament of his patience and brilliance.

What sets Ed Lammer aside from most of his scientific and clinical colleagues was the balance he was able to achieve in life. Ed was a passionate man who had developed and enthusiastically embraced multiple interests and hobbies that shaped his non-professional life. First and foremost came his family, and Ed was lovingly devoted to his wife Dibsy, and their two children, Aaron and Ellie, in whom he was so very proud of all of their achievements. Ed was passionate about music, and although his tastes were wide ranging, he held a special fondness for Jerry Garcia and the Grateful Dead. He loved the outdoors, whether it was hiking, mountaineering, bird watching, or fly-fishing, and he truly enjoyed sharing this passion with his many friends and colleagues. Ed also loved to share a great wine or two with friends, and he amassed a highly respectable collection in his Berkeley cellar.

Intellectual honesty, critical thinking, limitless generosity, compassionate commitment to children and their families, good wine and music, a brilliant pediatric geneticist/teratologist, a wonderful family man, an extraordinary mentor, and a gentle giant who made a real difference to children's lives. This is what we think about when we remember our beloved friend, Ed Lammer.

In Memoriam
Fernando José Eugenio Viteri, MD, ScD

Fernando was born in Guatemala City in 1930 to Ernesto and Marta Viteri. His father was the founder of a very successful law firm. His mother, who, on her own, was an accomplished house designer, opened a shelter with her husband for street children, many of whom went on to become professionals with university degrees. In this environment, Fernando's commitment to service was born. Upon graduating from Medical School, he married his wife Adelina. They became the proud parents of four children and five grandchildren.

He was easily moved by the plight of the less fortunate. This compassion and caring ultimately guided him to devote his life to medicine. He worked intensely at INCAP, collaborating in the development of INCAPARINA whose aim was to provide a simple and affordable solution to treat hunger and malnutrition especially in children. In 2008, one of the highest recognitions he received was having the "Institute of Pediatric Development and Research – IDIP" name the Children's Hospital in La Plata, Argentina after him.

Under the aegis of the inimitable Nevin Scrimshaw, Fernando threw himself into the compelling world of medical research, ultimately leading to a Ph.D. in Physiology. This was a natural progression given that he graduated from high school at the age of fifteen. He obtained his M.D. from the University of San Carlos in Guatemala. He studied at the University of Michigan, Harvard University, and the University of Cincinnati where he earned a Ph.D.

A few of the highlights of his work include:

- 1977 Elected member of the Academy of Sciences of Guatemala
- 1997 Received the first Kellogg Prize for Latin American Research in Human Nutrition
- 2003 Elected Fellow of the American Society of Nutritional Sciences
- 2007 Received the Decoration "Orden de Pedro de San Jose de Bethancourt," the highest honor for public service given by the Minister of Health of Guatemala
- 2008 Naming of the Institute of Development and Pediatric Research as the Professor, Dr. Fernando E. Viteri Institute
- 2011 Honored speaker at the 100th anniversary of the Argentinean Pediatric Society
- Published 255 scientific papers in English and 70 in Spanish

As a result of his studies in the US and the outstanding people he was privileged to work with, Fernando developed an abiding admiration and affection for this country which drew him to become a citizen.

Fernando truly loved his work and the people who came on this journey with him. He often said that eating and sleeping were interruptions. His calling took him around the world, exposing him to fascinating cultures and traditions which always left indelible marks.

Fernando injected energy and a great sense of fun into everything he did. He was a devout Catholic who found joy in all aspects of his faith. He was instrumental in the founding of schools for boys and girls as well as ICEF (The Institute for the Education of the Family) and was the first, and until the end of his life, President of AED (Association for Educational Development).

He and his wife of sixty years, both being ardent devotees of music, from the classical to the tango, founded the Associations for Chamber Music and the Musical Society of Antigua in Guatemala. His second love was the cello, and he aptly described himself as a frustrated cellist.

Fernando excelled in sports, or anything he set his mind to. He was a champion golfer and swimmer, still doing backflips into the pool up to a few years ago. He played tennis, sailed and loved to ride motorcycles. He also attempted bullfighting and crocodile hunting, but sanity ultimately prevailed to the considerable relief of all who loved him.

With his natural élan and exuberant sense of humor, his passion for new experiences at home and abroad allowed him to make lifelong friends of all ages and backgrounds the world over. He found the good in everyone he met regardless of their education, race, creed, or social position. Everyone merited dignity in his book.

He will be missed dearly by his family, friends, and colleagues.

GOD BLESS HIM
MAY HE REST IN PEACE AND
FOREVER LIVE IN OUR HEARTS AND MEMORIES

CHORI STUDENT PROFILE

Student Spotlight: Amarjit Bath

From India to CHORI and Children's: On a Journey Toward Her Dream

The CHORI Summer Research Program is designed to provide an unsurpassed opportunity for students to immerse themselves in the world of basic and/or clinical research for three months during the summer. The program pairs students with one or two CHORI principal investigators who serve as mentors, guiding the students through the design and testing of their own hypotheses and methodology development. At the end of the summer, students present their research to their peers just as any professional researcher would do. For more information about the CHORI Summer Research Program, go to http://bitly.com/CHORISummerProgram

"My experiences at CHORI and Children's were inspiring. Shadowing the various pediatricians at Children's solidified my choice to pursue a career as a pediatric cardiologist. And my experience in research showed me how scientific research can really benefit patients."
—Amarjit

Before Amarjit Kaur Bath was born in the Punjab region of northern India in November 1990, her father Palpinder Singh and mother Surinder Kaur had a son who died of a diarrheal disease. Although she never knew her older brother, his life and untimely death have played a role in her own life and ambitions—including her participation in the Summer Research Program at Children's Hospital Oakland Research Institute (CHORI) in 2014 and 2015.

