

Stanford



Charles Gawad

Associate Professor of Pediatrics (Hematology/Oncology)

Pediatrics - Hematology & Oncology

Bio

BIO

Our lab works at the interface of biotechnology, computational biology, cellular biology, and clinical medicine to develop and apply new tools for characterizing genetic variation across single cells within a tissue with unparalleled sensitivity and accuracy. We are focused on applying these technologies to study cancer clonal evolution while patients are undergoing treatment with the aim of identifying cancer clonotypes that are associated with resistance to specific drugs so as to better understand and predict treatment response. We are also applying these methods to understand how more virulent pathogens emerge from a population of bacteria or viruses with an emphasis on developing a deeper understanding of how antibiotic resistance develops.

ACADEMIC APPOINTMENTS

- Associate Professor, Pediatrics - Hematology & Oncology
- Member, Bio-X
- Member, Maternal & Child Health Research Institute (MCHRI)
- Member, Stanford Cancer Institute

HONORS AND AWARDS

- Investigator, Chan Zuckerberg Biohub (2019-2024)
- Taube Distinguished Scholar for Pediatric Oncology, Stanford (2019-2024)
- New Innovator Award, Office of Director, National Institutes of Health (2018-2023)
- Career Award for Medical Scientists, Burroughs Wellcome Fund (2015-2020)
- Special Fellow, Leukemia and Lymphoma Society (2013-2016)
- Fellow Basic Research Scholar, American Society of Hematology (2013-2015)
- Advanced Residency Training Program, Stanford (2011-present)
- Fellowship for Medical Students Continued Support Award, HHMI (2003-2005)
- Cloister Scholar, HHMI-NIH (2002-2003)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Co-Founder, Board Director, BioSkryb, Inc. (2018 - present)
- Editorial Board Member, Nucleic Acids Research Cancer (2019 - present)

PROFESSIONAL EDUCATION

- PhD, Stanford University , Cancer Biology (2015)
- MD, University of Arizona , Medicine (2006)
- BS, Arizona State University , Chemistry and Microbiology (2001)

PATENTS

- Charles Gawad, Veronica Gonzalez-Pena, Robert Carter, Sivaraman Natarajan, Jason West. "United States Patent 62/881,180 Genetic Mutation Analysis"
- Charles Gawad, Jason West. "United States Patent 62/881,183 Single Cell Analysis"
- Charles Gawad, Jason West, Paul McEwan. "United States Patent 62/972,557 Phi29 Mutants and Use Thereof"
- Charles Gawad, Veronica Gonzalez-Pena, John Easton. "United States Patent WO2019148119A1 Method for Nucleic Acid Amplification"
- Charles Gawad, Siddhartha Kadia, Jason West. "United States Detection of Low Abundance Nucleic Acids", Apr 28, 2020
- Charles Gawad, Jason West, Jon Zawistowski. "United States Patent 55461-706.101 Detection of Low Abundance Viruses", Mar 31, 2020

LINKS

- Gawad Lab Website: <http://www.gawadlab.org/>

Research & Scholarship

CLINICAL TRIALS

- Genome, Proteome and Tissue Microarray in Childhood Acute Leukemia, Recruiting

Teaching

COURSES

2025-26

- Clinical Cancer Research Internship Program: CBIO 246 (Aut, Win, Spr)

2024-25

- Clinical Cancer Research Internship Program: CBIO 246 (Aut, Win, Spr)

2023-24

- Clinical Cancer Research Internship Program: CBIO 246 (Spr)

GRADUATE AND FELLOWSHIP PROGRAM AFFILIATIONS

- Cancer Biology (Phd Program)

