

VOLUME 13 | ISSUE 5 | JUNE 2024

RHO^{Rx}CHI *post*

St. John's University College of Pharmacy & Health Sciences



THIS ISSUE'S FEATURED ARTICLE:

CARBAPENEM RESISTANT
ACINETOBACTER
BAUMANNII:
AN URGENT THREAT

AN INVESTIGATION INTO THE WHITE HOUSE PHARMACY

E. MBRACE THE NOVEL E. COLI VACCINE

REVOLUTIONIZING ADPKD TREATMENT: BREAKTHROUGH
DRUG UNVEILS UNPRECEDENTED BENEFITS

UTILIZATION OF TUMOR MICROENVIRONMENT IN THE
TREATMENT OF BREAST CANCER

INTRATUMORAL AND GUT MICROBIOTA ROLES IN CANCER
TREATMENT

About the Rho Chi Post

The Rho Chi Post was developed by the St. John's University Rho Chi Beta Delta Chapter in October 2011 as an electronic, student-operated newsletter publication with a team of three student editors and one Editor-in-Chief. Today, our newsletter boasts 12 volumes, over 90 published issues, and more than 600 unique articles to date with an editorial team of first to sixth year student pharmacists, as well as returning PharmD graduates.

The newsletter is distributed by St. John's University College of Pharmacy and Health Sciences to more than 1,500 students and faculty members. Our monthly electronic mailing list continues to extend readership far beyond campus.



Mission

The Rho Chi Post is an award-winning, electronic, student-operated, faculty-approved publication that aims to promote the pharmacy profession through creativity and effective communication. Our publication is a profound platform for integrating ideas, opinions, and innovations from students and faculty.

Vision

The Rho Chi Post aims to become the most creative and informative student-operated newsletter within St. John's University College of Pharmacy and Health Sciences. Our newsletter continues to be known for its relatable and useful content. Our editorial team continues to be known for its excellence and professionalism. The Rho Chi Post sets the stage for the development of individual writing skills, collaborative team work, and leadership.

Contact Information

The Rho Chi Post
St. John's University College of Pharmacy and Health Sciences
8000 Utopia Parkway, Jamaica, NY 11439

Website: <http://rhochistj.org/RhoChiPost>
Facebook: <https://www.facebook.com/RhoChiPost>
Instagram: @sjurhochipost
Email: rhochipost@gmail.com

2024-2025 TEAM MEMBERS



Editorial Team & Production

Editor-in-Chief

Anjali Thykattil

Senior Content-Focused

Copy Editors

Maliha Akter

Bao Qi Chen

Warda Basher

Content-Focused Copy

Editors

Ramesa Anan

Sameeha Arshad

Amanda Kim

Laiel Bravo

Arya Singh

Senior Graphics-Focused

Copy Editors

Zainab Masood

Graphics-Focused Copy

Editors

Celestine Van Sertima

Nalisha Xu

Senior Staff Editors

Jennalynn Fung

Sharupa Azmal

Staff Editors

Muskan Basra

Harsha Mattappally

Ariella Zadrima

Anyia Geiling

Celine Cherian

Wajiha Uddin

Christiana Popovic

Senior Staff Writers

Christine Mauceri

Staff Writers

Paulina Maczko

Katelyn Hoosein

Reyaz Mussaleen

Rosa Kang

Rand Ayoub

Sariah Grant

Nivaj Haque

Rebecca Sabzanov

Ameena Qadri

Michelle Flores

Amanda Nakhul

Social Media & Outreach

Engagement & Outreach Managers

Celestine Van Sertima

Paulina Maczko

Bhojranie Brahmanand

Maliha Akter

Advisors

Dr. Ketan Patel

MPharm, PhD

Dr. Joseph Etzel

BS Pharm, PharmD

Dr. Mohammad Rattu

PharmD, BCOP, BCPS, BCGP

The Rho Chi Society

Executive Board

President

Geraldine Ciaccio

Vice President

Javeria Amir

Secretary

Anjali Rana

Treasurer

Giavanna Carr

Historian

Christine Mauceri

Development & Outreach Coordinator

Sammi Wu

Academic Committee Coordinators

Daya Biju

Angel Gao

TABLE OF CONTENTS

| | |
|--|-----------|
| Message from the Editor-in-Chief | 4 |
| An Investigation Into the White House Pharmacy Holly Nguyen, PharmD Candidate c/o 2024 | 5 |
| E. mbrace the novel E. coli vaccine Ashley Dao, PharmD Candidate c/o 2024 | 7 |
| Revolutionizing ADPKD Treatment: Breakthrough Drug Unveils Unprecedented Benefits Bhojranie Brahmanand, PharmD Candidate c/o 2025 | 9 |
| Carbapenem Resistant Acinetobacter Baumannii: An Urgent Threat Giavanna Carr, PharmD Candidate c/o 2025 | 12 |
| Utilization of Tumor Microenvironment in the Treatment of Breast Cancer Sameen Siddiqui, PharmD Candidate c/o 2025, Madelyn Lombardo, PharmD Candidate c/o 2027, and Gabriella Lamantea, PharmD Candidate c/o 2027 | 16 |
| 6th Year Perspective: Deciphering D&Ds - A Peer-Led Piece Containing an Academic Overview, Study Tips, and Analysis Ashley Medina, PharmD Candidate c/o 2025 | 20 |
| Intratumoral and Gut Microbiota Roles in Cancer Treatment Ariella Zadrima, PharmD Candidate c/o 2026 | 23 |
| Meet Our 2024-2025 Team Members | 27 |

FROM THE EDITOR

A Message from the Editor-in-Chief, Anjali Thykattil

It is with great honor that I introduce the Rho Chi Post's final issue of our 13th volume. I thank you for taking time out of your day to read over our newsletter. It is my intention that this issue teaches you something new, whether it be clinical, pharmacy news, or advice from our Rho Chi Talks or 6th Year Perspective. I would like to take a moment to thank our Editorial Team, Executive Board, advisors, and readers as this newsletter would not be possible without them. With this, I leave you to the rest of the issue, and I wish the student body a wonderful summer break!

Frequently Asked Questions

Who can write for the Rho Chi Post Newsletter?

Anyone can write for the Rho Chi Post! Our newsletter is not exclusive to St. John's University students. The Rho Chi Post accepts articles on a daily basis!

How do I submit an article?

You can submit an article by creating an account on our website! Go to www.rhochistj.org/RhoChiPost, click the login button from the upper menu bar, and click register. Upon making an account, you will be able to submit articles to our author inbox.

Who determines article topics?

You are free to choose an article topic of your choice. Take a look at our Author Guidelines for ideas.

What happens after I upload my draft article on the Rho Chi Post website?

Our Editor-In-Chief (EIC) will either edit the article directly or assign the article to a staff editor. If any revisions are needed, the editor will upload the article back to the portal, notifying the author via email. The author can then download the edited article, make the suggested revisions, and reupload the draft back to the portal. Additional drafts will be reevaluated by our copy editors and then EIC, repeating this process. Once no further revisions are needed, the article is accepted for publication.

Is there a deadline for authors to send revisions?

There is no deadline to submit revisions for an article. However, the quicker revisions are made, the quicker the article can move through our editing process. Once an article is accepted for publication, it will be moved into a queue to be placed into an upcoming issue.

An Investigation Into the White House Pharmacy

By: By Holly Nguyen, PharmD Candidate c/o 2024

The White House Medical Unit employs a small confidential team of healthcare professionals, led by the Physician to the President, to be responsible for the health of the President, the Vice President, their families, the White House staff, and visitors such as national and international diplomats.^{1,2} Doctors, nurses, physician assistants, medics, and administrators work onsite at the White House in Washington, D.C., where routine physical examinations, urgent care, and emergency services are performed.² Members of the White House Medical Unit may also travel with the President to tend to his or his visitors' health needs abroad. Because of this, an operating room is incorporated into the President's plane, Air Force One, with an emergency medicine physician permanently posted onboard.^{2,3}

In 2018, the Inspector General of the U.S. Department of Defense launched an official investigation into the White House Medical Unit to address complaints of improper pharmaceutical practices and the eligibility of care for patients treated at executive medical facilities in the National Capital Region.⁴ In January 2024, the Inspector General of the U.S. Department of Defense released the investigation results to the public, and it garnered attention specifically for its operations under the Trump administration from 2017 to 2021.

Without proper credentials to establish itself as a pharmacy and the absence of pharmacists to oversee its functions, the White House Medical Unit pharmacy operations sector bypassed the TRICARE policy in the Code of Federal Regulations with the internal privileges of its senior leaders.⁴ One notable example was using Department of Defense funds to obtain brand-name medications over generic equivalents. Unauthorized medications, including prescription drugs and controlled substances, were dispensed to ineligible White House Staff (i.e., retired military officers and their families), and from 2017 to 2020, an average of 6 to 20 non-Department of Defense beneficiary patients per week skipped billing for their medications and medical services.^{4,5} Medical care and surgeries were also provided at no cost, and the pharmacy inadequately managed their medications with unmarked bottles, no instructions, and poor recordkeeping.^{4,5} Although healthcare providers were aware of the unethical nature of the pharmacy operations sector, they did not intervene due to the fear of losing their current positions or receiving poor evaluations for future job references.

The Inspector General of the U.S. Department of Defense proposes the reparation of the pharmacy operations sector of the White House Medical Unit with three main recommendations.

