



California Initiative to Advance  
**Precision Medicine**

**PREPARED BY THE  
GOVERNOR'S OFFICE OF  
PLANNING & RESEARCH**

**2022  
ANNUAL  
REPORT**





# **California Initiative to Advance Precision Medicine 2022 Annual Report to the California Legislature**

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# EXECUTIVE SUMMARY

The California Initiative to Advance Precision Medicine (CIAPM) focuses on supporting patient-focused research demonstration projects and connecting health and medicine partners across California. CIAPM supports biomedical research through grant-making and cross-sector coordination. Committed to health equity, it stimulates cross-sector collaborations among the state's scientists, clinicians, entrepreneurs, and patient participants to turn available large data sets and technical innovation into better health outcomes for all Californians, including those communities biomedical research has historically left behind. CIAPM's efforts have resulted in more tailored diagnostic and treatment options for those communities. CIAPM is a trauma-informed organization that focuses on collaboration to advance community voice and scientific rigor in precision medicine efforts.

Additionally, CIAPM has received unprecedented national and international attention at conferences and meetings, with the State of California's leadership in precision medicine being highly acknowledged as a notable model in 2022. The organization's activities span a multitude of areas with many partners across California, including a portfolio of demonstration projects. As the state continued to emerge from the pandemic in 2022, CIAPM achieved significant milestones including:

- CIAPM ran ten demonstration research projects in 2022, a CIAPM record
- The Legislature allocated \$19.25 million for CIAPM to pursue two new programs, starting in 2023
- CIAPM held its first-ever Research Symposium for Adverse Childhood Experiences at UCLA

- Researchers added 33 publications, 91 presentations, 1 patent, and 17 news stories
- State officials and external experts engaged in Advisory Working Groups focused on integrating social determinants of health in medical research and equitable consent processes in health research
- Staff developed district-specific CIAPM activity reports for more than half of all Members of the Legislature
- Researchers, Advisors, collaborators, and staff held prominent roles in the 2022 Precision Medicine World Conference, including as session chairs, moderators, and speakers
- Staff conducted record outreach at external conferences, meetings, and events
- Ten California-based graduate and undergraduate student interns and fellows contributed to programmatic efforts and staff trained them in research administration and science policy

## 2023 Priorities

- Recruit and onboard specialized staff
- Conduct CIAPM's first-ever statewide listening sessions
- Initiate the selections process for the new Depression Research Program
- Close out the Cancer Disparities Research Program and launch a formal evaluation
- Build partnerships with the National Institutes of Health, fellow state agencies, and cross-sector collaborators

Recognizing the public and the Legislature's continued interest in the strides CIAPM has made, the Governor's Office of Planning and Research respectfully submits this report. (Gov. Code, § 65057, subd. (b)(4).

# MESSAGE FROM THE DIRECTOR

Honorable Members of the State Legislature,

Alongside historic attention to and investments in uplifting equity across state government, the Office of Precision Medicine exhibited tremendous forethought with two successful proposals approved by the Legislature in the Fiscal Year 2022–2023 Budget Act, including \$10 million to develop new preventive, diagnostic, and therapeutic strategies for depression and \$9.25 million to increase participation by underrepresented minorities in biomedical research.

As one of the state's offices dedicated to medical research, the California Initiative to Advance Precision Medicine (CIAPM) acted boldly on its mission to deploy state resources toward investments that will pay dividends through improved health, a wider array of interventions for medical conditions, and a more capable healthcare and scientific workforce, particularly among underserved communities. Due to CIAPM's efforts, for example, more than 100 trainees – from postdoctoral fellows and residents to undergraduate student research assistants – have already engaged in developing next-generation solutions since the program's establishment in 2015. Patients afflicted with Multiple Sclerosis, Traumatic Brain Injury, and infectious diseases now have more targeted diagnostic and treatment options. And participation in biomedical research is on the rise among communities who have been historically left behind by the research enterprise, which is essential to address health disparities.

CIAPM showcases its strategic approach to innovation through identifying timely scientific topics, focusing on high-risk / high-reward projects, and fostering collaboration and cross-sector partnership. With unprecedented national and international attention at conferences and meetings, California's leadership was highly acknowledged in 2022 as a notable model.

Thank you for your support and partnership in this work. The Governor's Office of Planning and Research will continue to strive for a future that embodies the best of California: advanced scientific applications, a world-class workforce, and more equitable opportunity for all.

Sincerely,

A handwritten signature in black ink, appearing to read 'Samuel Assefa', written in a cursive style.

Samuel Assefa

Director, Governor's Office of Planning and Research



# BACKGROUND

## What is Precision Medicine?

Historically, medical research has been focused on developing prevention strategies, diagnostics, and treatments for the average patient. As our capacity to generate and analyze vast amounts of data has increased, so too has our ability to provide health care that is more individualized based on factors like genetics and disease subtype, for example. Additionally, we know that one's health is driven by environmental and societal conditions including, but not limited to, factors such as income, education level, housing status, gender, race, ethnicity, and others. Precision medicine, also called precision health, personalized medicine, or individualized medicine, aims to account for all aspects of one's biology, behavior, and environment in order to provide optimized health interventions. Examples of precision medicine include the following:

- More frequent and more refined screenings for people at higher risk of disease
- Administering antibiotics that are specific to a distinct infection
- Monitoring patients' biometrics to predict heart attacks or strokes
- Using digital imaging to help select a course of treatment for head injuries
- Offering culturally and linguistically appropriate educational materials and navigation services
- Modifying drug selection or dose depending on a patient's genetics

Central to precision medicine is the ability to share health data across a care team, and with researchers who are conducting clinical trials. When researchers can, with appropriate consent, analyze digitized medical data that is compatible across hospitals, clinics, and health-care systems, they can elucidate findings that would otherwise be difficult to discover. Additionally, shared health data can improve patient

outcomes because regardless of where a patient seeks care, at any emergency room, clinic, or hospital, clinicians would have their complete health record.

As it stands, many diagnostics and medical interventions, whether they are related to patient education, surgical, medicine-based, or devices, have reduced efficacy or more side effects in patient populations who have historically been underrepresented in medical research. Additionally, not all communities have the same access to precision medicine care. The promise of precision medicine will not be achieved until everyone can benefit from precision medicine in an equitable way.

More background information can be found online in CIAPM's Precision Medicine Primer.<sup>1</sup>

## About CIAPM

California is a world leader in biomedicine and data science, and home to some of the most productive research universities on the planet. Through strategic investment, California can work toward the goal of precision medicine, which is to provide “the right intervention, for the right patient, at the right time.” In 2014, Governor Jerry Brown worked with the California State Legislature to establish CIAPM, which adds value by coordinating California's precision medicine efforts across sectors. In alignment with statute, CIAPM funds, annually reports on, and evaluates research demonstration projects that illustrate the power and potential of this new approach to health and medical care. CIAPM also hosts and maintains the California Precision Medicine Asset Inventory, which is a searchable database of organizations, projects, datasets, and other entities that compose the statewide ecosystem. In 2022, with the help of the Legislature, CIAPM's responsibilities were expanded to include programs that extended beyond direct research support, such as community outreach.

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1 <https://opr.ca.gov/ciapm/resources/primer.html>

In addition to its statutory responsibilities, CIAPM facilitates the California Precision Medicine Advisory Council, which is comprised of precision medicine experts from a variety of sectors. Staff also coordinate precision medicine activities across agencies and departments, deliver presentations and participate on panels, and maintain a robust student intern program to train the science and research policy professionals of tomorrow.

Budget Year	Budget Appropriation for Precision Medicine (in millions)	Number of Projects Funded	Project Topics
2014/2015	\$3.0	2	<ul style="list-style-type: none"> <li>• Pediatric cancer</li> <li>• Genetics of infectious diseases</li> </ul>
2016/2017	\$10.0	6	<ul style="list-style-type: none"> <li>• Traumatic Brain Injury</li> <li>• Remote heart monitoring</li> <li>• Genomic sequencing</li> <li>• Mobile mental health</li> <li>• Multiple sclerosis</li> <li>• Prostate cancer</li> </ul>
2017/2018	\$10.0	3	Cancer health disparities
2018/2019	\$30.0	3	Adverse Childhood Experiences (\$10M)
2020	-\$18.2*		
2021/2022	\$12.415	4	Adverse Childhood Experiences
2022/2023	\$19.25	TBD	<ul style="list-style-type: none"> <li>• Depression</li> <li>• Representative Research Collaborative</li> </ul>

\*In 2020, \$18.2 million from CIAPM's 2018/2019 appropriation were diverted to the General Fund to support critical services during the COVID-19 pandemic.

Since 2014, CIAPM has granted over \$40 million across 18 research projects. Eight of those projects have concluded, and 10 are on-going. More information about the research CIAPM funds can be found in the Demonstration Projects section of this report.

CIAPM emphasizes equity in all its work, including project selection and hiring practices, in accordance with state and federal law. The projects and programs it funds specifically focus on subpopulations that experience health disparities. These practices and principles align with Governor Newsom's Executive Order N-16-22, which indicates that state government can "address unequal starting points and drive equal outcomes so all Californians may reach their full potential and lead healthy and rewarding lives."

# DEMONSTRATION PROJECTS

The backbone of CIAPM has always been the support of precision medicine research that fills gaps which lead to health disparities.

By adding to the global bank of health and medical knowledge, especially about communities and groups of people who have been historically marginalized by the biomedical research enterprise, CIAPM is advancing equity.

CIAPM has two ongoing demonstration project programs, one of which studies Adverse Childhood Experiences (ACEs), and another that aims to address disparities in cancer mortality and access to care. In 2022, CIAPM was appropriated funds for a forthcoming depression research program on precision medicine approaches for the prevention, diagnosis, and treatment of depression. Preparations for the Request for Proposals have begun, with additional effort and selections set to launch in 2023.

# Adverse Childhood Experiences Research Projects

Championed by the State's Surgeons General, Dr. Nadine Burke Harris and Dr. Diana Ramos, ACEs have been a priority of state government throughout the Newsom Administration. Within the age range of 0-17 years, many children confront 10 types of adversity known as Adverse Childhood Experiences (ACEs). These challenges fall into three domains: 1) child abuse, which includes physical, emotional, and sexual abuse; 2) neglect, encompassing both physical and emotional neglect; and 3) household challenges, such as losing a parent, being exposed to a caregiver with untreated mental illness, a family member grappling with substance dependence or incarceration, undergoing parental separation or divorce, or witnessing instances of intimate partner violence. ACEs can trigger toxic stress, leading to an ongoing and heightened activation of the physiological stress response system during the developmental phase. This toxic stress can result in enduring physiological changes that contribute to compromised mental and physical health throughout an individual's lifespan.

## Research Symposium

On November 7, UCLA hosted all seven CIAPM-funded ACEs research project teams. The inaugural half-day event included a showcase of ongoing projects. Discussions focused on data science, federated data systems, and computational tools as well as on evidence-based strategies for collecting community guidance and better engaging the public as partners in research.

Opening remarks were delivered by CIAPM Advisory Council Chair and UCLA Precision Health Institute Deputy Director Dr. Clara Lajonchere as well as UCLA ACEs Lead Principal Investigator Dr. George Slavich, who also graciously hosted the event at the UCLA Luskin Conference Center.



## First Annual Site Visits

Science Fellow Dr. Alexandra Colón-Rodríguez and Co-Director Dr. Julianne McCall conducted the first annual site visits for six project teams of the CIAPM ACEs Research Program. They met researchers and community leaders at each site and learned about milestones so far achieved as most projects marked one year of work.



Children's Hospital Los Angeles



University of California, Los Angeles





University of California, San Diego



Loma Linda University



University of California, San Francisco



University of California, Irvine

## Projects

### **A Multi-Component Intervention to Strengthen Families and Build Youth Resilience (2021-2024)**

**Lead Principal Investigator: Dr. Ariane Marie-Mitchell,  
Loma Linda University**

Partners (listed alphabetically): Help Me Grow Inland Empire; Inland Empire Health Plan; Loma Linda University Faculty Medical Group; Loma Linda University Institute for Community Partnerships; San Bernardino City Unified School District; Social Action Community Health in San Bernardino; University of California, Los Angeles; Walden Family Services

Dr. Marie-Mitchell's project applies a multi-pronged preventive intervention strategy to reduce health impacts of ACEs in patients age 3-11 years old. The challenge for most communities is that health and education systems are fragmented and often do not accommodate the unique needs of different families. This project fosters Health, Education, And Learning (HEAL) partnerships to mobilize three sectors: pediatricians, community health workers (CHWs), and Nurturing Families (NF) educators. In doing so, the team seeks

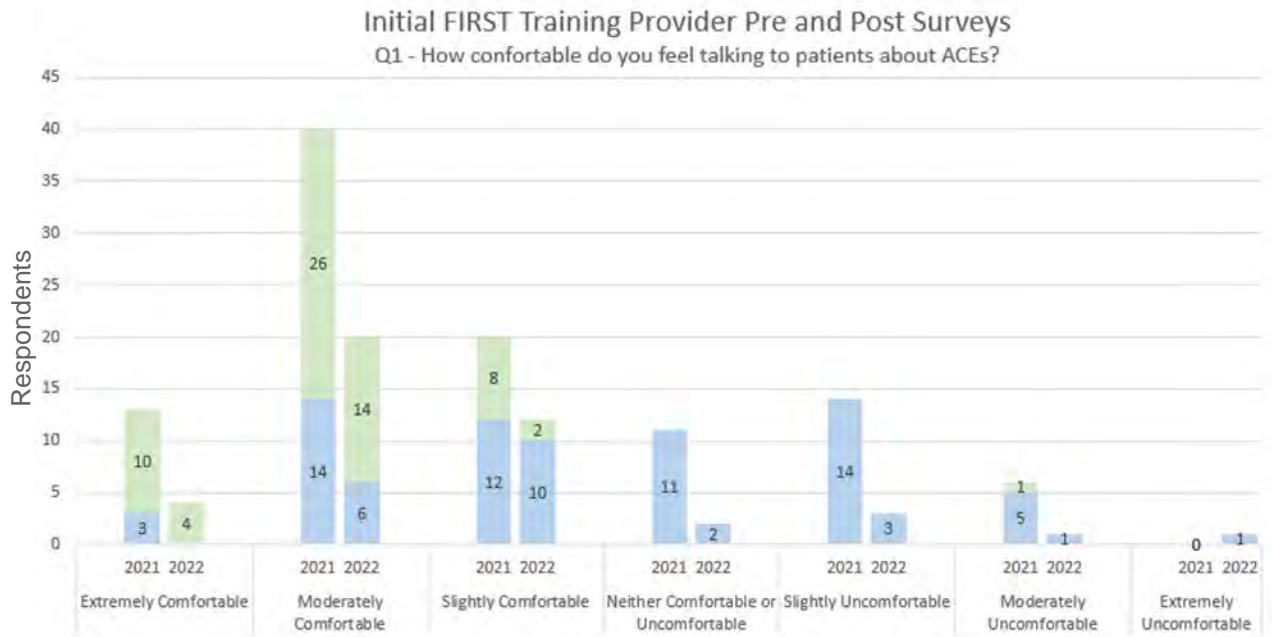
to optimize the delivery of vital information and resources to a diverse population of families with ACEs to improve health outcomes of young children.

Pediatricians, CHWs, and NF educators are all team members in this study and are trained using an evidence-informed curriculum called FIRST, which stands for “Families Implementing Resilient Systems Together.” The FIRST curriculum empowers professionals with the knowledge and skills needed to strengthen families and build resilience in youth by (1) understanding trauma and promoting resilience, (2) supporting stress management and executive function through mindfulness, emotional self-regulation, and healthy lifestyle, and (3) creating safe, stable, nurturing relationships to encourage social-emotional development. Pediatricians initiate the referral process to CHWs and NF educators who work closely with families to address risk factors and provide support. To evaluate the efficacy of the HEAL partnerships and the FIRST curriculum, pediatric patients are being recruited to participate in evaluations within two weeks and 3, 6, and 12 months after their regularly scheduled well-child doctor visit. The research evaluation includes collecting data on ACEs, biomarkers of toxic stress, child health and psychosocial problems, and potential mediators and moderators.

To date, the team has trained 50 pediatric residents, 7 pediatric faculty, 7 CHWs, and 7 NF educators with the FIRST curriculum. The team also established procedures for referrals to the CHWs and NF educators and developed promotional and educational materials in English and Spanish. Importantly, the team routinely gathers and incorporates feedback from interested parties regarding the curriculum and other aspects/processes relevant to project goals. The team also tracks the effectiveness of the training and refer-

-rral process. For example, approximately 40% of referrals resulted in successful contact with a CHW, and this rate did not differ by age, gender, or race/ethnicity. Additionally, caregivers of pediatric patients who connected with a family mentor were then connected to a range of community resources, including distribution of goods, behavioral health for parents and children, and parenting support. The team recruited a total of 49 participants which represents 23% of the no ACEs comparison group, 22% of the ACEs control group and 5% of the ACEs intervention group. They have also completed 26 three-month follow-up visits, 20 six-month follow-up visits, and 10 twelve-month visits.

In 2023, the team will continue training new pediatricians and CHWs, evaluate opportunities to improve the success rate of referrals to community resources, and intensify recruitment efforts for the research evaluation. They will also begin a preliminary exploration of their data.



## **The Collaborative Approach to Examining Adversity and Building Resilience (CARE) Program (2021-2024)**

Lead Principal Investigator: Dr. Neeta Thakur, University of California, San Francisco

Partners (listed alphabetically): Futures Without Violence; LifeLong Medical William Jenkins Health Center; Santa Barbara Neighborhood Clinics; UCSF Benioff Children's Hospital Oakland; UC Berkeley; UC Santa Barbara; University of Delaware

Dr. Thakur and colleagues previously found that children with a high number of ACEs exhibited metabolic dysregulation, a common sign of stress. In this Pediatric ACEs and Resiliency Study (PEARLS), children with a high number of ACEs with caregivers that reported low stress did not show metabolic dysregulation, suggesting a potential protective effect.

Dr. Thakur's CARE team aims to follow up on this finding to understand the biology of ACEs, how interventions may mitigate the negative effects of ACEs, and how knowledge about ACEs can be shared across diverse practice settings. Together, the CARE Program will accelerate understanding of how to best identify those children at greatest risk, enhance protective factors, and intervene to bolster resilience across the care continuum.

To achieve the first goal, the team is adding a three-year follow-up for biomarker testing upon the existing PEARLS cohort, to identify early effects of adversity and factors that mitigate stress. To achieve the second goal, the team is testing the effect of resilience-promoting, caregiver-child interventions on caregiver stress and behavioral and

biologic outcomes. Lastly, the team is developing a community-vetted resilience toolkit for low-resourced primary care settings that is scalable and of value across California. Additionally, there are a number of trainees, including three graduate students and two early-career faculty members on the CARE team.