Publications

PUBLICATIONS

- **Predicting bloodstream infection by plasma cell-free metagenomic sequencing: a prospective cohort study.** *The Lancet. Microbe*
Wolf, J., Goggin, K. P., Inaba, Y., Allison, K. J., Ahmed, A. A., Maron, G., Ferrolino, J., Lazure, L., Kohler, C., Brenner, A., Sun, Y., Tang, L., Gonzalez-Pena, et al
2027: 101312
- **Somatic mtDNA mutations at intermediate levels of heteroplasmy are a source of functional heterogeneity among primary leukemic cells.** *Science advances*
McCastlain, K., Welsh, C., Ni, Y., Ding, L., Chang, T. C., Autry, R. J., Sejdiu, B. I., Pan, Q., Franco, M., Chen, W., Wu, H., Gonzalez-Pena, V., Schreiner, et al

2025; 11 (37): eadt3873

- **Defining heritability, plasticity, and transition dynamics of cellular phenotypes in somatic evolution.** *Nature genetics*
Schiffman, J. S., D'Avino, A. R., Prieto, T., Pang, Y., Fan, Y., Rajagopalan, S., Potenski, C., Hara, T., Suvà, M. L., Gawad, C., Landau, D. A.
2024
- **scMicrobe PTA: near complete genomes from single bacterial cells.** *ISME communications*
Bowers, R. M., Gonzalez-Pena, V., Wardhani, K., Goudeau, D., Blow, M. J., Udway, D., Klein, D., Vill, A. C., Brito, I. L., Woyke, T., Malmstrom, R. R., Gawad, C.
2024; 4 (1): ycae085
- **Single-cell RNA sequencing distinctly characterizes the wide heterogeneity in pediatric mixed phenotype acute leukemia.** *Genome medicine*
Mumme, H. L., Raikar, S. S., Bhasin, S. S., Thomas, B. E., Lawrence, T., Weinzierl, E. P., Pang, Y., DeRyckere, D., Gawad, C., Wechsler, D. S., Porter, C. C., Castellino, S. M., Graham, et al
2023; 15 (1): 83
- **Single-cell Retrieval from Clinical Cytology Slides Under Morphologic Guidance Facilitates Future Comprehensive Genomic Profiling from Paucicellular Samples**
Zhu, Y., Aragon, A., Wang, A., Gonzalez-pena, V., Gawad, C., Lowe, A.
ELSEVIER SCIENCE INC.2023: S388
- **Duplex Sequencing Uncovers Recurrent Low-frequency Cancer-associated Mutations in Infant and Childhood KMT2A-rearranged Acute Leukemia.** *HemaSphere*
Pilheden, M., Ahlgren, L., Hyrenius-Wittsten, A., Gonzalez-Pena, V., Stuesson, H., Hansen Marquart, H. V., Lausen, B., Castor, A., Pronk, C. J., Barbany, G., Pokrovskaja Tamm, K., Fogelstrand, L., Lohi, et al
2022; 6 (10): e785
- **Single-cell genome sequencing of human neurons identifies somatic point mutation and indel enrichment in regulatory elements.** *Nature genetics*
Luquette, L. J., Miller, M. B., Zhou, Z., Bohrsen, C. L., Zhao, Y., Jin, H., Gulhan, D., Ganz, J., Bizzotto, S., Kirkham, S., Hochepped, T., Libert, C., Galor, et al
2022
- **Simultaneous monitoring of disease and microbe dynamics through plasma DNA sequencing in pediatric patients with acute lymphoblastic leukemia.** *Science advances*
Barsan, V., Xia, Y., Klein, D., Gonzalez-Pena, V., Youssef, S., Inaba, Y., Mahmud, O., Natarajan, S., Agarwal, V., Pang, Y., Autry, R., Pui, C. H., Inaba, et al
2022; 8 (16): eabj1360
- **Bringing precision oncology to cellular resolution with single-cell genomics.** *Clinical & experimental metastasis*
Xia, Y., Gawad, C.
2021
- **Accurate genomic variant detection in single cells with primary template-directed amplification.** *Proceedings of the National Academy of Sciences of the United States of America*
Gonzalez-Pena, V., Natarajan, S., Xia, Y., Klein, D., Carter, R., Pang, Y., Shaner, B., Annu, K., Putnam, D., Chen, W., Connelly, J., Pruett-Miller, S., Chen, et al
2021; 118 (24)
- **Integrative genomic analyses reveal mechanisms of glucocorticoid resistance in acute lymphoblastic leukemia.** *Nature cancer*
Autry, R. J., Paugh, S. W., Carter, R. n., Shi, L. n., Liu, J. n., Ferguson, D. C., Lau, C. E., Bonten, E. J., Yang, W. n., McCorkle, J. R., Beard, J. A., Panetta, J. C., Diedrich, et al
2020; 1 (3): 329–44
- **Evaluation of Plasma Microbial Cell-Free DNA Sequencing to Predict Bloodstream Infection in Pediatric Patients With Relapsed or Refractory Cancer.** *JAMA oncology*
Goggin, K. P., Gonzalez-Pena, V. n., Inaba, Y. n., Allison, K. J., Hong, D. K., Ahmed, A. A., Hollemon, D. n., Natarajan, S. n., Mahmud, O. n., Kuenzinger, W. n., Youssef, S. n., Brenner, A. n., Maron, et al
2019
- **Sequencing the Genomes of Single Cells.** *Methods in molecular biology (Clifton, N.J.)*

