

Mackenzie Callaway, PhD

Postdoctoral Research Fellow
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EDUCATION

Cold Spring Harbor Laboratory, Cold Spring Harbor, NY CSHL Cancer Center CATCH-32 Postdoctoral Fellow Principle Investigator: Camila dos Santos, PhD, Associate Professor	2021-present
University of Minnesota, Minneapolis, MN PhD in Biomedical Engineering Dissertation: Re-aligning patient prognosis: the role of collagen in establishing an immunosuppressive microenvironment and facilitating cancer cell dissemination in pancreatic ductal adenocarcinoma Advisor: Paolo P. Provenzano, PhD, Associate Professor	2015-2021
University of Missouri, Columbia, MO Bachelor of Science in Biological Engineering, Biology Minor <i>Cum Laude</i> and University Honors	2011-2015

HONORS AND AWARDS

Fellowships

• Cancer Center CATCH-32 Postdoctoral Fellowship Cold Spring Harbor Laboratory, <i>approximately \$200,000</i>	2023-present
• Physical Sciences in Oncology Center Engineering in Oncology Fellowship University of Minnesota, <i>approximately \$40,000</i>	2019-2020
• National Science Foundation Graduate Research Fellowship University of Minnesota, <i>approximately \$140,000</i>	2016-2019
• Summer Medical and Research Training Program Baylor College of Medicine	2013
• Howard Hughes Medical Institute Research Fellowship Additional funds awarded for Summer 2014 University of Missouri	2012-2013 2014
• Howard Hughes Medical Institute Research Apprentice University of Missouri	2011-2012

Honors and Awards

• Invited participant at NextProf Nexus in Atlanta, GA Facilitated by Georgia Tech, Berkley and University of Michigan	2019
• President's Student Leadership and Service Award (0.1% award rate) University of Minnesota	2019
• University Honors (Honors College Certificate and Departmental Research Honors) University of Missouri	2015
• <i>Cum Laude</i> Honors University of Missouri	2015
• American FFA Degree (<1% award rate) National FFA Organization	2012
• Engineering Dean's Scholar	2011-2015

PUBLICATIONS

- 12) Edwards R, **Callaway M**, Zettervall J, Provenzano P. "Pancreatic carcinoma-associated fibroblasts are predominantly derived locally and not from circulating precursors." In prep. (Est. submission, December 2023).
- 11) **Callaway M**[#], Noonan B, Schwertfeger K, and Provenzano P[#]. "Extracellular matrix mechanics drive the early establishment of an immunosuppressive microenvironment in pancreatic ductal adenocarcinoma." In prep. (Est. submission, November 2023). (**#Co-corresponding authors**)
- 10) Cyrill SL*, Henry S*, Lewis SM*, **Callaway MK**, Somasundara AVH, Jones G, He X, Ciccone MF, Biswas A, Hernandez E, Wang C, Egeblad M, Wilkinson JE, dos Santos CO. "UTI-induced, systemic TIMP1 mediates ECM remodeling and alters mammary gland biology." In revision. **Nature Communications**.
- 9) **Callaway MK**, dos Santos CO. "Gestational breast cancer—a review of outcomes, pathophysiology, and model systems." (2023). **Journal of Mammary Gland Biology and Neoplasia**. doi: 10.1007/s10911-023-09546-w.
- 7) Rodriguez-Merced NJ, **Callaway MK**, Provenzano PP. "Protocol to culture and image pancreatic ductal adenocarcinoma tumor slices to study T cell migration." (2023) **STAR Protocols**. doi: 10.1016/j.xpro.2023.102135.
- 8) Lewis SM, **Callaway MK**, dos Santos CO. "Clinical applications of 3D normal and breast cancer organoids: a review of concepts and methods." (2022) **Experimental Biology and Medicine**. 247(24), 2176-2183. doi: 10.1177/15353702221131877.
- 6) Ray A*, **Callaway M***, Rodriguez N, Crampton A, Carlson M, Emme K, Ensminger E, Schroppe J, Rasmussen H, Jiang H, Denardo D, Wood D, Provenzano P. "Collagen architecture directs early dissemination in pancreatic ductal adenocarcinoma." (2022) **JCI Insight**. doi: 10.1172/jci.insight.150330. (***Co-first authors**)
- 5) Tabdonov E, Rodriguez N, Cartagena-Rivera A, Puram V, **Callaway M**, Ensminger E, Pomeroy E, Yamamoto K, Lahr W, Webber B, Moriarty B, Zhovmer A, and Provenzano P. "Engineering T cells to enhance 3D migration through structurally and mechanically complex tumor microenvironments." (2021) **Nature Communications**. doi: 10.1038/s41467-021-22985-5.
- 4) Lange MJ, Nguyen PDM, **Callaway MK**, Johnson MC, Burke DH. "RNA-protein interactions govern antiviral specificity and encapsidation of broad spectrum anti-HIV reverse transcriptase aptamers." (2017) **Nucleic Acids Research**. 45:6087-97
- 3) Poudyal RR, Benslimane M, Lokugamage MP, **Callaway MK**, Staller S, and Burke DH. "Selective Inactivation of Functional RNAs by Ribozyme-Catalyzed Covalent Modification." (2017) **ACS Synthetic Biol**. 6:528-534
- 2) Poudyal RR, Nguyen PDM, Lokugamage MP, **Callaway MK**, Gavette JV, Krishnamurthy R, Burke DH. "Nucleobase modification by an RNA enzyme." (2017) **Nucleic Acids Research**. 45:1345-54
- 1) MJ Lange, PDM Nguyen, **MK Callaway**, DH Burke. "Broad-Spectrum Anti-HIV RT RNA Aptamers." Molecular Therapy. American Society of Gene & Cell Therapy 18th Annual Meeting. May 2015.