"When my brother died, my parents were living in a rural area of Punjab where they didn't have access to any medical resources," Amarjit explains. "My brother's death probably could have been avoided with proper medical care. So because of my family's loss, I've always wanted to pursue a career in medicine."

Amarjit's journey toward that dream has taken her far from her native India.

"When we moved to California, I was enrolled at Deer Valley High School in Antioch at age 12," she recalls. "My first day there was simply awful because I didn't understand English at all. I took ESL (English as a second language) courses for two years. English is actually my third language. During this time, my mother had a variety of health issues, and I served as her translator when she went to see various doctors. I found the doctors very caring, and that experience further fueled my desire to work in the field of medicine."

After Amarjit graduated from high school at age 16, she attended Boston Reed College in Napa, earning a Certificate of Completion as a Pharmacy Technician in May 2009. Working at the pharmacy was where she learned about CHORI's Summer Research Program from one her co-workers.

For the summer of 2014, Amarjit was assigned to the laboratory of Deborah Dean, MD, PhD, studying *chlamydia trachomatis,* the most common bacterial cause of sexually transmitted diseases in the United States.

"I learned how to isolate human endometrial cells and infect them with *chlamydia trachomatis* to study the host-pathogen interaction," Amarjit recalls. "My summer internship lasted for nine weeks, and after the internship was over, I continued to work on my research project as a volunteer for seven months."

As part of her requirements for earning her bachelor's degree in Pre-Doctoral Health Science, Amarjit's Supervised Field Training Health Science class required her to "shadow" physicians in various specialties at Children's Hospital for a total of 90 hours.

Amarjit applied to return to the CHORI Summer Research Program in 2015, and was once again accepted. She started her second internship in June, working in the laboratory of Joel Palefsky, MD, an infectious disease specialist and professor of medicine and laboratory medicine at the University of California San Francisco (UCSF).

"My experiences at CHORI and Children's were inspiring. It was an absolute pleasure to work with all the doctors. Shadowing the various pediatricians at Children's was phenomenal and solidified my choice to pursue a career as a pediatric cardiologist. My experience in research showed me how scientific research can really benefit patients."

Amarjit's next steps along the journey to her dream career include taking the MCAT and applying to medical schools.

"My ultimate goal is to be a pediatric cardiologist and make a difference by focusing on prevention and detection of early cardiovascular disease in youth—including, perhaps, in my native Punjab area of India."

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SEARCHING FOR ANSWERS

From the beginning, humans have been working to answer questions about the world in which we live. Nowadays it seems like there are no questions that cannot be answered with a quick search on Google, but we forget that there are researchers working every day to find answers and make discoveries that will change our world. I have a passion for learning and for serving others, and although I was not sure that I wanted to pursue a career in medicine, I knew that I really liked science, so with **achieve**'s support I applied to an amazing internship program at Children's Hospital Oakland Research Institute (CHORI).

In the spring, I was assigned a mentor at CHORI who was a research scientist with a PhD from Berkeley. On my first day, I was completely intimidated to find that Dr. Oda's lab was full of older men with PhDs (no women at all) and machines I had never seen. I understood a tenth of what they were saying, and I felt completely lost. I went home and spent hours online researching the concepts they had tried to explain to me. I worked hard because I did not want them to think they had been wrong in picking me.

For the next six months, I spent all the time I could in the lab, including five days every week of the summer. I was awed to be involved in exploring scientific concepts that had not been questioned and working with machines that were new to the science world. My mentor had developed a test that has proven to be one of the newest, most efficient ways of determining whether a person is at risk for atherosclerosis. As I was sitting in awe hearing about my mentor's invention, many questions popped into my head.

Lorena Ortega Guerrero
HNHS '16

Although he answered most of them, there was one that caused him to smile and say, "I have no idea, but I think we just found your project." I spent the rest of my internship answering my question. I wanted to find out if the various subclasses of HDL, determined by particle size, had any effect on the outflow of cholesterol from a person's arteries. My research helped improve the test and develop new information on a new subject. It was challenging in the lab to be the only female, the only person under 40, and the only person without a PhD. However, I did my best and was not afraid to turn to my mentors for help. At the end of my internship, I stood up in front of the doctors and scientists at CHORI and presented my findings. It was thrilling to hear researchers and doctors who are pioneers in their fields ask me questions, and humbling to hear them tell me that my work had provided helpful, new information. My mentor was so happy with the results that he even told me that they were publishable, and if they were published, I would receive credit.

This experience is one of my proudest achievements. I was outside of my comfort zone, but I worked hard to prove to the scientists in my lab that I could help them. I learned what it is like to have a full time job, especially one where a little slip up could waste thousands of dollars. I also learned to be more cautious and persistent. I accomplished something that not only challenged me and made me grow, but also filled me with the satisfaction that I was doing my part to improve the lives of others, no matter how small it seemed.

EYE-OPENING EXPERIENCE

This summer I worked at BRIDGE Housing, a nonprofit organization that builds and develops affordable housing for low-income families and seniors. In addition to the housing, they also provide programs for the residents such as Zumba, cooking classes and Job & Resource Fairs, not only to provide exercise and entertainment, but also to help them gain skills and knowledge that they otherwise would not be able to receive. As an intern, I, along with Evelyn (a recent **achieve** graduate), got to learn about BRIDGE and what each department does to make it all come together.