First, the Director of the Defense Health Agency will be enlisted to develop federally binding policies and procedures for controlled and noncontrolled medications with the White House Medical Director. Second, the Director of the Defense Health Agency will also establish billing and cost recovery controls for the outpatient medical services provided to non-military senior officials, on par with the Code of Federal Regulations. Lastly, oversight plans for pharmaceutical practices, patient eligibility, and the eligibility of the White House Medical Unit to implement its services will be created with the Assistant Secretary of Defense (Health Affairs), the Defense Health Agency Director⁴, and the Service Surgeons General. The Inspector General of the U.S. Department of Defense strives to create a system that will avert any future risks regarding non-executive patients' health and the haphazard distribution of controlled substances. Over the next several years, hopes to restore the credibility of executive medical care, as well as senior management and healthcare providers working with the federal healthcare system, remain.

References

1. Mishori R. When The Patient Is The President. Parade. Published August 16, 2009. Accessed January 31, 2024. <https://parade.com/47565/drranitmishori/16-when-the-patient-is-the-president/>.
2. White House doctors: The president's shadow. CNN. Published September 24, 2004. Accessed January 31, 2024. <https://www.cnn.com/2004/HEALTH/09/23/wh.doctors/>.
3. Air Force One. White House. Accessed January 31, 2024. <https://www.whitehouse.gov/about-the-white-house/the-grounds/air-force-one/>.
4. Evaluation of the DoD Internal Controls Related to Patient Eligibility and Pharmaceutical Management Within the National Capital Region Executive Medicine Services. Department of Defense. Published January 8, 2024. Accessed January 31, 2024. https://media.defense.gov/2024/Jan/09/2003373440/-1/-1/1/DODIG-2024-044_REDACTED%20SECURE.PDF.
5. Kime P. Free Surgeries and Prescriptions: White House Staff Got Access to Military Health Care Despite Being Ineligible. Published January 16, 2024. Accessed January 31, 2024. <https://www.military.com/daily-news/2024/01/16/ineligible-white-house-staffers-got-free-care-military-hospitals-free-prescription-drugs-watchdog.html>.

E. mbrace the novel E. coli vaccine

By: Ashley Dao, PharmD Candidate c/o 2024

Extraintestinal pathogenic *Escherichia coli* (ExPEC) is the most common gram-negative bacilli and is a leading bacterial cause of urinary tract infections (UTI), bacteremia and meningitis. *E. coli* is the leading cause of deaths associated with antibiotic resistant bacterial pathogens and a common cause of resistant hospital-acquired infections.¹

Older adults, especially those with a history of UTIs, have an increased risk of developing invasive extraintestinal pathogenic *Escherichia coli* disease (IED), including bacteremia and sepsis.^{2,3} UTIs are the most common source of infection reported in 21-59% of patients. Higher rates of UTIs in older patients may be secondary to the increased prevalence of urinary catheters, incontinence, and neurological disorders. *E. coli* is the most common pathogen in community acquired blood stream infections in the elderly. Although older patients had higher mortality and complications rates, studies demonstrated they were less likely to undergo infectious disease consultations and imaging studies. They were also less likely to be hospitalized in a critical care setting, have surgical/ drainage procedures and have their foreign body/ catheter removed or replaced.⁴ Important aspects of managing infection in older patients are antimicrobial stewardship in long-term care facilities, active and invasive diagnostic work-up and treatment and infectious disease consultation in older patients. Novel vaccines for bacterial infections may also prevent systemic bacterial infection in older adults.⁴

there are four ExPEC vaccines in clinical development. The most advanced in development is ExPEC9V by Janssen Pharmaceutical, Inc. (Janssen). ExPEC9V is nine-valent-O-polysaccharide conjugate vaccine currently in phase 3 clinical trial (NCT04899336) which is expected to be completed in May 2027.^{1,2} In 2023 Sanofi announced an agreement with Janssen Pharmaceuticals to develop and commercialize the vaccine candidate for ExPEC developed by Janssen.³

E.mbrace Study

The E.mbrace Study (NCT04899336) is a randomized, double-blind, placebo controlled, multicenter, global phase 3 study to assess the efficacy, safety, and immunogenicity of vaccination with ExPEC9V in the prevention of IED in adults aged 60 years and older with a history of UTI in the past 2 years. The study consists of a Screening Phase (performed 8 days prior to vaccination on Day 1), Randomization, Vaccination Phase (Day 1) and Follow-up Phase (up to 3 years post-vaccination).²

ExPEC9V is a vaccine candidate for active immunization for the prevention of IED in adults 60 years of age and older. Invasive ExPEC is defined as an acute illness consistent with systemic bacterial infection. This infection is microbiologically confirmed by either the isolation and identification of *E. coli* from blood or sterile body site, or by the isolation and identification of *E. coli* from

urine in patient with urosepsis and no other identifiable source of infection.²

Inclusion/Exclusion Criteria

Participants of the trial must have a history of UTI in the past 2 years. Recent history of UTI or acuter bacterial prostatitis must have resolved more than 14 days prior to randomization. Female participants must be either postmenopausal or permanently sterile, and not intending to conceive by any methods. Excluded participants were those with end-stage renal disease requiring dialysis, contraindication to intramuscular injections and blood draws (e.g. bleeding disorders or a history of difficult blood draws), history of acute polyneuropathy (e.g. Guillain-Barre syndrome) or chronic inflammatory demyelinating polyneuropathy. Participants were also excluded if they received any *E. coli* or ExPEC vaccine.

Study Design

The experimental arm, ExPEC9V, received a single intramuscular injection of nine-valent extraintestinal pathogenic *E. coli* vaccine on Day 1, while the placebo arm received a single intramuscular injection of matching placebo on Day 1. The primary outcomes were the number of participants with first IED event with microbiological confirmation in blood, other sterile sites, or urine, and number of participants with first IED event with microbiological confirmation excluding urine.²

The E.mbrace Study will assess the efficacy and safety of ExPEC9V in prevention of IED in older adults. Sepsis is a life-threatening blood stream infections (BSI) and *E. coli* is the most common pathogen in community acquired BSI. However, a significant part of BSIs in older

adults may be prevented by removal of unnecessary urinary catheters, adherence of infection control practice and appropriate inclusion of infection disease consultations. Since older patients are often under-represented in clinical trials, ExPEC9V may reduce the prevalence of IED in older patients, helping older adults live longer and healthier lives and reducing hospitalization costs.

References

1. Frost I, Sati H, Garcia-Vello P, et al. The role of bacterial vaccines in the fight against antimicrobial resistance: an analysis of the preclinical and clinical development pipeline. *Lancet Microbe*. 2023;4(2):e113-e125. doi:10.1016/S2666-5247(22)00303-2
2. ClinicalTrials.gov. A study of vaccination with 9-valent extraintestinal pathogenic *Escherichia coli* vaccine (ExPEC9V) in the prevention of invasive extraintestinal pathogenic *Escherichia coli* disease in adults aged 60 years and older with a history of urinary tract infection in the past 2 years (NCT04899336). Last Updated November 8, 2023. <https://clinicaltrials.gov/study/NCT04899336>. Accessed January 18, 2024.
3. Sanofi. Press Release: Sanofi announced agreement for potential first-in-class vaccine against extraintestinal pathogenic *E. coli*. October 3, 2023. <https://www.sanofi.com/en/media-room/press-releases/2023/2023-10-03-05-30-00-2753274>. Accessed January 18, 2024.
4. Yahav D, Eliakim-Raz N, Leibovici L, Paul M. Bloodstream infections in older patients. *Virulence*. 2016;7(3):341-352. doi:10.1080/21505594.2015.1132142

Revolutionizing ADPKD Treatment: Breakthrough Drug Unveils Unprecedented Benefits

By: Bhojranie Brahmanand, PharmD Candidate c/o 2025

The most prevalent manifestation within the spectrum of polycystic kidney diseases is recognized as autosomal dominant polycystic kidney disease (ADPKD). It is a genetic condition marked by the formation of fluid-filled cysts within the kidneys due to mutations in the PKD1 gene (located on chromosome 16) or the PKD2 gene (located on chromosome 4). In turn, these genetic alterations disrupt the typical function of proteins responsible for regulating cell growth and differentiation, specifically polycystin-1 and polycystin-2. Systemic manifestations include hypertension, valvular heart disease and intracerebral aneurysms.² With a global impact on over 12 million individuals, many of whom are the elderly, patients with this condition often find themselves in need of dialysis or a kidney transplant. The Food and Drug Administration (FDA)-approved drug for treating the disease, tolvaptan, impedes cyst growth. However, it has been associated with significant adverse effects such as frequent urination and potential liver damage. Now, researchers at the Massachusetts Institute of Technology (MIT) and Yale University School of Medicine have discovered that 11-beta compounds, originally developed as a potential cancer treatment, hold promise for treating ADPKD.

Nearly 25 years ago, Robert Croy, MIT research scientist, developed these compounds which comprised of an aniline mustard.

This deoxyribonucleic acid (DNA)-damaging agent had the capability to induce apoptosis in cancer cells. It was further revealed that these compounds can trigger oxidative stress by disrupting the mitochondria's ability to generate adenosine triphosphate (ATP) which can later be used as a source of energy and nicotinamide adenine dinucleotide phosphate (NADPH) which is an antioxidant that neutralizes damaging free radicals.⁴

While normal cells can tolerate oxidative stress, cystic cells have a low tolerance for oxidative stress and succumb to the treatment ultimately leading to cell death. Tumor cells and kidney cyst cells were observed to exhibit elevated levels of free radicals due to the induced oxidative stress. When exposed to the 11-beta compounds, these cells endure heightened oxidative stress, resulting in further depletion of NADPH. This ultimately pushes them beyond their threshold for toleration. While normal cells typically survive this treatment, cystic cells will undergo cell death as they surpass the threshold.