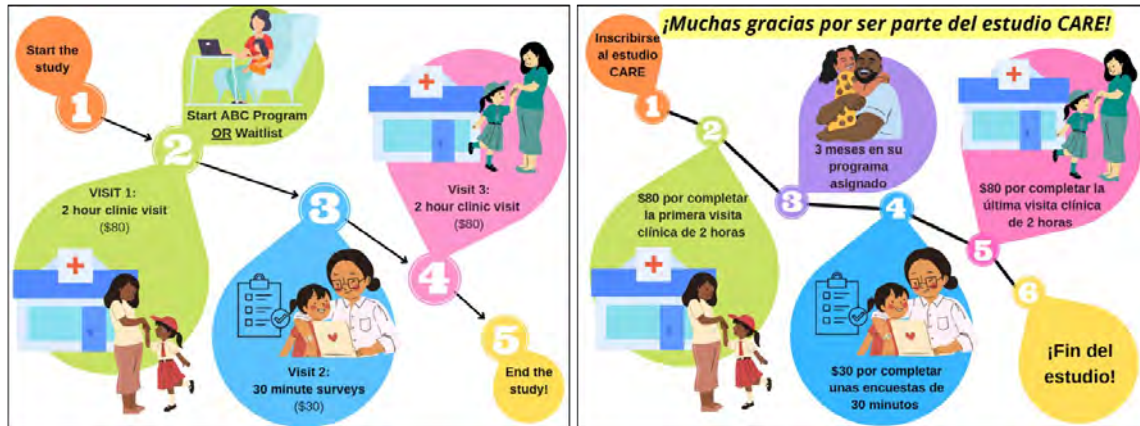
In 2022, the CARE team began recruitment for the follow-up of the original PEARLS cohort to measure stress-related biomarkers and for the intervention study. To aid in recruitment and education efforts, the team launched a website<sup>1</sup> for researchers, community groups, and potential participants and developed multi-language recruitment materials that describe what participating in research is like. To ensure the priorities and interests of patient families and of community partners serve as a guiding light, the CARE team formed the CARE Family Board. The CARE team also received feedback from clinical settings across California regarding the PEARLS screening tool. In response to the feedback, the CARE team revised the screening tool and conducted semi-structured interviews and a focus group. The changes were positively received, and the team is analyzing these data to inform workflows for future implementation.

The CARE team also conducted a set of trainings for providers and frontline staff that will be included in the Resilience Toolkit. These trainings were based on an evidence-based curriculum for a healing-centered approach to ACEs response and included topics on staff wellness and the importance of self-care when screening for ACEs, anticipatory guidance and universal education for ACEs, and suggested workflow. Lastly, the CARE team gathered resources in the

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1 <https://resilience.ucsf.edu/>

community to develop preliminary algorithms to aid staff in providing navigational services for unmet social needs. In 2023, the CARE team will focus on recruitment, research, and training. The team anticipates ramping up recruitment for both the PEARLS follow-up and intervention studies.



Sample research brochure provided to participants and their families, available in both English and Spanish

## Using Precision Medicine to Tackle Impacts of Adverse and Unpredictable Experiences on Children’s Neurodevelopment (2021–2024): The SoCal Kids Study

Lead Principal Investigator: Dr. Tallie Z. Baram, University of California, Irvine

Partners (listed alphabetically): Allevato Pediatrics; Chapman University; Children’s Hospital of Orange County (CHOC); CHOC Health Center Centrum; CHOC Health Center Garden Grove; CHOC Primary Care Network; Clínica CHOC Para Niños; First 5 Orange County; Illumina, Inc.; Illumination Foundation; Los Alamitos Pediatrics; Madison Park Neighborhood Association; MOMS Orange County; Orange County Health Care Agency; Orange Doctors of Kids and Teens; Pediatric and Adult Medicine; Premier Pediatrics; Santa Ana Boys & Girls Club; Sea View Pediatrics; Simms/Mann Family Foundation; Southern Orange County Pediatric Associates; Syntropy Technologies, LLC; Total Pediatrics of Orange County; University of California Irvine Institute for Clinical and Translational Science.

In prior research, Dr. Baram and colleagues conceptualized an additional novel ACE, characterized by unpredictable sequences of sensory signals that the caregiver transmits to the infant and child such as speech, touching, or visual cues. They then extended the source of signals from caregiver to the household and environment and established that unpredictability of signals of a child's world contribute to adverse neurodevelopmental outcomes and compromised mental health in several independent human cohorts, even after accounting for previously established ACEs.

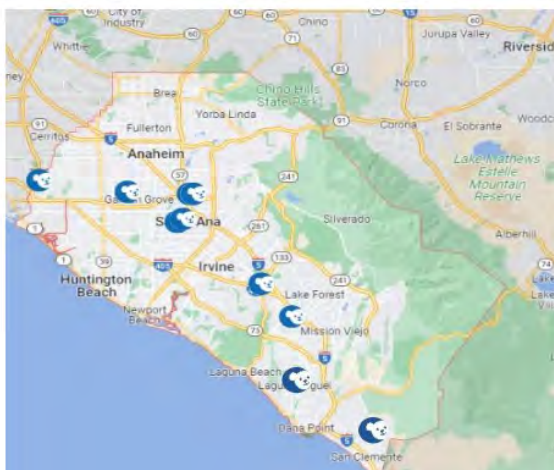
Dr. Baram's project aims to build upon these findings by (1) understanding the impact of this novel ACE, early-life unpredictability, on neurodevelopment in the real world, in the context of the diverse populations of Orange County, California; and (2) distinguishing infants exposed to all ACEs who are vulnerable from those who are resilient by measuring a biological marker called DNA methylation of buccal/saliva cells. For the first goal, the SoCal Kids team seeks to understand whether the independent and combined contributions of ACEs and early life unpredictability contribute to neurodevelopmental outcomes in 100,000 children receiving care from the Children's Hospital of Orange County (CHOC) primary care clinics, representing the broad demographics of Orange County. For the second goal, the team is recruiting 120 mother-infant pairs and is assessing the infants' exposure to ACEs and early life unpredictability during the first year of life. Additionally, the team is obtaining biological samples with a cheek swab to characterize a potential marker of vulnerability to ACEs exposure and assessing neurodevelopmental outcomes at 2 years of age.

During 2022, the research team implemented the Questionnaire of Unpredictability (QUIC-5) screen and the Pediatric ACEs and Related Life-Events Screener (PEARLS) question-



questionnaire in English and Spanish in 13 partner pediatric primary care clinics (See Figure 1) and screened more than 18,000 participants. In addition, they collected cheek swab samples for the biological marker component of the project from 98 infants and continue the recruitment and data collection efforts to reach and perhaps surpass their goal of 120 mother–infant pairs. In progress towards the second goal, the team now has demonstrated that infant DNA methylation is driven by age (as anticipated), and, importantly, the change in methylation profile between the two samples from the same child is a far better predictor of neurodevelopmental outcome compared to each individual methylation profile at ages 10 days or one year of age. In addition, they collected cheek swab samples for the biological marker component of the project from 98 infants and continue the recruitment and data collection efforts to reach and perhaps surpass their goal of 120 mother–infant pairs. In progress towards the second goal, the team now has demonstrated that infant DNA methylation is driven by age (as anticipated), and, importantly, the change in methylation profile between the two samples from the same child is a far better predictor of neurodevelopmental outcome compared to each individual methylation profile at ages 10 days or one year of age.

Figure 1. Map of Orange County Pediatric Clinics Participating in QUIC



1. Allevalo Pediatrics, Orange
2. Orange Doctors of Kids and Teens, Orange
3. CHOC Primary Care Clinic, Orange
4. CHOC Health Center, Orange
5. Los Alamitos Pediatrics, Los Alamitos
6. CHOC Health Center, Garden Grove
7. Clinica CHOC Para Niños, Santa Ana
8. Santa Ana Boys and Girls Club, Santa Ana
9. Premier Pediatrics, Irvine
10. Sea View Pediatrics, Irvine
11. Sea View Pediatrics, Laguna Hills
12. Sea View Pediatrics, Aliso Viejo
13. Sea View Pediatrics, San Clemente

Additionally, in 2022, the team conducted four Community Engagement Studios (CES) in partnership with the UC Irvine Institute for Clinical and Translational Science (ICTS). The CES is a structured program to enhance design, implementation, and dissemination of research studies by gathering project-specific input from relevant community stakeholders. Specifically, the team gathered key perspectives on challenges and recommendations for conducting a research study on ACEs, biomarkers, and health during CES with CHOC physicians and allied health providers as well as a group of Orange County mothers. The team also assembled a Community Advisory Board (CAB) that meets quarterly (See Figure 2) to coordinate and inform their work with the insight of community members who have expertise aligned with their study aims (Community Advisory Board Directory can be found in the Appendix).



Figure 2. Open house for Community Partners, October 2022.

Notably, the project is a tremendous opportunity of training and providing a rich experience to the new generation of scientists and clinicians who are interested in precision health and mental health, including one postdoctoral fellow, two graduate students, three postbaccalaureate students, and three undergraduate students.

In 2023, the SoCal Kids team will continue their recruitment, screening, research, and community engagement efforts. They will expand preliminary data analyses linking the QUIC and PEARLS data to child mental and physical health outcomes and embark on their first 24-month infant assessment. In parallel, the methylomics team will continue to gather, process, and sequence the data obtained from the enrolled infants, including samples from both infancy and the 12-month visit.

### **Advancing a Precision Population Health Approach to ACEs to Reduce Health Disparities (2021-2024)**

Lead Principal Investigator: Dr. Gary S. Firestein, UC San Diego

Partners (listed alphabetically): American Academy of Pediatrics, California Chapter 3; Chicano Federation; Comité Organizador Latino de City Heights; Family Health Centers of San Diego; Olivewood Gardens and Learning Center, Kitch-enistas; San Diego County Childhood Obesity Initiative; San Diego County Promotores Coalition; San Diego State University School of Public Health; South Bay Community Services; StreetWyze; Vista Community Clinic/Poder Popular; YMCA Partners in Prevention

The Healing Experiences of Adversity for Latinos (HEAL) Healthy4You/Más Por tu Salud team aims to address ACE-related health problems among Latino families in the San Diego area by implementing a precision, community-based approach.

To achieve this goal, the HEALthy4You team (1) built the infrastructure to enable family-based interventions that are tailored to each family's needs as defined by the community, (2) is using informatics and analytics to enable continually improved matching of these interventions to subgroups of families and communities, and (3) will determine if their precision, community-based approach is superior to the current family care standards. In this first phase, the team engaged with community resident stakeholders and community health workers (promotoras) to adapt prior evidence-based, family-focused interventions for both resiliency to ACEs and obesity to local community needs and develop culturally appropriate ways to detect ACEs in families. In the second phase, the team designed a data integration system for tailoring family-based interventions to local needs. Lastly, the team is performing the clinical trial to determine if their precision, community-based approach to ACEs and comorbid childhood obesity improves ACE-related health outcomes.

To establish precision interventions, the team combined evidence-based behavioral and social self-regulatory skill training appropriate for Latino families with support from local community members and promotoras, who are guiding how to deliver interventions for each family. The team is working with several community-based organizations, such as the Chicano Federation, Comité Organizador, Latino de City Heights, and South Bay Community Services to facilitate this approach. The team is also working towards

determining how assessments of molecular markers and environmental influences might correlate with health outcomes, which they hope will help inform family care best practices.

In 2022, the team engaged the broad community to understand which interventions meet their needs and which measures will be used to evaluate success and developed the infrastructure necessary for project completion. The team worked with 12 community organizations (listed above), ranging from community-based organizations that serve the Latino/a/x population with accessing health services to increasing access to nutritious foods to providing case management support through promotora programming. Four Research Assistant interns from UC San Diego and George Washington University were recruited to support data gathering and refinement. They piloted their approach at one clinical site, Family Health Centers San Diego North Park, and developed a phased approach for recruitment for the full study. Based on feedback from their pilot study, the team re-designed the study protocols and assessment schedule to both support the providers and strengthen the evaluation of the mental health and promotora interventions.

Additionally, the Healthy4You team partnered with community-based organizations to collect community-generated data through Streetwyze, a web-based mapping platform for sharing stories and information regarding community resources and needs. The team also trained promotoras and other team members on core competencies, motivational interviewing, ACEs, social determinants of health, and healing-centered relationships. Additionally, the team trained Research Assistants on survey administration for both English and Spanish-speaking participants. Lastly, the

HEALthy4You team launched their program in four Family Health Centers of San Diego clinics.

In 2023, the Healthy4You team will accelerate accrual by enrolling participants at multiple Family Health Center clinics around the county. The team is also in the process of writing manuscripts describing the processes used to develop the community-drive protocols and generate consensus with a broad array of interested parties.



Streetwyze Training -South Bay Community Services,  
Chula Vista, San Diego

### **Scalable Measurement and Clinical Deployment of Mitochondrial Biomarkers of Toxic Stress (2021-2024)**

Lead Principal Investigator: Dr. Pat Levitt, Children's Hospital Los Angeles

Partners (listed alphabetically): Fiesta Educativa, Inc.; Kaiser Permanente of Southern California; Karsh Family Social Service Center; Maternal Mental Health Now; Para Los Niños; St. Anne's Family Services; Ventura County Medical Center

The goal of Dr. Levitt's project is to identify infants at greatest risk for toxic stress and intervene as early as possible to decrease the likelihood of poor health and quality-of-life outcomes. To achieve this, Dr. Levitt's team combines a robust questionnaire to identify infants exposed to ACEs with innovative laboratory measures to understand infant-caregiver interactions and identify disruptions in metabolic health, a specific consequence of toxic stress. Specifically, the team video records and analyzes infant-caregiver interactions and assesses laboratory measurements of alterations of mitochondria, which produce energy for our cells. Through the application of precision medicine strategies, the team aims to bring together improved screening for toxic stress during infancy with a greater understanding of infant-caregiver well-being, and, thus, close the equity gap in access to quality behavioral health programs.

After establishing the study protocols in 2021, the team continued with recruitment and research in 2022, including the participant's questionnaires and measurements of metabolic and mitochondrial alterations. For recruitment, the team posted on social media, disseminated flyers in English and Spanish, and collaborated with Kaiser Permanente of Southern California and Ventura County Medical Center for clinical referrals through electronic health records of families who previously had agreed to be contacted about participating in research or from their family practitioner. The team has been successfully recruiting infants under five months of age and their caregivers in the study, with a total of around 100 infant-caregiver pairs enrolled in 2022, half of which have completed their six- and twelve-month follow-ups.

In the research laboratory, the scientific team conducted the mitochondria and metabolic health assessments. To study

neurodevelopment across infancy, researchers collected biological samples (saliva and urine from the infant; blood from the mother), measured infant eye movements to assess attention, conducted social infant-caregiver interactions, evaluated infant development, and provided caregiver questionnaires for ACEs, depression, stress, and resiliency. The team is currently analyzing these data and has found that around 18% of mothers endorse four or more ACEs, which is consistent with average epidemiological data in California and the U.S.

The research team is comprised of trainees including four bilingual research assistants and two postdoctoral fellows, in addition to the principal investigators and community member collaborators. The team works closely with a community advisory committee (CAC) to obtain input on all aspects of the project and help build community. Comprised of several organizations, including Fiesta Educativa, St. Anne's Family Services, Maternal Mental Health Now, Para los Niños, and the Karsh Family Social Service Center, the CAC helps the research team in recruitment efforts, development of visual aids, and understanding research from the community perspective. For example, the CAC reviewed the research protocol and recruitment materials and provided feedback on how the materials could be more effective. In 2023, the team will continue their research efforts with the aim of reaching its goal of engaging over three hundred families.

### **Identifying Social, Molecular, & Immunological Processes for Mitigating Toxic Stress & Enhancing Personalized Resilience (2021-2024)**

Lead Principal Investigator: Dr. George Slavich, UCLA



Partners (listed alphabetically): All Children Thrive; Am I Hungry Organization; Burnham Benefits; Donna Jackson Nakazawa; Los Angeles County Department of Health Services; Nutritious Movement; Palo Alto University; Stanford University; UC Berkeley; UC Health; UCLA Online Teaching and Learning Team; UCLA STAND Program; UCLA-UCSF ACEs Aware Family Resilience Network (UCAAN); UCSF; Yale University

The overarching goal of Dr. Slavich's project is to mitigate toxic stress and enhance personalized resilience in Californians through science, education, and training, all administered through the new network this project developed, called the California Stress, Trauma, and Resilience (CAL STAR) Network.

For the scientific research component, the main project goal is to reduce the substantial disparities in human health that are attributable to ACEs and toxic stress. To achieve this goal, the team conducts a highly collaborative, multi-site demonstration project in which they monitor stress levels as well as assessments of physiological and biological system functioning in 725 adults using state-of-the-art tools. These data will be integrated into CAL STAR's established and secure Personal Health Dashboard, which provides real-time results and feedback to patients and providers. These data will, in turn, inform CAL STAR's intervention, in which CAL STAR coaches deliver personalized online resiliency training to up to 425 high-stress participants by targeting five key domains that are commonly affected by stress: thinking style, social relationship, eating, sleep, and physical activity. The CAL STAR team is also developing a website that displays real-time estimates of stress burden at the city, state, and country level to predict stress-related health events and inform policymakers and health officials.

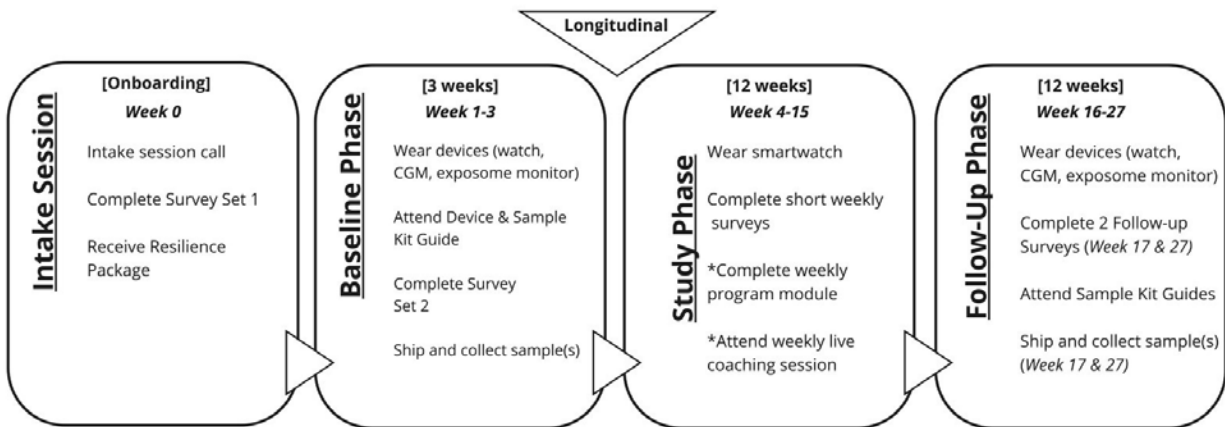
For the education component, the team is developing an evidence-based Massive Open Online Course (MOOC) that provides free stress and resilience education from both the research and lived experience perspectives for students, professionals, and the public. The MOOC aims to increase participants' capacity for stress awareness and healthy management. For the training component, the team is developing a clinical research training program to prepare researchers at all levels to conduct cross-disciplinary translational research on stress, precision medicine, health, and resilience.