Emily Cano
MHS '16

Though our experience in each department was different, each tied into the main idea of affordable housing. For three weeks we spent time with the Human Resources, Programs, and Asset Management departments working on several small research and Excel projects, such as finding low-cost or free Wi-Fi for residents or inserting information about liens on a spreadsheet. We spent the remaining time with the Property Management and Development departments, which were our personal favorites because we got to tour different properties all over the Bay Area.

After learning about what it takes to build and maintain a property, I gained an appreciation for BRIDGE and all they do to make low-income families and seniors feel as normal as possible. Coming to BRIDGE, I thought affordable housing meant run-down projects where bad people lived. My perception completely changed after visiting the properties because I realized that you could not tell their properties apart from normal market rate apartment buildings, and the residents were hard working people.

I have so much admiration for BRIDGE and those who work there. I cannot tell you how many times I heard someone say, "No matter how fast or how many properties we build, we'll never be able to make enough housing for all those who need it." I did not believe this until we helped the temps sort through the 5,000 applications received for a 96 unit property in Oakland. Although the number of people who need this housing is overwhelming, I love that BRIDGE continues to work hard at what they do. They know that every little bit counts. My summer at BRIDGE Housing was not only an educational experience, but it was also eye opening and inspirational to see all that BRIDGE does to help those in need.

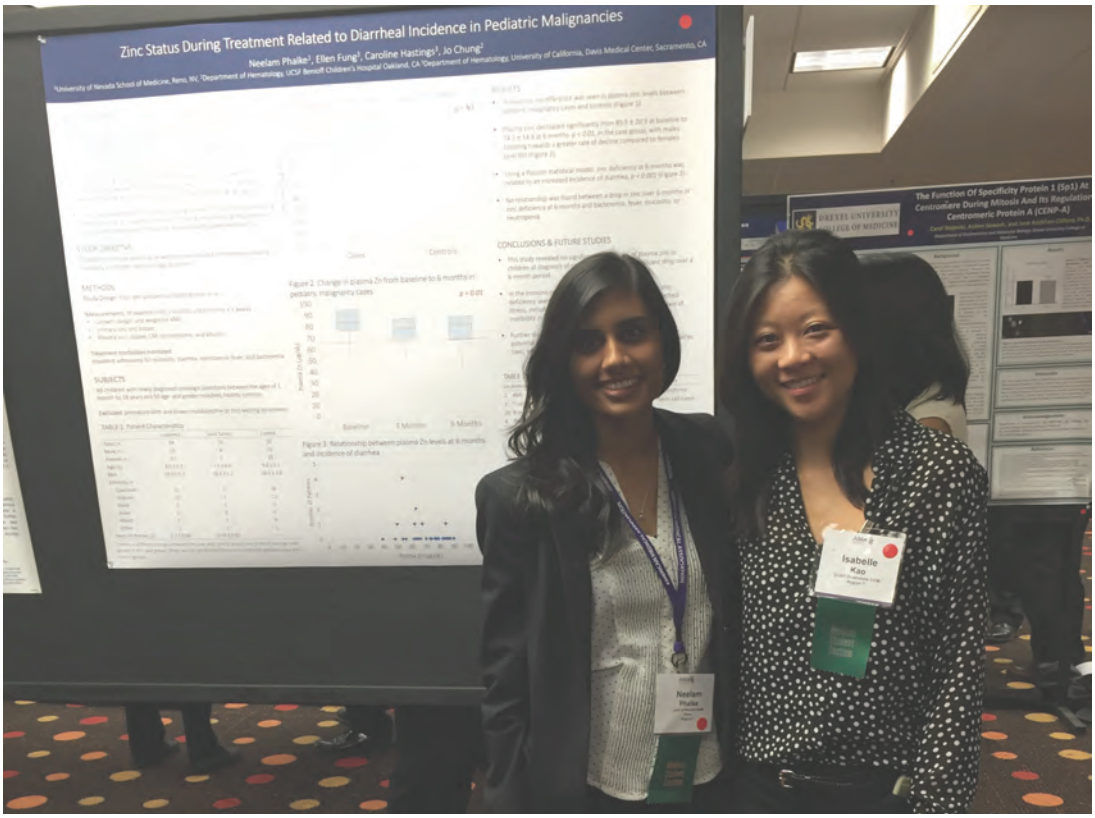
Super Achiever, Eduardo Lujan

Eduardo Lujan was a student in our 2014 CHORI summer program. At the end of the summer he continued to work at CHORI on the project while enrolled in a master's program in microbiology at San Francisco State University. As a result of his hard work and persistence in the Granoff lab, in November, 2015 he published a first author manuscript entitled: "***Impaired Immunogenicity of Menigococcal Neisserial Surface Protein A in Human Complement Factor H Transgenic Mice***" in the Journal of Infection and Immunity.

He is also second author on another manuscript and has several other projects that are in late stages or are just being written up for publication. He was recently accepted into PhD programs in Immunology and Microbiology at both University of California, Santa Cruz and University of California, Davis. Eduardo decided to accept the offer at Davis, but defer for a year to finish up projects in the Granoff lab. You may see this Super Achiever around the halls at CHORI, as he is currently is employed as a Research Associate.

Summer Students Presenting Elsewhere…

Each year a few of our CHORI summer students have the unique opportunity to also present their research at other conferences either locally or nationally. **Neelam Phalke,** a medical student at the University of Nevada and CHORI summer student 2015 worked with Drs. Fung and Hastings on a project entitled: Zinc status during treatment related to diarrheal incidence in pediatric malignancies. She submitted this work to the Annual Conference for the American Society for Pediatrics. One of the highlights of her conference experience was running into another CHORI summer student, Isabella Kao, who was also attending- small world, but highlights how your fellow summer students will very soon become your scientific colleagues.



