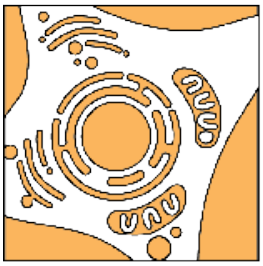
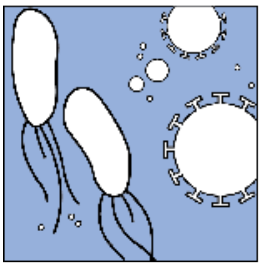




CAMB Student Newsletter

Volume 7 | Issue 2 | May 2022

In this issue

Letter from the Editors

Dear CAMB Students, Faculty, and Alumni,

We're excited to share with you the May 2022 installment of the CAMB Student Newsletter! In this month's issue, we dive into the work of MVP student **Andrew Marques** and recap his study of SARS-CoV-2 prevalence in Pennsylvania's wild white-tailed deer population. We speak with current and former SACNAS board members **Nicole Robles-Matos**, **Marisa Egan**, and **Kimberly Veliz** to learn more about the SACNAS organization and how students can utilize their resources. Finally, we compare the various pathways into industry by interviewing CAMB alumni **Dr. Monika Eiva** (scientist at a big pharma company), **Dr. Priya Khurana** (scientist at a biotech startup), and **Dr. Antonia Bass** (industry postdoctoral research fellow).

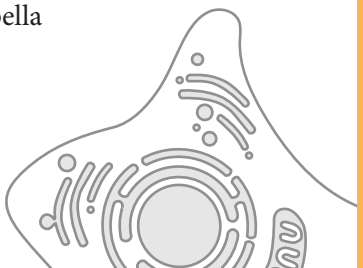
And, be sure to check out our latest installment of CAMB's Positivity Posts! This month we hear from CPM student **Dr. Anna Garcia Whitlock** and celebrate the arrival of her son (a future UNC Chapel Hill Tar Heel!).

For additional articles, past publications, and to learn more about the CAMB Student Newsletter team, visit our blog at cambnewsletter.wix.com/blog or follow us on Twitter at @CambNewsletter. Current students interested in contributing to the CAMB Student Newsletter can complete this form to sign up for our email list. We hope you enjoy the May 2022 issue!

Sincerely,

Hannah Kolev, James Gesualdi, and Kay Labella

Editors-in-Chief



Research Spotlight

Animal Reservoirs of SARS-CoV-2

James Gesualdi

Peer Edited by Kay Labella

As we enter the third year of the COVID-19 pandemic, there is a growing consensus that SARS-CoV-2 will eventually become an endemic infection, regularly circulating at relatively static or predictable levels. However, we remain unsure when the pandemic phase will end and what long-term coexistence with SARS-CoV-2 will entail. One key question – given the likely zoonotic origin of SARS-CoV-2 – is whether the virus can establish animal reservoirs, as pathogens with robust animal reservoirs are more challenging to control or eradicate. CAMB MVP student **Andrew Marques** recently contributed to a growing body of literature regarding potential SARS-CoV-2 animal reservoirs by publishing a study examining the prevalence of SARS-CoV-2 in wild white-tailed deer throughout Pennsylvania (1).

During a roughly three-month sampling period in late 2021, nasal swabs were collected from 93 white-tailed deer in 31 counties throughout Pennsylvania and tested for SARS-CoV-2 infection via PCR. Of the sampled population, 19.3% were found to be COVID positive. During the same sampling period, the test positivity rate for the whole United States ranged from an average of 4 – 5% to a high of 13.2% as case counts rose due to the ascendance of the omicron variant and the holiday travel season (2).

This is a surprisingly high rate of infection when compared to the human disease burden at the same time. Previous studies of wild deer populations further corroborate the animals bearing higher SARS-CoV-2 burden. Studies performed in Iowa and Ohio showed test positivity rates of 33% and 36%, respectively (3, 4). During each sampling period, the rates of infection in deer are substantially larger than those seen in people, suggesting that high rates of SARS-CoV-2 positivity in deer may be the norm.

Andrew Marques, MVP PhD Candidate

Animal Reservoir: A population of organisms in which a pathogen naturally lives and reproduces

Tropism: The ability of a given virus to infect a particular cell type (cellular tropism) or host species (host tropism)

Phylogeny: The study of evolutionary history and relationships among or within groups of organisms. In the context of these studies, we are discussing the phylogenetic relationships between different SARS-Cov-2 variants

Clade: A group of organisms believed to have evolved from a single common ancestor

Andrew and colleagues next examined the viral isolates obtained from the sampled deer; high quality viral genome sequences were successfully recovered from the seven deer samples with the highest concentrations of SARS-CoV-2 viral RNA. Using whole genome sequencing, two of the sequenced samples were shown to be derived from the Alpha variant of SARS-CoV-2 (B.1.1.7), and five were shown to be closely related to the Delta variant (AY.#).

The Alpha variant, first documented in the UK in September 2020 and designated a variant of concern by