In 2022, the UCLA team launched the CAL STAR Network website<sup>1</sup>, which serves as the central hub for their work, providing stakeholders a streamlined avenue for signing up for workgroups, newsletters, and getting in contact with the team. The UCLA team is comprised of numerous trainees, including five postdoctoral fellows, three graduate students, and eighteen undergraduate students. After developing the MOOC curriculum, the team is currently finalizing the speaker list and creating the infrastructure for the course. The team continued tailoring their study design and details, including creating the CAL STAR intervention, onboarding coaches for the intervention, and finalizing their recruitment strategy. The team also refined the online stress tracker after a soft launch. The research team continues to ensure that diversity, equity, inclusion, and social justice guide their work, including 1) making all community-facing content accessible and inclusive and 2) developing a community listserv to engage diverse clinics, nonprofits, and organizations across California.

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1 <https://calstarnetwork.org/>

In 2023, the UCLA team will continue with the research study, launch the online MOOC and research training programs, and continue to refine the online stress tracker. The UCLA team is also pursuing community partnerships, including with All Children Thrive, a community-led movement that works to address childhood trauma and advance opportunities that foster child wellbeing.



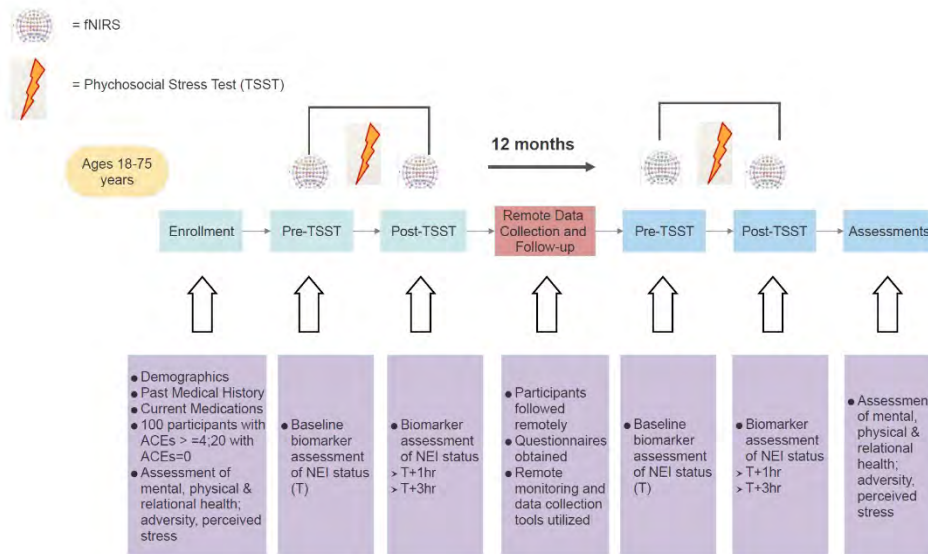
**Systems-based, Multidisciplinary Assessment of Adversity and Toxic Stress for Individualized Care (The SYSTEMAATIC Project) (2022-2025)**

Lead Principal Investigator: Dr. Sayantani Sindher, Stanford University

Partners (listed alphabetically): California Health Collaborative; Center for Youth Wellness/Safe and Sound; Central Valley Community Foundation; Federally Qualified Health Center (FQHC) clinics of San Mateo Medical Center; Fresno Community Health Improvement Partnership; Sean N. Parker Center for Allergy & Asthma; South San Francisco Clinic; Stanford Precision Health for Ethnic and Racial Equity; The Primary School in Palo Alto; University of San Francisco

The goals of Drs. Sindher and Gilgoff's SYSTEMAATIC project are to develop a multidisciplinary assessment strategy to diagnose toxic stress, guide integrated precision medicine treatment recommendations, and ultimately assess treatment efficacy. To achieve their goals, the SYSTEMAATIC team (1) assesses dysregulation in biological pathways impacted by stress, (2) identifies patients with dysregulation in these biological pathways who might otherwise be missed by the traditional symptom-based approach, and (3) develops a system for multidisciplinary, integrated care that accounts for protective factors and community voices. Ultimately, the SYSTEMAATIC team seeks to have a transformative impact on ACE-related health conditions.

First, the team identifies biomarker patterns in adults impacted by ACEs that predict dysregulation of biological systems. To do this, the team measures changes in a toxic stress assessment panel, stress-related biomarkers (cortisol and an immune panel), a protective biomarker (oxytocin), and neurological activity with functional near-infrared spectroscopy across a one-year period. Second, the team will pilot the feasibility, adaptability, and validity of the toxic stress assessment profile and impact of interventions within their partner clinics and organizations. Third, the team will investigate how risk modifiers (medical history, baseline ACE score, management and control of chronic illness) can affect the biomarker profile collected at 12 months. Together, the team aims to show ACEs and toxic stress dysregulate biological systems and pilot an approach that could be translated into clinical practice to diagnose toxic stress, guide integrated precision medicine treatment recommendations, and ultimately assess treatment efficacy.



Throughout the study, focus groups with participants and community council members will convene to review de-identified research data, interpret data based on lived experience, and discuss prioritization of interventions for individuals and communities. The SYSTEMAATIC team will perform qualitative analysis on data from focus groups to capture community specific barriers and facilitators in the context of diagnostic strategies and feasible interventions – thus accelerating implementation. With this community-based approach, the SYSTEMAATIC team aims to support marginalized and underserved populations who are more impacted by current and historical environmental stressors and consequently have worse health outcomes.

The SYSTEMAATIC project research team works with their regional Community Advisory Council/Health Navigator Team for the coordination, recruitment, and advice on best practices for research with communities. Community partners, including the Center for Youth Wellness, a program of Safe and Sound, are facilitating focus groups. Additionally, the team is connecting with the California Health Collaborative and the Fresno Community Health Improvement Partnership to set up a clinical site in Fresno that would allow

for study-related research and data collection. The SYSTEMATIC team also provides training for students in the master's program in Public Health at University of San Francisco and the Community Health & Prevention Research master's program at Stanford in addition to a 2- or 4-week research elective through the Department of Medicine. In 2023, the team will continue to focus on recruitment and the development and implementation of the multidisciplinary Toxic Stress Assessment Profile.

# Cancer Disparities Research Projects

In the 2017/2018 budget, California allocated \$9 million to fund precision medicine demonstration projects that address cancer disparities using a precision medicine lens. With the help of a selection committee made up of out-of-state experts, CIAPM granted three research teams \$3 million each to investigate the causes of and potential solutions to higher rates of cancer mortality in California's Latinx and Hispanic communities. The original project period was three years; all three teams were granted a one-year no-cost extension to accommodate delays caused by the COVID-19 pandemic and will complete their work by the end of 2023.

## **Addressing Disparities in Breast Cancer in Latinas: A multi-tiered approach (2019-2023)**

Lead Principal Investigator: Dr. Elad Ziv, UC San Francisco

Partners: Bay Area Cancer Connections; City of Hope; Promoters for Better Health; The Latino Cancer Institute; UC Davis; Vision y Compromiso; Zuckerberg SF General Hospital

More Latinas die of breast cancer than of any other type of cancer. Latinas tend to be diagnosed at later stages and have higher mortality rates than non-Latina women. These disparities are partly due to external factors like barriers to screening and appropriate tests. Genetic testing for breast cancer susceptibility genes can help identify the highest risk women for prevention and earlier detection. The healthcare

system may be able to address some of these social drivers of health through community health education efforts that lead to improved screening and increased access to genetic testing. However, researchers need to further examine the genetic factors that contribute to higher rates of mortality among Latinas who have breast cancer, and determine if existing tests, which were designed largely without Latina patients and samples, are sufficient to accurately assess risk and optimize treatments.

In order to test if a community education program about hereditary breast cancer, paired with navigation services, could identify women at greater genetic risk of developing breast cancer, the research team developed and implemented a program in which trained community health workers, or promotores, hold sessions with community members to inform them about how family history of breast cancer could be an indication that they are more likely to develop the disease. Since 2019, the program, Tu Historia Cuenta (Your Story Matters), has recruited and trained 24 promotores, who have held educational sessions with over 1300 community members, reaching their enrollment target. Of those, 1,100 completed family histories and 82 of those, or about seven percent, met the criteria to be referred to a genetic counselor. Through the end of 2022, 20 women were referred and received genetic testing. Six women so far have tested positive for genes that commonly predict breast cancer. The research team is working to set up genetic counseling, testing, and result reporting for the remaining project participants who were identified as high risk.

Dr. Ziv and his research team are also enrolling Latina women with breast cancer and testing their germline (inherited) cell DNA to identify new genes that may be involved in breast cancer risk in this population. They are also



testing the DNA of the tumors which harbor non-inherited genetic changes that can affect treatment, to see which of these genetic changes are common among Latinas. They have found a few genes that, in Latinas, predict an increased risk of developing breast cancer better. In the future, clinicians may be able to use this information to recommend a more rigorous screening plan for Latinas with these variants. The functions of the identified genes also suggest a certain treatment to which these specific types of cancer may be susceptible.

In 2023, Dr. Ziv and his team plan to analyze new data on inherited breast cancer genetic variants from over 2,500 Latina breast cancer cases. They will also analyze over 700 breast tumors from Latina women to identify new genetic changes that these tumors have gained and determine how these changes affect outcomes.

### **Integrated Machine-Learning Platform to Inform Precision Therapy in Underrepresented Triple-Negative Breast Cancer Patients (2019- 2023)**

Lead Principal Investigators: Dr. William Kim and Dr. Pablo Tamayo, UC San Diego

Partners: American Cancer Society; Cancer Resource Center of the Desert; El Centro Regional Medical Center; Michigan State University; Moores Cancer Center; Quality Partners; Rady Children's Hospital; San Diego State University; Sanford Burnham Prebys Medical Discovery Institute; University of Guadalajara

Despite recent progress in the development of new cancer medications, Triple-Negative Breast Cancers (TNBCs) remain largely untreatable. TNBC tumors grow faster and are

more likely to metastasize than other breast cancers, leading to higher mortality rates. TNBCs are prevalent among Hispanic women, representing a major health disparity in cancer diagnosis and treatment. Project CELSUS applies precision medicine genomic profiling to identify new treatments and match TNBC tumors with existing cancer therapies. The project is named after Aulus Cornelius Celsus, a first-century Roman-Greek scholar who was an early proponent of evidenced-based medicine.

Since 2019, Drs. Kim and Tamayo have been working to compile data about TNBC tumor cells across several sources, and add their own data as they collect tumor samples from hospitals and clinics. Many of these samples are from Hispanic women, who are underrepresented in existing TNBC databases, which means that existing research conclusions may not be as applicable to Hispanic women as they are to women of European ancestry. The public database they are creating will allow a high-powered analysis and identification of molecular signatures indicating the tumor's activity. By classifying the tumors into distinct states, based on their molecular activity, they will be able to test hypotheses and better understand the mechanisms by which TNBC cells evade treatment, and what types of drugs might best treat tumors and in which state, including those resistant to treatment. The research team has tested drugs both alone and in combination, and has observed some promising results. Notably, these promising combinations include drugs that are already on the market, so discoveries that lead to better outcomes could be used in the clinic by repurposing them, therefore avoiding delays from further development and FDA approval.

The technology that Drs. Kim and Tamayo are using to analyze tumor samples is cutting-edge. As with any organ,

cells in one tumor are not all the same. The UCSD team can measure cellular activity from a single tumor cell, instead of average measurements across all cell types. Using this technique is giving them a much more fine-grained understanding of tumors, and will hopefully lead to a future in which clinicians can make better treatment recommendations.

In addition to the molecular analysis of tumor samples from Hispanic women who have TNBC, the UCSD research team, in partnership with the Institute for Public Health at San Diego State University, is in the process of publishing a report on the lived experiences of Hispanic TNBC patients. After reviewing 48 interested parties, including patients and caregivers, clinicians, researchers, social workers, and patient navigators, the team compiled qualitative responses about the emotional impact of a TNBC diagnosis, lack of support for those with limited English proficiency, racial biases, and barriers to clinical care and participation in clinical trials, among other topics. The report will be made available to the interested parties.

In 2023, Drs. Kim and Tamayo will use the modeling capabilities they developed to study the most common TNBC cellular and tumor state transitions by investigating cell-level activity before and after cancer treatment. This work will provide important information about how tumor cells become resistant and reoccur.

**Reducing Cancer Disparities Through Innovative Community-Academic Partnership to Advance Access and Delivery of Precision Medicine in Monterey County (2019-2023)**

Lead Principal Investigator: Dr. Manali Patel, Stanford University

Partners: Cancer Patients Alliance; Clinica de Salud del Valle de Salinas; Community Hospital of Monterrey Peninsula; Natividad Medical Center; Pacific Cancer Care; The Latino Cancer Institute

Low-income and racial and ethnic minority populations experience disproportionately high rates of cancer incidence and mortality, lower rates of evidence-based cancer care, and increased burden of untreated symptoms compared with more affluent and White populations. The objective of the ALCANCE (Addressing Latinx CANcer Care Equity) project is to develop, implement, and evaluate community health worker-led interventions to increase access to and delivery of precision medicine across the cancer care continuum from prevention and screening to cancer diagnosis, treatment, survivorship, and end-of-life.

In 2022, Dr. Patel and her team accomplished several deliverables, including completing the enrollment of 150 participants in a cancer screening and prevention study at Clinica de Salud del Valle de Salinas (CSVS), a Federally Qualified Health Center. Participants completed a baseline survey to measure their knowledge, beliefs, and risk related to cancer, and reviewed their family health history with community health workers (CHWs). The CHWs referred participants with high risk to genetic counseling and when appropriate, genetic testing. The research team also developed and implemented an administrative protocol and trained physicians at the clinic on the genetic testing and referral processes. Invitae, the company responsible for administering the tests, offered post-test counseling, and CHWs assisted patients with access to this service.

Dr. Patel's team also continued their work on a randomized controlled trial at Pacific Cancer Care, a community

oncology clinic in Monterey County. The research team screened approximately 1,400 patients for eligibility and enrolled 110 in the ongoing study, which seeks to evaluate whether CHWs can improve knowledge of precision targeted therapies and precision medicine as well as receipt of such care. CHWs also discuss basics of cancer diagnosis and treatment, patients' goals, values, and preferences for care, advance directives, and surrogate decisionmakers. CHWs also deliver patient navigation services, such as assistance with insurance and paperwork, registration for social programs such as CalFresh, and connection to community resources for other identified health-related social needs. Participants are predominantly low-income Latinx patients who have attained less than a high school education. Research participants complete a staff-administered initial survey, and are resurveyed three, six, and twelve months later to assess the effectiveness of the intervention to improve knowledge of precision medicine, patient understanding of cancer diagnoses and treatment options, and advance care planning. Clinicians review electronic health records for each patient 12 months after their enrollment in the study to assess the impact on precision medicine cancer care receipt (e.g., molecular testing, genomic testing, and treatment), the current standard of care including chemotherapy, radiation, and surgery, and emergency department visits and hospitalizations.

Throughout the project, the research team engaged the project's Community Advisory Board (CAB), which includes members from the state legislature, industry, academia, clinical care, and philanthropy, in addition to current patients with cancer and survivors from cancer. The CAB received project updates from the research team and discussed programmatic sustainability beyond the CIAPM-funded period.

In 2023, the research team will complete the randomized controlled trial at Pacific Cancer Care and the prevention and screening project at CSVS. They will also finalize and disseminate the resources and precision medicine educational materials they developed and share their results in academic publications and presentations.

# Depression Research Program

CIAPM was allocated \$10 million in the 2022–2023 budget to fund 3–5 demonstration research projects that use a precision medicine approach for the prevention, diagnosis, and/or treatment of depression in populations that experience the disease at disproportionate rates. CIAPM staff began to engage with external partners, the Precision Medicine Advisory Council, the legislature, and fellow members of the Newsom Administration in the early development of the Request for Proposals, which is scheduled to be released in 2023.

## Former Projects Overview

The first eight CIAPM-funded demonstration research projects concluded in December 2018. CIAPM continues to collect and report on the ongoing impact of the work. Summaries about the first eight projects are listed in Appendix B. Detailed reports about the first eight projects can be found in the [2019 Evaluation Report to the California Legislature](https://www.opr.ca.gov/ciapm/docs/reports/20200327-Evaluations_Report_CIAPM_Projects_2015-2018_update.pdf).<sup>1</sup>

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1 [https://www.opr.ca.gov/ciapm/docs/reports/20200327-Evaluations\\_Report\\_CIAPM\\_Projects\\_2015-2018\\_update.pdf](https://www.opr.ca.gov/ciapm/docs/reports/20200327-Evaluations_Report_CIAPM_Projects_2015-2018_update.pdf)

# PROGRAM HIGHLIGHTS

## Representative Research Collaborative

In 2022, the Legislature approved Governor Newsom's budget proposal to launch a cross-sector program to improve the equitable application of health research. The effort will encourage more Californians from underrepresented backgrounds to participate in biomedical research, thereby promoting more health solutions that benefit all communities, particularly those which have been underserved.

Starting in 2023, CIAPM will onboard specialized staff and begin designing the multi-year effort in collaboration with fellow agencies and organizations across government, academia, and non-profits to study strategies, develop new materials, engage community-based organizations and leaders, and implement evidence-driven informational campaigns. The program aims to galvanize interest and action in research participation among historically underrepresented communities, including those with racially diverse backgrounds, those who are older, people who identify as LGBTQ, rural residents, youth, and/or Californians with physical or developmental disabilities.