Leyna Nguyen, a current UC Berkeley Student and 2015 CHORI Summer student is also returning this year to work with her mentor, Dr. Mary Lesser. Leyna had the pleasure of attending the Experimental Biology meetings in San Diego, April 2-6, 2016. This conference is the annual meeting for 6 major scientific societies including: American Society for Nutrition, Physiology, Anatomy, Biochemistry & Cell Biology, Investigative Pathology and Pharmacology. At the conference, along with her mentor, she presented a poster of some of the research she worked on during her in the summer entitled: Calcium Absorption in Pregnancy Among Women of Different Ethnicities. Their poster won first place in a competition for new investigators.

[Below, photo of Dr. Mary Lesser & Leyna Nguyen at Exp Biology Conference in SD)

Calcium Absorption Among Racially Diverse Pregnant Women

Mary N. R. Lesser, Leyna Nguyen, Janet C. King, Kimberly O. O'Brien, Ellen B. Fung
Children's Hospital Oakland Research Institute, Oakland, CA
University of California at Berkeley, Berkeley, CA
Cornell University, Division of Nutritional Sciences, Ithaca, New York

Abstract

Longitudinal studies of calcium metabolism during pregnancy (PG) have shown that maternal calcium (Ca) absorption increases progressively from the first to the third trimester to meet the needs of the developing fetus. This increase in calcium absorption is directly related to maternal Ca intake. However, even with this increase in absorption, maternal and fetal needs may not be met in women with chronically low Ca intakes (<500 mg/day). Low Ca intakes are not uncommon among women in the USA and may result in maternal bone mobilization. Studies of Ca intake and absorption among racially diverse pregnant women are limited. Thus, this cross-sectional study was done to determine the effect of racial differences on Ca absorption during the third trimester of pregnancy. Forty women, 10 each from four racial groups (African-American (AA), Asian, Caucasian, Latina) were recruited between 30-36 weeks gestation. The following outcomes were measured: Ca intake from validated FFQ, Ca absorption, 24 hour urinary Ca excretion, 25OH vitamin D, and bone resorption as assessed by C-terminal telopeptide (CTx). Ca absorption was measured from a standardized breakfast meal providing 330 mg Ca using the dual stable isotope technique (44Ca oral & 42Ca IV). To date, 34 women have completed the study (6 AA, 8 Asian, 10 Caucasian, 10 Latina) and are presented herein. Preliminary results show that of the 4 groups, only Latina and AA women met the pregnancy Ca RDA. Fasting serum Ca averaged 10.4 ± 0.6 mg/dL in the group as a whole, and it was not associated with CTx or race (r=0.0019, p=NS). Ca absorption ranged from 28.6-80.6% in the whole group of 34 women, and it was not associated with the habitual Ca intake. However, there is an interaction between race, calcium intake and calcium absorption, suggesting that women of different race absorb calcium differently based on calcium intake. 25OH vitamin D was significantly higher (p=0.053) in Caucasian women (29.9 ± 6.5 ng/mL) compared to Asian women (21.3 ± 6.0 ng/mL), and it was inversely related to Ca absorption (p=0.044). 24 hour urinary Ca excretion averaged 163.6 ± 85.5 ug/mL in the whole group; it did not differ by racial group, but it was positively related to Ca absorption (p=0.016). Our preliminary results suggest that in this group of racially diverse women, Ca metabolism is highly variable (intake, absorption, and excretion), which has a larger influence on Ca metabolism parameters than any potential effect due to race.

Hypothesis & Specific Aim

Hypothesis: Calcium absorption during late pregnancy varies among racial groups.

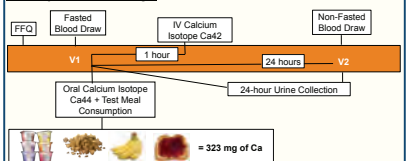
Aim: To determine the differences in calcium absorption during late pregnancy among African-American, Asian, Caucasian, and Latina women.

Methods

Subjects:

- 36 women, from four racial group
  - African American, Asian, Caucasian, Latina
- Between 30 – 36 weeks of gestation
- Age: 18-45 years
- Exclusion criteria: Non-singleton pregnancy, Calcium supplementation, Gestational Diabetes, Pre-eclampsia, Metabolic disorders known to affect calcium metabolism

Summary of Research Design:



Data Collection & Analysis:

- Calcium intake estimated from validated FFQ
- Calcium absorption
  - Measured from a standardized breakfast meal providing 330 mg calcium using the dual stable isotope technique (44Ca oral & 42Ca IV)
  - Isotopes measured by magnetic sector TIMS
- 24 hour urinary calcium excretion by ICP-OES
- 25OH vitamin D assessed using quantitative chemiluminescent immunoassay
- Bone resorption assessed by Collagen Type 1 C-terminal telopeptide (CTx) Crosslaps ELISA

	Caucasian (n=10)	Latina (n=10)	African American (n=7)	Asian (n=9)	p-value
Age (years)	34.7 ± 1.3	35.3 ± 2.1	28.9 ± 2.2	32.2 ± 2.0	NS
Height (cm)	167.6 ± 1.8*	160.1 ± 2.6	162.7 ± 1.6	159.1 ± 1.9*	0.024
Weight (kg)	72.2 ± 1.8	84.0 ± 7.9	82.0 ± 6.3	70.1 ± 2.1	NS
BMI (kg/m^2)	25.8 ± 0.6*	32.6 ± 2.3*	31.0 ± 2.4	27.9 ± 1.3	0.036
Gestational Age (Weeks)	33.1 ± 0.7	34.6 ± 0.6	33.7 ± 0.9	33.9 ± 0.6	NS
Vitamin D (ng/mL)	29.9 ± 2.0	24.0 ± 2.0	24.1 ± 2.2	22.9 ± 2.5	0.10
Serum Calcium (mg/dL)	10.3 ± 0.2	10.1 ± 0.2	10.3 ± 0.2	10.5 ± 0.2	NS
Calcium Intake (mg/day)	961.8 ± 80	1408.6 ± 220*	1173.8 ± 186	810.2 ± 82*	0.045
Urine Calcium (mg)	461.5 + 56.8	299.7 + 51.9	282.3 + 53.9	331.6 + 31.6	0.06