In an established early inactivation model for ADPKD, researchers used Pkd1^{fl/fl}; Pkhd1-Cre mice. PKD1 was selectively inactivated in the collecting duct by postnatal day seven (P7). The mice received daily intraperitoneal injections of 11-beta-dichloro at 10 mg/kg starting from postnatal day 10 (P10) to P23. This treatment demonstrated significant structural

improvement in PKD, as evidenced by gross morphology and reduced kidney weight: body weight ratio with cystic area percentage. The slowed cyst growth was associated with improved kidney function, indicated by lower levels of blood urea nitrogen and serum creatinine compared to the control group. The treatment was well-tolerated with no significant weight loss observed in the treated animals.⁶

Another model of ADPKD that closely mimics the gradual progression seen in humans is the "adult Pax8" model. In this model, mice were exposed to doxycycline in their drinking water from postnatal day 28 to day 42, deactivating PKD1 in a substantial portion of the nephron. Starting at postnatal day 42, the mice were treated for 12 weeks intraperitoneal injections of 11beta-dichloro three times a week at a dose of 10 mg/kg body weight. At 18 weeks of age, mice treated with 11beta-dichloro exhibited a less severe form of polycystic kidney disease compared to those treated with the vehicle. The treatment was well tolerated, with no significant body weight loss observed in the treated animals compared to the controls. This aligns with prior mouse toxicity studies on 11beta-dichloro, which confirmed that the employed dose of 10 mg/kg would not result in adverse effects.⁶

A modified form of the compound, 11-beta-dipropyl, which lacks any direct DNA-damaging potential, has been identified as a safer option for human use. The findings indicated its efficacy to be comparable to that of 11-beta-dichloro. It is important to highlight that, in all the experiments conducted, the treatment did not seem to have any adverse effects on healthy kidney cells.

In addition to recovering kidney function, the therapy demonstrated improvement in various clinical aspects of ADPKD. Biomarkers indicating tissue inflammation and fibrosis were reduced in the treated mice. These results reinforce the idea that 11-beta compounds targeting mitochondria and induce oxidative stress are the pivotal mechanisms through which these compounds induce selective apoptosis of cystic cells and enhance preclinical outcomes in mouse models of ADPKD.⁴

The findings have suggested that administering 11-beta compounds to patients at intervals of a few months, or annually could substantially slow down the progression of the disease. This approach may offer an alternative to continuous and demanding antiproliferative treatments like tolvaptan.⁶ Researchers hope to run further tests on 11-beta-dipropyl, as well as develop ways to produce it on a larger scale. They also plan to explore related compounds that could be good drug candidates for PKD. It is evident to say that 11-beta compounds hold strong potential as a compelling therapeutic option for ADPKD patients. This groundbreaking finding contributes to the forefront of impactful medical interventions.

References

1. Chapin HC, Caplan MJ. The cell biology of polycystic kidney disease. *J Cell Biol.* 2010;191(4):701-710. doi:10.1083/jcb.201006173
2. Bais T, Gansevoort RT, Meijer E. Drugs in Clinical Development to Treat Autosomal Dominant Polycystic Kidney Disease. *Drugs.* 2022;82(10):1095-1115. doi:10.1007/s40265-022-01745-9

3. Zhou L, Tian Y, Ma L, Li WG. Tolvaptan ameliorated kidney function for one elderly autosomal dominant polycystic kidney disease patient: A case report. *World J Clin Cases*. 2022;10(31):11500-11507. doi:10.12998/wjcc.v10.i31.11500
4. Trafton A. A new drug candidate can shrink kidney cysts. *MIT News*. January 22, 2024. Accessed April 23, 2024. <https://news.mit.edu/2024/new-drug-candidate-can-shrink-kidney-cysts-0122>.
5. Gyurászová M, Gurecká R, Bábíčková J, Tóthová L. Oxidative Stress in the Pathophysiology of Kidney Disease: Implications for Noninvasive Monitoring and Identification of Biomarkers. *Oxid Med Cell Longev*. 2020;2020:5478708. Published 2020 Jan 23. doi:10.1155/2020/5478708

Want to read more articles like this?

We currently have 12 volumes published consisting of over 90 issues and hundreds of unique articles!

Feel free to browse through previous volumes and issues by visiting our website:

<http://rhochistj.org/RhoChiPost>



Carbapenem Resistant *Acinetobacter* Baumannii: An Urgent Threat

By: Giavanna Carr, PharmD Candidate c/o 2025

Acinetobacter is a gram-negative organism typically found in soil and water, but it has been found to colonize intravenous fluids and irrigation solutions.¹ Of the species of *acinetobacter*, *A. baumannii* is the most clinically significant.¹ *Acinetobacter* is a slow growing organism with the potential to cause infections in immunocompromised and neutropenic patients, while also, commonly infecting those who are on ventilators, have catheters, open wounds from surgeries, in the intensive care unit (ICU), or prolonged stay in the hospital.¹ *A. baumannii* is prone to causing infections in the blood, urinary tract, lungs colonizing as pneumonia, or in wounds in various parts of the body.^{1,2}

Antibiotic Resistance

Acinetobacter gained clinical significance due to its ability to survive desiccation and sustain life in a healthcare setting for an extended period of time.¹ This organism has the potential to acquire resistance to frequently used antibiotics and thus can be deemed as multidrug resistant (MDR), when the organism is resistant to at least one agent in three or

or more antimicrobial classes, extensively drug resistant (XDR), when the organism is resistant to more than one agent in two or fewer antimicrobial classes and pan drug resistant (PDR), when the organism is resistant to all antimicrobial classes, when categorized by the Centers for Disease Control (CDC), antimicrobial resistance report.¹ The 2013 CDC report classified *Acinetobacter* as MDR under a threat category “serious”.¹

The typical agents used to fight *A. baumannii* include broad spectrum beta lactams such as ceftazidime, cefepime, ampicillin/sulbactam and piperacillin/tazobactam.³ Between the 1970s and the 1980s, widespread resistance of *A. baumannii* was experienced and by the late 1990s, the only drug of use against *A. baumannii* were the carbapenems: meropenem and imipenem.⁴ Due to the sudden emergence of Carbapenem Resistant *Acinetobacter* Baumannii (CRAB), the therapeutic choices for *A. baumannii* are decreasing. The CDC has classified CRAB as an urgent threat in antibiotic resistance.⁵

Mechanisms of Resistance

There are three main mechanisms by which acinetobacter acquires resistance to different antibiotics: enzymes inactivating antibiotics, reduced entry into the target sites of antibiotics, and alteration of the target or cellular functions due to mutation.⁶ Carbapenems are impacted by two of the three mechanisms of resistance, consistent with the fact that this is an urgent threat. The enzymes responsible for the inactivation of antibiotics, such as penicillins, synthetic cephalosporins, and carbapenems, are beta-lactamases.⁶ Beta lactamases are known to hydrolyze and confer resistance against various groups of antibiotics, most importantly the carbapenems. Class D, OXA-type inactivating enzymes, and class B, metallo-beta-lactamases (MBLs) are the most threatening. Carbapenems also deemed resistant to acinetobacter due to reduced entry into the target site of the bacteria. In the case of CRAB, the porin channels are too small in size and number to allow the delivery of the carbapenem to the target protein for it to complete its action, therefore resistance is conferred.⁶

Antimicrobial Susceptibility Testing

In order to determine if the patient is infected with CRAB, an antimicrobial susceptibility test would need to be conducted. Antimicrobial Susceptibility Testing (AST) is performed to identify the proper antimicrobial regimen for a specific patient based on what their specific infection is susceptible or resistant to. The first step is specimen collection, and the most common specimens used for culture and sensitivity (C&S) tests are urine, blood, cerebrospinal fluid, sputum, wound, or stool. The culture and sensitivity test will return and

provide the minimum inhibitory concentration (MIC) and the MIC breakpoints, which will classify whether a specific antibiotic is susceptible or resistant to the organism.⁷ In the case of CRAB, the AST and C&S would disclose that the organism is resistant to carbapenems and not an appropriate antimicrobial regimen for that specific patient.

Treatment of CRAB

In cases of CRAB, clinicians often turn to combination therapy to combat resistant isolates. Colistin, administered in its prodrug form, colistimethate, is typically used in combination with other agents like vancomycin.⁸ Studies have shown that colistimethate yield low serum concentrations in the early stages of therapy, thus patients may experience subtherapeutic levels of the drug and not show signs of improvement.⁸ Colistimethate and vancomycin both have the potential for nephrotoxicity and may be seen as a limitation in the use of these medications to treat CRAB.⁸ Another drug which has shown bacteriostatic activity against Acinetobacter is tigecycline. Overtime resistance to this medication has been documented due to the overexpression of efflux pumps in Acinetobacter. The current regimen recommended within the IDSA guidelines include the use of high dose ampicillin-sulbactam with a total daily dose of 6-9 grams of the sulbactam component in combination with polymyxin B, minocycline, or tigecycline. Due to the adverse effects and resistance that current treatments pose, there is extensive research for new antibiotics to be introduced into the market to fight this urgent threat.

