David Thomas Rach

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Research scientist, computational biologist and cytometry enthusiast. I have extensive experience with spectral and conventional flow cytometry (both analyzers and sorters), from high-parameter panel design through unsupervised data analysis. Passionate about teaching and training others to further best practices. I am the author and maintainer of 3 cytometry-focused R packages, that enable more reproducible analyses and expand our fundamental understanding of human immunology.

Education:

University of Maryland, Baltimore — Baltimore, MD
Ph.D., Molecular Microbiology and Immunology — August 2018 – June 2026 (expected)

University of Wyoming — Laramie, WY
B.S., Molecular Biology and Microbiology — August 2014 – May 2016

Northwest College — Powell, WY
A.S., Natural Resources Biology — August 2011 – May 2013

Research Experience:

Molecular Microbiology and Immunology PhD Student — Baltimore, MD
University of Maryland, Baltimore — August 2018 - Present
Thesis title: Immune responses of HIV-exposed Uninfected (HEU) infants

- Designed and validated high-parameter spectral flow cytometry panels (29-34 fluorophores) characterizing cytokine responses of Innate-like and Adaptive T cells from rare clinical specimens on a 5-laser Cytek Aurora.
- Created and implemented supervised and unsupervised analytical pipelines in R, facilitating troubleshooting of unmixing errors, enabling more thorough and reproducible analysis, revealing hidden functional heterogeneity in the acquired datasets.
- Trained 12 lab members (from undergraduates to assistant professors) to carry out their own spectral cytometry experiments.

Predoctoral Staff - UMGCC Flow Cytometry Shared Resource — Baltimore, MD
University of Maryland Greenebaum Comprehensive Cancer Center — September 2025 - Present

- Performed all core operations encompassing user training, panel design, data analysis, cell sorting, instrument maintenance and quality control, procurement, as well as general troubleshooting and correspondence.
- Proposed, organized and co-led the yearly Baltimore Introductory Spectral Cytometry Course (BISCC), an intensive 5-day workshop, delivering lectures on unmixing and autofluorescence and led hands-on training and troubleshooting sessions.
- Created and taught the weekly Cytometry in R course, aimed at those without prior coding experience, both in-person and online (https://umgcccfcsr.github.io/CytometryInR/), reducing barriers to implementation of unsupervised analysis.
- Developed automated quality control data processing for the core's Cytek and BD instruments, enabling real-time and historical instrument performance monitoring via a website (https://umgccfcss.github.io/InstrumentQC/).

INBRE Undergraduate Research Fellow — Laramie, WY
University of Wyoming — August 2014 – May 2016

- Investigated Natural Killer cell responses to secondary and chronic *Toxoplasma gondii* infection, utilizing conventional flow cytometry, genetic and molecular biology approaches. Gained additional expertise in cell culture, animal handling and infection, chemical ablation of bone marrow and adoptive transfers.

Technical Skills:

Flow Cytometry: Experienced operator for both spectral (Cytek Aurora) and conventional (BD LSR-II, Guava Easycyte) analyzers. Additionally proficient in the operation of cell sorters (Cytek Aurora CS and BDFACS Aria II). Extensive experience with supervised analysis and troubleshooting of the acquired data using R, FlowJo, FCSExpress, Diva, and SpectroFlo software.

Bioinformatics: Advanced knowledge of the R programming language, with functional knowledge of Rust, Python and SQL. Experience creating and validating unsupervised analytical pipelines to handle larger-than-memory spectral flow and mass cytometry datasets. Author and maintainer of 3 open-source cytometry-focused R packages (Luciernaga, Coereba, CytometryQC), with additional experience building dashboards and Shiny apps. Familiarity with both Windows and Linux (Debian) operating systems.

Laboratory Skills: Routinely performed blood processing, cell cryopreservation, cell culture, all performed under BSL-2 conditions with required blood-borne pathogen certification. Previously extensive experience with animal handling, IP and IG infections, chemical bone marrow ablation and adoptive transfers. Additional experience with ELISA, RT-PCR, and fluorescence microscopy.

References available upon request

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Teaching Experience:

Lecturer – Cytometry in R Baltimore, MD
UMGCCC Flow Cytometry Shared Resource February 2026 – Present

- Developed and taught a free weekly "Cytometry in R" course, targeting participants with no-to-little prior coding experience, offered both in-person and online, reaching over 600 active participants worldwide.
- Delivered 5 hours of instruction per week; additional responsibilities encompassed lesson planning and preparation, course website development and maintenance, and providing targeted participant feedback.

Science Education Volunteer Klikor-Agbozume, Ghana
U.S. Peace Corps May 2016 – July 2018

- Taught high school biology and chemistry to 650 first- and second-year students at Klikor Secondary Technical School, delivering 20 hours of instruction per week across classes of approximately 50 students with diverse ages and knowledge levels.
- Prepared and graded lessons, assignments, practical demonstrations, and exams; additionally served on the exam and library committees.