TABLE 1: Baseline Subject Characteristics (Visit 1); means + SEM; * indicate significant differences at p<0.05

Calcium Absorption & 24 Hr Urinary Calcium Excretion

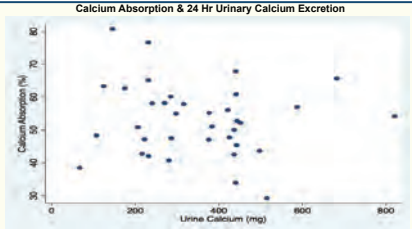


FIGURE 1: Average urine calcium for all participants was 344 ± 19 mg. No significant differences were observed for absorption or urine calcium between the groups. No interaction was found between absorption and urine calcium due to race.

Total Absorbed Calcium

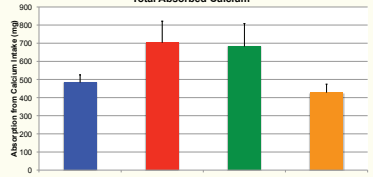


FIGURE 2: Total Absorbed Calcium; means ± SEM. Total absorbed calcium was similar among all cohorts.

Acknowledgements

Special thanks to Dr. Ellen Fung, Leyna Nguyen, Dr. Kimberly O'Brien, Dr. Janet King, Dr. David Killilea, PCRC CTSI Staff at UCSF Benioff Children's Hospital, Oakland, Dr. Lenard Lesser for statistical guidance, and the enthusiastic participants for their support.

This work was supported by USDA grant #2009-02925 and NIH-HL 12545-01.

Calcium Absorption & Habitual Calcium Intake

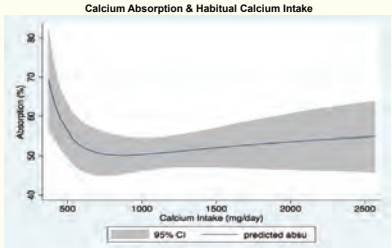


FIGURE 3: Calcium absorption widely ranged (29.2 – 80.8%) among all participants and was inversely related to calcium intake, particularly at the low end of the curve (<750 mg/day).

Relationship between Calcium Absorption & Calcium Intake in subjects consuming <1000 mg/day

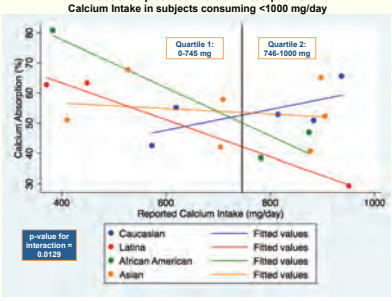


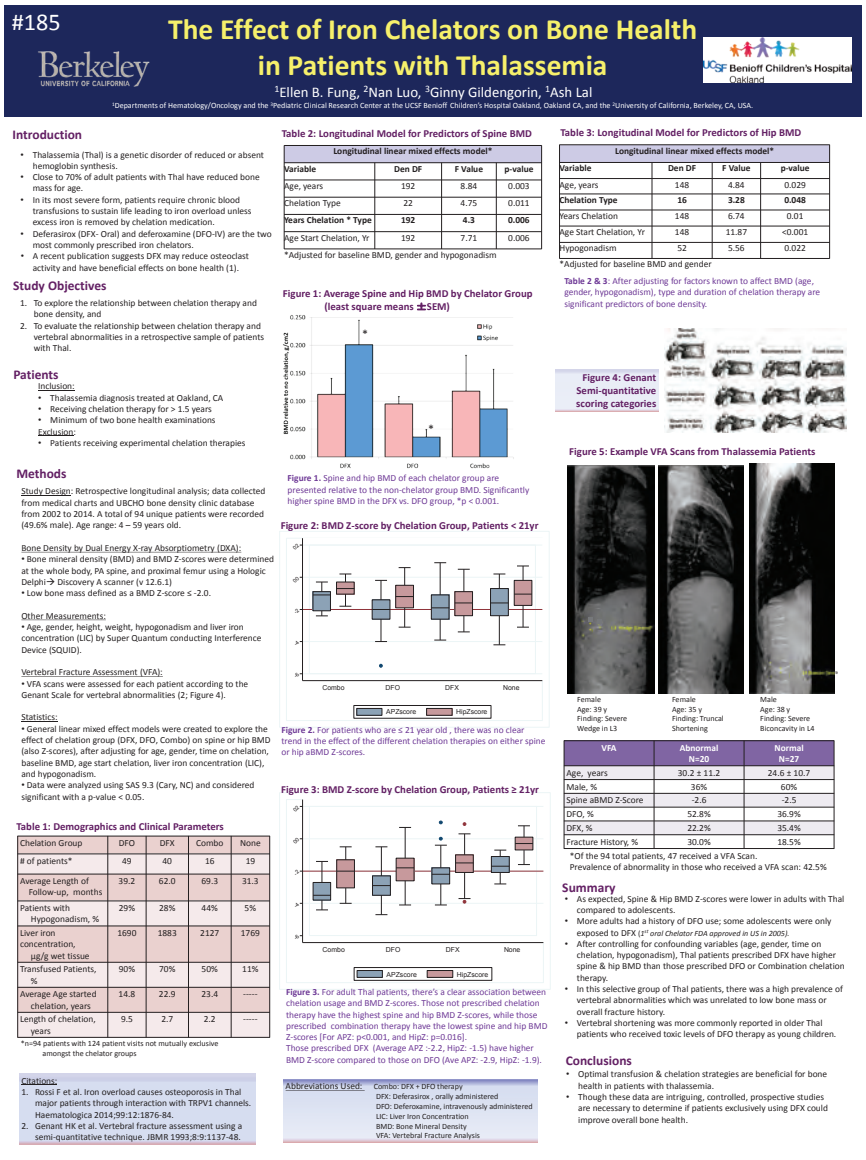
FIGURE 4: An interaction was found between race and intake by quartile on absorption (p=0.0129). No effect of race was found on the association between calcium absorption & habitual calcium intake.