Emergence of Zosurabalpin

Following the classification of CRAB as a priority 1 pathogen, the need for a new antibiotic to fight this pathogen is abundantly necessary. No new antibiotic class with activity against *Acinetobacter* has been discovered within the last 50 years. Because of this, the discovery of Zosurabalpin is¹⁰ ground breaking. The novel antibiotic is currently under phase 1 trials by F. Hoffmann-La Roche, a Swiss pharmaceutical company. Currently, Roche has evidence that Zosurabalpin effectively treats CRAB in vitro and in mouse models. The mechanism of Zosurabalpin is completely unique to this drug, and also specific to CRAB and no other infection. This can be seen as both a pro and con to the drug. On the bright side, it is less likely to acquire resistance since it is only active against one organism. At the same time, clinicians need to be entirely sure the organism they're fighting is CRAB because Zosurabalpin is efficacious solely against CRAB. CRAB is such a difficult organism to defeat due to its protective outer layer of lipopolysaccharide (LPS). Zosurabalpin's mechanism of action is to block the lipopolysaccharide transporter, LptB2FGC, which prevents the organism from transporting the LPS from the interior to the outer layer to protect it from antibiotics. Keeping the LPS inside of the organism itself will cause a self-destructive mechanism, resulting in bacterium death.

Conclusion

Zosurabalpin is a revolutionary discovery in that no antibiotic has been found to have activity against *Acinetobacter* in the past 50 years! CRAB is a priority 1 pathogen as defined by both the World Health Organization and the Centers for Disease Control and Prevention, therefore indubitably at the top of all scientists

list. This revelation will aid in antimicrobial resistance as well as save countless lives due to this destructible pathogen.

References

1. Brady MF, Jamal Z, Pervin N. *Acinetobacter* - StatPearls - NCBI Bookshelf. August 8, 2023. Accessed January 28, 2024. <https://www.ncbi.nlm.nih.gov/books/NBK430784/>.
2. *Acinetobacter* in healthcare settings. Centers for Disease Control and Prevention. November 13, 2019. Accessed January 28, 2024. <https://www.cdc.gov/hai/organisms/acinetobacter.html>.
3. Kanafani ZA, Kanj SS. UpToDate. November 8, 2023. Accessed January 28, 2024. [https://www.uptodate.com/contents/acinetobacter-infection-treatment-and-prevention#:~:text=First%2Dline%20antibiotics%20%E2%80%94%20Infections%20caused,or%20imipenem%2Dcilastatin\).](https://www.uptodate.com/contents/acinetobacter-infection-treatment-and-prevention#:~:text=First%2Dline%20antibiotics%20%E2%80%94%20Infections%20caused,or%20imipenem%2Dcilastatin).)
4. Manchanda V, Sanchaita S, Singh N. Multidrug Resistant *Acinetobacter*. *Journal of global infectious diseases*. September 2010. Accessed January 28, 2024. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2946687/>.
5. 2019 antibiotic resistance threats report. Centers for Disease Control and Prevention. November 23, 2021. Accessed January 28, 2024. <https://www.cdc.gov/drugresistance/biggest-threats.html>.
6. *Acinetobacter* in healthcare settings. Centers for Disease Control and Prevention. November 13, 2019. Accessed January 28, 2024. <https://www.cdc.gov/hai/organisms/acinetobacter.html>.

7. Singh H, Thangaraj P, Chakrabarti A. *Acinetobacter baumannii*: A brief account of mechanisms of multidrug resistance and current and future therapeutic management. *Journal of clinical and diagnostic research: JCDR*. November 10, 2013. Accessed January 28, 2024. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3879836/#:~:text=Three%20main%20mechanisms%20of%20resistance,cellular%20function%20due%20to%20mutations>.
8. Bayot ML, Bragg BN. Antimicrobial susceptibility testing - statpearls - NCBI bookshelf. October 10, 2022. Accessed January 28, 2024. <https://www.ncbi.nlm.nih.gov/books/NBK539714/>.
9. Viehman JA, Nguyen MH, Doi Y. Treatment options for carbapenem-resistant and extensively drug-resistant *Acinetobacter baumannii* infections. *Drugs*. August 1, 2015. Accessed January 28, 2024. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4258832/>.
10. Tamma PD, Aitken SL, Bonomo RA, Mathers AJ, David van Duin, Clancy CJ. Infectious Diseases Society of America 2023 Guidance on the Treatment of Antimicrobial Resistant Gram-Negative Infections. *Clinical Infectious Diseases*. Published online July 18, 2023. doi:<https://doi.org/10.1093/cid/ciad428>
11. Healthcare G. Zosurabalpin shows promise in the fight against antibacterial resistance. *Clinical Trials Arena*. January 16, 2024. Accessed January 28, 2024. <https://www.clinicaltrialsarena.com/analyst-comment/zosurabalpin-promise-antibacterial-resistance/?cf-view>.

Utilization of Tumor Microenvironment in the Treatment of Breast Cancer

By: Sameen Siddiqui, PharmD Candidate c/o 2025, Madelyn Lombardo, PharmD Candidate c/o 2027, and Gabriella Lamantea, PharmD Candidate c/o 2027

Breast cancer, besides skin cancer, is the most common cancer detected in women and one of the most common cancers linked to female mortality.¹ Due to the silent rapidity of the disease, breast cancer is difficult to catch early on. Breast cancer can be diagnosed via screening, biopsy, or self-discovery of lumps on the breast. Metastasis, the spread of cancerous cells from a point of origin to other areas of the body, plays a significant role in a patient's prognosis. When it comes to breast cancer, bone is the most common mode of metastasis because it provides a viable environment for tumor cell growth. In later stages of the disease, metastasis induces bone deterioration via osteoclast stimulation. The highly vascularized nature of bone marrow allows for tumor cells in circulation to gain access within the marrow. Upon their arrival, breast cancer cells rearrange these vessels in a disorderly manner, contorting² and scrambling them. It is here that dormant cells are found to reside. Dormant cancer cells are typically found in secondary organs where they remain until a signal is released which activates cancer growth and metastasis. Interestingly, emotional states are involved with metastasis as well. Factors such as stress, trauma and depression were shown to alter marrow tissue and stimulate metastasis. Constant activation of the sympathetic nervous system by these emotional states has been shown in studies to increase osteoclast activity and promote the spread of osteolytic lesions, a characteristic sign² of metastatic breast cancer.

The term 'tumor microenvironment' refers to the physical surroundings of a tumor which involves components like immune cells, cytokines, and pH levels. When examining the complex territory, three levels exist: the local, regional, and metastatic. The local level refers to the environment within the tumor itself, while the regional microenvironment is the leading site of cancerous growth. In the case of breast cancer, the regional level is the breast. Finally, the metastatic level refers to any secondary cancerous growths in other distant body³ niches. Within these levels are several kinds of cells, each contributing to the tumor in some way. Cancer-associated fibroblasts (CAFs) comprise the majority of cells in cancerous breast stroma and play a significant role in tumor development and cell invasion. Through extensive study, we have come to understand that CAFs contain specific mRNA that is unlike that of fibroblasts residing in normal non-cancerous breast tissue.⁴ The origins of cancer-associated fibroblasts are not entirely understood, though some postulate that women with certain single nucleotide polymorphisms have fibroblasts with increased expression of a protein called MMP3, which promotes cancer cell invasion. Tumor-associated macrophages (TAMs) are another population of cells that make up a large percentage of the cancerous environment. They can be divided into two classes: M1 and M2. M2 macrophages, whose usual functions involve mending wounds and remodeling tissue, are the ones that are

primarily involved with the survival and proliferation of cancer cells via cytokine secretion. Similar to the macrophages are tumor infiltrating lymphocytes, another cell type consisting of different classes. Of these classes, our main focus is on Regulatory T cells, cells which work against the body's autoimmune responses.

Regulatory T cells normally halt autoimmune reactions, though when residing in the tumor microenvironment, block anti-tumor responses. They also have a role in cancer progression by producing high amounts of a protein called receptor activator of nuclear factor kappa-B ligand (RANKL). RANKL can activate breast cancer cells with RANK receptors, therefore leading to metastasis.⁴ Higher amounts of RANKL are associated with increased osteoclast activity as well; this increased osteoclast activity may lead to the advancement of tumor growth in bones, which is a frequent site of metastasis for breast cancer.²

Within tumor-associated stroma are immature dendritic cells whose normal function is marred. Due to incomplete functionality, these cells cannot act on their anti-tumor capabilities; in fact, they even work against the body to promote tumor development. Finally, the extracellular matrix, which is usually a stable and supportive environment, is observed to be quite the opposite in cancerous tissue. The rigid stroma of cancerous extracellular matrix forms the characteristic lumps of breast cancer. An enzyme known as lysyl oxidase causes this rigidity to occur and serves as a marker of cancer progression. Cancerous extracellular matrix may also interfere with regular immune function via stunting regulatory T cell growth and disrupting their abilities.⁴

Breast cancer has many options for treatment depending on how far the cancer has spread based on medical scans and decisions made by patients. Presently, there exist three treatment options utilizing breast tumor microenvironments as a target: aromatase inhibitors, HER2 inhibitors, and angiogenesis inhibitors.⁴ Aromatase and human epidermal growth factor receptor 2 (HER2) inhibitors work against certain aspects in the stroma. For example, aromatase inhibitors such as anastrozole, letrozole, and exemestane block the aromatase enzyme which prevents the conversion of androgens to estrogen, ultimately decreasing tumor growth in hormone receptor- positive breast cancer patients.⁷ HER2 inhibitors (i.e., trastuzumab and pertuzumab) are specific to breast cancer patients whose tumor growth is due to overexpression of human epidermal growth factor 2 HER2 receptor-positive breast cancer. These drugs function by blocking HER2 signaling triggered by stromal growth factors in breast cancer patients. Vascular endothelial growth factor (VEGF) inhibitors such as bevacizumab is a cytokine produced by TAMs that prevent the growth of new blood vessels. Dendritic cells show some promise in being a possible target for breast cancer treatment as well. By promoting the development of immature dendritic cells in the tumor-associated stroma, this method may increase their anti-tumor activity and therefore decrease proliferation of the malignancy.⁴

Tumor microenvironment is a topic undergoing continuous research. In order to help patients with cancer, investigators must understand how the various cells of tumor microenvironments communicate with one another. Once the communication within these signaling networks is prevented, tumor growth can be suppressed.⁹

BREAST CANCER TREATMENT

Present-day technology lends itself to studying tumor microenvironments; for example, the development of multi-omics technologies that combine methods such as transcriptome and proteome. This provides an advantage to scientists when comprehending the cancer because it provides the diverse makeup of the tumor in the TME, resulting in a better understanding of the cancer stage and developing a more precise and accurate treatment. In addition, tumor microenvironments aim to have better therapeutic advantages than cancer treatments like immunotherapy and radiation therapy. In TME, cells that are non-tumor are more exposed and stable compared to tumor cells. This shows a therapeutic advantage due to their instability because cancer cells are more inclined to drug resistance¹⁰.