# California Precision Medicine Asset Inventory

The California Precision Medicine Asset Inventory (<https://opr.ca.gov/ciapm/resources/asset-inventory.html>) is a database and mapping tool of precision medicine related resources, projects, researchers and others. The asset inventory can be used by researchers, clinicians, and community partners to foster relationships between diverse networks of precision medicine professionals. The interactive tool has a user-friendly interface that allows individuals to add and update their organization's entries. CIAPM encourages users to search through hundreds of included assets to find collaborators for future partnerships throughout the state.

## Network Engagement & Outreach

In addition to funding research demonstration projects, California established CIAPM to coordinate public, private, and nonprofit partners and bring together state precision medicine leaders. Indeed, without CIAPM California would miss a valuable opportunity to take full advantage of the state's world-class, cross-sector precision medicine network that, when connected, might advance precision medicine more than it could while siloed.

To bolster California's precision medicine network in 2022, CIAPM increased engagement with the Legislature, hosted both current and former grantees for an All-Teams Meeting, participated in several conferences including the Precision Medicine World Conference, and implemented a vigorous communication strategy including publishing newsletters and social media posts.

## Outreach to the Legislature

CIAPM increased outreach activities to the legislature to provide information on programmatic activity and impact, often by providing information specific to individual legislative districts. Staff met with legislative offices to provide tailored briefings and an overview of precision medicine, the initiative, and CIAPM's investment in their district, when applicable.

CIAPM also held a virtual briefing providing an overview of the 2021 annual report for legislators and their staff, and delivered printed copies of the report and individualized one-pagers to legislators. The one-pagers provided information about CIAPM-funded projects, and the upcoming launch of the Representative Research Collaborative and the Depression Research Program. Staff also worked with the Senate Mental Health Caucus to gather background information in preparation for the Depression Research Program. CIAPM will continue to engage the legislature, foster awareness of the initiative and its work, and highlight opportunities for involvement, such as event announcements and program impacts.

## 2022 CIAPM All-Teams Meeting

For the first time since the start of the COVID-19 pandemic, CIAPM hosted nearly 50 members of the Initiative's network for an All-Teams Meeting that showcased current and former CIAPM-funded researchers, members of Governor Newsom's Cabinet, and California Precision Medicine Advisory Council members. Attendees had the opportunity to network, present research findings, and discuss best practices in community engagement and data management.

The half-day event was generously hosted by the California Endowment with a reception sponsored by California Life Sciences and the Sierra Health Foundation.



## Precision Medicine World Conference



CIAPM staff hosted a booth at the Precision Medicine World Conference 2022 in Santa Clara.

CIAPM continued its substantial participation at the Precision Medicine World (PMWC) Conference in Silicon Valley, one of the world's largest gatherings of commercial, academic, government, venture capital, and non-profit actors in precision medicine. Each year, the conference features presentations on the latest advances in technology, clinical implementation, and research; industry showcases; and recognition of giants in the field. More than a dozen of CIAPM's Advisory Council, community partners, and funded researchers were central figures -- chairing sessions, delivering presentations, and moderating panels.

In a session dedicated to CIAPM-funded researchers, UCSD's Dr. William Kim and Stanford University's Dr. Michael Snyder presented on their projects related to cancer disparities and ACEs, respectively. CIAPM Co-Director Dr. Julianne McCall also moderated the panel "Past, Present, and Future: How will we manage the next pandemic?" The panel featured California State Public Health Officer Dr. Tomás Aragón, Stanford University Pediatric Infectious Diseases Division Chief Dr. Yvonne Maldonado (also a CIAPM Advisor), Fred Hutchinson Cancer Research Center President and Director Emeritus Lawrence Corey, and UCSF Department of Medicine Chair Robert Wachter.

CIAPM's standing at PMWC thus continuously increases global regard for California and its first-in-the-nation government program, and broad cognizance of California's unique leadership in driving precision medicine research and cultivating cross-sector collaboration.

CIAPM also annually staffs a prominently featured booth at the World Conference; in 2022, staff, fellows, and interns publicized the upcoming funding opportunities for depression research and equitable participation in research.

The booth also further increased CIAPM's visibility and created new connections with and between biotech, academia, labs, and information management and data systems providers that enable it to continue to deliver on its statutory mandate. CIAPM's outreach, furthermore, increased awareness and use of its Precision Medicine Asset Inventory, laying a permanent foundational network of research projects, data sets, community organizations, and industry that will further build out California's already profound and rapidly expanding precision medicine ecosystem.

## Newsletter

CIAPM continued to release bimonthly newsletters, providing its network of about 1,200 recipients with updates and opportunities for involvement. The newsletters shared key announcements, provided meeting summaries, introduced new staff, and highlighted upcoming events. In addition, they included updates from the California Precision Medicine Advisory Council and provided information on Governor Newsom's budget proposals and the legislature's key actions. New for 2022 was a series of Investigator Spotlights in which CIAPM-funded researchers detailed the goals of their demonstration projects and respective accomplishments, and shared how CIAPM-funded projects stimulate cross-sector partnerships.

Newsletter issues are publicly available and archived on the [CIAPM website](https://www.opr.ca.gov/ciapm/activity/news.html#newsletters)<sup>1</sup>.

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1 <https://www.opr.ca.gov/ciapm/activity/news.html#newsletters>

# Social Media

CIAPM utilized social media to keep the public informed of important announcements, upcoming meetings, general precision medicine news, and research updates. Working closely with the Governor's Office of Planning & Research communications team, CIAPM created content that was both informative and engaging. Posts showcased demonstration project team breakthroughs, partnership opportunities, and professional achievements from Advisory Council Members.





The impacts of mental health challenges demand new and resourceful approaches. Applying modern technology can help, and CIAPM grant recipient Dr. @GeorgeSlavich is leading the way. Read more about his vision for the future at



10:59 AM · Dec 22, 2022 · 691 Views



Join the Oct. 12 meeting of the CA Precision Medicine Advisory Council Working Group on Data Integration for Social Determinants of Health, featuring a discussion with Mike Valle, Chief Information Officer of the CA Dept. of Health Care Access & Information.

**California Initiative to Advance Precision Medicine**

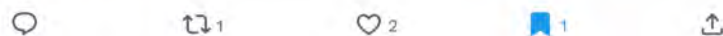
Public Meeting of the California Precision Medicine Advisory Council Working Group on Data Integration for Social Determinants of Health

Featuring Mike Valle, Chief Information Officer of the CA Department of Health Care Access and Information

Wednesday, October 12, 2022 | 2:30 - 4:00 pm PT

<https://governorca.zoom.us/meeting/register/tZcqO6rqTkpEUJoeqkBwbvBNzCaMrYVBZfd>

6:07 PM · Oct 5, 2022



## Invited Talks and Sessions

CIAPM ramped up its outreach in 2022, increasing its efforts to engage with diverse audiences and spark conversations surrounding precision medicine. Dr. Julianne McCall and Dr. Shannon Muir traveled throughout the state and beyond, delivering talks on subjects including social determinants of health, precision medicine policy priorities, future pandemic management, and equity in science. The full list of these talks can be found in Appendix D and E. CIAPM continues to foster connection and collaboration in alignment with its goal of fostering partnerships between the state, researchers, patients, communities, and industry to promote better health outcomes.

## Interagency Cooperation

Throughout 2022, CIAPM staff served several interagency efforts toward reducing health disparities and addressing top priorities of Governor Gavin Newsom's Administration, including:

1. California Surgeon General's Trauma-Informed Primary Care Advisory Committee (member)  
Advises the Surgeon General and California Health & Human Services Agency on promising models, best practices, evolving science, and clinical expertise for the implementation of trauma-informed care systems
2. CA Essentials for Childhood Initiative Consortium (member)  
Addresses child maltreatment as a public health issue and aims to (1) raise awareness and commitment to promote safe, stable, nurturing relationships and environments; (2) create the context for healthy children and families through social norms change, programs, and policies; and (3) uses data to inform actions



3. California Health in All Policies Task Force (member)  
Identifies priority programs, policies, and strategies to improve the health of Californians while advancing the goals of improving air and water quality, protecting natural resources and agricultural lands, increasing the availability of affordable housing, improving infrastructure systems, promoting public health, planning sustainable communities, and meeting climate change goals
4. Governor's COVID-19 Testing Task Force (member)  
Seeks to reduce transmission of COVID-19 and support public health by improving accessibility, equity, timeliness, and sustainability of testing
5. OPR Tribal Affairs Working Group (member)  
An agency-wide cohort of programmatic staff with experience or interest in engaging tribal communities as leaders, partners, and grant candidates and recipients

## **Racial Equity Action Plan Development**

In 2022 the Governor's Office of Planning and Research (OPR) engaged in the planning and development of actions to advance racial equity. As part of this effort, all programs within OPR, including CIAPM, participated in the Racial Equity Action Plan (REAP). As CIAPM's liaison, Dr. Alexandra Colón-Rodríguez worked with the REAP leadership to guide the process of identifying and selecting three action items for 2023-2024. The team reviewed existing strategies and underwent a process of expanding and refining new proposals, including those listed below:

1. To create a series of toolkits for researchers, research and health care funders, patients, and admin/clinic staff to boost equitable consent practices

2. Increase the engagement of racially diverse patient advocacy groups and interested parties across all CIAPM programming
3. Work with OPR leadership in refining recruitment practices to increase representation of geographic, ethnic, and racial diversity and historically marginalized populations in government office leadership

These ongoing efforts are a small part of OPR's wider efforts towards advancing racial equity.

## Impact Assessment: Workforce Development

As part of an ongoing impact assessment spanning programmatic engagements and achievements since 2015, CIAPM is developing an overview of the initiative's accomplishments and advancements using innovative models for community partnerships in health research. The site will also highlight the ways CIAPM's research has affected communities, scientific understanding, healthcare, and Californians' lives. Insights will be released in phases and updated as projects proceed. To date, the initiative has funded 18 community-based demonstration research projects and continues to support cross-sector collaborations and build public resources. All of these activities share a common goal: to encourage a more equitable and patient-centered healthcare ecosystem.

In line with the legislature's encouragement to strengthen workforce development in precision medicine<sup>1</sup>,

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<sup>1</sup> At the September 2019 Informational Hearing of the Assembly Select Committee on Biotechnology, CIAPM Co-Directors provided testimony and responded to legislators' questions and comments about the field of precision medicine and the program. Among several insightful conversations, members of the committee expressed keen interest in boosting the program's efforts toward workforce development.

CIAPM introduced its internship program in 2019. Since then, CIAPM has directly trained and supported 13 graduate student interns and two PhD-level science and technology policy fellows, who are recruited, selected, and supported by the California Council on Science & Technology<sup>1</sup>.

Interns and fellows are recruited through an expansive outreach effort exceeding targeted invitations to approximately 80 academic programs, followed by a competitive selections process. Over 300 applications have been submitted to CIAPM, averaging about 25 applicants per internship opening. Over the course of four months or longer, interns apply and broaden their skill sets by supporting the implementation of CIAPM programs, developing proposals, and creating communication materials and resources to convey the value and importance of precision medicine to a variety of audiences.

This program runs independently of and in parallel to research project-based trainees at universities, nonprofits, and clinics across California, including students, fellows, and residents. These students draw on diverse disciplines, ranging from life sciences, business, communications and graphic design, and public health to apply their academic backgrounds and lived experience to the precision medicine field and gain policy experience. Featured below are quotations from several interns and fellows.

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<sup>1</sup> Read more about the California Council on Science and Technology Policy Fellowship program at [www.ccst.us](http://www.ccst.us).

*“My passion for precision medicine, healthcare, and the advancement of these fields together spurred my interest in CIAPM... and it remains one of the highlights of my policy career thus far.”*

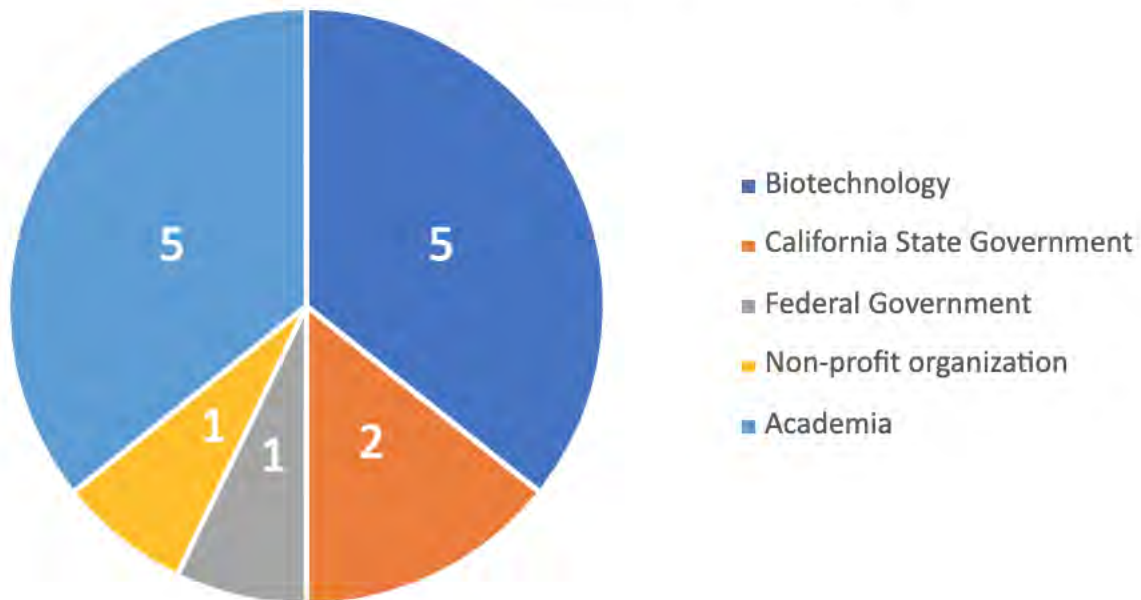
*– Nichole Holm, PhD, former CIAPM Intern and current Policy Fellow with the American Society for Human Genetics*

Students have represented a range of universities, including UC Davis, Sacramento State University, UC Riverside, Charles Drew University, UC Los Angeles, Claremont Graduate University, and others. Former interns and fellows have gone on to complete degrees and pursue impactful careers, including in government, non-profits, and the private sector.

*“I have worked in the scientific field of trauma and post-traumatic stress disorder for a long time. I was interested in how the government addresses mental health and initiatives aimed at improving mental health. More broadly, I was interested in working in a more public facing field addressing public health and community resourcing. Working with CIAPM greatly expanded my horizons around precision medicine and medicine writ large. I believe my fellowship experience will continue to benefit me throughout my career.”*

*– Ken McCullough, PhD, former CCST Science and Technology Policy Fellow and current Sr. Manager of Pharmacology at Jazz Pharmaceuticals*

## Current Positions of CIAPM Interns



The internship program contributes to CIAPM’s goals of advancing equity in the state in many ways, including uplifting trainees from underrepresented backgrounds in science and policy, such as individuals with first-generation immigrant status, who identify as LGBTQ+, living with a disability, and/or from underserved communities. Interns provide unique perspectives, leading to fresh ideas, improved work environments, and new approaches to complex challenges.

To see all current and former members of the CIAPM Team with brief biographies, navigate to the About Section of the CIAPM website, [www.opr.ca.gov/ciapm](http://www.opr.ca.gov/ciapm).

# CALIFORNIA PRECISION MEDICINE ADVISORY COUNCIL

The California Precision Medicine Advisory Council was established in 2020 to advise and make recommendations to OPR on matters related to the initiative. The 11-member council is comprised of precision medicine experts from a broad range of backgrounds and sectors, including academia, government, industry, finance, patient advocacy, and clinical care; one member was nominated by the Assembly and another by the Senate. The council meets quarterly for discussions and updates on CIAPM's programs and projects, and has two working groups: Data Integration and Equitable Consent.

## Data Integration Working Group

The eight members of the Advisory Working Group on Data Integration for Social Determinants of Health engaged a number of state officials who are leading statewide efforts to improve the use, confidentiality, storage, sharing, and interoperability of health and other data reflective of Californians' wellbeing. With evidence linking socioeconomic status to health outcomes, strategies have been developed to tailor care to underlying conditions that evoke illness and disability, such as food insecurity, housing instability, and poor access to health care. Instead of promoting the continued treatment of poor health, precision medicine identifies and treats the root causes, physical or otherwise.

This working group is furthering its effort to ensure that critical data is included in electronic health records (EHRs), guiding clinical decision making and improving quality of care. Entities involved with these efforts include the California Health and Human Services Data Exchange Framework, the California Department of Health Care Access and Information All Payer Claims Database, and the Coleridge Administrative Data Research Facility.

Throughout the year, state leaders joined the Working Group for public discussions, including John Ohanian, Hal Richardson, and Mike Valle. Topics included the HHS Data Exchange Framework, the HCAI All-Payer Claims Database, and Cal-AIM.

## **Equitable Consent Working Group**

The advisory council established the Equitable Consent Working Group to increase transparency and equity regarding the consent process for participants in clinical research. Due to historical, cultural, economic, and geographical factors, some communities participate in clinical research at lower rates than others, resulting in medical prevention strategies, diagnostics, and treatments that don't work as well or have more side effects in some populations. For the consent process to be truly equitable, researchers need to invest in authentic community engagement strategies prior to recruitment so that the participant pool is as diverse as possible. The Equitable Consent Working Group is creating, for clinical research partners including sponsors, researchers and their staff, clinicians, and community members, a website which will have curated best practices for clinical research community engagement, consent, enrollment, and retention for underrepresented groups. With additional guidance from several external partners including those

from industry, patient advocacy groups, academics, and more, the working group has finished generating content for researchers and community members, and is in the process of building the website to host the information.



# LOOKING AHEAD

Through strategic investment by the California State Legislature and the Newsom Administration, CIAPM has funded impactful precision medicine research projects that use an innovative model which prioritizes patients and research participants as partners, and has created a cross-sector community of California's precision medicine practitioners that can work together to address some of the state's most pressing health issues. Going forward, CIAPM will continue to support and launch new precision medicine demonstration projects that further health equity; increase the scope and impact of our work through new programs; and engage our network to share our progress and solicit guidance on ways in which CIAPM can strengthen its role as a unique and valuable asset to the state.