Languages:

Spanish (Fluent), Ewe (Advanced)

Publications:

1. David Rach, Hao-Ting Hsu, Nginache Nampota, Godfrey Mvula, Felix A. Mkandawire, Osward M. Nyirenda, Bernadette Hritzo, Francesca Boldrin, Giulia Degiacomi, Laura Cioetto Mazzabò, Riccardo Manganelli, Andrea G. Buchwald, Franklin R. Toapanta, Marcelo B. Sztein, Miriam Laufer, Kirsten E. Lyke, Cristiana Cairo. Cord Blood Innate-like T cell responses in neonates born to healthy women and women living with HIV. *Frontiers in Immunology* 2025 https://doi:10.3389/fimmu.2025.1628145
2. Haoting Hsu, Claudio Zanettini, Modupe Coker, Sarah Boudova, David Rach, Godfrey Mvula, Titus H Divala, Randy G Mungwira, Francesca Boldrin, Giulia Degiacomi, Laura Cioetto Mazzabò, Riccardo Manganelli, Miriam K Laufer, Yuji Zhang, Luigi Marchionni, Cristiana Cairo. Concomitant assessment of PD-1 and CD56 expression identifies subsets of resting cord blood Vδ2 T cells with disparate cytotoxic potential. *Cellular Immunology* 2024 Jan 01, 395-396, 104797 https://doi.org/10.1016/j.cellimm.2023.104797
3. Haoting Hsu, Sarah Boudova, Godfrey Mvula, Titus H Divala, David Rach, Randy G Mungwira, Francesca Boldrin, Giulia Degiacomi, Riccardo Manganelli, Miriam K Laufer, Cristiana Cairo. Age-related changes in PD-1 expression coincide with increased cytotoxic potential in Vδ2 T cells during infancy. *Cellular Immunology* 2021 Jan 01, 359, 104244 https://doi.org/10.1016/j.cellimm.2020.104244
4. Daria L. Ivanova, Ryan Krempels, Stephen L. Denton, Kevin D. Fettel, Giandor M. Saltz, David Rach, Rida Fatima, Tiffany Mundhenke, Joshua Materi, Ildiko R. Dunay, Jason P. Gigley. NK cells negatively regulate CD8 T cells to promote immune exhaustion and chronic Toxoplasma gondii infection. *Frontiers in Cellular and Infection Microbiology* 2020 Jul 07, 10, 313 https://doi.org/10.3389/fcimb.2020.00313

Invited Talks:

1. David Rach. Complex Data Analysis – "No cells left behind – Wrangling the full biological discover potential out of spectral flow cytometry (SFC) datasets". Association for Biomolecular Resource Facilities (ABRF) Annual Meeting. Pittsburgh, USA. March 30, 2026.

Presentations:

1. David Rach, Natarajan Ayithan, Xiaoxuan Fan. Cytometry in R: A free weekly course for flow cytometrist with no-to-little coding experience. *Bioc2026*. Seattle, USA. Accepted - Oral.
2. David Rach, Nginache Nampota-Nkomba, Godfrey Mvula, Felix A. Mkandawire, Osward M. Nyirenda, Winter A. Okoth, Daniela Franco, Andrea G. Buchwald, Franklin R. Toapanta, Marcelo B. Sztein, Miriam K. Laufer, Kirsten E. Lyke, Cristiana Cairo. A semi-supervised pipeline for a comprehensive and scalable analysis of immune heterogeneity in human samples. *Cyto 2026*. West Palm Beach, USA. Accepted - Oral.
3. David Rach, Natarajan Ayithan, Xiaoxuan Fan. Being Everything, Everywhere, All at Once: Open-Source Automation for Situational Awareness in SRLs. *Cyto 2026*. West Palm Beach, USA. Accepted - Oral.
4. David Rach, Natarajan Ayithan, Xiaoxuan Fan. Cytometry in R: A free weekly course for coding beginners. *Cyto 2026*. West Palm Beach, USA. Accepted - Poster.

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5. David Rach, Kirsten E. Lyke, Cristiana Cairo. “Well, how bright does it need to be?” Investigating the interplay of fluorescent signature and brightness in single-color unmixing controls. *Cyto 2025.* Denver, USA. Exceptional Student Award finalist – Oral.
6. David Rach, Kirsten E. Lyke, Cristiana Cairo. “Are these autofluorescences in the room with us right now?” Quantifying impact of autofluorescence variation on unmixing. *Cyto 2025,* Denver, USA. Poster.
7. David Rach, Kirsten E. Lyke, Cristiana Cairo. “Well, how bright does it need to be?” Investigating the interplay of fluorescent signature and brightness in single-color unmixing controls. *Cyto 2025.* Denver, USA. Poster.
8. David Rach, Mikayla Trainor, Natarajan Ayithan, Xiaoxuan Fan. “Wait, when was QC last run???” Evaluating MFI drift after morning QC and its impact on unmixing. *Cyto 2025.* Denver, USA. Poster.
9. David Rach, Hao-Ting Hsu, Nginache Nampota, Godfrey Mvula, Felix A. Mkandawire, Osward M. Nyirenda, Bernadette Hritzo, Ingrid Peterson, Franklin R Toapanta, Marcelo B Sztein, Miriam Laufer, Kirsten E. Lyke, Cristiana Cairo. Vγ9Vδ2 T cell responses in HIV-exposed Uninfected (HEU) Infants. *10th International γδ T cell Conference 2023*. Lisbon, Portugal. Poster.
10. David Rach, Hao-Ting Hsu, Nginache Nampota, Godfrey Mvula, Felix A. Mkandawire, Osward M. Nyirenda, Ingrid Peterson, Franklin R. Toapanta, Marcelo B. Sztein, Miriam Laufer, Kirsten E. Lyke, Cristiana Cairo. Spectral flow cytometry analysis of Innate-like T cell responses in Malawian HIV-exposed Uninfected (HEU) Infants. *Cyto 2023.* Montreal, Canada. Poster.
11. David Rach, Hao-Ting Hsu, Nginache Nampota, Godfrey Mvula, Franklin R. Toapanta, Marcelo B. Sztein, Miriam Laufer, Kirsten E. Lyke, Cristiana Cairo. Innate-like T cell responses in HIV exposed uninfected Malawian infants. *ASTMH 2021.* Virtual. Poster.

References available upon request