- Gonzalez-Pena, V. n., Gawad, C. n.
2019; 1979: 227–34
- **Single-cell RNA sequencing reveals the impact of chromosomal instability on glioblastoma cancer stem cells.** *BMC medical genomics*
Zhao, Y. n., Carter, R. n., Natarajan, S. n., Varn, F. S., Compton, D. A., Gawad, C. n., Cheng, C. n., Godek, K. M.
2019; 12 (1): 79
 - **Resolving medulloblastoma cellular architecture by single-cell genomics.** *Nature*
Hovestadt, V. n., Smith, K. S., Bihannic, L. n., Filbin, M. G., Shaw, M. L., Baumgartner, A. n., DeWitt, J. C., Groves, A. n., Mayr, L. n., Weisman, H. R., Richman, A. R., Shore, M. E., Goumnerova, et al
2019; 572 (7767): 74–79
 - **Murine hematopoietic stem cell activity is derived from pre-circulation embryos but not yolk sacs.** *Nature communications*
Ganuza, M. n., Chabot, A. n., Tang, X. n., Bi, W. n., Natarajan, S. n., Carter, R. n., Gawad, C. n., Kang, G. n., Cheng, Y. n., McKinney-Freeman, S. n.
2018; 9 (1): 5405
 - **Measurable residual disease detection by high-throughput sequencing improves risk stratification for pediatric B-ALL.** *Blood*
Wood, B. n., Wu, D. n., Crossley, B. n., Dai, Y. n., Williamson, D. n., Gawad, C. n., Borowitz, M. J., Devidas, M. n., Maloney, K. W., Larsen, E. n., Winick, N. n., Raetz, E. n., Carroll, et al
2018; 131 (12): 1350–59
 - **Pan-cancer genome and transcriptome analyses of 1,699 paediatric leukaemias and solid tumours.** *Nature*
Ma, X. n., Liu, Y. n., Liu, Y. n., Alexandrov, L. B., Edmonson, M. N., Gawad, C. n., Zhou, X. n., Li, Y. n., Rusch, M. C., Easton, J. n., Huether, R. n., Gonzalez-Pena, V. n., Wilkinson, et al
2018; 555 (7696): 371–76
 - **High-resolution transcriptional dissection of in vivo Atoh1-mediated hair cell conversion in mature cochleae identifies Isl1 as a co-reprogramming factor.** *PLoS genetics*
Yamashita, T. n., Zheng, F. n., Finkelstein, D. n., Kellard, Z. n., Carter, R. n., Rosencrance, C. D., Sugino, K. n., Easton, J. n., Gawad, C. n., Zuo, J. n.
2018; 14 (7): e1007552
 - **A Single-Cell Transcriptional Atlas of the Developing Murine Cerebellum.** *Current biology : CB*
Carter, R. A., Bihannic, L. n., Rosencrance, C. n., Hadley, J. L., Tong, Y. n., Phoenix, T. N., Natarajan, S. n., Easton, J. n., Northcott, P. A., Gawad, C. n.
2018; 28 (18): 2910–20.e2
 - **LC3-Associated Phagocytosis in Myeloid Cells Promotes Tumor Immune Tolerance.** *Cell*
Cunha, L. D., Yang, M. n., Carter, R. n., Guy, C. n., Harris, L. n., Crawford, J. C., Quarato, G. n., Boada-Romero, E. n., Kalkavan, H. n., Johnson, M. D., Natarajan, S. n., Turnis, M. E., Finkelstein, et al
2018; 175 (2): 429–41.e16
 - **Genome-wide segregation of single nucleotide and structural variants into single cancer cells.** *BMC genomics*
Easton, J. n., Gonzalez-Pena, V. n., Yergeau, D. n., Ma, X. n., Gawad, C. n.
2017; 18 (1): 906
 - **Early somatic mosaicism is a rare cause of long-QT syndrome** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Priest, J. R., Gawad, C., Kahlig, K. M., Yu, J. K., O'Hara, T., Boyle, P. M., Rajamani, S., Clark, M. J., Garcia, S. T., Ceresnak, S., Harris, J., Boyle, S., Dewey, et al
2016; 113 (41): 11555-11560
 - **Single-cell genome sequencing: current state of the science** *NATURE REVIEWS GENETICS*
Gawad, C., Koh, W., Quake, S. R.
2016; 17 (3): 175-188
 - **Dynamic ASXL1 Exon Skipping and Alternative Circular Splicing in Single Human Cells.** *PLoS one*
Koh, W., Gonzalez, V., Natarajan, S., Carter, R., Brown, P. O., Gawad, C.
2016; 11 (10)
 - **Dissecting the clonal origins of childhood acute lymphoblastic leukemia by single-cell genomics.** *Proceedings of the National Academy of Sciences of the United States of America*