Summary of Results

- In this group of racially diverse women, calcium intake was highly variable and ranged between 371-2566 mg/day.
- Calcium excretion was also highly variable and was also not different by race. Our participants averaged 344 ± 19 mg, which is slightly elevated compared to non-pregnant urinary calcium excretion, which is typically 100-300 mg.
- Calcium absorption during the third trimester of pregnancy was not found to be associated with race in this population of subjects with variable calcium intake.
- However, for subjects with calcium intake below the DRI (1000 mg/day), an interaction was observed between race and intake, suggesting that for those individuals who consume less than the DRI for calcium, race becomes important.

Summer Students Presenting Elsewhere…

Nan Luo, CHORI summer student from 2014, presented her work with her mentor, Dr. Fung, at the 7th International Conference on Children's Bone Health in Salzburg, Austria in June 27-30, 2015. There were close to 500 conference attendants for this 4-day intensive conference. Nan's poster presentation was entitled: "***The Effect of Iron Chelators on Bone Health in Patients with Thalassemia***". Nan just completed a one year accelerated Master's degree in Cell Biology at Tufts University and is applying to Medical school for the 2017 school year. Pictured Nan Luo (left) Dr. Ellen Fung (right) on the hill atop Salzburg, Austria.



#185

The Effect of Iron Chelators on Bone Health in Patients with Thalassemia

Berkeley UNIVERSITY OF CALIFORNIA

UCSF Benioff Children's Hospital Oakland

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Introduction

- Thalassemia (Thal) is a genetic disorder of reduced or absent hemoglobin synthesis.
- Close to 70% of adult patients with Thal have reduced bone mass for age.
- In its most severe form, patients require chronic blood transfusions to sustain life leading to iron overload unless excess iron is removed by chelation medication.
- Deferasirox (DFX- Oral) and deferoxamine (DFO-IV) are the two most commonly prescribed iron chelators.
- A recent publication suggests DFX may reduce osteoclast activity and have beneficial effects on bone health (1).

Study Objectives

1. To explore the relationship between chelation therapy and bone density, and
2. To evaluate the relationship between chelation therapy and vertebral abnormalities in a retrospective sample of patients with Thal.

Patients

Inclusion:
- Thalassemia diagnosis treated at Oakland, CA
- Receiving chelation therapy for > 1.5 years
- Minimum of two bone health examinations

Exclusion:
- Patients receiving experimental chelation therapies

Methods

Study Design: Retrospective longitudinal analysis; data collected from medical charts and UBCHO bone density clinic database from 2002 to 2014. A total of 94 unique patients were recorded (49.6% male). Age range: 4 – 59 years old.

Bone Density by Dual Energy X-ray Absorptiometry (DXA):
• Bone mineral density (BMD) and BMD Z-scores were determined at the whole body, PA spine, and proximal femur using a Hologic Delphi→ Discovery A scanner (v 12.6.1)
• Low bone mass defined as a BMD Z-score ≤ -2.0.

Other Measurements:
• Age, gender, height, weight, hypogonadism and liver iron concentration (LIC) by Super Quantum conducting Interference Device (SQUID).

Vertebral Fracture Assessment (VFA):
• VFA scans were assessed for each patient according to the Genant Scale for vertebral abnormalities (2; Figure 4).

Statistics:
• General linear mixed effect models were created to explore the effect of chelation group (DFX, DFO, Combo) on spine or hip BMD (also Z-scores), after adjusting for age, gender, time on chelation, baseline BMD, age start chelation, liver iron concentration (LIC), and hypogonadism.
• Data were analyzed using SAS 9.3 (Cary, NC) and considered significant with a p-value < 0.05.

Table 1: Demographics and Clinical Parameters

Chelation Group	DFO	DFX	Combo	None
# of patients*	49	40	16	19
Average Length of Follow-up, months	39.2	62.0	69.3	31.3
Patients with Hypogonadism, %	29%	28%	44%	5%
Liver iron concentration, µg/g wet tissue	1690	1883	2127	1769
Transfused Patients, %	90%	70%	50%	11%
Average Age started chelation, years	14.8	22.9	23.4	-----
Length of chelation, years	9.5	2.7	2.2	-----

*n=94 patients with 124 patient visits not mutually exclusive amongst the chelator groups

Table 2: Longitudinal Model for Predictors of Spine BMD

Longitudinal linear mixed effects model*			
Variable	Den DF	F Value	p-value
Age, years	192	8.84	0.003
Chelation Type	22	4.75	0.011
Years Chelation * Type	**192**	**4.3**	**0.006**
Age Start Chelation, Yr	192	7.71	0.006

*Adjusted for baseline BMD, gender and hypogonadism

Figure 1: Average Spine and Hip BMD by Chelator Group (least square means ±SEM)

Figure 1. Spine and hip BMD of each chelator group are presented relative to the non-chelator group BMD. Significantly higher spine BMD in the DFX vs. DFO group, *p < 0.001.