## **Demonstration projects**

- Launch the RFP for research that uses a precision medicine lens to study the prevention, diagnosis, and treatment of depression
- Continue to administer the seven ACEs research projects
- Oversee the completion of the cancer disparities project

## **Expanded scope of work**

- Launch the Representative Research Collaborative, in partnership with the National Institutes of Health, to encourage increased participation by underrepresented communities in clinical research
- Hire and train specialized staff that bring new expertise and perspectives to CIAPM's team

### **External engagement**

- Expand strategic outreach to community leaders, external experts, and others to highlight accomplishments and seek feedback to inform our work
- Support new federal programs like the Advanced Research Projects Agency for Health (ARPA-H) to ensure California's world-class community of precision medicine scientists, engineers, and patients are involved in setting agendas and implementing paradigm-shifting research

In addition, CIAPM will carry on the implementation of OPR's racial equity action plan, and foster the professional development of student interns and fellows, training the next generation of precision medicine leaders.

# APPENDICES

## Appendix A. New Publications, Presentations, and Press Coverage of Currently Funded Projects

### A Multi-Component Intervention to Strengthen Families and Build Youth Resilience (2021-2024)

Lead Principal Investigator: Dr. Ariane Marie-Mitchell, Loma Linda University

#### Presentations

1. Marie-Mitchell, A. "Building Resilient Families through Pediatric Practice." Invited Keynote Speaker, ACEs Wellness Summit, Sierra Community Medical Foundation (Rocklin, CA), September 2022.

#### Websites

1. Information related to the Whole Child Assessment, <https://lluch.org/health-professionals/whole-child-assessment-wca>

### The Collaborative Approach to Examining Adversity and Building Resilience (CARE) Program (2021-2024)

Lead Principal Investigator: Dr. Neeta Thakur, University of California, San Francisco

#### Abstracts

Erika Cagampan, Morgan Ye, Danielle Hessler, Neeta Thakur. Pediatric adverse childhood experiences and 1. related life events screener (PEARLS) as an individual predictor of child executive function. UCSF Student Research Symposium May 2023. San Francisco, CA (manuscript in preparation)

#### Publications

1. de la Rosa, R., Zablony, D., Ye, M., Bush, N. R., Hessler, D., Koita, K., Bucci, M., Long, D., & Thakur, N. (2023). Biological Burden of Adverse Childhood Experiences in Children. *Psychosomatic medicine*, 85(2), 108–117. <https://doi.org/10.1097/PSY.0000000000001167>

#### Presentations

1. PEARLS study findings and introduction of the CARE Program at the UCSF Pediatric Grand Rounds in January 2022: [https://youtu.be/hc7A\\_PY4nYY](https://youtu.be/hc7A_PY4nYY)

### Using Precision Medicine to Tackle Impacts of Adverse and Unpredictable Experiences on Children's Neurodevelopment (2021-2024): The SoCal Kids Study

Lead Principal Investigator: Dr. Tallie Z. Baram, University of California, Irvine

#### Publications

1. Birnie MT, Baram TZ. Principles of emotional brain circuit maturation. *Science*. 2022 Jun 3;376(6597):1055-1056. doi: 10.1126/science.abn4016.

2. Lindert NG, Maxwell MY, Liu SR, Stern HS, Baram TZ, Davis EP, Risbrough VB, Baker DG, Nievergelt CM & Glynn LM. (2022) Exposure to unpredictability and mental health: Validation of the brief version of the questionnaire of unpredictability in childhood (QUIC) in English and Spanish. *Frontiers in Psychology*.

3. Liu SR, Glynn LM. The contribution of racism-related stress and adversity to disparities in birth outcomes: evidence and research recommendations. *F S Rep*. 2021 Nov 18;3(2 Suppl):5-13. doi: 10.1016/j.xfre.2021.10.003.

4. Bolton JL, Short AK, Othy S, Kooiker CL, Shao M, Gunn BG, Beck J, Bai X, Law SM, Savage JC, Lambert JJ, Beilelli D, Tremblay ME, Cahalan MD, Baram TZ. Early stress-induced impaired microglial pruning of excitatory synapses on immature CRH-expressing neurons provokes aberrant adult stress responses. *Cell Rep*. 2022 Mar 29;38(13):110600. doi: 10.1016/j.celrep.2022.110600.

## **Presentations at Professional Conferences**

1. Baram, T.Z., (January). How Early-Life Adversity Impacts Cognitive and Emotional Health: Causality, Mechanisms, Novel therapies, Paper presented in: Uniformed Services University, Dept. of Pharmacology.
2. Baram, T.Z., (February). Learning About Life: Curiosity, Adversity, and Leveraging Early Brain Plasticity, Virtual panel presentation in: AAAS Annual Meeting.
3. Baram, T.Z., (March). Molecular and Circuit Mechanisms by which Early-life Adversity Impacts Reward seeking Behaviors are Sex-Dependent, Paper presented in: The 3rd Munich Winter Conference on Stress.
4. Baram, T.Z., (April). Addressing Developmental Epileptogenesis: Tackling A Moving Target, Paper presented in: World Wide Neuro Lecture Series on Experimental Epilepsy.
5. Baram, T.Z., (April). Disruption of Brain Maturation by Early-Life Adversity: Circuits, Molecules and Disease Vulnerabilities, Paper presented in: Einstein College, Neuroscience Department Seminar.
6. Baram, T.Z., (April). How Early-Life Experiences Shape Our Brain: Signals, Synapses Circuits, Behaviors, Virginia Tech, Paper presented in: Pioneers in Biomedical Research Seminar Program.
7. Baram, T.Z., (June). Early-Life Experiences And Mental Health Disorders: From The Clinic To The Lab And Back, Paper presented in: McGill University, AMH Seminar Series.
8. Baram, T.Z., (June). Acute trauma, Memory and Sex: Low Estrogen Protects Female Mice From The Memory-Disrupting Effects Of Multiple, Concurrently Occurring Acute Stresses, Paper presented in: 33rd CINP Hybrid World Congress of Neuropsychopharmacology.
9. Baram, T.Z., (June). How Early Life Experiences Modulate the Development of Brain Circuits, Paper presented in: Functional Neurological Disorder Society's 4th International Conference.
10. Liu, S.R., & Glynn, L., (June). The Contribution of Racism-Related Stress and Adversity to Disparities in Birth Outcomes: Evidence and Research Recommendations. Paper presented in: Perinatal Adversity as a Determinant of Childhood Health Problems: Implications for Prevention, Society for Prevention Research Annual Meeting.
11. Baram, T.Z., (July). Plasticity & Dysfunction Of Hypothalamic CRH-Neurons Induced By Early-Life Adversity: Microglia And Single-Cell Transcriptomics, Paper presented in: Gordon Research Conference on Hypothalamus.
12. Baram, T.Z., (August). Adaptation Of CRH Stress Circuitry During Early Life Adversity, Keynote Speech in: REGPEP24: Stirling, Scotland.
13. Baram, T.Z., (September). How Early-Life Experiences Are Encoded: Role Of The PVT, Paper presented in: Flux Society, International Meeting, Paris, France.
14. Baram, T.Z., (October). A Small Woman's Guide to the Academic Galaxy, Presented in: Columbia University, Wise Initiative.
15. Baram, T.Z., (November). Symposium organizer and speaker; study group speaker, American College of Neuropsychopharmacology (ACNP)
16. Baram, T.Z., (November). A Neuroscience Student Guide to the Academic Galaxy, Presented in: UCI Interdepartmental Neuroscience Program.
17. Baram, T.Z., (November). The 4-Dimensional Brain in Mental Health and Illness, UCI, Nu Rho Psi.

18. Baram, T.Z., (November). ACES Symposium, Presented in: California Initiative to Advance Precision Medicine (CIAPM).
19. Baram, T.Z., (November). Precision Medicine And Clinical Practice, Presented in Children's Hospital of Orange County Research Day 2022.
20. Baram, T.Z., (November). Why Brain Research is Important for Pediatricians: Real World Example, Presented in: UCI, Pediatrics Department.
21. Lindert, N., Maxwell, M., Liu, S., Stern, H., Baram, T., Golden, C., Weiss, M., Ehwerhemuepha, L., Glynn, L. (November). Screening For Unpredictability In Childhood In CHOC Primary Care Clinics. Children's Hospital of Orange County Research Day 2022.
22. Liu, S.R., Lucas, C.T., Maxwell, M., & Glynn, L., (November). Elevating Key Perspectives from Parents and Healthcare Providers to Improve ACEs Research: Findings from the SoCal Kids Study, Poster presented in: Children's Hospital of Orange County Research Day 2022.
23. Maxwell, M., Lindert, N., Liu, S., Stern, H., Baram, T., Golden, C., Weiss, M., Ehwerhemuepha, L., Glynn, L., (November). Screening For Toxic Stress Exposures In CHOC Primary Care Clinics, Poster presented in: Children's Hospital Orange County Research Day 2022.

### **Public Outreach and Education**

1. Liu, S.R. (May). Understanding and Addressing Adverse Childhood Experiences in Healthcare for Under-served Communities. Student National Medical Association Lecture, University of California Irvine School of Medicine, CA.
2. Liu, S.R. (February). ACEs and Pediatric Health Equity, Health Equity Across the Life course (HEAL) Grand Rounds, University of California Irvine, CA
3. Baram, T.Z. (March). The California Initiative to Employ Precision Medicine to Address ACEs: Integration with the Conte Center. UCI Conte Center 9th Annual Symposium.
4. Baram, T.Z., (May). How Early-life Adversities Shape Adult Behaviors: From the Clinic to the Lab and Back. School of Medicine Dean's Research Council.
5. Lucas, C.T. (October). Maternal-Child Health Inequities and Anti-Black Racism. UCI/CHOC Pediatric Residency Program Noon Conference.
6. Lucas, C.T. (November). Health Equity Talk on Anti-Black Racism and Child Health. UCI School of Medicine, Pediatrics Interest Group.

### **Press Coverage**

1. **NPR Academic Minute** Podcast featuring Dr. Tallie Z. Baram discussing her research on early life adversity, microglia dysfunction, to aberrant adult stress responses, and mental illness. The Academic Minute - Astronomy to Zoology
2. **Press release** Predictable and consistent parental behavior is key for optimal child brain development, TheConversation.com
3. **Press release** UCI research finds parents' unpredictable behavior may impair optimal brain circuit formation. School of Medicine, University of California, Irvine
4. **Press coverage** Why having an unpredictable childhood can be traumatizing, Salon.com

## **Advancing a Precision Population Health Approach to ACEs to Reduce Health Disparities (2021-2024)**

Lead Principal Investigator: Dr. Gary S. Firestein, UC San Diego

## **Scalable Measurement and Clinical Deployment of Mitochondrial Biomarkers of Toxic Stress (2021-2024)**

Lead Principal Investigator: Dr. Pat Levitt, Children's Hospital Los Angeles

## **Identifying Social, Molecular, & Immunological Processes for Mitigating Toxic Stress & Enhancing Personalized Resilience (2021-2024)**

Lead Principal Investigator: Dr. George Slavich, UCLA

### **Press Coverage**

1. **Press release** UCLA researcher says focused research and treatment guidelines are needed to ensure 'behavioral psychedelics' help patients make lasting, positive change, UCLA Health News & Insights

### **Publications**

1. Slavich, G. M. (2022). Social Safety Theory: Understanding social stress, disease risk, resilience, and behavior during the COVID-19 pandemic and beyond. *Current Opinion in Psychology*, 45:101299. doi: 10.1016/j.copsyc.2022.101299
2. Slavich, G. M., Roos, L. G., & Zaki, J. (2022). Social belonging, compassion, and kindness: Key ingredients for fostering resilience, recovery, and growth from the COVID-19 pandemic. *Anxiety, Stress, & Coping*, 35, 1-8. doi: 10.1080/10615806.2021.1950695.
3. Neuhaus, E. C., & Slavich, G. M. (2022). Behavioral psychedelics: Integrating mind and behavior to improve health and resilience. *Frontiers in Psychiatry*, 13, 821208. doi: 10.3389/fpsy.2022.821208
4. Thames, A. D., Nunez, R., Slavich, G. M., Irwin, M. R., & Senturk, D. (2022). Racial differences in health and cognition as a function of HIV among older adults. *The Clinical Neuropsychologist*, 36, 367-387. doi: 10.1080/13854046.2021.1967449
5. Brady, R. G., Rogers, C. E., Prochaska, T., Kaplan, S., Lean, R. E., Smyser, T. A., Shimony, J. S., Slavich, G. M., Warner, B. B., Barch, D. M., Luby, J. L., & Smyser, C. D. (2022). The effects of prenatal exposure to neighborhood crime on neonatal functional connectivity. *Biological Psychiatry*, 92, 139-148. doi: 10.1016/j.biopsych.2022.01.020
6. Princip, M., Meister-Langraf, R. E., Slavich, G. M., Pazhenkottil, A. P., Hackl-Zuccarella, C., Cammann, V. L., Ghadri, J. R., Templin, C., & von Känel, R. (2022). Psychosocial and clinical characteristics of a patient with Takotsubo syndrome and her healthy monozygotic twin: A case report. *European Heart Journal - Case Reports*, 6(7):ytac255. doi: 10.1093/ehjcr/ytac255
7. Banica, I., Sandre, A., Shields, G. S., Slavich, G. M., & Weinberg, A. (2022). Associations between lifetime stress exposure and the error-related negativity (ERN) differ based on stressor characteristics and exposure timing in young adults. *Cognitive, Affective, & Behavioral Neuroscience*, 22, 672-689. doi: 10.3758/s13415-021-00883-z
8. Bendezú, J. J., Calhoun, C. D., Vinograd, M., Patterson, M. W., Rudolph, K. D., Giletta, M., Hastings, P., Nock, M. K., Slavich, G. M., & Prinstein, M. J. (2022). Exploring joint HPA-inflammatory stress response profiles in adolescent girls: Implications for developmental models of neuroendocrine dysregulation. *Developmental Psychobiology*, 64, e22247. doi: 10.1002/dev.22247
9. Ganz, A. B., Rolnik, B., Chakraborty, M., Wilson, J., Tau, C., Sharp, M., Reber, D., Slavich, G. M., Snyder, M. P. (2022). Effects of an immersive psychosocial training program on depression and well-being: A randomized clinical trial. *Journal of Psychiatric Research*, 150, 292-299. doi: 10.1016/j.jpsychires.2022.02.034

10. Hamlat, E. J., Laraia, B., Bleil, M. E., Deardorff, J., Tomiyama, A. J., Mujahid, M., Shields, G. S., Brownell, K., Slavich, G. M., & Epel, E. S. (2022). Effects of early life adversity on pubertal timing and tempo in black and white girls: The National Growth and Health Study. *Psychosomatic Medicine*, 84, 297-305. doi: 10.1097/PSY.0000000000001048
11. McLoughlin, E., Arnold, R., Fletcher, D., Spahr, C. M., Slavich, G. M., & Moore, L. J. (2022). Assessing lifetime stressor exposure in sport performers: Associations with trait stress appraisals, health, well-being, and performance. *Psychology of Sport and Exercise*, 58, 102078. doi: 10.1016/j.psychsport.2021.102078
12. Moriarity, D. P., Joyner, K. J., Slavich, G. M., & Alloy, L. B. (2022). Unconsidered issues of measurement noninvariance in biological psychiatry: A focus on biological phenotypes of psychopathology. *Molecular Psychiatry*, 27, 1281-1285. doi: 10.1038/s41380-021-01414-5
13. Rahal, D., Fales, M. R., Haselton, M. G., Slavich, G. M., & Robles, T. F. (2022). Achieving status and reducing loneliness during the transition to college: The role of entitlement, intrasexual competitiveness, and dominance. *Social Development*, 31, 568-586. doi: 10.1111/sode.12569
14. Raio, C. M., Lu, B. B., Grubb, M., Shields, G. S., Slavich, G. M., Glimcher, P. (2022). Cumulative lifetime stressor exposure assessed by the STRAIN predicts economic ambiguity aversion. *Nature Communications*, 13, 1686. doi: 10.1038/s41467-022-28530-2
15. Senft Miller, A., Nop, O., Slavich, G. M., Dumas, J. A. (2022). Lifetime stress exposure, cognition, and psychiatric wellbeing in women. *Aging & Mental Health*, 26, 1765-1770. doi: 10.1080/13607863.2021.1958144
16. Gillespie, S. L., Christian, L. M., Mackos, A. R., Nolan, T. S., Gondwe, K. W., Anderson, C. M., Hall, M. W., Williams, K. P., & Slavich, G. M. (2022). Lifetime stressor exposure, systemic inflammation during pregnancy, and preterm birth among Black American women. *Brain, Behavior, and Immunity*, 101, 266-274. doi: 10.1016/j.bbi.2022.01.008
17. Gray, Z. J., Shields, G. S., Sichko, S., Bui, T. Q., Vinograd, M., Olvera-Alvarez, H. A., & Slavich, G. M. (2022). Neural and peripheral markers of reward during positive social evaluation are associated with less clinician-rated depression symptom severity in adolescence. *Comprehensive Psychoneuroendocrinology*, 11:100149. doi: 10.1016/j.cpne.2022.100149
18. Malat, J., Johns-Wolfe, E., Smith, T., Shields, G. S., Jacquez, F., & Slavich, G. M. (2022). Associations between lifetime stress exposure, race, and first-birth intendedness in the United States. *Journal of Health Psychology*, 27, 765-777. doi: 10.1177/1359105320963210
19. Schüssler-Fiorenza Rose, S. M., Snyder, M. P., & Slavich, G. M. (2022). Adverse childhood experiences, diabetes and associated conditions, preventive care practices and health care access: A population-based study. *Preventive Medicine*, 160, 107044. doi: 10.1016/j.ypmed.2022.107044
20. Wulsin, L. R., Sagui-Henson, S. J., Roos, L. G., Wang, D., Jenkins, B., Cohen, B. E., Shah, A. J., & Slavich, G. M. (2022). Stress measurement in primary care: Conceptual issues, barriers, resources, and recommendations for study. *Psychosomatic Medicine*, 84, 267-275. doi: 10.1097/PSY.0000000000001051
21. Moriarity, D.P. (2022). A primer on common analytic concerns in psychoneuroimmunology: Alternatives and paths forward. *Brain, Behavior, and Immunity*, 102, 338-340. <https://doi.org/10.1016/j.bbi.2022.03.007>

### Invited Talks

1. *Developing a blueprint for ACEs screening, response, and prevention in California*. Office of the California Surgeon General, Sacramento, CA (2022, January)
2. *A science-based strategy for reducing stress-related health disparities*. California Stress, Trauma, and Resilience Network (2022, January)

3. *Managing stress for enhancing wellbeing*. CrossFit Health (2022, January)
4. *Diagnostics and therapeutics for assessing toxic stress and enhancing resilience*. California Institute for Regenerative Medicine, Sacramento, CA (2022, February)
5. *Science of adverse childhood experiences and resilience*. Centers for Disease Control and Prevention (2022, February)
6. *Biologically grounded perspectives on stress-related health disparities across the lifespan*. Department of Psychological Science, University of Arkansas (2022, March)
7. *Identifying social, molecular, and immunological processes for mitigating toxic stress and enhancing personalized resilience*. California Initiative to Advance Precision Medicine (CIAPM), Sacramento, CA (2022, May)
8. *Addressing ACEs and toxic stress in primary care to improve population health*. UCLA-UCSF ACEs Aware Family Resilience Network (UCAAN), Los Angeles, CA (2022, June)
9. *Developing evidence-based systems for reducing ACE-associated health risks and achieving health equity in California*. Trauma Informed Primary Care (TIPC) Implementation Advisory Committee, California Department of Health Care Services, Sacramento, CA (2022, June)
10. *From cells to society: A precision health approach to mitigating toxic stress and achieving health equity in California*. 2022 Precision Medicine World Conference, Santa Clara, CA (2022, June)
11. *An evidence-based strategy for address stress-related health disparities in California and beyond*. Office of the California Surgeon General, Sacramento, CA (2022, June)
12. *Translating basic and clinical research into population health*. 19th annual meeting of Society in Science, Zurich, Switzerland (2022, November).