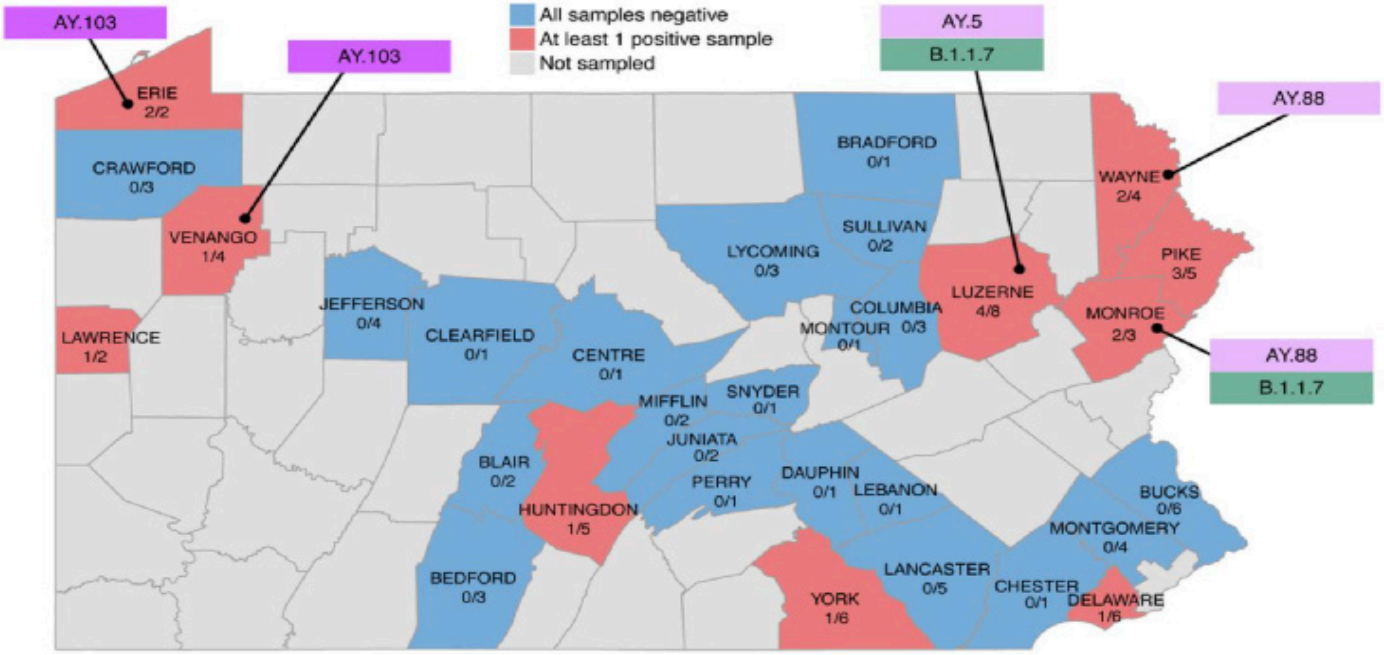


Figure 1. Map of Pennsylvania (PA), showing sampling sites and locations of SARS-CoV-2 positive deer. The counties comprising PA are outlined. Counties with positive samples are shown in red; counties sampled but lacking positive samples are in blue; counties in grey were not sampled. The numbers of deer sampled and the number positive are shown for each county sampled. The deer samples sequenced were assigned to variants as indicated by the rectangles outside the map; variant type is color coded (teal for alpha/B1.1.7, purple/pink for delta/AY.#). Image credit: https://www.medrxiv.org/content/10.1101/2022.02.17.22270679v4

the WHO in December 2020, outcompeted more ancestral strains in some parts of the world. Later, the prevalence of the Alpha variant waned substantially as the more contagious Delta variant, which was first documented in India in October 2020 and designated a variant of concern in May 2021, began to comprise the overwhelming majority of observed cases (5).

The two Alpha sequences sampled from deer were shown to be significantly divergent both from each other and from nearly all Alpha variant strains collected from infected human subjects. The two isolates showed clearly distinct phylogeny and differed from each other by 45 nucleotide substitutions. For context, sequencing studies of SARS-CoV-2 infection in humans have shown that a typical virus accumulates roughly two single nucleotide mutations per month (6). Andrew and colleagues interpreted this substantial difference between recovered Alpha genomes as evidence that two separate human to deer transmission events gave rise to these cases, rather than a single jump to deer followed by rapid mutation of the virus in its new host.

The five recovered Delta sequences were annotated into three distinct clades within a broader Delta phylogenetic tree. Two of the genomes were assigned to one clade, AY.103, and two were assigned to a second, AY.88, and the final sequence was assigned to a third clade, AY.5. The two AY.88 sequences were identical, and the AY.5 sequence differed by 13 nucleotide substitutions, while the two AY.103 sequences differed by just 7 substitutions. Again, the most plausible interpretation of these data is at least two separate transmission events; one that introduced the AY.103 viruses into the deer population, and another that introduced the AY.88 viruses, followed by some slight divergence as mutations accumulated in the viral genome during replication in the deer.

Andrew and colleagues then moved on to further define the individual mutations that they observed in their recovered viral genomes. Interestingly, many of the substitutions observed in the deer viruses were rare or absent in databases of human clinical SARS-CoV-2 isolates but were highly enriched in a database of deer viral genome isolates. Multiple mutations observed in the 7 recovered deer genomes were found to be hundreds of times more prevalent in other deer isolates than in human-derived viral genomes. This is not surprising for viruses with broad enough tropism to infect multiple hosts, and suggests that SARS-CoV-2 in deer is subjected to considerable selective pressure based on species-specific restriction factors or other constraints.

These findings, currently available as a preprint on MedRXiv awaiting peer review, have serious implications for the future of the pandemic and our understanding of SARS-CoV-2 endemicity. First of all, widespread infection in wild white-tailed deer is a highly reproducible phenomenon in North America (1, 3, 4, 7). Given the high density of wild deer on many parts of the continent – Pennsylvania has roughly 30 per square mile or a statewide total of over 1 million, for example – they could certainly constitute a bonafide animal reservoir for SARS-CoV-2. Time will tell if these high levels of infection are stable. Given previous documentation of SARS-CoV-2 infection in other common mammals like hamsters, some mice, minks, and feral cats, the list of potential animal reservoirs appears to be growing (8). SARS-CoV-2 generally appears to show much broader tropism than other coronaviruses. The SARS coronavirus that caused the 2003 epidemic in east Asia has been shown to infect minks and wild boars, but at lower levels than those observed in deer (9).