SERVICE AND LEADERSHIP EXPERIENCE

Leadership Experience

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| Chair , Postdoctoral Liaison Committee, Cold Spring Harbor Laboratory | 2023-present |
| <ul style="list-style-type: none"> • Serve as liaison between postdoctoral fellows and CSHL administration • Host professional development events geared toward networking, transition to faculty position or industry, etc. | |
| Symposium Moderator , Cancer Center Annual Symposium, Cold Spring Harbor Laboratory | 2023 |
| Seminar Host , Cold Spring Harbor Laboratory Cancer Center | 2023-present |
| <ul style="list-style-type: none"> • Introduce seminar speakers at each Cancer Center In-House, organize seminars and travel for external speakers | |

Founding Member , UMN Biomedical Engineering Mental Health Working Group	2019-2020
Co-Chair , UMN Student Health Advisory Committee	2018-2021
<ul style="list-style-type: none"> • Authored and presented a resolution to the Vice Provost and Vice President to increase access to emergency contraception on campus via vending machines, and succeeded! Pending implementation this February 2021. • Established access to menstrual products in men's restrooms in Boynton Health • Maintained a diverse group of student stakeholders to represent various cultural centers and student groups • Meet bi-weekly with Boynton Leadership to create agendas for general meetings • Lead bi-weekly meetings with students and Boynton leadership to discuss student needs and concerns • Compiled and presented Boynton's Student Service Fees for fiscal years 2019-2020 and 2020-2021 	
Coordinator , UMN College of Science and Engineering Graduate Women's Group	2019-2020
Founding member , UMN Student Mental Health Advisory Committee	2019-2020
Member , UMN Assistant Vice Provost and Director of Boynton Health Search Committee	2019-2020
<ul style="list-style-type: none"> • Collaborated with UMN leadership and a third-party search firm to recruit, interview, and identify the next Assistant Vice Provost and Director of Boynton Health 	
Member , UMN Boynton Student Service Fee Committee	2017-2020
<ul style="list-style-type: none"> • Developed and submitted requests for an increase in the annual allocation of the University of Minnesota's student service fees to support, as an example, the expansion of mental health care resources 	
Representative , UMN Council of Graduate Students General Assembly	2018-2019
Member , UMN Boynton Request For Plan Committee	Fall 2018
<ul style="list-style-type: none"> • Worked with Boynton and UofM System leadership to interview and negotiate with companies like Blue Cross Blue Shield, Medica, and Health Partners to identify a new insurance provider for UofM students 	
Member , UMN Learn to Live Evaluation Committee	2017-2018
<ul style="list-style-type: none"> • Evaluated novel online psychotherapy resource with Boynton leaders, UofM faculty, and Blue Cross Blue Shield 	
Representative , UMN Student Health Advisory Committee	2017-2018
President , UMN Graduate Women in BME	2017-2018
<ul style="list-style-type: none"> • Assembled and presented budget request for 2018-2019 to Dr. Robert Tranquillo, BME Department Head • Acquired over \$3000 in funding from local companies like Boston Scientific • Mentored a start-up GWBME group at the University of Utah 	
Mentor , College of Science and Engineering Women in Science and Engineering (WISE)	2016-2019
Vice President of Outreach , UMN Graduate Women in BME	2016-2017