### **Conference Symposia**

1. Moriarity, D.P., Slavich, G.M., Alloy, L.B., & Olino, T.M. (2022). Beyond symptom-level & toward hierarchical biotypes of psychopathology. To be presented as part of the Innovative Ideas Series at the 2022 Society for Research in Psychopathology Annual Convention.
2. Moriarity, D.P., Grehl, M., Walsh, R., Roos, L., & Alloy, L.B. (2022). A Systematic Review of the Relationships between Emotion Regulation Characteristics and Inflammation: Towards Integrated Immunocognitive Models of Psychopathology Risk. In H. Zainal and M. Newman (Chairs), *Frontiers in Transdiagnostic Perspectives: Exploring Immune and Endocrine Markers as Potential Missing Links in Common Mental Disorders*. Talk to be presented at the 56th Association of Behavioral and Cognitive Therapies Annual Convention.
3. Moriarity, D.P., Ellman, L.M., Coe, C.L., Olino, T.M., & Alloy, L.B. (2022). A physiometric investigation of inflammatory composites: Comparison “a priori” aggregates, empirically- identified factors, and individual proteins. In D. P. Moriarity and M. Byrne (Chairs), *Why Measurement Matters for Clinically-Impactful Research: Applied Physiometrics in Immunopsychiatry and Psychoneuroendocrinology*. Talk presented at the 77th Society of Biological Psychiatry Annual Convention.
4. Eisenlohr-Moul, T., Moriarity, D.P., Rubinow, D., Girdler, S, Walsh, E. (2022). Temporal specificity of inflammatory biomarker and depression symptom associations across the menstrual cycle. In D. P. Moriarity and M. Byrne (Chairs), *Why Measurement Matters for Clinically-Impactful Research: Applied Physiometrics in Immunopsychiatry and Psychoneuroendocrinology*. Talk presented at the 77th Society of Biological Psychiatry Annual Convention.



5. Parra, L., Roos, L. G., Spahr, C. Goldbach, J., Bray, B. Kipke, M., & Slavich, G. M. (2022, June). Optimism mitigates the negative effects of lifetime financial stressors on mental health among sexual minority people of color. Poster presented at the International Conference on LGBT+ Psychology and Related Fields.

### **Conference Presentations/Posters**

1. Roos, L. G., Kachmarik, J., Slavich, G. M., Bennett, J. M. (2022, February). Reappraisal and health: How effective reappraisal ability improves and life stress degrades mental and physical health. Paper presented at the 2022 Annual Convention of the Society for Personality and Social Psychology, San Francisco, CA.

2. Martin, S., Pelletier-Baldelli, A., Sheridan, M., Patel, K., Giletta, M., Hastings, P. D., Nock, M. K., Rudolph, K. D., Slavich, G. M., Somerville, L., Prinstein, M. J., & Bryant Miller, A. (2022, March). Amygdala activation and emotional regulation in early- and post- pubescent girls. Poster presented at the 9th Biennial Meeting of the Society for Research on Adolescence, New Orleans, LA.

3. Garrisi, K., Patel, K., Giletta, M., Hastings, P. D., Nock, M. K., Rudolph, K. D., Slavich, G. M., Somerville, L., Prinstein, M. J., Sheridan, M., & Bryant Miller, A. (2022, March). Examining the relationship between exposure to threat or deprivation and cortical thickness and surface area in youth. Poster presented at the 9th Biennial Meeting of the Society for Research on Adolescence, New Orleans, LA.

4. Beier, L. M., Thaker, P. H., Cole, S. W., Sood, A. K., Slavich, G. M., & Lutgendorf, S. K. (2022, March). Sleep mediates the effect of meaning on pre-treatment inflammation in ovarian cancer patients. Paper presented at the 79th annual meeting of the American Psychosomatic Society, Long Beach, CA.

5. Alvarez, G. M., Sheridan, M., Robertson, M., Martin, S., Bonar, A., Giletta, M., Hastings, P. D., Nock, M. K., Patel, K., Rudolph, K. D., Slavich, G. M., Somerville, L. H., Prinstein, M. J., & Bryant Miller, A. (2022, March). Experiences of deprivation, but not threat, are associated with differences in network connectivity during affective processing. Paper presented at the 79th annual meeting of the American Psychosomatic Society, Long Beach, CA.

6. Roos, L. G., Bui, T. Q., Sichko, S., Irwin, M. R., Shields, G. S., Olvera-Alvarez, H. A., & Slavich, G. M. (2022, March). How lifetime stressor exposure and reappraisal affect depressive and inflammatory reactivity to social stress in adolescent girls. Paper presented at the 79th annual meeting of the American Psychosomatic Society, Long Beach, CA.

7. Moen, A., Spahr, C. M., Slavich, G. M., Olvera-Alvarez, H. A. (2022, March). Association of early life stressor exposure and depressive symptoms in Hispanic women. Paper presented at the 79th annual meeting of the American Psychosomatic Society, Long Beach, CA.

8. Kim, E., Shields, G. S., Spahr, C. M., Joseph, N. T., Slavich, G. M., Zilioli, S. (2022, March). Validation of the Stress and Adversity Inventory for Adults (Adult STRAIN) among urban middle-aged and older African Americans. Paper presented at the 79th annual meeting of the American Psychosomatic Society, Long Beach, CA.

9. Peltzer, J. N., Lumpkins, C., Mabachi, N., & Slavich, G. M. (2022, March). A scoping review of measures of structural racism and discrimination-related stress. Paper presented at the 46th annual meeting of the Midwest Nursing Research Society Annual Conference, Schaumburg, IL.

10. Armer, J. S., Thaker, P. H., Slavich, G. M., Goodheart, M. J., Cole, S. W., Sood, A. K., & Lutgendorf, S. K., (2023, April). The impact of longitudinal risk and resilience factors in long-term ovarian cancer survivors. Paper presented at the 43rd annual meeting of the Society of Behavioral Medicine, Baltimore, MD.

11. Delfel, E., Tatevosyan, E., Slavich, G. M., & Thames, A. D. (2022, April). Lifetime health-related acute life event exposure and coping style mediate perceived stress levels in HIV. Poster presented at the 102nd annual meeting of the Western Psychological Association, Portland, OR.

12. Figueroa, M. B., Roos, L. G., Sichko, S., Bui, T. S., & Slavich, G. M. (2022, April). Investigating depressed mood responses to social evaluation in adolescent girls at high vs. low risk for depression. Poster presented at the 102nd annual meeting of the Western Psychological Association, Portland, OR.
13. Mohan, L., Parra, L. A., Spahr, C. M., Goldbach, J. T., Bray, B. C., Kipke, M. D., & Slavich, G. M. (2022, April). Ethnic/racial and sexual minority group differences in lifetime stressor exposure and mental health. Poster presented at the 102nd annual meeting of the Western Psychological Association, Portland, OR.
14. Mohan, L., Parra, L. A., Spahr, C. M., Goldbach, J. T., Bray, B. C., Kipke, M. D., & Slavich, G. M. (2022, April). Lifetime stressor exposure and mental health among sexual minority people of color. Poster presented at the 102nd annual meeting of the Western Psychological Association, Portland, OR.
15. Raio, C. M., Lu, B., Grubb, M., Shields, G. S., Slavich, G. M., & Glimcher, P. (2022, April). Cumulative lifetime stress is selectively associated with ambiguity aversion. 2022 Annual Meeting of the Society for Biological Psychiatry, New Orleans, LA.
16. Gray, Z. J., Shields, G. S., Sichko, S., Bui, T. Q., & Slavich, G. M. (2022, April). You look fantastic today, and so does your brain! Striatal activity during positive social evaluation is associated with fewer depression symptoms and greater  $\beta$ -endorphin levels in adolescent girls. Poster presented at the 29th annual meeting of the of the Cognitive Neuroscience Society, San Francisco, CA.
17. Carolus, A., Davis, M., Bonar, A., Rodriguez-Thompson, A., Giletta, M., Hastings, P. D., Nock, M. K., Prinstein, M. J., Rudolph, K. D., Slavich, G. M., Somerville, L., Patel, K., Bryant Miller, A., & Sheridan, M. (2022, May). Emotional awareness: Associations with deprivation and threat. Paper presented at the 2021 Harvard Women in Psychology's Annual Trends in Psychology Summit, Harvard University, Cambridge, MA.
18. Pelletier-Baldelli, A., Martin, S. M., Somerville, L., Sheridan, M., Urban, C., Patel, K., Giletta, M., Hastings, P. D., Nock, M. K., Rudolph, K. D., Slavich, G. M., Prinstein, M. J., & Bryant Miller, A. (2022, May). Toward a comprehensive neurodevelopmental model of social motivation. Paper presented at the 14th Annual Meeting of the Social & Affective Neuroscience Society (virtual meeting).
19. Parra, L. A., Roos, L. G., Spahr, C. M., Goldbach, J. T., Bray, B. C., Kipke, M. D., & Slavich, G. M. (2022, June). Optimism mitigates the effects of financial stressors on mental health among sexual minority people-of-color. Poster presented at the 3rd International Conference on LGBT+ Psychology and Related Fields, Lisbon, Portugal.
20. McLoughlin, E., Moore, L. J., Arnold, R., Turner, J., Freeman, P., Fletcher, D., & Slavich, G. M. (2022, July). Lifetime stressor exposure and psychophysiological responses to repeated acute stress. Paper presented at the 16th European Congress of Sport and Exercise Psychology, Padova, Italy.
21. Moseley, R. L., Turner-Cobb, J. M., Spahr, C. M., Shields, G. S., & Slavich, G. M. (2022, July). Lifetime stress and its associations with physical and mental health in autistic adults. Paper presented at the 2022 Autistica Research Festival, London, United Kingdom.
22. Ho, T. C., Ojha, A., Teresi, G. I., Slavich, G. M., & Gotlib, I. H. (2022, September). Social threat, fronto-cingulate-limbic morphometry, and symptom course in adolescents with depression: A longitudinal investigation. Paper presented at the 2022 annual meeting of the Flux Society, Paris, France.
23. Pelletier-Baldelli, A., Martin, S., Sheridan, M. A., Gates, K. M., Patel, K. K., Bonar, A. S., Giletta, M., Hastings, P. D., Nock, M. K., Somerville, L. H., Slavich, G. M., Rudolph, K. D., Prinstein, M. J., Bryant Miller, A. (2022, September). The associations among puberty, brain development, and internalizing symptoms in girls transitioning to adolescence: A combined multivariate pattern and brain network approach. Paper presented at the 2022 annual meeting of the Flux Society, Paris, France.

24. Gruhn, M., Bryant Miller, A., Giletta, M., Hastings, P. D., Nock, M. K., Rudolph, K. D., Slavich, G. M., Prinstein, M. J., & Sheridan, M. A. (2022, September). Neural correlates of cortisol regulation: Examining associations among markers of stress reactivity in adolescent females. Paper presented at the 2022 annual meeting of the Flux Society, Paris, France.
25. Donzella, B., Tsakonas, N., Zhong, D., Bowen, M., Thilges, H., Slavich, G. M., Reid, B. M., & Gunnar, M. R. (2022, September). The association between parent and child self-reported stress and child hair cortisol in internationally-adopted and comparison youth. Poster presented at the 52nd annual meeting of the International Society of Psychoneuroendocrinology, Chicago, IL.
26. McMullin, S. D., Shields, G. S., Burnett, C. L., Doonan, A., Slavich, G. M., & Buchanan, T. W. (2022, September). How do early and recent life stressors shape cortisol reactivity and decision making in middle-to-older adulthood? Paper presented at the 52nd annual meeting of the International Society of Psychoneuroendocrinology, Chicago, IL.
27. Olvera-Alvarez, H. A., Delaney, S. W., Slavich, G. M., Campen, M. J., & Kubzansky, L. D. (2022, September). Adverse childhood experiences intensify microvascular and inflammatory responses to semi-controlled acute traffic related air pollution exposure. Paper presented at the 34th Annual Meeting of the International Society of Environmental Epidemiology, Athens, Greece.
28. Moriarity, D. P., Slavich, G. M., Alloy, L. B., & Olino, T. M. (2022, September). Beyond symptom-level: toward hierarchical biological phenotypes of psychopathology. Poster presented at the 2022 Annual Meeting of the Society for Research in Psychopathology, Philadelphia, PA.
29. Redic, M., Machlin, L., Sheridan, M., Patel, K., Giletta, M., Hastings, P. D., Nock, M. K., Rudolph, K. D., Slavich, G. M., Prinstein, M. J., & Bryant Miller, A. (2022, November). Associations between peer victimization and whole-brain neural activation during social evaluation in adolescent girls. Poster presented at the 2022 annual meeting of the Society for Neuroscience, San Diego, CA.
30. Martin, S., Gruhn, M., Pelletier-Baldelli, A., Sheridan, M., Patel, K., Giletta, M., Hastings, P. D., Nock, M. K., Rudolph, K. D., Slavich, G. M., Prinstein, M. J., & Bryant Miller, A. (2022, November). Childhood threat exposure moderates cortisol reactivity in response to stress and ACC activation during cognitive reappraisal in adolescent girls. Poster presented at the 2022 annual meeting of the Society for Neuroscience, San Diego, CA.
31. Mashash, M., Usacheva, M., Hamlat, E., Slavich, G. M., Laraia, B., Epel, E. S., & Mayer, S. E. (2022, November). A dimensional approach to early life adversity in Black and White women: Associations with telomere length. Poster presented at the 55th annual meeting of the International Society for Developmental Psychobiology, San Diego, CA.
32. Donzella, B., Tsakonas, N., Zhong, D., Bowen, M., Thilges, H., Slavich, G. M., Reid, B. M., & Gunnar, M. R. (2022, November). The association between parent and child self-reported stress and child hair cortisol in internationally-adopted and comparison youth. Poster presented at the 55th annual meeting of the International Society for Developmental Psychobiology, San Diego, CA.
33. Roos, L. G., \*Kachmarik, J., Slavich, G. M. & Bennett, J. M. (2022, February). Reappraisal and health: How habitual reappraisal and reappraisal ability interact to protect against life stress. Poster presented at the annual meeting of the Society for Personality and Social Psychology, San Francisco, CA.

**Systems-based, Multidisciplinary Assessment of Adversity and Toxic Stress for Individualized Care (The SYSTEMAATIC Project) (2022-2025)**

Lead Principal Investigator: Dr. Sayantani Sindher, Stanford University

## Publications

1. Jeung, J., Hessler Jones, D., Frame, L., Gilgoff, R., Long, D., Thakur, N., Koita, K., Bucci, M., Burke Harris, N. A Caregiver-Child Intervention for Mitigating Toxic Stress ("The Resiliency Clinic"): A Pilot Study. *Matern Child Health J* (2022). <https://doi.org/10.1007/s10995-022-03485-4>.
2. Long, D., Hessler, D., Koita, K., Bucci, M., Benson, M., Gilgoff, R., Thakur, N., & Burke Harris, N. (2022). Screening for adverse childhood experiences in pediatrics: A randomized trial of aggregate-level versus item-level response screening formats. *PloS one*, 17(12), e0273491. <https://doi.org/10.1371/journal.pone.0273491>
3. Yeh, A, Gilgoff, R., Arruda, J. Chapter 109: Integrative Medicine for Disorders of Development and Behavior. Feldman, Heidi M., et al., eds. *Developmental-Behavioral Pediatrics E-Book*. Elsevier Health Sciences, 2022.
4. Ortiz R, Gilgoff, R. Burke Harris N. Adverse Childhood Experiences, Toxic Stress, and Trauma-Informed Neurology. *JAMA Neurol*. 2022 Jun 1;79(6):539-540. doi: 10.1001/jamaneurol.2022.0769. PMID: 35467693.

## Presentations

1. Trauma Informed Asthma Clinical Care Considerations. National Committee on Asthma and Toxic Stress, Center for Youth Wellness, Stanford Medical Center. Sayantani Sindher MD, Rachel Gilgoff MD, Kari Lockett RN BSN MSW, Kadiatou Koida MD, Breanna Gentile PhD, John David Mark MD, Shannon Thyne MD, Beatrice Wood PhD, Esmeralda Morales MD, Rosalind Wright MD. (December, 12, 2022)

## Appendix B. Summaries of Previously Funded Projects

### Artificial Intelligence for Imaging of Brain Emergencies

Lead Principal Investigator: Dr. Pratik Mukherjee

Host Institution: UC San Francisco

Project Period: February 1, 2017 – December 31, 2018

Partners: Brain Trauma Foundation; Community Regional Medical Center in Fresno; Stanford University; TBI Endpoints Development Project; Transforming Research and Clinical Knowledge in Traumatic Brain Injury Consortium; UC Berkeley; Zuckerberg San Francisco General Hospital and Trauma Center

Irreversible damage to the brain can occur within minutes following a brain injury. However, the ability to diagnose such injuries relies on the expertise of skilled radiologists who assess brain scans, thereby limiting the promptness of treatment available to patients during this critical timeframe.

Researchers at UCSF and UC Berkeley pioneered a cutting-edge technology designed to automate the analysis of Computed Tomography (CT) brain scans. This approach harnessed image recognition software and Artificial Intelligence (AI) to detect brain injuries. Following extensive training on a dataset comprising over 100,000 CT scans, the technology achieved an accuracy rate of over 99% in identifying brain injuries, which is on par with the performance of board-certified radiologists.

The team created a cloud-based, automated image analysis system that can identify intracranial bleeding with over 99% accuracy, matching the proficiency of a board-certified radiologist. After receiving FDA approval, the technology can be deployed in regions that lack radiologists, including rural, remote areas, and underserved regions in developing countries.