Gawad, C., Koh, W., Quake, S. R.
2014; 111 (50): 17947-17952

- **Noninvasive in vivo monitoring of tissue-specific global gene expression in humans (vol 111, pg 7361, 2014) PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA**

Koh, W., Pan, W., Gawad, C., Fan, H., Kerchner, G. A., Wyss-Coray, T., Blumenfeld, Y. J., El-Sayed, Y. Y., Quake, S. R.
2014; 111 (30): 11223

- **Noninvasive in vivo monitoring of tissue-specific global gene expression in humans. *Proceedings of the National Academy of Sciences of the United States of America***

Koh, W., Pan, W., Gawad, C., Fan, H. C., Kerchner, G. A., Wyss-Coray, T., Blumenfeld, Y. J., El-Sayed, Y. Y., Quake, S. R.
2014; 111 (20): 7361-7366

- **A quantitative comparison of single-cell whole genome amplification methods. *PloS one***

de Bourcy, C. F., De Vlamincq, I., Kanbar, J. N., Wang, J., Gawad, C., Quake, S. R.
2014; 9 (8)

- **Massive evolution of the immunoglobulin heavy chain locus in children with B precursor acute lymphoblastic leukemia *BLOOD***

Gawad, C., Pepin, F., Carlton, V. E., Klinger, M., Logan, A. C., Miklos, D. B., Faham, M., Dahl, G., Lacayo, N.
2012; 120 (22): 4407-4417

- **Circular RNAs Are the Predominant Transcript Isoform from Hundreds of Human Genes in Diverse Cell Types *PLOS ONE***

Salzman, J., Gawad, C., Wang, P. L., Lacayo, N., Brown, P. O.
2012; 7 (2)

- **Gene Expression Arrays in Pancreatic Cancer Drug Discovery Research *DRUG DISCOVERY IN PANCREATIC CANCER: MODELS AND TECHNIQUES***

Gawad, C.
edited by Han, H., Grippo, P.
2010: 113-134

- **Towards molecular medicine - A case for a biological periodic table *AMERICAN JOURNAL OF PHARMACOGENOMICS***

Gawad, C.
2005; 5 (4): 207-211