Certification in Diversity, Equity and Inclusivity

University of Minnesota Office for Equity and Diversity Certificate Program (30 hours)

- "Implicit bias in Search and Selection Processes," April 2019
- "Race, Racism and Privilege," October 2019
- "LGBTQIA Identities and Communities," October 2019
- "Understanding and Advancing Gender Equity," November 2019
- "Collective Access for All," November 2019
- "My Role in Diversity and Equity Work," January 2020
- "Facilitating Challenging Conversations," February 2020
- "Addressing Implicit Bias and Microaggressions," February 2020
- "Challenging Classism," April 2020
- "Ableism and Disability Justice," August 2020

Professional and Honor Societies

- **Member**, Cancer Epigenetics Society 2017-present
- **Member**, Biomedical Engineering Society Cellular and Molecular Biology Group 2016-present
- **Member**, Tau Beta Pi Engineering Honor Society 2013-present

Volunteer Experience in Engineering and Medicine

Outreach in New York	2023
<ul style="list-style-type: none"> East Woods Science Fair Judge, Oyster Bay, NY 	
Outreach at local elementary schools in Minnesota	2015-2020
<ul style="list-style-type: none"> Nellie Stone Johnson School, Minneapolis, MN Bethune Community School, Minneapolis, MN Sun Path Elementary, Shakopee, MN 	
UMN Math and Science Family Fun Fair, Minneapolis, MN	
Leader, October-November	2016
Member, October-November	2015
Teaching SMART, Minnesota	2015-2016

ORAL AND POSTER PRESENTATIONS

2023	Invited panelist: "3D Cellular Models for Drug Development." Biocompare Webinar.
2023	Invited seminar: "The influence of pregnancy hormones on gestational breast cancer." Cancer Center In-House, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.
2023	Invited seminar: "Preclinical models of gestational breast cancer." Northwell Health Center for Cancer, Pregnancy and Reproduction, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.
2022	Invited seminar: "Pregnancy, hormones, and gestational cancer." Demerec In-House, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.
2021	Invited seminar: "Re-aligning patient immunity: collagen architectures and their role in pancreas cancer." Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.
2021	Invited seminar: "Collagen architectures and their role in pancreas cancer." Cold Spring Harbor Laboratory, Cold Spring Harbor, NY.
2020	Invited symposium: "Re-aligning patient immunity: how alignment influences macrophages in pancreatic cancer." Physical Sciences in Oncology Network Annual Retreat, Minneapolis, MN.
2019	Poster presentation: "Collagen architecture influences early dissemination in pancreatic ductal adenocarcinoma." Physical Sciences in Oncology Network Annual Meeting, Minneapolis, MN.
2014	Selected abstract: "Temperature dependence of nucleobase phosphorylation by a kinase ribozyme catalyst." Institute of Biological Engineers, Lexington, KY.
2014	Poster presentation: "RNA Enzymes as Potential Tools for Artificial Gene Regulation." Biomedical Engineering Society, San Antonio, TX.
2014	Poster presentation: "Engineering ribozymes to regulate genes via phosphoryl transfer." Undergraduate Research & Creative Achievements Forum, University of Missouri Columbia, MO.
2013	Invited seminar: "Identifying DNaseI hypersensitive sites in murine mammary tissue chromatin." Baylor College of Medicine, Houston, TX.
2013	Invited seminar: "Identifying DNaseI hypersensitive sites in murine mammary tissue chromatin." Children's Nutrition Research Center, Houston, TX.
2013	Poster presentation: "Targeting HIV RT with Aptamers." HHMI Fellowship, University of Missouri Columbia, MO.
2012	Video presentation: "Trail to a Cure.", HHMI Fellowship, University of Missouri Columbia, MO.
2012	3 Minute Pitch: "RNA luddites: a wrench in HIV's gears." HHMI Apprenticeship (2 nd place winner), University of Missouri Columbia, MO.