### Notable Accomplishments

- Showcased the potential of AI-driven automated image analysis for neurological injuries, applicable in routine clinical practice, research studies, and pharmaceutical trials.
- Designed a computer vision AI solution to detect and measure biomarkers associated with brain injuries.
- Examined numerous patient images, achieving a diagnosis accuracy exceeding 99%.
- Enhanced the AI tool for cloud-based, multi-scanner use, with the goal of securing FDA approval for

## **California Kids Cancer Comparison**

Lead Principal Investigator: Dr. David Haussler

Host Institution: UC Santa Cruz

Project Period: September 1, 2015 – December 31, 2018

Partners: Alex's Lemonade Stand Foundation; Amazon Services, Inc.; Azure, Inc.; Children's Hospital Orange County; Children's Mercy Hospital in Kansas City; DNAnexus, Inc.; Jacob's Heart; Key for a Cure; Kids v Cancer; Live for Others Foundation; Microsoft, Inc.; NuMedii, Inc.; Pacific Pediatric Neuro-Oncology Consortium; Philanthropist George Kraw; Sanford University of South Dakota Medical Center; Seven Bridges Genomics, Inc.; Stanford University Hospital; St. Baldrick's Foundation; Team Finn; Team G Foundation; UC San Francisco; University of British Columbia Cancer Agency; University of Michigan; University of Pittsburg; Unravel Pediatric Cancer

While there have been notable progress and innovations in the treatment of cancers in adults, the approaches for pediatric cancer have seen minimal evolution over the 50 years. Consequently, cancer continues to be the leading cause of death due to disease among children. In California, 1,700 children are diagnosed with cancer each year, 500 of which fail to respond to available treatments or do not have access to standard therapies for their condition.

Given that DNA testing and analysis offer valuable insights for less than 10% of pediatric cancer patients, the California Kids Cancer Comparison (CKCC) aimed to construct a more comprehensive genetic profile of each tumor through RNA sequencing. Unlike DNA, RNA reveals the functioning of the tumor and identifies the genes and pathways potentially fueling cancer growth. CKCC's objective was to enhance pediatric cancer care by using RNA to profile patient tumors, identifying targets for therapeutic intervention and treatment.

CKCC's RNA-based approach provided the researchers with new information in all the pediatric cancer cases, surpassing their goal of new information in 20% of pediatric cases. Additionally, the team established a registry of the tumor RNA profiles, which physicians can use when diagnosing and treating pediatric cancer patients. Overall, CKCC's RNA approach discovered new treatment options when DNA-based diagnoses did not provide useful treatment information. The results of this project can be scaled to a wider spectrum of pediatric and adult cancers, leaving a broader impact.

### **Notable Accomplishments**

- Formed a network comprising hospitals and research organizations
- Used data to propose new treatment options
- Communicated discoveries to molecular tumor panels
- Used computational techniques to develop an extensive catalog of tumor data.
- Involved patients in clinical-decision making and the research process
- Instituted an initial-phase patient registry study to validate the data's practicality

## **Early Prediction of Major Adverse Cardiovascular Event Surrogates**

Lead Principal Investigator: Dr. Brennan Spiegel

Host Institution: Cedars-Sinai Medical Center

Project Period: January 1, 2017 – December 31, 2018

Partners: Agilent, Inc.; AliveCor, Inc.; Beckman Coulter, Inc.; DocuSign, Inc.; Fitabase, Inc.; Fitbit, Inc.; HealthLoop, Inc.; Neoteryx, Inc.; SCIEX, Inc.; Tasso, Inc.; Thermo Fisher Scientific, Inc.; UCLA

Cardiovascular disease stands as the primary cause of death in both men and women throughout California, with a higher incidence among younger women and racial/ethnic minorities. The initial indicators of disease often go unnoticed, and the absence of regular healthcare can lead to detrimental disease advancement.

The research team based at Cedars-Sinai Medical Center conducted on a study to investigate the feasibility of identifying cardiovascular risks at an early stage, thereby enabling effective treatment or prevention. They collected physical, biochemical, and psychosocial data to predict Major Adverse Cardiac Events (MACEs). Over a twelve-month period, the team remotely monitored a group of 200 patients diagnosed

with ischemic heart disease using wearable biosensors. These tracked various metrics, including their physical activity, sleep patterns, heart rate, stress levels, self-reported mental health, and finger-prick blood samples. The comprehensive dataset was then analyzed to ascertain whether monitoring these parameters could aid in predicting MACEs among the patients.

The remote monitoring system showcased the capacity for tracking patients beyond the confines of a medical facility, while potentially helping to predict and prevent MACEs. To illustrate, a 64-year-old male participant noticed chest pain and an abnormal cardiac reading on his wearable biosensor. In response, the program advised him to seek emergency room care, preventing a more severe cardiac episode. The team has published their successful findings, and intends to continue publishing additional results after further analysis of over 500 potential biomarkers from the patients' blood samples.

#### Notable Accomplishments

- Established that collecting blood samples remotely at a patient's residence yields high-quality samples for clinical examination, comparable to, if not superior to, samples obtained in a clinical setting.
- Demonstrated a 72% patient adherence rate throughout the study, affirming the feasibility and consistency of patient engagement within this research framework.
- Found a correlation between reduced physical activity and sleep patterns and an elevated likelihood of developing anxiety and depression among participants.
- Identified an association of physical activity and overall well-being with improved cardiac health and a reduced risk of MACEs.

#### **Early Prostate Cancer: Predicting Treatment Response**

Lead Principal Investigator: Dr. Sheldon Greenfield

Host Institution: UC Irvine

Project Period: January 1, 2017 – December 31, 2018

Partners: Ambry Genetics Corporation; Cedars-Sinai Medical Center; GenomeDx

Biosciences, Inc.; Vanderbilt University; Veterans Affairs Los Angeles; UCLA Medical Center

Prostate cancer, the most prevalent cancer among men in the United States, relies on a limited set of tests for diagnosis and treatment decisions, which do not effectively predict how the tumor will respond to treatment. Disparities in prostate cancer outcomes have been associated with varying levels of healthcare access, chronic stress, socioeconomic status, and environmental factors. Despite this knowledge, these factors have not been considered in the profiling of prostate cancer or the customization of patient treatments.

UC Irvine's research team addressed this healthcare gap by introducing an individualized risk profile to tailor care and mitigate disparities in prostate cancer outcomes. The Comparative Effectiveness Analysis of Surgery and Radiation (CEASAR Study) aimed to explore whether the severity of prostate cancer and a patient's personal circumstances could predict health outcomes following therapeutic radiation or surgery. The models developed during this study are expected to evolve, providing valuable insights into treatment effectiveness and cancer recurrence in patients. As these models are refined, the research team plans to share their findings with healthcare professionals in southern California, starting with urologists and radiation oncologists at the five partner institutions. Their goal is to implement this model to enhance patient care.

#### Notable Accomplishments

- Established a consortium of clinicians, researchers, and industry collaborators for the study.
- Formed a Citizen Science Committee to provide patient perspectives
- Created a federated registry that allows for data searches that inform patient outcomes, all while enforcing the privacy of patient data.
- Examined the connection between genetic risk, patient characteristics, and treatment, revealing that African American and Latino men typically show a heightened genetic predisposition to prostate cancer.

## **Full Genome Analysis to Guide Precision Medicine**

Lead Principal Investigator: Dr. David Martin

Host Institution: Children's Hospital Oakland Research Institute

Project Period: March 1, 2017 – December 31, 2018

Partners: GenomeOne, Inc.; Human Longevity, Inc.; Illumina, Inc.; UC Berkeley; UC San Francisco; UCSF Benioff Children's Hospital Oakland

While significant advancements have been made in genetic testing over the past decade, the majority of tests conducted in medical practices and hospitals are tailored to a limited set of common genetic disorders, rather than comprehensively analyzing the patient's entire genetic makeup, known as the genome. Furthermore, genetic tests often inadequately represent communities of color, resulting in underdiagnosis of potential genetic disorders among individuals in these demographics.

Researchers at the Children's Hospital Oakland Research Institute pioneered a method called Full Genome Analysis (FGA), aimed at sequencing the complete genome of children who may have genetic disorders.

They tested 45 pediatric cases, primarily from underserved backgrounds, successfully identifying the probable genetic cause of the disorder in 40% of these cases.

This research showed that FGA can enable clinicians to assess disease risk and potential therapies early in their pediatric patient treatment. Additionally, it contributed to the identification of genetic diseases that may otherwise go unnoticed within communities of color, improving the list of genetic disorders that clinicians consider when diagnosing patients.

### **Notable Accomplishments**

- Successfully pinpointed the probable genetic cause of the condition in 40% of the pediatric patients in the study.
- Demonstrated the ability of Full Genome Analysis in clinical care of pediatric patients, potentially establishing a new standard of care for undiagnosed illnesses.
- Added genomic data from underrepresented communities to the catalog of disease information that clinicians consider.

## **Personal Mobile and Contextual Precision Health**

Lead Principal Investigator: Dr. Nicholas Anderson

Host Institution: UC Davis

Project Period: January 1, 2017 – December 31, 2018

Partners: Overlap Health, Inc.; UC Berkeley; UC San Francisco

Managing chronic illnesses like hypertension and depression can be challenging when patients are away from medical facilities and lack constant contact with their healthcare providers. However, patients continuously collect personal data on their mobile devices, offering an opportunity for both patients and clinicians to track disease progression. Despite the potential value of this data for health records and patient care, many mobile applications do not facilitate healthcare providers' access to this information or integration with electronic health records (EHRs).

The research team at UC Davis developed a mobile health application compliant with HIPAA. This application was designed to transmit alerts and gather, oversee, and report patient-generated data while seamlessly integrating it with the patient's EHR. This integration allowed both the clinical care team and the patient to interact with and access their health data in real-time.

This project created, implemented, and evaluated a comprehensive system capable of connecting two major hospital record systems with a private mobile health industry partner. The research team demonstrated the capability to link EHR data with applications that track daily lifestyle-generated data, offering a model for integrated precision medicine care both inside and outside the clinic.

### **Notable Accomplishments**

- Exemplified how chronic diseases can be monitored using an integrated mobile phone application with EHRs.
- Created a policy and privacy framework that connects data providers with clinical and personal data
- Analyzed the user experience associated with the application

## **Precision Diagnosis of Acute Infectious Diseases**

Lead Principal Investigator: Dr. Charles Chiu

Host Institution: UC San Francisco

Project Period: September 1, 2015 – December 31, 2018

Partners: Abbott Laboratories, Inc.; American Tissue Culture Collection; California Department of Public Health; Children's Hospital Colorado / University of Colorado; Children's Hospital Los Angeles; Children's National Medical Center at Washington D.C.; DNAnexus, Inc.; Google, Inc.; Illumina, Inc.; Oxford Nanopore Technologies, Inc.; Quest Diagnostics, Inc.; St. Jude Children's Research Hospital; Synapse, Inc.; U.S. Food and Drug Administration; UC Berkeley; UC Davis; UCLA; UC San Diego; University of Maryland; Zuckerberg San Francisco General Hospital and Trauma Center

Rare bacterial infections are challenging to diagnose, often resulting in patients with suspected infections receiving generalized therapies like antibiotics instead of tailored treatments. This non-specific approach not only escalates healthcare expenditures but also heightens the risks associated with antibacterial resistance and potential fatalities.

To enhance the accuracy of diagnosing and treating brain infections, the Precision Diagnosis of Acute Infectious Disease (PDAID) team at UCSF devised a genomic test, referred to as metagenomic sequencing. This approach involved the search for microbial DNA in patient samples, such as cerebrospinal fluid or blood. By genetically profiling these patient samples, the team was able to pinpoint the presence of bacterial and microbial DNA, confirming whether bacteria were the cause of the infection.

The application of the metagenomic test to patients with brain infections unveiled 14 previously unidentified infections among the enrolled individuals. Furthermore, the team illustrated the cost-saving potential of this precision medicine approach through a case involving a 14-year-old boy who had endured months of inconclusive tests before receiving a diagnosis. The new test expediently identified the source of his infection, offering the potential to alleviate suffering and reduce medical expenses by avoiding the need for hospitalizations and unproductive diagnostic tests. Overall, this research represents an excellent precision medicine strategy with the capacity for broader application across various diseases.

### **Notable Accomplishments**

- Created clinical-grade software
- Validated the experimental metagenomics test within a clinical laboratory setting for the purpose of diagnosing the origins of brain inflammation.
- Confirmed the applicability of the test within a clinical laboratory context for diagnosing infections through blood plasma.
- Began clinical studies of critically ill hospitalized patients to compare conventional and metagenomic-based approaches
- Instituted and routinely convened a clinical microbial sequencing board, a diverse group that meets to discuss complex patient cases
- Initiated efforts to make the test affordable and widely available.

## **Precision Medicine for Multiple Sclerosis: Making It Work**

Lead Principal Investigator: Dr. JB Jones

Host Institution: Sutter Health

Project Period: March 1, 2017 – December 31, 2018

Partners: National Multiple Sclerosis Society; Palo Alto Medical Foundation; Plan Language Health, Inc.; Roche/Genentech, Inc.; Sutter's Jordan Research and Education Institute; Sutter Philanthropy; UC San Francisco

Multiple sclerosis (MS) is a chronic disorder of the nervous system affecting the brain and spinal cord. It arises when the body's immune system erroneously targets healthy cells, leading to neurodegeneration. Although symptoms typically manifest between the ages of 20 to 40, the progression of the disease varies among individuals and remains challenging to predict or effectively treat.

To address the knowledge gap concerning MS progression, a collaborative research team from Sutter Health and UCSF developed an interactive tool known as neuroSHARE. This application was conceived to



facilitate access to clinical and patient-reported data, forecast disease management strategies aimed at slowing progression and alleviating symptoms, and promote collaborative decision-making between patients and physicians. The neuroSHARE design streamlines the process, incorporating the latest MS research as a resource for patients while also interpreting patient data to ensure their unique concerns are addressed during subsequent medical appointments.

As a result of this study, neuroSHARE was successfully implemented in various real-world neurology practice settings. The concept behind this application, which established a precision medicine link between the patient's bedside and the doctor's office, has the potential for versatile application across a range of medical conditions. Tools like neuroSHARE highlight the significance of bringing data into the conversation between clinicians and patients, particularly within the framework of electronic health records.

#### Notable Accomplishments

- Developed an effective data management tool
- Progressed towards the reduction of health disparities
- Used partnerships to encourage clinical and commercial use, with potential to scale toward other diseases/conditions

## Appendix C. New Publications, Presentations, Press, and Patents from Past CIAPM Projects

CIAPM recognizes that research results cannot always be collected during the term of funding and therefore stays connected with researchers for five years following the conclusion of CIAPM grants. Below are publications, presentations, press coverage, and patents accumulated by past-funded research teams resulting from CIAPM

### PUBLICATIONS

#### **Precision Medicine for Multiple Sclerosis: Making It Work** **Lead Principal Investigator: Dr. J.B. Jones, Sutter Health**

1. Swetlik, C., Bove, R., & McGinley, M. (2022). Clinical and Research Applications of the Electronic Medical Record in Multiple Sclerosis: A Narrative Review of Current Uses and Future Applications. *International Journal of MS Care*, 24(6), 287-294. doi: 10.7224/1537-2073.2022-066
2. Yan, X., Husby, H., Mudiganti, S., Gbotoe, M., Delatorre-Reimer, J., Knobel, K., Hudnut, A., & Jones, J. B. (2022). Evaluating the Impact of a Point-of-Care Cardiometabolic Clinical Decision Support Tool on Clinical Efficiency Using Electronic Health Record Audit Log Data: Algorithm Development and Validation. *JMIR medical informatics*, 10(9), e38385. <https://doi.org/10.2196/38385>

#### **California Kids Cancer Comparison**

#### **Lead Principal Investigator: Dr. David Haussler, UC Santa Cruz**

1. Sanders, L. M., Chandra, R., Zebarjadi, N., Beale, H. C., Lyle, A. G., Rodriguez, A., Kephart, E. T., Pfeil, J., Cheney, A., Learned, K., Currie, R., Gitlin, L., Vengerov, D., Haussler, D., Salama, S. R., & Vaske, O. M. (2022). Machine learning multi-omics analysis reveals cancer driver dysregulation in pan-cancer cell lines compared to primary tumors. *Communications biology*, 5(1), 1367. <https://doi.org/10.1038/s42003-022-04075-4>
2. Beale, H. C., Roger, J. M., Cattle, M. A., McKay, L. T., Thompson, D. K., Learned, K., ... & Vaske, O. M. (2021). The case for using mapped exonic non-duplicate reads when reporting RNA-sequencing depth: examples from pediatric cancer datasets. *GigaScience*, 2021 Mar 13;10(3):giab011. doi: 10.1093/giga-science/giab011
3. Bjork I, Peralez J, Haussler D, Spunt SL, Vaske OM. Data sharing for clinical utility. *Cold Spring Harb Mol Case Stud*. 2019 Oct 23;5(5). pii: a004689. doi: 10.1101/mcs.a004689. Print 2019 Oct. Erratum in: *Cold Spring Harb Mol Case Stud*. 2019 Dec 13;5(6):. PMID: 31645349
4. Learned, K., Durbin, A., Currie, R. et al. Barriers to accessing public cancer genomic data. *Sci Data* 6, 9(2019). <https://doi.org/10.1038/s41597-019-0096-4>

5. Pfeil, J., Sanders, L. M., Anastopoulos, I., Lyle, A. G., Weinstein, A. S., Xue, Y., ... & Vaske, O. M. (2020). Hydra: A mixture modeling framework for subtyping pediatric cancer cohorts using multimodal gene expression signatures. *PLoS computational biology*, 16(4), e1007753. <https://doi.org/10.1371/journal.pcbi.1007753>
6. Reed, M. R., Lyle, A. G., De Loose, A., Maddukuri, L., Learned, K., Beale, H. C., ... & Rodriguez, A. (2021). A Functional Precision Medicine Pipeline Combines Comparative Transcriptomics and Tumor Organoid Modeling to Identify Bespoke Treatment Strategies for Glioblastoma. *Cells*, 10(12), 3400.
7. Sanders, L. M., Cheney, A., Seninge, L., van den Bout, A., Chen, M., Beale, H. C., ... & Vaske, O. M. (2020). Identification of a differentiation stall in epithelial mesenchymal transition in histone H3-mutant diffuse midline glioma. *GigaScience*, 2020 Dec 15;9(12):giaa136. doi: 10.1093/gigascience/giaa136.
8. Sanders LM, Rangaswami A, Bjork I, et al. Comparative RNA-seq analysis aids in diagnosis of a rare pediatric tumor. *Cold Spring Harb Mol Case Stud*. 2019 Oct 23;5(5). pii: a004317. doi: 10.1101/mcs.a004317
9. Sanders, L.M., Chandra, R., Zebarjadi, N. et al. Machine learning multi-omics analysis reveals cancer driver dysregulation in pan-cancer cell lines compared to primary tumors. *Commun Biol* 5, 1367 (2022). <https://doi.org/10.1038/s42003-022-04075-4>
10. Sanders, L, "RNA Sequencing", AACCC Pearl of Laboratory Medicine. 2019 Jul 23. <https://doi.org/10.1161/CIR.0000000000000471> Vaske OM and Haussler D. Data sharing for pediatric cancers. *Science*. 2019; 363(6432):1125
11. Vaske OM, Bjork I, Salama SR, et al. Comparative Tumor RNA Sequencing Analysis for Difficult-to-Treat Pediatric and Young Adult Patients With Cancer. *JAMA Netw Open*. 2019 Oct 2;2(10):e1913968. doi: 10.1001/jamanetworkopen.2019.13968
12. Vaske OM and Haussler D. Data sharing for pediatric cancers. *Science*. 2019; 363(6432):1125. doi: 10.1126/science.aax2739
13. Vivian J, Eizenga JM, Beale HC, et al. Bayesian Framework for Detecting Gene Expression Outliers in Individual Samples. *JCO Clin Cancer Inform*. 2020 Feb;4:160-170. doi: 10.1200/CCI.19.00095.