In conclusion, breast cancer is detected primarily in women. Metastasis, the spread of cancerous cells, is expected mainly in the bone. Metastasis can happen when you're emotional, like stress, which changes the marrow tissue. Tumor microenvironment and all its components play a unique role in the development and metastasis of cancer. Each cell involved in the cancerous environment contributes in their own way to tumor development, with cancer associated fibroblasts being the largest population of these cells. Others include the M2 class of tumor associated macrophages which facilitate cancer cell proliferation, a kind of tumor infiltrating lymphocyte known as regulatory T cells which suppress autoimmune responses and increase osteoclast activity, and immature dendritic cells which promote tumor development. Today, TME is still being researched to help patients with cancer. Technology, such as multi-omics, has improved significantly over the years, which

can help scientists figure out more ways to develop treatments for patients.

References

1. What is breast cancer? Centers for Disease Control and Prevention. Last Reviewed July 25, 2023.
https://www.cdc.gov/cancer/breast/basic_info/what-is-breast-cancer.htm
2. Zarrer J, Haider MT, Smit DJ, Taipaleenmäki H. Pathological Crosstalk between Metastatic Breast Cancer Cells and the Bone Microenvironment. *Biomolecules*. 2020;10(2):337. Published 2020 Feb 19. doi:10.3390/biom10020337
3. Li JJ, Tsang JY, Tse GM. Tumor Microenvironment in Breast Cancer- Updates on Therapeutic Implications and Pathologic Assessment. *Cancers (Basel)*. 2021;13(16):4233. Published 2021 Aug 23. doi:10.3390/cancers13164233
4. Soysal SD, Tzankov A, Muenst SE. Role of the Tumor Microenvironment in Breast Cancer. *Pathobiology*. 2015;82(3-4):142-152. doi:<https://doi.org/10.1159/000430499>
5. How is breast cancer treated? Centers for Disease Control and Prevention. Last Reviewed July 23, 2023[IL1] .
https://www.cdc.gov/cancer/breast/basic_info/treatment.htm
6. Types of cancer treatment. National Cancer Institute. Published 2020.
<https://www.cancer.gov/about-cancer/treatment/types>
7. Goldfarb SB, Hudis C, Dickler MN. Bevacizumab in metastatic breast cancer: when may it be used?. *Ther Adv Med Oncol*. 2011;3(2):85-93. doi:10.1177/1758834010397627

8. Murfin K. 3 things to know about the tumor microenvironment. MD Anderson Cancer Center. Accessed January 29, 2024.
<https://www.mdanderson.org/cancerwise/what-is-the-tumor-microenvironment-3-things-to-know.h00-159460056.html#:~:text=The%20components%20of%20the%20microenvironment>
9. Shi Y, Zhang Q, Mei J, Liu J. Editorial: Multi-omics analysis in tumor microenvironment and tumor heterogeneity. *Frontiers in Genetics*. 2023;14.
doi:<https://doi.org/10.3389/fgene.2023.1271295>
10. Xiao Y, Yu D. Tumor microenvironment as a therapeutic target in cancer. *Pharmacol Ther*. 2021;221:107753.
doi:[10.1016/j.pharmthera.2020.107753](https://doi.org/10.1016/j.pharmthera.2020.107753)



6th Year Perspective: Deciphering D&Ds - A Peer-Led Piece Containing an Academic Overview, Study Tips, and Analysis

By: Ashley Medina, PharmD Candidate c/o 2025

Embarking on the professional years of St. John's Pharmacy curriculum allows the aspiring professional to gain knowledge and exposure to various disease states and available treatments, as well as pipeline treatment options. These courses are some of the most rigorous and challenging, yet exciting, essential courses for the completion of the Doctor of Pharmacy degree here at St. John's University. Here, you will read valuable advice from fellow peers on how to be successful in the course series we all know as "D&Ds," which is short for the drugs and diseases curriculum.

What are "D&Ds"?

The drugs and diseases curriculum is designed to introduce and familiarize the student with the pharmacy-oriented patient care process in correlative populations. Interdisciplinary instruction includes faculty with various expertise and experience, allowing full immersion into each disease state and its treatment process. The framework for each D&D covers pathology, pharmacology, medicinal chemistry, and therapeutic lecturing, and is organized based on the affected organs, systems, and diseases.

Understanding the Curriculum

The best way to approach the initiation of each D&D begins with understanding what this information pertains to. This knowledge is acquired within the first half of the Doctor of Pharmacy program, which covers basic science and instills the crucial foundation necessary for successful comprehension of the remaining didactic courses.

The courses one will look forward to cover are Introduction to Drugs and Disease: Skin and Miscellaneous Topics, Infectious Diseases, Cardio-Renal I & II, Neurology and Psychological Disorders, Respiratory Diseases, Endocrine and Reproductive System Diseases, Oncology, and finally Gastrointestinal & Gastroenterology Diseases. As you begin each course, it is a good idea to familiarize yourself with course content and expectations which can all be found in the provided syllabi. The importance of these courses is to enhance the depth of knowledge and bases for critical thinking and application in real-world medical practice as well as serve to supplement additional providers on a patient's healthcare team. Completion of the D&D courses will be followed by application-based experiential experiences which will act as a shift into a student's professional career and will require informative interventions.

6TH YEAR PERSPECTIVE

Personal Experiences and Insights from Peer Contributors

Hearing so much about these courses may seem overwhelming at first, but adoption of productive habits and personalized approaches will exhibit promising results. Aside from your professors, another great resource as you navigate through these courses, and any course really, is from your fellow peers. Peer insight is invaluable for student success through the utilization of a collaborative and welcoming learning environment. Through this exposure from peers who have shared a parallel academic career, one will gain various approaches and perspectives that may be useful and personalized. These interactions can help individuals overcome challenges, clarify doubts, and enhance their understanding of these complex and information-heavy topics. Not only does this help younger students, but it also fosters active engagement with course content and promotes critical thinking as students analyze questions and provide feedback to one another. Below are some helpful tips from class candidates of 2025:

- Study daily. Review the material you learn every day to stay on top of it.
- Manage your time well! D&Ds are every day, so make sure you dedicate time to them.
- Ask questions when you're not sure about something.
 - Sean G., Pharm D. Candidate c/o 2025
- Study in groups! Collaborating can be very helpful, especially when you don't understand something.
- Be prepared with the cases and for the quizzes ahead of time. It's super beneficial to have it all completed and reviewed beforehand.

- Having a dedicated study space that promotes focus will positively impact how much you can achieve when studying. A good place could be home, the library, or even HERC.
 - Devin J., Pharm D. Candidate c/o 2025
- Active engagement is key. Attend lectures, participate in discussions, and ask questions. These all enhance understanding and retention of material.
- Stay organized and practice healthy time management. Use a planner or a calendar to track assignments, deadlines, exams, and use to-do lists to prioritize tasks.
- No question is not good enough to not get the answer to! If you are uncomfortable asking in class, use office hours! Professors want to help you.
- The university offers peer-led tutoring, which I have personally found very helpful!

Challenges and Solutions

One of the most common misconceptions about the difficulty of D&Ds is not found within the content, but rather the time allotted for each educational block. Due to the small frame of time the coursework is spread over, approximately one month is dedicated to each course. In other words, there is typically an assessment at least bi-weekly, if not every week. Due to this fast-paced learning, students may often find themselves falling behind, most often due to not fully comprehending the content, which is why the practice of the tips shared above can provide preventative measures and solutions for overcoming these challenges.

6TH YEAR PERSPECTIVE

In conclusion, embarking on the journey through D&Ds for aspiring pharmacists at St. John's University can be exciting as much as it is challenging. To excel in these courses and gain a deep understanding of the complex topics and treatments, students must adopt effective habits and strategies, and embrace this unfamiliar learning process. In addition to the information provided, additional resources that can supplement class materials may be found at the end of this article. This article has aimed to provide peer-led guidance, emphasizing the importance of trying your best and seeking support when needed as one prepares for their future professional careers in healthcare.