Andrew's data also raises the question of re-transmission from deer back into the human population. Based on another study in Canada, there was at least a single documented case of a re-transmission event in which a human patient was infected with a strain of SARS-CoV-2 that harbored mutations that were previously observed exclusively in viral samples recovered from infected wild deer (6). Again, time will tell if this observation is reproducible, but this is generally concerning news for pandemic mitigation efforts. If SARS-CoV-2 variants – such as the Alpha variants recovered in Andrew's study – are capable of taking refuge in deer or other animal populations and eventually re-infecting humans, viruses that are no longer considered variants of concern could return to cause further damage in the future as population immunity wanes or changes.

Regarding the potential clinical relevance of transmission from infected deer back into the human population, Andrew states that "The worst-case scenario is that spillovers and spillbacks occur regularly with substantial changes to the viral genome while infections last in other species. This could have the potential to reintroduce new variants into the human population with [novel] mutations ... The best-case scenario is that white-tailed deer are a dead end in the context of human infections. I believe that the truth lies somewhere in the middle: deer get infected and can perhaps infect some humans, but the evolution is limited. Or at least as limited as evolution in humans".

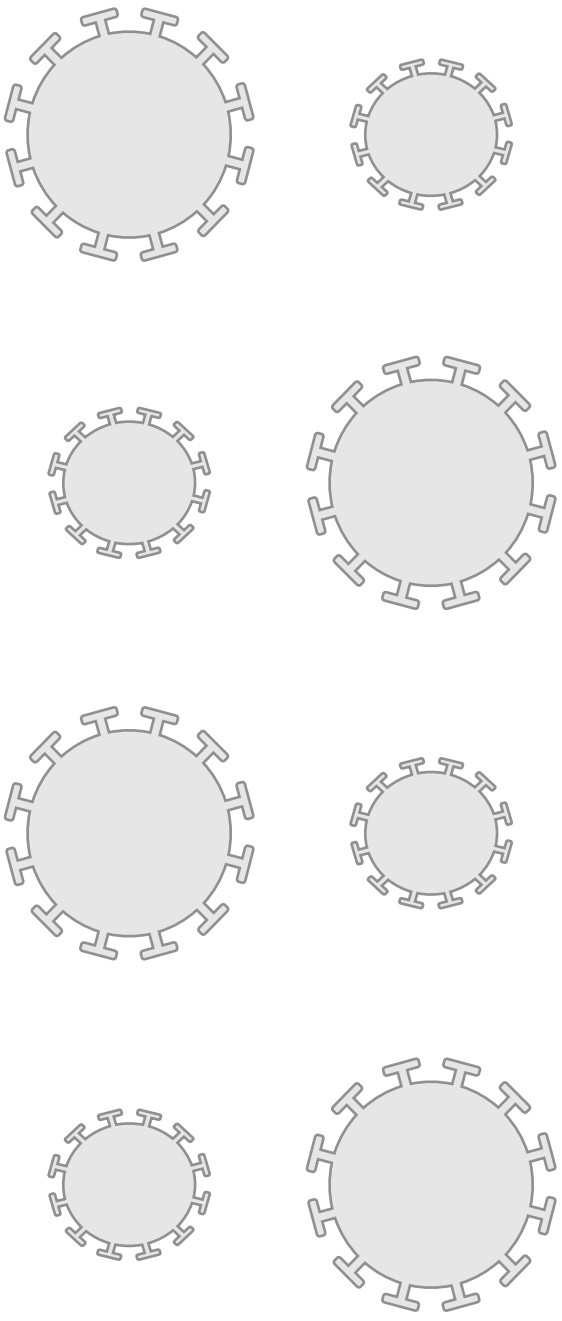
While the Delta samples were detected in October 2021, after the Delta variant had become the dominant strain throughout the US, the Alpha samples were recovered in November of 2021, long after the prevalence of Alpha lineage viruses in the human population had dropped precipitously in favor of Delta. This suggests that some variants of concern might be capable of long-term persistence in deer or potentially other animal reservoirs. Additionally, a longer period of incubation in the deer host could account for the comparatively large number of mutations that accumulated in the recovered Alpha sequences.

Andrew and colleagues then moved on to further define the individual mutations that they observed in their recovered viral genomes. Interestingly, many of the substitutions observed in the deer viruses were rare or absent in databases of human clinical SARS-CoV-2 isolates but were highly enriched in a database of deer viral genome isolates. Multiple mutations observed in the 7 recovered deer genomes were found to be hundreds of times more prevalent in other deer isolates than in human-derived viral genomes. This is not surprising for viruses with broad enough tropism to infect multiple hosts, and suggests that SARS-CoV-2 in deer is subjected to considerable selective pressure based on species-specific restriction factors or other constraints.

Another open question is how exactly wild deer are becoming infected at such high frequencies. Contact between deer and covid positive people could play a role, but it is also possible that another SARS-CoV-2 susceptible animal is acting as an intermediate host and ferrying the virus from human to deer. Recent in silico modeling studies have suggested that as many as several hundred mammal species may ultimately be susceptible to SARS-CoV-2, based on simulations of the viral spike protein's ability to bind its entry receptor ACE2 in various animals (10). Interestingly, both wildlife observations and lab studies show that deer do not experience symptoms due to SARS-CoV-2

infection (7). However, this may not be the case for other animals that cross paths with deer. In particular, grazing livestock may be vulnerable to infection and disease, or could act as an intermediary in transmission of viruses back into the human population.

The high prevalence of SARS-CoV-2 in wild deer poses new challenges for pandemic control, and further complicates models of endemicity. Historically speaking, diseases with well-established animal reservoirs can be functionally impossible to eradicate and challenging to control. Going forward, people may need to exercise more caution around deer and other SARS-CoV-2 susceptible wildlife, including taking measures to keep pets and livestock protected. Indeed, these data suggest that broader screening for SARS-CoV-2 infection among potentially susceptible wildlife will be essential for understanding which species might be acting as viral reservoirs. Broadly, these findings are part of the growing body of evidence that suggests that we will all be dealing with SARS-CoV-2 for the foreseeable future and should continue to be vigilant and proactive with mitigation measures.