Figure 2: BMD Z-score by Chelation Group, Patients < 21yr

Figure 2. For patients who are ≤ 21 year old , there was no clear trend in the effect of the different chelation therapies on either spine or hip aBMD Z-scores.

Figure 3: BMD Z-score by Chelation Group, Patients ≥ 21yr

Figure 3. For adult Thal patients, there's a clear association between chelation usage and BMD Z-scores. Those not prescribed chelation therapy have the highest spine and hip BMD Z-scores, while those prescribed combination therapy have the lowest spine and hip BMD Z-scores [For APZ: p<0.001, and HipZ: p=0.016].
Those prescribed DFX (Average APZ :-2.2, HipZ: -1.5) have higher BMD Z-score compared to those on DFO (Ave APZ: -2.9, HipZ: -1.9).

Table 3: Longitudinal Model for Predictors of Hip BMD

Longitudinal linear mixed effects model*			
Variable	Den DF	F Value	p-value
Age, years	148	4.84	0.029
Chelation Type	**16**	**3.28**	**0.048**
Years Chelation	148	6.74	0.01
Age Start Chelation, Yr	148	11.87	<0.001
Hypogonadism	52	5.56	0.022

*Adjusted for baseline BMD and gender

Table 2 & 3: After adjusting for factors known to affect BMD (age, gender, hypogonadism), type and duration of chelation therapy are significant predictors of bone density.

Figure 4: Genant Semi-quantitative scoring categories

Figure 5: Example VFA Scans from Thalassemia Patients

Female
Age: 39 y
Finding: Severe Wedge in L3

Female
Age: 35 y
Finding: Truncal Shortening

Male
Age: 38 y
Finding: Severe Biconcavity in L4

VFA	Abnormal N=20	Normal N=27
Age, years	30.2 ± 11.2	24.6 ± 10.7
Male, %	36%	60%
Spine aBMD Z-Score	-2.6	-2.5
DFO, %	52.8%	36.9%
DFX, %	22.2%	35.4%
Fracture History, %	30.0%	18.5%

*Of the 94 total patients, 47 received a VFA Scan.
Prevalence of abnormality in those who received a VFA scan: 42.5%

Summary

- As expected, Spine & Hip BMD Z-scores were lower in adults with Thal compared to adolescents.
- More adults had a history of DFO use; some adolescents were only exposed to DFX (*1st oral Chelator FDA approved in US in 2005*).
- After controlling for confounding variables (age, gender, time on chelation, hypogonadism), Thal patients prescribed DFX have higher spine & hip BMD than those prescribed DFO or Combination chelation therapy.
- In this selective group of Thal patients, there was a high prevalence of vertebral abnormalities which was unrelated to low bone mass or overall fracture history.
- Vertebral shortening was more commonly reported in older Thal patients who received toxic levels of DFO therapy as young children.

Conclusions

- Optimal transfusion & chelation strategies are beneficial for bone health in patients with thalassemia.
- Though these data are intriguing, controlled, prospective studies are necessary to determine if patients exclusively using DFX could improve overall bone health.

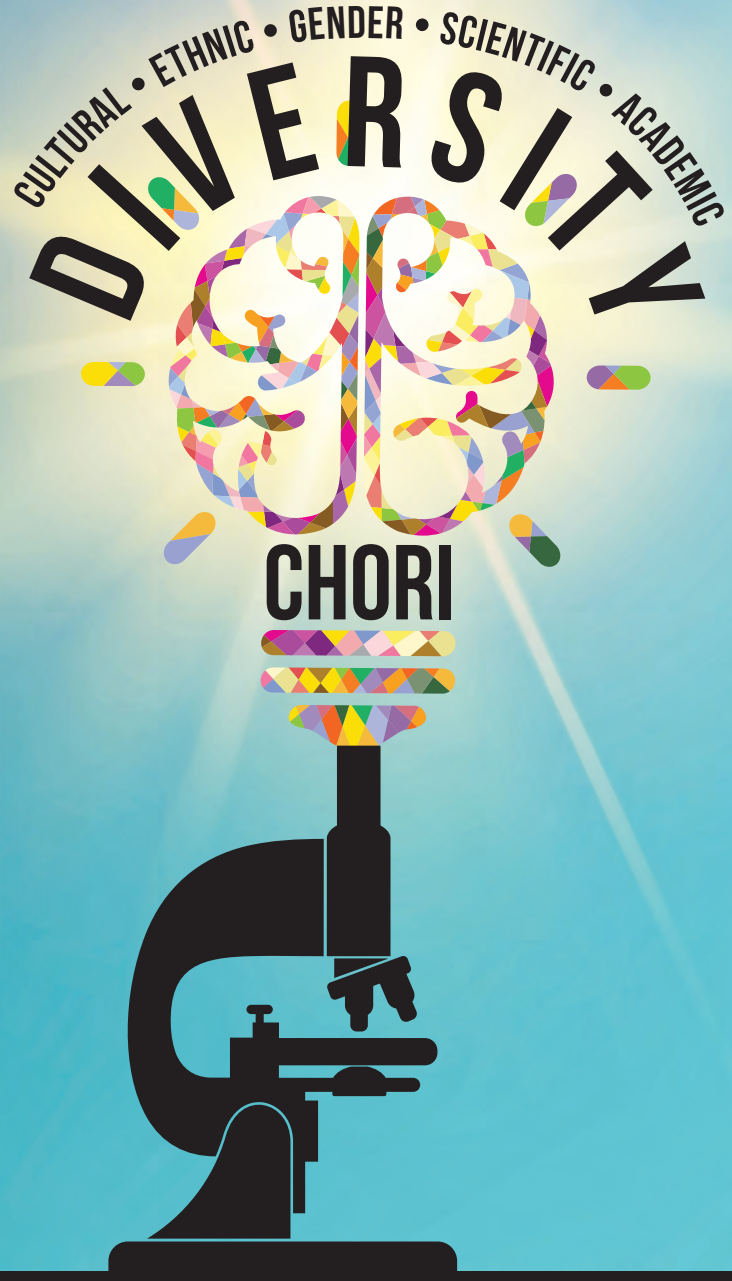
Citations:
1. Rossi F et al. Iron overload causes osteoporosis in Thal major patients through interaction with TRPV1 channels. Haematologica 2014;99:12:1876-84.
2. Genant HK et al. Vertebral fracture assessment using a semi-quantitative technique. JBMR 1993;8:9:1137-48.