Helpful Resources and References

1. <https://www.stjohns.edu/libraries>
2. <https://www.stjohns.edu/libraries/help-services/health-education-resource-center-herc>
3. <https://www.stjohns.edu/life-st-johns/student-success/university-learning-commons>

The Rho Chi Post would like to thank Ashley for taking the time to explain what D&D courses are and sharing some advice on how to excel in such courses!

Intratumoral and Gut Microbiota Roles in Cancer Treatment

By: Ariella Zadrima, PharmD Candidate c/o 2026

Introduction

Cancer is a disease state in which abnormal cells in the body rapidly and uncontrollably divide to destroy body tissue. This growth occurs as a result of genetic changes and can affect many areas and systems of the body. The most common cancers involve breast and lung ¹tissue. One fundamental feature of cancer is a tumor, which is a solid mass of tissue that forms when abnormal cells group together. Similar to the microbiota of the gut, these tumors contain tumor- type-specific intracellular bacteria that can influence the progression of cancer in the body. Intratumoral bacteria can perform several functions related to cancer pathogenesis, including secreting toxins that can directly damage DNA, or mimicking tumor neoantigens to further activate tumor-specific T cells, aiding in cancer treatment. On the other hand, other microbiota may allow for better regulation of these growths, primarily through modulating tumor-infiltrated myeloid cells. ^{2,3} It has been recently discovered that these organisms may be an effective form of cancer management and treatment when used as an adjunct to chemotherapy.

The microorganisms found in cancerous sites are expected to produce a microenvironment where tumor grows freely, regulate local immunity, and modify tumor cell biology, frequently interfering with a drug's efficacy and altering the methods by which chemotherapy or anticancer drugs treat an individual's cancer. Gut microbiota may also be affected by intratumoral microbiota as

these cancerous sites, affecting both local and distant tumors, alter the inflammation and metabolism patterns of the tumor. Though researchers are unsure whether these microbiotas can halt the production of cancer or promote it, there are distinct correlations between human microbiomes, and tumor cells.

Microbiota on Immune Response

In one study conducted by the University of Texas MD Anderson Cancer Center, scientists observed the relationship between tumor microbiome diversity and pancreatic cancer outcomes. The team analyzed tumor microbiomes in patients with both short (survival < 5 years post- surgery) and long-term (survival > 5 years post-surgery) survival phases of pancreatic cancer. In patients with long-term survival, it was found that greater microbiome diversity allowed the patient to exhibit high immune activation and combat cancer more efficiently. More specifically, the presence of Saccharopolyspora, Pseudoxanthomonas, and Streptomyces along with Bacillus Clausii was predictive of long-term survival in these patients. Additionally, using singleplex immunohistochemistry and immunofluorescence staining, the study hypothesizes that tumoral bacteria can shape the immune tumor microenvironment, which can affect the natural history of the cancer. CD8+ T cells were found in significantly greater quantities in long-term survival patients compared to short-term survival patients. A positive correlation was found between CD8+ T cell recruitment and activation and the presence of

Volume 13 | Issue 5 | June 2024

23

iSaccharopolyspora, Pseudoxanthomonas, and Streptomyces in the tumor. All in all, the study concluded that in long-term survival patients, a more diverse tumor microbiome may activate immune cells to greater combat cancer.

Continuing with inflammation factors, the STING signaling pathway, or Stimulator of Interferon Genes, is a process cells undergo to activate host innate immunity, more specifically cytokines, against a pathogen infection that is set to alter DNA and promote cancer growth. It involves cytosolic DNA sensing proteins that may activate expression of Interferon B and other inflammatory genes. This pathway plays a key role in propagating the cancer immunity cycle, remodeling the tumor environment, and eliminating all steps to tumorigenesis, whether it be malignant cell transformation or metastasis.² In a study conducted by the Department of Radiation and Cellular Oncology, one specific intratumoral microorganism, Lactobacillus rhamnosus GG (LGG), was observed in its efficiency in activating this pathway and prohibiting tumor growth in specific microbiomes like the gut. The study focused on specific cancers such as colorectal carcinoma or melanoma, and were induced in murine models with some mice also being administered the intratumoral antibodies against these cancers twice weekly. All mice were also given an oral supplement of LGG to further observe agents against live microbiota environments. It was ultimately concluded that the animals receiving both the intratumoral supplement and the antibody demonstrated a markedly tumor inhibition as compared to either agent used alone upon analyzing the tumor size and survival from the beginning of the experiment. The study reports that this is due to the alteration in gut

microbiome caused by the oral supplement; LGG was associated with greater levels of commensal bacteria like Lactobacillus murinus which work to activate antitumor immunity through inducing Cyclic GMP-AMP Synthase and STING-dependent IFN- β production. Furthermore, in order to further determine the supplement's effect on IFN- β , the team isolated cytokines produced dendritic cells CXCL 9 and 10. These cytokines are known to be strong mediators of T-cell tumor infiltration and would play a key role in inflammation pathways such as the STING pathway. It was found that the combination therapy, as well as the monotherapy oral supplement, greatly expanded the population of infiltrating CD11c⁺ cells. The study ultimately concluded that the combination of lactobacillus rhamnosus GG oral supplements and antibodies greatly activated cytokine cells and interferon cells associated with the STING pathway in efforts to mediate tumor growth, demonstrating how STING pathways and dendritic cells, in specific, play an essential role in antitumor activity when it comes to the live LGG supplement and combination treatment.

Cons of Bacteria in Cancer Therapy

Though intratumoral microorganisms can promote immunoactivities, it has been shown that some organisms may actually promote tumor progression. For example, Bacteroides fragilis is an enterotoxigenic bacteria that can lead to increased secretion of interleukin-17 which can promote the infiltration of intratumoral B cells, leading to colon cancer growth.⁴ These microorganisms can also activate the beta-catenin signal, which promotes cancer stem cell development, an essential cancer intrinsic signal. A prime example of this can be found with the Cytotoxicity-associated immunodominant

antigen, a major virulence factor of *Helicobacter pylori*. This protein can be directly injected into the host's cytoplasm to activate the beta-catenin signaling and ultimately cause gastric cancer.⁵ Another example of drug resistance can be seen in gammaproteobacteria, which expresses cytidine deaminase. This enzyme can completely metabolize gemcitabine, a chemotherapy drug utilized in the management of many cancers including bladder and breast cancer. Gemcitabine, when introduced to tumor microbiota, a high risk of drug resistance may occur and lead to tumor growth. In a study using a colon cancer mouse model, it was found that the presence of intratumoral bacteria, specifically gammaproteobacteria, was greatly linked to treatment resistance in tumors. Because this tumor type possessed the bacteria to modulate this tumor sensitivity to gemcitabine, a chemotherapy resistance was observed, with a lower concentration of gemcitabine in the body and increased adverse effects on the patient. These findings furthered ideas that microbiota plays a controversial role in cancer pathogenesis and development, as seen in its inflammation and resistance activities.

Microbiota as a Biomarker

Due to the difference in microbial population and quantity within tumor tissues as compared to normal cell tissues, the intratumoral microbiome can serve as a reliable diagnostic tool. For example, in the case of prostate cancer, it was found that the bacteria *Propionibacterium acnes* heavily resides in cancerous tissue and is even responsible for promoting a strong inflammatory response due to its activation of transcription and ⁷ metalloproteinase pathways, such as STAT3 and COX2-prostaglandin.

Therefore, if a patient experiences strong inflammatory responses, it can be said there is a high likelihood for prostate cancer. The bacteria *Fusobacterium nucleatum* has been found in high amounts in the tissues of patients with colorectal cancer as well as in those with esophageal squamous cell carcinoma. In both types of cancer, these high levels of *F. nucleatum* have been associated with poor chemotherapeutic response and tumor recurrence.⁷ Due to its ability to upregulate cancer progression, metastases, and drug resistance, it can be advised that patients with high levels of this microorganism can receive antibiotic intervention, as there is a chance it greatly decreases neoadjuvant chemotherapy and significantly lowers survival rates in cancer patients.

Conclusion

Intratumoral microorganisms continue to remain a puzzling aspect of cancer pathogenesis and other microbiomes in the body, such as gut microbiota, due to its paradoxical behavior of both suppressing tumor growth and promoting cancer development and inflammation. Though it is unclear yet why these microorganisms differ for each patient and how they can ultimately aid in cancer treatment, it is apparent that these agents are a helpful biomarker for a disease difficult to treat and diagnose.

References:

1. National Cancer Institute. Cancer Statistics. National Cancer Institute. Published 2020. <https://www.cancer.gov/about-cancer/understanding/statistics>. Accessed February 20, 2024.

2. Yang L, Li A, Wang Y, Zhang Y. Intratumoral microbiota: roles in cancer initiation, development and therapeutic efficacy. *Signal Transduction and Targeted Therapy*. 2023;8(1). doi:<https://doi.org/10.1038/s41392-022-01304-4>

3. Jandhyala SM, Talukdar R, Subramanyam C, Vuyyuru H, Sasikala M, Nageshwar Reddy D. Role of the normal gut microbiota. *World J Gastroenterol*. 2015;21(29):8787-8803.doi:10.3748/wjg.v21.i29.8787

4. Si, W., Liang, H., Bugno, J., Xu, Q., Ding, X., Yang, K., Fu, Y., Weichselbaum, R. R., Zhao, X., & Wang, L. (2021). *Lactobacillus rhamnosus* GG induces cGAS/STING- dependent type I interferon and improves response to immune checkpoint blockade. *Gut*, *gutjnl-2020-323426*. <https://doi.org/10.1136/gutjnl-2020-323426>.