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Changing the Face of STEM | SACNAS

Yee Hoon Foong

Peer Edited by Amber Abbott

Innovations from the Science, Technology, Engineering, Mathematics (STEM) fields have profoundly touched every aspect of human life. More often than not, our narrative of scientific breakthroughs focuses solely on the brilliance and merits of individual scientists. However, this myopic view crumbles under the modern research enterprise, where scientific research is cultivated through the collective efforts of talented teams, not individuals. In this setting, a diverse background of problem solvers is equally if not more important than individual prowess. This phenomenon resonates deeply in Scott Page's book "The Difference" (1), where his research redefined how diversity of the team is indispensable for solving complex problems. For the simplest reason, people from diverse backgrounds tend to adopt different approaches in problem solving, and bring in unique and creative perspectives to the scientific colloquy.

Although the STEM world is moving forward at breakneck speeds, its workforce demography is not keeping pace. Despite the shift in America's population demographic, Chicanos/Hispanics and Native Americans are still underrepresented in STEM. The 2019 United States Census Bureau estimated that 60.5 million Hispanics are living in the US, but Hispanic adults make up merely 8% of all STEM employees (2,3). The face of STEM is not representative of our diverse world, a fact indicating that significant talent is precluded from entering the scientific fields.

To promote and amplify diverse voices in STEM, Kevin Alicea-Torres founded the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) chapter here at the University of Pennsylvania. We had the delightful opportunity to speak with members of the SACNAS board of directors **Nicole Robles-Matos** (former Academic Development Chair), **Marisa Egan** (current Academic Development Chair), and K**imberly Veliz** (Professional Development Chair) about their experiences in SACNAS.

Could you tell us more about the SACNAS chapter here at Penn? What are the missions and impacts of this organization?

Nicole Robles-Matos

Nicole Robles-Matos (NRM): The SACNAS student chapter here at Penn was established with the mission to provide a welcoming and supporting environment in which our diverse members have the necessary tools and community-building activities for successful academic and professional development in graduate school and beyond. Our organization has been impactful in creating a bridge between the STEM community and [the diverse] culture.

Marisa Egan (ME): The SACNAS chapter here at Penn promotes diversity, equity, and inclusion in science. It creates a supportive community that is welcoming to everyone on campus. By hosting a range of events, from social gatherings to professional development workshops, the SACNAS chapter empowers all scientists to be themselves and grow as thinkers, students, and individuals.

Kimberly Veliz (KV): The Penn SACNAS Chapter mission is to provide support to underrepresented students in STEM through academic, professional and/or social workshops. The goal is to build a community that they can rely on and use to expand their network in and outside of academia.

What are some of the professional programs or activities organized by SACNAS to promote diversity and inclusion in the STEM field?

NRM: At the beginning of each academic year, our chapter has the opportunity to create a space for new students

to join our community. Our members share their experiences in our Surviving Grad School 101 workshop with the goal to help new students adjust to the challenges of graduate school and living in a new city. Our chapter collaborates with multiple student organizations in the development of Career Panels with a diverse community of alumni. This type of initiative helps our members to network with alumni with similar backgrounds and to identify role models and mentors in their career options. We also organized Public Speaking and Software workshops (i.e. Illustrator) to promote the learning experience of new professional skills. During the pandemic, we created a new series of seminars including our first Social Seminar in which we invited Dr. Denise Collazo to have a conversation with our members about her book: "Thriving in the Fight" and the role of STEM scientists in society. In order to make science more accessible, we collaborate with community-based organizations in outreach events to increase representation in STEM and increase the interest in underrepresented children to pursue STEM fields.

ME: Our SACNAS chapter has hosted a variety of events to promote diversity and inclusion in the STEM field. Currently, I'm the academic development chair of SACNAS, and I planned a workshop entitled "Promoting Diversity, Equity, and Inclusion in Science Education." The workshop was co-hosted by the Center for Teaching and Learning (CTL). It featured Dr. Sunny Shin, Associate Professor of Microbiology, who discussed ways in which she works to foster a culture of diversity, equity, and inclusion in her lab and her classroom.

KV: In the past we have held alumni career panel series that expose the students to career options in and outside of academia. We've also had workshops on public speaking, we had a monthly "women in science speaker" as well as invited guest speakers that highlighted minority faculty in institutions across the country.

As part of the initiative to support the underrepresented students in advancing their careers and leadership positions, what are the resources and opportunities offered by SACNAS?

NRM: Our chapter collaborates with the office of IDEAL (Inclusion, Diversity, Equity and Learner) Research to support underrepresented graduate students and undergraduates. Our members participate in recruitment events and grant workshops for Penn PREP (Post-Baccalaureate Research Education Program) students interested in graduate school. [They also] have access to the National SACNAS Career Center which is dedicated to matching underrepresented minority scientists with careers and positions of leadership in STEM fields. Additionally, we encourage our members to apply for National SACNAS travel awards to present at the National SACNAS Conference to network with a diverse community of scientists and present their research to a broader audience.

ME: SACNAS offers URM (Underrepresented Minorities) students access to a warm and welcoming community on campus. The workshops, seminars, and other events hosted by SACNAS also allow for a safe space for honest and meaningful conversations to occur about what it means to be a URM student in STEM and how we can lead efforts to support diversity, equity, and inclusion on campus.

KV: I think community is an incredibly powerful and underrated commodity in grad school. Being able to connect with other students who have similar backgrounds and/or stories is empowering and encouraging. I think SACNAS is an important group that gives underrepresented graduate students the confidence to know they are not alone and that their voice and ideas matter.

Could you comment on how your SACNAS leadership position enriches your professional experience here at Penn?