Abbreviations Used:
Combo: DFX + DFO therapy
DFX: Deferasirox , orally administered
DFO: Deferoxamine, intravenously administered
LIC: Liver Iron Concentration
BMD: Bone Mineral Density
VFA: Vertebral Fracture Analysis

On December 3rd and 4th, 2015 the CHORI Summer Program Administration was asked to host the 3rd annual Doris Duke Charitable Foundation Directors Meeting. In attendance were the Directors from the 7 other DDCF High School Summer programs in the United States. The focus of the 2-day meeting was on persistence in STEM careers for our students and encouragement of mentors in the program.

Mentor	Discipline / Field
Ash Lal, MD	Hematology; UCSF Benioff Children's Hospital Oakland
Barbara Laraia, PhD	Community Health Science, School of Public Health; UC Berkeley
Beate Illek, PhD	Center for Nutrition & Metabolism; CHORI
Bob Ryan, PhD	Center for Cardiovascular Disease & Diabetes; CHORI
Brian Dolan, PhD	History of pediatrics, patient records; UCSF
Catherine Liu, MD	Infectious Disease & Epidemiology; UCSF
Christine Schudel, MSW MPH	Primary Care Clinic; UCSF Benioff Children's Hospital Oakland
Cindy Leung, MD	Food Insecurity, nutrition, health disparities; UCSF
Claudia Cattoglio, PhD	Molecular & Cell Biology; UC Berkeley
Courtney Lyles, MD	Health disparities, vulnerable populations; UCSF
Dario Boffelli, PhD	Center for Genetics; CHORI
David Killilea, PhD	Center for Nutrition & Metabolism; CHORI
Dayna Long, MD	Primary Care; UCSF Benioff Children's Hospital Oakland
Deborah Dean, MD, MPH	Center for Immunobiology & Vaccine Development; CHORI
Elaine Pico, MD FAAP	Rehabilitation Medicine, UCSF Benioff Children's Hospital Oakland
Ellen Fung , PhD RD CCD	Bone Density Clinic; UCSF Benioff Children's Hospital Oakland
Frans Kuypers, PhD	Red Cell Biochemistry, CHORI
Greg Moe, PhD	Center for Immunobiology & Vaccine Development, CHORI
Janelle Noble, PhD	Center for Genetics; CHORI
Jennifer Michlitsch, MD	Hematology/Oncology; UCSF Benioff Children's Hospital Oakland
Joel White, MD	Dental disparities, prevention, dental caries; UCSF
Kathy Schultz	Center for Nutrition & Metabolism; CHORI
Katie T. Carlberg, MD	Hematology; UCSF Benioff Children's Hospital Oakland
Lela Bachrach, MD	Joint MD/PHD Progam, School of Public Health; UC Berkeley
Lenny Lopez, MD	Health disparities, patient safety, language barriers, UCSF
Lorrene Ritchie, PhD RD	Nutrition & Public Policy; UC Berkeley
Lynne Neumayr, MD	Hematology; UCSF Benioff Children's Hospital Oakland
Marcela Weyhmiller, PhD	Iron Msmt Program, UCSF Benioff Children's Hospital Oakland
Marisa Medina, PhD	Center for Cardiovascular Disease & Diabetes; CHORI
Marsha Treadwell, PhD	Psychology, UCSF Benioff Children's Hospital Oakland
Mary Henderson, PhD RD	Nutrition, UCSF Benioff Children's Hospital Oakland
Mary Jones, MD	RETT Clinic, UCSF Benioff Children's Hospital Oakland
Mike Oda, PhD	Center for Cardiovascular Disease & Diabetes; CHORI
Mike Rowland, MD	Hematology; UCSF Benioff Children's Hospital Oakland
Mindy Bensen, PNP	Asthma Clinic, UCSF Benioff Children's Hospital Oakland
Nancy Keller	Center for Genetics; CHORI
Nisha Acharya, MD	Opthalmology, global health, epidemiolog; UCSF
Peter Beernick, PhD	Center for Immunobiology & Vaccine Development; CHORI
Polina Ilieva, PhD	History of pediatrics, patient records, gender studies; UCSF
Ryo Higuchi, PhD	Molecular & Cell Biology; UC Berkeley
Sandy Calloway, PhD	Center for Genetics; CHORI
Suzanna Martinez, PhD	Public Health & Nutrition Policy; UC Berkeley
Swapna Shenvi, PhD	Center for Nutrition & Metabolism, CHORI
Tariq Ahmad, MD	Endocrinology, UCSF Benioff Children's Hospital Oakland
Titi Singer, MD	Hematology, UCSF Benioff Children's Hospital Oakland

Notes



CHORI summer research symposium 2016

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