5. Abreu, M., Peek Jr., R. (2017). Gastrointestinal Malignancy and the Microbiome. *The Gut Microbiome and Disease*, 146 (6), 1534-1546. <https://doi.org/10.1053/j.gastro.2014.01.001>

Interested in writing for the Rho Chi Post?

Go to <http://rhochistj.org/RhoChiPost> and click on the login option from the menu bar to make an account! With an account, you'll have access to the article submission portal where you can submit your writing for publication in an upcoming issue!

Remember, you do NOT have to be a member of Rho Chi, a member of the editorial team, or a student of St. John's to write for our newsletter!

If you have any questions, feel free to email us at rhochipost@gmail.com!

MEET THE TEAM

Meet the 2024-2025 Team Members



Editorial Team & Production



Anjali Thykattil
Editor-in-Chief

The Rho Chi Post serves as both a creative and educational platform that allows students and faculty to collaborate in sharing their knowledge with the pharmacy community. Unlike other pharmacy organizations at St. John's, it also allows for the unique experience of expanding research and writing skills outside of the classroom setting. As pharmacy students, it is imperative we continue to educate ourselves as the world of healthcare is ever-changing. I am honored to be a part of the Rho Chi Post's Editorial Team and look forward to serving as this year's Editor-in-Chief!

John Ortiz
Managing Editor

Rho Chi Post is an opportunity for students to foster their writing and investigative skills concerning the pharmacy practice. Through Rho Chi Post, students are also exposed to novel information and perspectives that are present in the pharmacy community and in our own student body. By honing our understanding of new innovations and developments in pharmacy, we will be better adept at providing accurate information to readers and maintaining the continuous education expected of pharmacists.



Bao Qi Chen
Senior Content-Focused Copy Editor

The Rho Chi Post is a bridge between students and the world we will soon enter once we graduate. My ambition is to promote intellect, values, and opportunities that not only allow students to be heard but also impact the pharmacy profession as a whole. I am honored to be a part of the Rho Chi Post's editorial team and work with colleagues who share this ambition. I am excited and grateful for this opportunity, and I look forward to working with everyone!



MEET THE TEAM



Warda Basher

Senior Content-Focused Copy Editor

Joining this esteemed team excites me with the opportunity to gain invaluable experience and insights into the latest trends in pharmacy. I am eager to expand my professional network and make significant contributions to the field. As a member of the editorial team, I'll be at the forefront of disseminating the most current news and knowledge, effectively impacting pharmacy professionals worldwide with timely and relevant information.

Ramesa Anan

Content-Focused Copy Editor

Being in the Rho Chi Post means being part of an environment that allows me to grow both academically and professionally in the field of pharmacy. It means being able to participate with like minded individuals who strive to grow in the field of pharmacy by publishing newsletters with relatable and useful content. I hope to contribute to the continuing success of this student-operated newsletter and aid my team to the best of my ability.



Sameeha Arshad

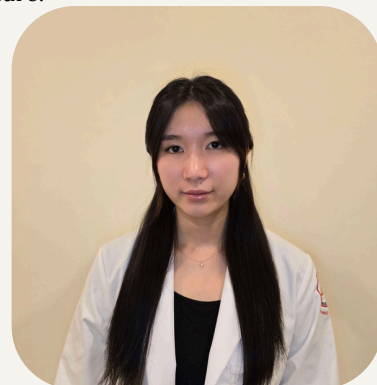
Content-Focused Copy Editor

To me, being a part of the Rho Chi Post means being part of a community that values knowledge sharing, collaboration, and making a positive impact in the field of pharmacy. It provides me with a platform to contribute meaningful insights, engage with fellow pharmacy students, and inspire others through informative articles and discussions. The opportunity to be a part of this publication is both rewarding and enriching, allowing me to grow professionally and connect with a diverse audience passionate about pharmacy and healthcare.

Amanda Kim

Content-Focused Copy Editor

Being part of the Rho Chi Post means having the opportunity to help actively contribute to the advancement of the pharmacy profession. As an editor, I will be able to enhance my own writing, be inspired, and share the new innovations/issues within healthcare with my peers. I am very excited to join the team this year!



MEET THE TEAM



Laiel Bravo
Content-Focused Copy Editor

The Rho Chi Post has been a segway for pharmacy students to immerse themselves in valuable research work, advancements, and issues within the field. As future pharmacists, it is important to be informed of the latest news and gain insight from the experiences/ideas of others so that we are equipped to further improve the healthcare system. I aspire to use this opportunity to not only enhance my own preparedness but also to help enhance my peers in being ideal professionals who provide exemplary care to patients.

Zainab Masood
Senior Graphics-Focused Copy Editor

Being part of Rho Chi Post, which provides information on discoveries and research to others, is an honor. Taking insight from professionals and peers to educate others is a rather significant effort in the expanding and evolving role of pharmacists. I look forward to collaborating with the team in pushing this effort further while also learning from them.

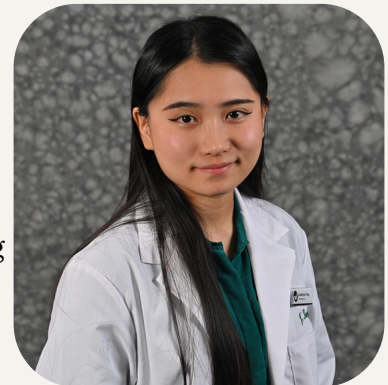


Nalisha Xu
Graphics-Focused Copy Editor

By becoming a part of the Rho Chi editorial team, I wish to learn more about the pharmacy field and community by gaining insight through our publications. This position will not only allow me to broaden my views on the profession of pharmacy, but also explore topics related to the medical field as a whole. Through Rho Chi's team, I will utilize this experience to grow professionally, develop leadership skills, and be more involved in our community to improve my confidence and professionalism on my journey to becoming a pharmacist.

Jennalynn Fung
Senior Staff Editor

I am thrilled to have the opportunity to express my creativity, critical thinking, and research skills through contributing to the Rho Chi Post. The mission to promote intellectual discourse and showcase diverse perspectives aligns with my values; I look forward to putting my writing and editing experience to use in each issue, and hope that my involvement can ensure that future cohorts will also have this valuable platform available to them.



MEET THE TEAM



Sharupa Azmal
Senior Staff Editor

The Rho Chi Post serves as a notable forum for pharmacy students who wish to expose themselves to medical journalism. Being a staff editor of the Rho Chi Post means amplifying the voices of our writers and educating our readers regarding current events in healthcare. This role provides me with the opportunity to present insightful stories that are relevant to the pharmacy community and contribute to the advancement of the profession through writing.

Anya Geiling
Staff Editor

Hello! My name is Anya, and I am very grateful to be a part of Rho Chi Post. As a rising Sophomore studying Nursing, I have a passion for understanding and sharing research about the medical field. I am ecstatic to be able to utilize my editing skills to assist with medical-related articles.



Wajiha Uddin
Staff Editor

The Rho Chi Post is a robust community of pharmacy students that are dedicated to fostering growth and sharing newest technologies and innovations in pharmaceutical practice. Being part of the Rho Chi Post means being involved in the supportive network of peers that share a passion for pharmaceutical education, practice, and the drive for contributing to the advancement of pharmaceutical knowledge.



Christiana Popovic
Staff Editor

As a member of the Rho Chi Post, I would be part of a professional community that shares insights, advancements, and challenges within the field of pharmacy. The Rho Chi Post not only empowers and educates, but it shapes the future of pharmacy through its engaging and concise writing.



MEET THE TEAM



Christine Mauceri
Senior Staff Writer

Every student deserves a voice, and to me, being a part of the Rho Chi Post allows us to make that voice heard. Whether it's through opinion pieces, talking about personal experiences, or educating on new pharmacy advancements, this newsletter sticks to its mission of promoting the pharmacy profession. As a Staff Writer, I am excited to learn, grow, and make meaningful contributions to the profession!

Rand Ayoub
Staff Writer

Being in Rho Chi Post gives us the opportunity to shed light on crucial topics within healthcare to the St. John's Community. By using the skills and information given to us in our academic classes, this organization offers a chance for people to build on those skills and be able utilize them for the better. I look forward to contributing to Rho Chi Post as well as learning from an amazing group of people!



Nivaj Haque
Staff Writer

Joining the Rho Chi Post will allow me to merge my analytical skills with my passion for public health, within the rapidly evolving field of pharmacy. This role helps keep us at the forefront of pharmacy innovations and enables me to contribute to keeping our pharmacy community well-informed. I'll explore new research and policy changes, aiming to enhance our collective understanding and application of pharmacy practices that positively impact patient care and healthcare delivery. I'm excited about starting this role and engaging in discussions that shape the future of our profession.



Rebecca Sabzanov
Staff Writer

Being part of Rho Chi Post is an exciting opportunity for me to merge my passions for writing and pharmacy in a prestigious organization. I'm enthusiastic to contribute to such a respectful organization and collaborate with other members of the Rho Chi Post to produce meaningful content that will impact others.



MEET THE TEAM



Ameena Qadri
Staff Writer

Being a member of the Rho Chi post means a great deal to me because it is the perfect outlet for me to write about pharmacy related topics that interest me the most. I feel that the Rho Chi post will also allow me to develop my writing skills both professionally and creatively. I sincerely appreciate your consideration and I am looking forward to joining the team!