NRM: When I was an Academic Development Chair, I was involved in the development of workshops providing guidance on scientific writing and how to prepare

Marisa Egan

Kimberly Veliz

for thesis committee meetings. These events allowed me to connect with multiple faculty members committed to supporting the academic development of our members. I had the opportunity to organize our bi-annual Women in Science Seminar. This experience was very enriching and rewarding because we recruited female [Penn] scientists to provide diverse graduate students with valuable advice [directly] from a successful female scientist navigating through academia. The goal of this seminar series is to inspire women and underrepresented groups to pursue scientific careers and to identify role models in their fields. To foster inclusive initiatives beyond our community, we developed the Academic Development Seminar with invited speakers from other institutions to establish a network across different communities. This initiative allowed me to connect with underrepresented faculty and students in other institutions.

ME: I'm currently the Academic Development chair of SACNAS. My experiences on the Executive Board of SACNAS have been very formative! I've truly enjoyed my leadership roles and working with the other board members, who are all so passionate and dedicated to increasing diversity in STEM.

KV: I have been involved in SACNAS since I started grad school, I was initially just a member but began to be more involved as a Professional Development Chair for two reasons (1). I wanted to give back to a group that made me feel supported and connected to and (2). I wanted to be more connected to the needs of our student outside of just academia.

What are some of the fun social events organized by SACNAS?

NRM: [SACNAS hosts] Parranda, a Christmas celebration with music and food. [We also organize] DIY activities for community building, [such as] creating concrete planters, Day of the Dead painting, mocktail classes, [and] creating your own candle. [Some other] SACNAS [events include] SACNAS Cafecito and Zumba classes

ME: The SACNAS chapter has celebrated Día de los Muertos by decorating sugar skulls while watching Coco!

KV: Before COVID we had an annual end of the year parranda with Hispanic music and food, there were also opportunities to go dancing as a group. Since COVID though, most of the social activities were done virtually, but we hosted several painting nights, DIY plant pots, DIY wax and wine kits, as well as virtual game nights.

Could you tell us how the SACNAS community has impacted your life?

NRM: The Penn SACNAS community has impacted my life in so many ways including: building a community of diverse scientists, improving my communication skills to the public and my networking skills, as well as gaining teamwork and leadership skills.

ME: The SACNAS community has empowered me as a leader in STEM! It's also inspired my own deep commitment to increasing diversity, equity, and inclusion in STEM!

KV: I grew up in Los Angeles, California where there is a large Hispanic community and I was used to being able to speak Spanish with people all around me. It took a bit of adjusting when I moved to Philly, but being a part of SACNAS allowed me to connect with a group of people that reminded me of home and I could speak Spanish with. By providing a network of support to empower the underrepresented to thrive in their careers, Penn's SACNAS is changing the face of STEM, one step at a time.

To learn more about Penn's SACNAS chapter, follow them on Twitter @Penn_SACNAS or click the link below:

Penn's SACNAS Official Webpage.

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Alumni Spotlight

Small Biotech vs. Big Pharma vs. Industrial Postdoc: Guide to getting your foot in the door!

Kanika Jain

For this edition's Alumni Spotlight, I had the opportunity to interview three recent CAMB graduates who pursued different routes for getting their foot in the industry "door" following their graduations. I am excited to share the journeys of the following three alums -

Dr. Priya Khurana (PK) joined the Boston-based small biotech firm Catamaran Bio in July 2021 as a Scientist in the Cell Process group. She completed her doctoral research in Dr. Hamid Bassiri's laboratory and graduated from the CAMB (CB) program in June 2021. Her doctoral work was focused on immunometabolism and anti-tumor properties of invariant natural killer T (iNKT) cells.

Dr. Monika Eiva (ME) joined Janssen Pharmaceutical Companies of Johnson & Johnson in August 2021 as a Scientist in the Large Molecule and Drug Product Development department. She completed her doctoral research in the laboratory of Dr. Daniel J. Powell Jr. and graduated from the CAMB (CB) program in July 2021. Her dissertation work investigated the immunobiology of human cancers, specifically ovarian, focusing on mechanisms of immune maintenance via memory T cells, and analysis of biomarkers predictive of T cell anti-tumor reactivity. PhD studies outside of her dissertation focused on CAR-T immunobiology and engineering.

Dr. Antonia Bass (AB) joined Merck in October 2020 as a postdoctoral research fellow investigating innate immune responses to adjuvants. Dr. Bass conducted her doctoral research in Dr. Sunny Shin's laboratory, where she studied the role of interferon-gamma in human immune responses to gram-negative bacteria. She graduated from the CAMB (MVP) program in September 2020.

Can you describe your current roles or programs within industry?

PK (Catamaran Bio): Our company is a small biotech working on chimeric antigen receptor (CAR) modified natural killer (NK) cell-based therapies for solid tumors. Our ultimate goal is to produce allogeneic, off-the-shelf cell therapies for cancer patients, and our CAR-NK cells have many novel features that allow them to be efficacious against solid tumors, addressing a major challenge in the field of immunotherapy. For my role, our cell process team is focused on figuring out the best ways to isolate, activate, engineer, and expand NK cells in order to manufacture these cells to deliver sufficient doses of high-quality cells to patients to best kill tumors.

ME (Janssen): My department focuses on late-stage drug development, where we formulate and optimize processes for the drugs at the final stage right before they go to patients or for FDA filing. Hence, most drugs are either undergoing clinical trials or about to enter one. The team I am on focuses on cell therapies, such as CAR-T. One of the products I was working on just received FDA approval, CARVYKTI!