### **Early Prediction of Major Adverse Cardiovascular Events Using Remote Monitoring**

**Lead Principal Investigator: Dr. Brennan Spiegel, Cedars-Sinai Medical Center**

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### **Artificial Intelligence for Imaging of Neurological Emergencies**

**Lead Principal Investigator: Dr. Pratik Mukherjee, UC San Francisco**

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2. Moon, J. Y., Mukherjee, P., Madduri, R. K., Markowitz, A. J., Cai, L. T., Palacios, E. M., Manley, G. T., & Bremer, P. T. (2022). The Case for Optimized Edge-Centric Tractography at Scale. *Frontiers in neuroinformatics*, 16, 752471. <https://doi.org/10.3389/fninf.2022.752471>
3. Palacios, E. M., Yuh, E. L., Mac Donald, C. L., Bourla, I., Wren-Jarvis, J., Sun, X., Vassar, M. J., Diaz-Arastia, R., Giacino, J. T., Okonkwo, D. O., Robertson, C. S., Stein, M. B., Temkin, N., McCrea, M. A., Levin, H. S., Markowitz, A. J., Jain, S., Manley, G. T., Mukherjee, P., & TRACK-TBI Investigators (2022). Diffusion Tensor Imaging Reveals Elevated Diffusivity of White Matter Microstructure that Is Independently Associated with Long-Term Outcome after Mild Traumatic Brain Injury: A TRACK-TBI Study. *Journal of neurotrauma*, 39(19-20), 1318–1328. <https://doi.org/10.1089/neu.2021.0408>
4. Wickwire, E. M., Albrecht, J. S., Capaldi, V. F., 2nd, Jain, S. O., Gardner, R. C., Werner, J. K., Mukherjee, P., McKeon, A. B., Smith, M. T., Giacino, J. T., Nelson, L. D., Williams, S. G., Collen, J., Sun, X., Schnyer, D. M., Markowitz, A. J., Manley, G. T., Krystal, A. D., & Transforming Research and Clinical Knowledge in Traumatic Brain Injury (TRACK-TBI) Investigators (2022). Trajectories of Insomnia in Adults After Traumatic Brain Injury. *JAMA network open*, 5(1), e2145310. <https://doi.org/10.1001/jamanetworkopen.2021.45310>

4. Wickwire, E. M., Albrecht, J. S., Capaldi, V. F., 2nd, Jain, S. O., Gardner, R. C., Werner, J. K., Mukherjee, P., McKeon, A. B., Smith, M. T., Giacino, J. T., Nelson, L. D., Williams, S. G., Collen, J., Sun, X., Schnyer, D. M., Markowitz, A. J., Manley, G. T., Krystal, A. D., & Transforming Research and Clinical Knowledge in Traumatic Brain Injury (TRACK-TBI) Investigators (2022). Trajectories of Insomnia in Adults After Traumatic Brain Injury. *JAMA network open*, 5(1), e2145310. <https://doi.org/10.1001/jamanetworkopen.2021.45310>

## PRESENTATIONS

### California Kids Cancer Comparison

**Lead Principal Investigator: Dr. David Haussler, UC Santa Cruz**

1. Olena Vaske. Advancing pediatric cancer cures through new genomic approaches. Santa Cruz Cancer Benefits Group. July 2022.
2. Olena Vaske. RNA sequencing in cancer diagnosis and treatment. UC San Francisco Grand Rounds. July, 2022.
3. Olena Vaske. The clinical utility of shared datasets. Big data panel. MIB Agents Factor Conference, San Diego, CA. June, 2022.
4. Gina Mawla. Comparative RNA sequencing analysis enables individualized treatments for children with cancer. National Foundation for Ectodermal Dysplasias, November 2021.
5. Olena Vaske, Yvonne Vasquez, Sheri Spunt. Precision genomics: bringing research into the clinic for children with cancer. Kraw Lecture, May 2021.
6. Olena Vaske. Comparative RNA-Seq analysis for children with cancer. University of Washington Laboratory Medicine Grand Rounds, October 2020.
7. Olena Vaske. Comparative RNA sequencing analysis of pediatric tumors. NCI Childhood Cancer Data Initiative (CCDI), October 2020. This is an invitation-only national gathering of experts in pediatric oncology, genomics and bioinformatics to discuss priorities for the NCI CCDI Initiative.
8. Yvonne Vasquez, "New Hope For Children With Cancer Through Comparative Genomic Analysis," The Scotts Valley Rotary Club. January 13, 2019.
9. Yvonne Vasquez, "New Hope For Children With Cancer Through Comparative Genomic Analysis," The Watsonville Rotary Club. January 15, 2019.
10. Olena Vaske, "Comparative RNA-Seq gene expression analysis" at the Association for Molecular Pathology (AMP) 2019 Annual Meeting & Expo. November 2019 in Baltimore, Maryland.
11. Holly Beale, "Using RNA-Seq in a clinical context" at the Women in Computational Biology Conference on November 11, 2019 in Baltimore, Maryland.
12. Allison Cheney "Epithelial-mesenchymal Transition In Diffuse Midline Gliomas" at the UC Santa Cruz PBSE Lightning Talks on September 11, 2019.
13. Olena Vaske was invited by the NIH National Cancer Institute to participate in a panel on data federation at the newly-announced Presidential Childhood Cancer Data Initiative (CCDI). In July 2019. she gave a talk "Approaches to data federation at Treehouse Childhood Cancer Initiative" and contributed to a breakout session discussion at the CCDI Symposium in Washington, DC
14. Lauren M. Sanders, "Shared long non-coding RNA dysregulation in Histone H3 K27M gliomas and PF-A ependymomas." Conference talk (selected from highly ranked abstracts), SNO Pediatric Research Conference, San Francisco, May 2019.
15. POSTER: Mawla, G. D., Lyle, A. G., Kephart, E. T., Learned, K., Beale, H. C., Goldford, J. E., & Vaske, O. M. (2022). Subtype classification of pediatric high-grade glioma tumors by comparative transcriptomics. Poster, Cancer Genomics Consortium Annual Meeting. St. Louis, MO, August 2022.
16. POSTER: Mawla, G. D., Lyle, A. G., Kephart, E. T., Learned, K., Beale, H. C., Goldford, J. E., & Vaske, O. M. (2022). Subtype classification of pediatric high-grade glioma tumors by comparative transcriptomics. Poster, National Institutional Research and Academic Career Development Conference, Albuquerque, NM, July 2022.
17. POSTER: Mawla, G. D., Lyle, A. G., Kephart, E. T., Learned, K., Beale, H. C., Goldford, J. E., & Vaske, O. M. (2022). Subtype classification of pediatric high-grade glioma tumors by comparative transcriptomics. Poster, Postdoctoral Association for Research Symposium. June 2022.

18. POSTER: Mawla, G. D., Lyle, A. G., Kephart, E. T., Learned, K., Beale, H. C., Goldford, J. E., & Vaske, O. M. (2022). Abstract LB059: Subtype classification of pediatric high-grade glioma tumors by comparative transcriptomics. *Cancer Research*, 82(12\_Supplement), LB059-LB059. Poster, AACR
19. POSTER: Yvonne Vasquez, Jacob Pfeil, Letitia Mueller, A. Geoffrey Lyle, Lauren Sanders, Katrina Learned, Ellen Towle Kephart, Isabel Bjork, Sofie R. Salama, Anouk Van Den Bout, Allison Cheney, Holly Beale, Olena Morozova Vaske, "Identifying Novel Druggable Targets For Synovial Sarcoma Using Comparative Rna-seq Analysis" Poster, Molecular Cell and Developmental Biology Retreat, UCSC, September 2019
20. POSTER: Lauren M. Sanders, A. Geoffrey Lyle, Holly C. Beale, Ellen Towle Kephart, Katrina Learned, Jacob Pfeil, Jennifer Peralez, Norman Lacayo, Arun Rangaswami, Sheri L. Spunt, Isabel Bjork, David Haussler, Sofie R. Salama, Olena M. Vaske, "Comparative gene expression analysis for identification and prioritization of therapeutic targets in a cohort of childhood cancers." Poster, AACR Advances in Pediatric Cancer Research Conference, Montreal, September 2019.
21. POSTER: Allison Cheney, Lauren M. Sanders, Lucas Seninge, Holly C. Beale, Ellen Towle Kephart, Jacob Pfeil, Katrina Learned, A. Geoffrey Lyle, Isabel Bjork, David Haussler, Sofie R. Salama, Olena M. Vaske. "The Epithelial-Mesenchymal Transition in Diffuse Midline Gliomas with H3K27M mutation". Poster, AACR Advances in Pediatric Cancer Research Conference, Montreal, September 2019.
22. POSTER: Holly Beale, A. Geoffrey Lyle, Isabel Bjork, Sofie R. Salama, Avanthi Tayi Shah, Lauren Sanders, Jacob Pfeil, Du Linh Lam, Katrina Learned, Ann Durbin, Ellen Towle Kephart, Rob Currie, Yulia Newton, Teresa Swatloski, Duncan McColl, John Vivian, Jingchun Zhu, Alex G. Lee, Stanley G. Leung, Aviv Spillinger, Heng-Yi Liu, Winnie S. Liang, Sara A. Byron, Michael E. Berens, Adam Resnick, Norman Lacayo, Sheri L. Spunt, Arun Rangaswami, Van Huynh, Lilibeth Torno, Ashley Plant, Ivan Kirov, Keri Zabokrtsky, S. Rod Rassekh, Rebecca J. Deyell, Janessa Laskin, Marco A. Marra, Leonard S. Sender, Sabine Mueller, E. Alejandro Sweet-Cordero, Theodore C. Goldstein, David Haussler, Olena Morozova Vaske. "Clinical application of shared genomic data for pediatric cancer." Poster, NCI CCDI, July 2019.

## PRESS

### California Kids Cancer Comparison

**Lead Principal Investigator: Dr. David Haussler, UC Santa Cruz**

1. **Press coverage** \$1.2M for Genomics Institute's Kids Cancer Project, Santa Cruz Tech Beat

## PATENTS

### Artificial Intelligence for Imaging of Neurological Emergencies

**Lead Principal Investigator: Dr. Pratik Mukherjee, UC San Francisco**

1. Yuh, Esther L., Mukherjee, P., Manley, Geoffrey T. (2022) US Patent Application No. 15782005.

## Appendix D. Invited Talks and Sessions

- February 8 – UC Berkeley Institute for Government Studies, "Research and Policy", Dr. McCall
- February 11 – UC Riverside Policy Chats Podcast Interview, "Evidence-Based Policymaking", Dr. McCall
- February 18 – AAAS 2022 Annual Meeting, "Data in Policy", Dr. McCall
- March 11 – Latina History Day, "Social Determinants of Health", Dr. McCall
- March 18 – UC Davis Department of Environmental Policy and Sciences, "Infusing equity in science policy", Dr. McCall
- March 22 – Iowa State University, "From Science to Policy", Dr. McCall
- March 26-27 – UNESCO Workshop, Dr. McCall
- April 7 – Gladstone Institute Graduate Student Career Workshop, Dr. Muir
- April 23-24 – AAAS Workshop, Dr. McCall
- April 29 – UNESCO, "Open Science and Governance Policies", Dr. McCall
- May 4 – UC San Diego, "Precision Medicine Policy Priorities", Dr. McCall
- May 6 – Journal of Science Policy & Governance, "Science Policy", Dr. McCall
- May 18 – American Society for Gene and Cell Therapy Annual Meeting 2022, "Equity in Research Policy"

- May 20– UNESCO, the Major Group for Children and Youth, and the Journal of Science Policy & Governance, “Aligning incentives, rewards, and evaluation methods for open science in the scientific process”, Dr. McCall
- June 4-5– The Lancet, Journal of Science Policy & Governance, and the Financial Times, “Strengthening youth-centered policy and governance of digital transformations in health”, Dr. McCall
- June 14– Biotechnology Innovation Organization International Convention 2022, “Advancing Policies to Shorten the Rare Disease Patient’s Diagnostic Journey”, Dr. McCall
- June 22– National Academies of Science, Engineering, and Medicine Futurecasting Workshop, Dr. Muir
- June 24– Virginia Academy of Science, Engineering, and Medicine, “Health Policy and the Biomedical Research Enterprise”, Dr. McCall
- June 27– Precision Medicine World Conference 2022, “Past, Present, and Future-How will We Manage the Next Pandemic”, Dr. McCall
- June 28– Precision Medicine World Conference 2022, “Government Partnerships: California Initiative to Advance Precision Medicine”, Dr. McCall
- July 7– International Brain Bee Neuroscience Olympiad and Federation of European Neuroscience Societies 2022 Forum, “Brain Health and Equity”, Dr. McCall
- July 15– The Lancet, Journal of Science Policy & Governance, and the Financial Times on “Governing health data to increase its public value and foster trust”, Dr. McCall
- August 9– California Capitol Roundtable with the UC Science Policy Slam Winners, Dr. McCall
- August 30– National Science Policy Network, the Journal of Science Policy & Governance, Science Debate, and the Union of Concerned Scientists, “Science Policy in Action”, Dr. McCall
- October 5– eLife Journal, “Science for the Advancement of Equity”, Dr. McCall
- October 14– California 100, “Technology Policy Workshop at Lawrence Livermore National Laboratory”, Dr. McCall
- November 3– Journal of Science Policy & Governance Ambassador Program, “Equity in Policymaking: Partnering with Scientific and Community Experts”, Dr. McCall
- November 5– National Science Policy Network Scientists for Communities, “DEI in Precision Medicine”, Dr. McCall
- November 10– American Society for Biochemistry and Molecular Biology, “DEI in precision medicine: successes, challenges, and paths ahead”, Dr. McCall
- November 12– Annual Meeting of the Society for Neuroscience, Connecting With the Next Generation of Diverse Neuroscientists, “California Advances Brain Health Research & Outreach”, Dr. McCall
- November 14– Japan-U.S. Science Communication & Policy Fellowship Network, “Best Practices for Inclusive Science Communication”, Dr. McCall
- November 28– Inter-Americas Institute for Global Change Research, the Journal of Science Policy & Governance, and the Belmont Forum, “Transdisciplinarity in the Development of Science Policy & Diplomacy Outputs”, Dr. McCall
- December 7– UC Riverside Center for Science to Policy, 2022 Graduation Ceremony, Dr. McCall
- December 9– National Institute of Environmental Health, 2022 Annual Symposium, “Equity in Research Policy”, Dr. McCall
- December 20– Japan-U.S. Science Communication & Policy Fellowship Network, “Roundtable with Science Policy Leaders”, Dr. McCall

## **Appendix E. CIAPM Representation at Select 2022 External Events**

1. January 6 – Gravity Project Terminology Workstream, Dr. McCall
2. January 11 – NIH Listening Session on Racial Equity, Dr. McCall
3. January 27 – NASEM Workshop, Dr. McCall
4. January 31 – Breaking Barriers for Youth Programs, Dr. McCall
5. January 31 – AAAS Section X Committee Meeting, Dr. McCall
6. February 22 – Government Innovation California, Ms. Cortez & Dr. McCall
7. February 24-25 – CIRM Workshop, Dr. McCall
8. March 23 – UC Irvine Conte Center Symposium, Dr. McCall
9. April 28 – All In Data for Community Health, “Health and Housing Data Integration Affinity Group Kick-off”, Dr. McCall
10. May 9 – Annual Summit of The Center for Advancing Research Impact in Society, Dr. McCall

11. June 23 - Centering Racial Equity Throughout Data Integration: Racial Equity in Data Analysis, Algorithms, and Use of Statistical Tests, Dr. McCall
12. Aug 8 - NIH Office of Science Policy on the New NIH Data Management and Sharing Policy, Dr. McCall
13. September 23 – California Native American Day, Dr. McCall
14. September 29-30 – Medex Evolution California, Dr. McCall
15. November 17-18 – National Academies of Science, Engineering, and Medicine Workshop on Valley Fever, Dr. McCall

## Appendix F. Key Personnel in 2022

Sam Assefa, OPR Director

Julianne McCall, Co-Director of CIAPM

Shannon Muir, Co-Director of CIAPM

Megan Varvais, Communication Specialist & Administrator (May 2019-May 2022)

Aiyana Emigh Cortez, Policy Fellow (August 2020-October 2022)

Hyunsoo Gloria Kim, Policy Fellow (August 2020-January 2022)

Jessica Lumian, Policy Fellow (May 2021-May 2022)

Hannah Chu, Policy Fellow (November 2021-July 2022)

Alexandra Colón-Rodríguez, CCST Science and Technology Policy Fellow (February 2022-Present)

Esther Omaiye, Graduate Student Intern (February 2022-August 2022)

Bridgette Smith, Policy Fellow (June 2022-Present)

Megan Neel, Student Intern (June 2022-Present)

Yuki Hebner, Policy Fellow (October 2022-Present)

Max Wayne, Student Intern (December 2022-Present)

**\*Special acknowledgment to Graduate Student Interns Hanna Butler-Struben and Joanna Guan and Science Officer David Reiner for helping assemble material for the 2022 Annual Report**