TEACHING AND MENTORING EXPERIENCE

Teaching Experience

Cold Spring Harbor Laboratory, Cold Spring Harbor, NY

Co-Lead for Writing Resource Center Coffee Chat: Effective Powerpoint Presentations 2023

- Co-lead a webinar on creating and presenting effective scientific presentations

University of Minnesota Twin Cities, Minneapolis, MN

Teaching Assistant and Postdoctoral Professional Development Program	2019
• Earned certificate through the Center for Educational Innovation for completing 6-part enrichment series	
Teaching Assistant for BMEN 5701: Cancer Bioengineering (25%)	Fall 2018
• Independently lead 75 minute discussion on how tissue mechanics influence tumor and immune cell function	
Preparing Future Faculty Program	2017-2018
GRAD 8101: Teaching in Higher Education and GRAD 8200: Practicum for Future Faculty	
• Earned certificate for completion of the PFF program	
• Worked closely with a tenured professor at Augsburg College teaching BIO 253 Intro to Cell Biology	
○ Developed and taught three 70 minute course sessions in an undergraduate cell biology course	
○ Created and implemented one 70 minute learning activity and facilitated course discussion	
○ Attended other professional events (i.e., faculty meetings and student advising appointments)	
• Developed teaching portfolio (teaching philosophy, syllabi, lesson plans, and interactive learning strategies)	
<u>University of Missouri, Columbia, MO</u>	
Student Services, Global Engineering Ambassador	2014-2015
• Assisted in teaching an interdisciplinary engineering humanities course abroad	
Hudson Hall, Peer Advisor	2013-2014
• Created content for and directed a 16 week interdisciplinary freshman level course for engineers	
<u>Mentoring Experience</u>	
<u>Cold Spring Harbor Laboratory, Cold Spring Harbor, NY</u>	
• Lucia Tellez Perez, PhD Student at CSHL	2022-present
• Dhivyaa Anandan, MD/PhD Student at Stony Brook	2022-present
• Adina Lippman, High School Student	2022-2023
• Kyra Shah, High School Student	2022
<u>University of Minnesota Twin Cities, Minneapolis, MN</u>	
• Demi Zhang, PhD student in Biomedical Engineering	2019-2021
• Nelson Rodriguez, Masters student in Biomedical Engineering	2017-2018
• Margaret Braunreuther, Undergraduate in Chemical Engineering from University of Michigan	2018
○ Poster Presentation: M Braunreuther, <u>M Callaway</u> , G Venkatesan, P Provenzano, M McAlpine. “Bioprinting to Support Macrophages.” Where, when for what, etc.	
• Brock Noonan, Undergraduate in Biomedical Engineering	2016-2019
<u>University of Missouri, Columbia, MO</u>	
• Creighton Deyoung, Undergraduate in Biological Engineering	2015
• Anna Lauriello, High School Student	2014-2015
• Espther Liu, High School Student	2013-2015

SUPPLEMENTAL

Service:

Articles reviewed:

- “Breast Cancer during Pregnancy and Lactation; A five years retrospective hospital based study.” *International Journal of Women’s Health*. (April 2023)
- “Pregnancy associated invasive apocrine carcinoma of breast: Case report from Ethiopia.” *Breast Cancer: Targets and Therapy*. (March 2023)
- “Immune collagen orchestration in mammary glands during pregnancy.” *PNAS Nexus*. (September 2022)
- “Immune collagen orchestration in mammary glands during pregnancy.” *Signal Transduction and Targeted Therapy*. (August 2022)
- “Mutation and low expression of ARID1A predicts poor prognosis and high immune infiltration in triple-negative breast cancer.” *Frontiers in Oncology*. (August 2022)

- "Epigenetic state of oxytocin receptor is associated with exogenous oxytocin needs during human birth and increased risk of postpartum hemorrhage." *Nature Comms Med.* (June 2022)

Additional awards:

- 2011 Greater Kansas City Top 10 of Tomorrow Scholarship
- 2011 Dave Wright Foundation Support of Public Education Scholarship
- 2011 Blue Springs Teacher of the Year Scholarship
- 2011 Blue Springs NEA Paul Kinder Scholarship
- 2011 Dolores Priddy Scholarship
- 2011 Delta Woods MS PTSA Scholarship
- 2011 Melody Powell Scholarship
- 2011-2013 American Business Women's Association Scholarship
- 2011-2015 Ellis Foundation Scholarship
- 2011-2015 Bright Flight Scholarship
- 2011-2015 Curators Scholar Award
- 2011-2015 Engineering Achievement Scholarship
- 2011-2015 Mizzou Alumni Scholarship
- 2011-2015 Engineering Dean's Scholar, University of Missouri