AB (MRL): The postdoc program at Merck is a great program for PhD's looking to transition into industry. There are many opportunities for postdocs to get involved such as the Merck Research Laboratory (MRL) Postdoc Association which is a team of postdocs who can be from any of the different MRL sites, and their goal is to support the postdoc program. It's a great opportunity for professional development and networking. There's an annual postdoc symposium where all the postdocs and their mentors working within MRL come together to listen to talks and poster presentations of all the research conducted by postdocs. We also have monthly postdoc lunches which have been virtual during the pandemic but hopefully will be in person soon! We have a career development series called Meet the Merck Experts seminar where pharmaceutical industry experts from various functional areas within Merck share their career path and advice for attaining that position.

What does your day-to-day look like? What are your key responsibilities?

Dr. Priya Khurana

PK (Catamaran Bio): My day-to-day can vary quite a bit, but generally is a mix of bench work, data analysis, making slides to present data to both my team and other groups at the company, planning experiments, and managing collaborative projects with external groups (contract research organizations (CROs) and contract manufacturing organizations (CMOs)). And lots of meetings! I am mainly responsible for helping plan and execute studies involving isolating, engineering, and expanding NK cells and studying NK functional properties as well as leading projects, which entails coordinating people, and schedules, and planning out experiments and data analysis across other teams.

ME (Janssen): My day-to-day can vary, but lately involves a lot of back-and-forth discussion with the manufacturing, filing, and the clinical and Chemistry, Manufacturing and Controls groups. There are lots of collaborative meetings, coordinated lab studies, data and documents to review (eg tech transfers) that are done. It's like a matrix system of working and collaboration. There is some portfolio work where I lead the studies, while other associate scientists and contractors conduct the more hands-on work. My experience here is offering me the opportunity to learn in-depth about the nuanced functioning of a big pharmaceutical and the final stages of translating drug products to the patients.

AB (MRL): My day schedule looks different every day, much like how it was in grad school. I have various department or lab meetings each month and weekly meetings with my research mentor. I attend postdoc seminars and other internal Merck seminars, but most of my time is spent conducting experiments and analysis, and keeping up to date with the literature. Planning is essential to making sure that your experiments don't overlap with important meetings and seminars.

Were you also looking at other small or big biopharma companies or different career trajectories? What made you choose your current positions?

PK (Catamaran Bio): Yes, I actually started my job search looking primarily at larger pharma companies - this was because most of my connections and career panels I'd seen were largely people at big companies, so I knew almost nothing about the biotech/startup world until late into my job search when I began networking with people in the Boston area, where biotech is huge and booming especially right now. I was drawn to small-medium biotech as soon as I learned more, and I loved that you could really make a huge impact and have a lot of visibility because you can really shape the course of a company in its early stages. I've always loved small environments where I could contribute and be an integral part of the community and culture; for instance, I attended a small college and joined a small lab in grad school – so it seemed like the right fit for me. There are definitely pros and cons to large pharma vs smaller biotech. At a larger company, more things have been optimized/figured out so you may be able to jump right in and work on projects already on a path to the clinic. With smaller biotech, the culture can vary a lot, and many protocols and programs are still being worked out. This can be both risky and exciting! I think with anywhere you go, if you're excited about science and helping patients, and like the people you are working with, it can be a great learning experience. Plus, people often move around companies a lot (especially in Boston!) so it's not like grad school where you are more locked in for years.

ME (Janssen): Yes, I was talking to a couple of biotechs and other companies. The final pay and benefits, work-life balance, and job description were the key factors that made me choose Janssen. I had realized that I wanted less of an academic-like environment with better financial security and work-life balance unlike what might have been offered by biotech's.

AB (MRL): I was looking for industry postdocs at big pharma companies. I thought that doing a postdoc was better for me as opposed to doing a full-time scientist position because a postdoc position allows you to learn a different research field and new techniques as well as develop more independence, while a scientist position

felt more senior to me and required more experience. For me, it felt like a better transition into industry.

What might be the key benefits/perks of working for your current roles?

PK (Catamaran Bio): To me, the key benefit is visibility and contribution. Our company has about 45 people (30 when I joined), so it's small enough that I know everyone fairly well, even the leadership team. In fact, our CEO sits in our desk space and will often have beers with us after work! Everyone is very friendly and open to collaborating and helping out, which creates great culture and helps you learn new things from others. Also, even though I'm relatively new, many of the studies I've done have been presented at board meetings and to investors, so I feel like every study I'm working on matters a lot and is directly working to help patients and inform big decisions of how our company will move forward. While this can be high pressure, it's very team-oriented so you are never really alone and instead get to make important contributions as a team!

ME (Janssen): Janssen being a well-established big pharma, has more defined roles for everyone, without the need to over-work to solicit funding. The department I'm in offers the opportunity to collaborate with other departments (e.g. early development, analytical department), but also to take on a more managing role. Currently I think my favorite aspect is learning about the intricacies of launching a product in different countries around the world.

AB (Merck): Key benefits/perks of doing an industry postdoc are that you're not really limited in the resources you need to do your experiments. Also, when doing animal work, you don't need to do the husbandry and you have help with performing the experiments from the animal resource department. You always have people to help you, you are not alone.

What have been the biggest differences between working in an academic and industry setting?

PK (Catamaran Bio): Some of the biggest differences in industry/biotech is that you are really working as a team, not just seeking to answer your own questions and fulfill your own goals but doing what is best for the company and what the company itself needs at a given time. This is certainly a big change in mindset from the PhD process, which at times can be isolating because you are on your own, working towards an individual goal (with timelines created by you and your PI, not an entire company!). Also, the work I'm doing is a lot more patient-driven, so instead of spending a lot of time answering interesting mechanistic questions, I'm more focused on studies that address actual manufacturing of therapies to patients, which is very new to me. Finally, it's a lot more meetings and communication than grad school! So much of my time is spent planning with others, electronic lab notebook record-keeping, and coordinating studies across many groups of people.

ME (Janssen): There is a lot more flexibility in grad school with timings and schedule. You can plan your experiments based on your schedule, take breaks during the day, or start late and then continue until later in the evenings. However, you don't have this luxury during a job. There are lots of teams at play in an industry, like a unified force and you must coordinate with everyone to get the work done. The stakes are much higher now, especially for my group when we are handling the final optimization of drugs before they reach the patients. Hence, you have to be much more detail oriented.