Michelle Flores
Staff Writer

My name is Michelle Flores and an incoming fourth year pharmacy student. Having the opportunity to be a Staff Writer gives me the chance to educate others about pharmacy news. Pharmacy is a field that is constantly evolving and as future pharmacists, it is our responsibility to continue learning. Maintaining current knowledge benefits not only our patients but also enriches our own expertise. I'm thankful and excited to be a part of Rho Chi Post as a Staff writer this upcoming year!



Amanda Nakhul
Staff Writer

Hello! My name is Amanda Nakhul, I'm a rising sophomore and biomedical sciences major. I'm rather new to St. John's, so being a part of a high-quality collaborative organization such as the Rho Chi Post means the world to me. As a Staff Writer I am able to incorporate my passion for writing with my appreciation for Pharmacy and medicine. The Rho Chi Post provides a foundation for student-operated publications and it is an honor to be included in this journey.



Royal Mussaleen
Staff Writer

As a member of the Rho Chi Post, I see this as an opportunity to enhance the pharmacy profession. By highlighting the diverse roles pharmacists play; from ensuring medication safety and efficacy, conducting research, advocating for patient safety, to analyzing healthcare trends like telepharmacy and personalized medicine, and advancements in gene therapy and immunotherapy; I aim to showcase the impact pharmacists have on society's well-being. I intend to offer engaging perspectives on pharmaceutical developments, healthcare policy changes, and the role of pharmacists in regulatory affairs. Through my contributions, I hope to spark curiosity in our readers to explore the underlying reasons and mechanisms behind these processes.



MEET THE TEAM



Ariella Zadrina
Staff Writer

As a pharmacy student and future pharmacist, I believe it is a quintessential duty to educate ourselves on current media regarding the medical field and continuously adapt to the new ideas we may face as we enter the pharmacy profession. With topics from emerging diseases to scientific advances made, it is important to be accustomed to new ideas that pertain to our potential responsibilities as a pharmacist. As a Rho Chi Staff Writer, I hope to discuss matters that will inform not only pharmacy students but the St. John's community as a whole on topics that have to do with general health and scientific developments. With my interest in writing and the pharmacy field, I hope to touch upon subjects passionate to me that can benefit our community and inspire our readers to integrate themselves into the ever-growing profession of pharmacy.

MEET THE TEAM

Social Media & Outreach



Maliha Akter

Engagement & Outreach Manager

In my pursuit of becoming a knowledgeable and skilled pharmacist, I remain committed to staying informed about disease treatment and public-health policy. Being a part of Rho Chi Post provides an excellent platform for continuous education and knowledge-sharing with peers. Engaging with individuals from diverse backgrounds fosters critical viewpoints and discussions, all focused on enhancing patient-centered care. Additionally, the newsletter enables me to nurture my lifelong passion for writing while staying updated on the latest healthcare developments. As I embrace this transformative journey, I am dedicated to adapting, learning, and making a positive impact on patient well-being as a compassionate and competent pharmacist.

Bhojranie Brahmanand
Engagement & Outreach Manager

The Rho Chi Post uses its platform to spread knowledge of groundbreaking discoveries that are changing the standard of care for society. It delivers a creative and innovative scope of the pharmacy world. As a school of pharmacy, it is pivotal to become aware of healthcare matters. In turn, we can strengthen our understanding of the field and become more competent pharmacy practitioners. I am excited to be joining the team this year as a staff writer. I look forward to working alongside like-minded individuals in cultivating writing pieces that will share the importance of this profession.



Paulina Maczko

Engagement & Outreach Manager

As pharmacy students, I believe we have an obligation of staying informed on current healthcare topics, topics that the Rho Chi Post sheds light on.

To be part of such a team is an honor, as students are granted the opportunity of a creative outlet, whether that is by writing the articles or organizing the newsletter. As a copy editor, I look forward to seeing firsthand how students voice their opinions, thoughts, and academic learnings. I'm grateful to be part of a team that allows students to understand what they are capable of, and simultaneously advance their writing, comprehension, and communication skills.



MEET THE TEAM

Social Media & Outreach



Celestine Van Sertima
Engagement & Outreach Manager

When applying to the Rho Chi Post, I was initially fascinated by their goals of providing the highest quality of information to the St. John's community through a student operated newsletter that cultivates both student spirit and expansion of knowledge. Through my passion for writing and health care, combined with my experience in graphic designing, I look forward to what I can contribute to the Rho Chi Post.

MEET THE TEAM

Advisors



Dr. Ketan Patel
MPharm, PhD

It is an honor to serve as a faculty advisor of Beta Delta Chapter of a 100-year-old prestigious society of pharmaceutical professionals – The Rho Chi Society. With great enthusiasm, I am committed to assist the Rho Chi member's endeavors in: (1) disseminating the latest information/technology in healthcare system; (2) promoting pharmaceutical field & career propulsive networking of current students, alumni, and faculties; and (3) facilitating the scholastic activities and recognizing the scholars.

Dr. Joseph Etzel
BS Pharm, PharmD

Dr. Etzel served as the Rho Chi Post's interim faculty advisor for the 2022-2023 academic school year and continues to aid the Rho Chi Honor Society as we welcome in our new advisor. Dr. Etzel is not new to our organization, as he has previously served as the faculty advisor for the Rho Chi Honor Society. He has been a huge influence to the success of Rho Chi in the past, and we look forward to continue working with him!



Dr. Mohammad Rattu
PharmD, BCOP, BCPS, BCGP

I am thankful to have been the 2012 editor-in-chief of the Rho ChiPost newsletter, as well as on the 2019 alumni honor roll of the national Rho Chi organization. This is one of the most successful longitudinal projects at my alma mater, as evidenced by its decade-long persistence and teams of highly-motivated students. I remain available for professional support and assistance with the new year's initiatives.

The Rho Chi Society

Executive Board



Geraldine Ciaccio

President

The Rho Chi Society prides itself on fostering intellectual achievement and cultivating professional development. It provides opportunities for students, faculty, alumni, and colleagues to expand their knowledge of pharmacy practice. Through events, seminars, and fundraisers, Rho Chi allows pharmacy students to develop leadership skills that are vital to the profession. I have learned valuable lessons about pharmacy and myself from Rho Chi thus far, and I am honored to be able to give back to the organization. I am humbled to hold such a position and work with a dedicated executive board.

Javeria Amir

Vice President

The Rho Chi Society is an organization that contributes to the development of intellectual leaders in pharmacy. Through this, Rho Chi Society fosters collaboration and initiatives to advance learning in the field of pharmacy. Being part of this organization has allowed me to reach out for help when needed, and continuously improve my skills as a future pharmacist. To be a part of the executive board that will continue to uphold these initiatives is an honor and responsibility I take on with pride. Wishing all a wonderful and successful academic year ahead of us!



Anjali Rana

Secretary

Being a part of Rho Chi has provided me with invaluable opportunities for professional development, connection, and mentorship. The society's commitment to academic excellence and ethical pharmacy practice has inspired me to strive for continuous improvement in my studies and future career. Serving on this year's executive board, provides a sense of belonging among a supportive and inclusive community.

Giavanna Carr

Treasurer

The Rho Chi Honor Society encourages and recognizes intellectual achievements, stimulates critical inquiry in order to advance the future of pharmacy, provides its members with the ability to develop into intellectual leaders, promotes high ethical standards for its members, and fosters collaboration. Through being a member of Rho Chi, we are able not only to grow ourselves, but to help uplift our colleagues and allow them the chance to excel academically through the events we provide. Rho Chi has been a great influence on my studies during my time in this program and being given the opportunity to serve on the executive board allows me to become the influence for the younger students in our program. I'm inspired by every member of this years executive board and can't wait to see all we're able to accomplish together this year!



The Rho Chi Society

Executive Board



Christine Mauceri

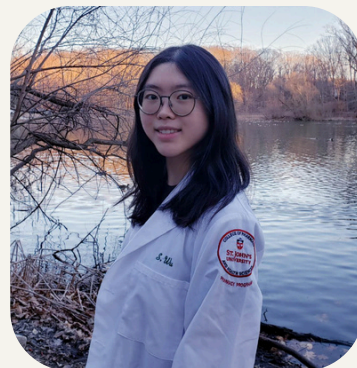
Historian

Rho Chi is an amazing organization that encourages leadership and support among its members. Not only does it offer a space where all pharmacy students can help each other academically, but the opportunities for networking and professional growth are endless. I am proud to be a part of an organization that has helped me immensely throughout my studies, and I am excited to give back to my pharmacy community!

Sammi Wu

Development and Outreach Coordinator

The Rho Chi Society is committed to the development of future pharmacists that excel in both areas of professional expertise and acts of service. It forms a community for pharmacy students to motivate each other's academic growth and provide support within a challenging degree program. It also keeps students informed on news related to breakthroughs in drug therapy and patient care. I am honored to accept my position on the executive board for this upcoming academic year and I hope to fulfill my duties so Rho Chi can continue to have its positive impact on the pharmacy profession!



Daya Biju

Academic Committee Chair

The Rho Chi Honor Society is a distinguished academic organization that recognizes excellence in pharmaceutical studies. It promotes ethical conduct, leadership, and research in pharmacy education. With chapters across the United States, Rho Chi fosters a sense of community and offers valuable networking and mentorship opportunities. Members actively engage in service projects to improve public health awareness. I am truly honored to serve this esteemed organization and embrace the opportunities it offers for personal and professional growth.



Angel Gao

Academic Committee Chair

Rho Chi fosters a community where students can collaborate with each other, upholding the core principles of service and professional development. Being a part of this supportive community is an honor, and I take pride in contributing to the culture of excellence that Rho Chi cultivates.