AB (Merck): As a grad student, I was independently working on a project that involved learning new techniques that the lab hasn't done before. As a postdoc at Merck, I'm still independent, however I am working with many different cross-functional teams to conduct the experiments. For instance, I'm working with an imaging group separately from the animal resource group as well as others. It is definitely a collaborative research environment where I would not be able to conduct the work on my own. Like I said, it takes a lot of planning to make sure all the people involved in the experiments know what needs to be done and when.

Can you tell us about the interview process at your company and how you prepared for it?

PK (Catamaran Bio): At my company and other small-medium biotech's, the process consisted of a 20-30 minute phone screen with a recruiter or HR member to ask basic background questions from your resume and make sure on paper you are a good fit for the position, followed by a 30 minute interview with the hiring manager (which is more scientifically driven), followed by a seminar talk (similar to thesis defense talk) open to the whole team/company, and finally, team interviews where I met on Zoom with several of the other scientists I'd be working with. It was a great way for them to get to know me, and

for me to get a sense of the company and people. Also at Catamaran, we are given the chance in our interview process to meet with the Chief Scientific Officer (CSO) and the VP of Research which was really awesome exposure and helped sway my decision! At all stages of the interview, they expect you to have a lot of questions for them as well, so it's really a two-way street. At the time I applied and even now, most of the interview is on Zoom, but we are starting to transition to giving people the option of an on-site visit.

ME (Janssen): You start with an HR interview, where they just want to make sure you do know the skills you say you have on your resume. This is followed by a full day interview where you first have to present your research (talk to your professor beforehand to make sure they are okay with you presenting the project). You should be able to communicate the significance of your work and your results. You then get to meet multiple people who see if you are a good fit (personality and skill). Make sure you know what the company does, and you can ask questions. Some people might also check every detail of your resume, so be prepared to talk about all the skills you mention there. Remember, it's a two-way interview-you should also check if the company is a good fit for you. You are a candidate for them with valuable skill sets, so make sure what they are offering you aligns with your interests.

AB (Merck): Merck lists openings for postdoctoral positions on their website along with listings for full-time positions. The details of the project are mentioned in the job description, and you apply to it directly. Attach your cv and a cover letter when applying. My interview was virtual and took over the course of two days. I gave my one-hour research seminar that included questions at the end, followed by eight one-on-one interviews with different scientists within the department and an HR representative. To prepare for my interviews, I did multiple mock interviews with my thesis advisor - Dr. Sunny Shin, and with career services. I recommend looking up all the people you are set to interview with on LinkedIn beforehand and have a couple of questions to ask each person about the position, or their expectations from you. Also, have an answer ready for questions like 'Why do you want to do an industrial postdoc over an academic postdoc'?

What are the key skills that Biotech/Pharma companies look for during the hiring process?

PK (Catamaran Bio): For a scientist-level position straight after a PhD, they are looking for curiosity/passion for science, being able to self-motivate and execute projects independently, and relevant technical skills (in my case, a lot of molecular biology and immunological assays like flow, metabolic assays, and ELISAs). Other things that can help are fellowships, presentations at conferences/retreats, and mentoring junior scientists (like summer or rotation students). Coming out of Penn and CAMB, we are extremely qualified candidates – the key is in being able to communicate how great we are to the hiring manager/team! Practice interviews with the career center, friends, or anyone in your network.

ME (Janssen): The companies I interviewed at were looking for someone to fit a specific skill set (in my case immunotherapy and experience with CAR-T), that either they lacked or were trying to build up. Everywhere I interviewed as well cared about clear communication, critical thinking, and an ability to get along with a wide range of people. Make sure to show enthusiasm and curiosity for the position you're interviewing for, and at the same time if you realize you aren't interested in a position thank them politely and move on.

AB (Merck): Merck looked for someone who can explain their research clearly, can think critically and answer challenging questions, and who is interested in the research that the postdoc position is for. I made sure to include a slide at the end of my research presentation that explained how my PhD work and skills could be applied to the postdoc research and what I would contribute to the project.

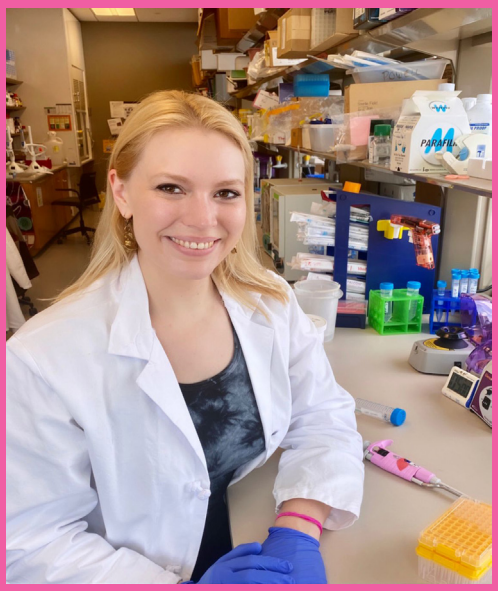
What was your timeline like with submitting your paper, writing your thesis, defending, and applying for jobs?

PK (Catamaran Bio): My timeline was pretty tight! I submitted my manuscript in April, got permission to defend in May, wrote my thesis in 6 weeks, and defended towards the end of June. I started applying to a few jobs in the winter prior to knowing my defense date, as a few opportunities came my way that I decided to apply to anyway. But the majority of my applications and interviews and networking were during the months of April and May, right at the same time I was writing my thesis. The job search was much easier once I had a set defense date that I could tell companies, but it was still a lot of work to apply for jobs and work on my the-

sis/paper at the same time! If I could have done things differently, I probably would have tried to spread out the process more and apply to jobs more after my defense. I felt a lot of pressure because I came across many Boston-area scientist job opportunities in the spring and was worried that if I waited until summer after my defense, there wouldn't be as many openings left, but right now biotech and pharma (at least in the cell therapy field) are so hot that there are CONSTANTLY openings! There is a lot of turnover, and a lot of new companies that are rapidly hiring – in fact, in Boston, they are actually competing for good candidates so you may even end up with multiple offers. So, I'd say there's no rush and it's best to go on a timeline that allows you time to apply, relocate if needed, and maintain sanity.

ME (Janssen): My thesis committee required that I receive full permission to defend and have my pending manuscript be accepted completely (and not in revisions). However, I got conditional permission in March 2021 which allowed me to start looking for jobs. Janssen wanted me to join by March end/April beginning, however I told them that I wouldn't be able to join until the end of August, and they agreed! So, if they really like you, they will move the timeline for you. Having a set joining date really helped push things forward for me in the lab. I worked on my revisions and re-submitted the paper. Once it got accepted, I requested permission to defend via email and had less than a month to write my thesis and defend to start at Janssen on time. I wrote my dissertation in around two weeks, submitted it to my committee, and defended it a week after! I was glued to my computer, and I cranked it out! Whosoever says no one reads a defense, they didn't meet my committee- they even commented in detail about the introduction. My committee seemed to read all of it and gave lots of points. Thankfully, they really liked it and didn't require any edits from my side. While my timeline was a bit crazy, it worked out well for me, and so in a way, I recommend it! Two weeks deadline made me highly efficient. One advice I would give to all the students is to be assertive and support your timeline, since your PI or committee's idealized timeline might be different from yours

AB (Merck): I slowly began writing my thesis when the pandemic hit in March 2020, had my committee meeting in April where I asked for permission to defend my thesis, a couple of months later I applied to the Merck postdoc position and submitted my paper. I received a



Dr. Monika Eiva

phone interview a week or so after applying and had the formal interview a couple weeks later and received an offer two weeks after my interview. My thesis defense was in September, and I started my postdoc in October. My advice for everyone is to look for industry positions 3-5 months in advance and to make sure that you will have defended your thesis by the job start deadline.

What's the biggest myth about working at small biotechs or big pharma?

PK (Catamaran Bio): I think the biggest myth about biotech is crazy work hours, intense environments, and no work-life balance. While in many cases this is sadly true, every company has a very different culture, and this could not be less true in my case! The best way to assess this is during your interview as you speak with your hiring manager and other team members. You can usually tell how happy people are or by their tone about how work-life balance is. There are also certain companies (in the Boston area particularly) that have reputations, so if you network and ask around, you can also get a sense of how a company is.

ME (Janssen): Biggest myth would be the weird guilt feeling around not doing early discovery research. Not choosing academia feels like you are selling out. But you need to know that you are still making a huge impact on the lives of the patients in need from working in industry.

AB (Merck): That you will be conducting research fo-

Dr. Antonia Bass

cused on pipeline products. This is not true, as an industry postdoc, you can only work on non-proprietary research so that you are able to present your work to external conferences and publish.

Any advice for current grad students who are in the early years of their PhD and for those who are ready to defend and want to pursue a career in industry research like you?

PK (Catamaran Bio): Sure! My advice for early-stage graduate students is just to explore different career options by attending panels. There's no need to put pressure on yourself that early but starting to think about what kinds of jobs sound interesting can always help, because you can then focus your networking in the later years. I think if you do know you want to go to industry very early on, it could help to let your PI know and potentially shape your grad school lab choice or project choice accordingly – for example, immunology and computational skills are two examples of very marketable technical expertise for industry. For those closer to defending, I would try to talk to as many people as you can in the relevant fields – this can be anyone from alums, speakers at career panels, personal connections, or second-degree connections on LinkedIn. My PI and committee members were also very supportive and helped me connect with people in their networks who were in industry/biotech. I also used BGS Career Services for help with my resume and interviewing practice, which was super helpful too. For interview prep, especially the seminar talk, it helps to practice with other colleagues or friends. Just like most other things in grad school, it requires a lot of reaching out and advocating for yourself! If anyone is interested in biotech and wants to talk to me further, I'm happy to connect – please reach out to me on LinkedIn or email me at pkhurana11@gmail.com.

ME (Janssen): My advice would be to take advantage of the flexibilities that are available as a student. Go take vacations and breaks, don't work till 2am if it is not required. It's no heroism working till late every day unless you have some critical time point. Don't stress yourself needlessly and be social! Work on your natural social skills and go party with a purpose (of finding jobs and making connections)! Personal connections are highly valuable for any type of hiring process. Also take advantage of the multiple opportunities UPenn provides, be more well rounded than just your research. As Priya mentioned above, connect with alumni like us!

AB (Merck): To those in their first few years of grad school, grow your network and learn about different careers in industry, participate in organizations at Penn, such as SACNAS and Penn Biotech Group, and take on leadership roles. If you are ready to apply to an industry position, I recommend communicating with someone in the company and department you are interested in so that they can forward your resume/CV and cover letter directly to the hiring manager.

Positivity Corner:

Anna Garcia Whitlock

"I had a baby this summer! He is now 10 months old and is the most fun little guy! My husband and I are incredibly grateful for how supportive my lab and mentors have been throughout this new chapter as I am learning how to be the best PhD Student, resident, and mom I can be. Who knows, maybe all this will inspire the little guy to apply for the Penn PhD class of 2046… after graduating from UNC Chapel Hill undergrad of course (per the photo we are also still pumped from that National Championship run - Go Heels!)"

Congratulations, Anna! If you would like to share your positive stories, please do so here!

Thank you for reading.

For any questions, comments, concerns, or if you're interested in joining our team, please feel free to contact us at:
camb.studentnews@gmail.com

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