Approved by the Regents
May 20, 2021

PROMOTION RECOMMENDATION
THE UNIVERSITY OF MICHIGAN
MEDICAL SCHOOL
DEPARTMENT OF INTERNAL MEDICINE

Krishna Rao, M.D., M.S., assistant professor of internal medicine, Department of Internal Medicine, Medical School, is recommended for promotion to associate professor of internal medicine, with tenure, Department of Internal Medicine, Medical School.

Academic Degrees:

M.S.	2015	University of Michigan
M.D.	2006	Rush Medical College
B.S.	2001	Northwestern University

Professional Record:

2015- present	Assistant Professor of Internal Medicine, University of Michigan
2013- 2015	Clinical Lecturer of Internal Medicine, University of Michigan
2010-2011	Clinical Lecturer of Internal Medicine, University of Michigan

Summary of Evaluation:

Teaching: Dr. has a deep commitment to teaching. While attending on the inpatient infectious diseases consult service, he supervises medical students, internal medicine residents and infectious diseases fellows. He employs standard methods of teaching, including traditional case-based bedside clinical instruction and formal didactic lectures, as well as non-traditional. He has found that trainees tend to skip the differential diagnosis and look immediately to a care plan; and he focuses the trainees' attention on the why before the what. Dr. Rao also advises on how to search literature for guidance on both the diagnosis and management of infections that they encounter. He has non-clinical trainees shadow him on both the wards and in the clinic as to better appreciate the context and potential impact of their research. He provides lectures on biostatics and clinical research to graduate students who directly work with him and those who rotate through his collaborators' labs. Dr. Rao participates in a monthly trainee-run symposium as a presenter, and has served as a lecturer and small group instructor for the medical students' travel medicine rotation. The role of research mentor is one that Dr. Rao values most. He has mentored numerous medical students, graduate students, fellows, house officers and faculty members with great success in accepted publications, grant funding and continued research in academia through faculty positions as well as in industry.

Research: Dr. Rao's primary scholarly focus is in the development of biomarker based predictive models for infections. His hope is that these models will assess which patients are at greater risk for infection earlier in the disease process, and it would allow physicians more treatment options as well as improve patient outcomes. His work is focused in three research domains: how the gut microbiome mediates the onset and course of infections, infection from multidrug resistant organisms, such as *Klebsiella pneumonia* and *Enterobacteriaceae* and the diagnosis and treatment of *Clostridioides difficile* infection. Dr. Rao's research has been assisted by fruitful collaborations with multidisciplinary teams along the way. One such collaboration was with Michael Bachman, M.D., Ph.D., who is both a pathologist and microbiologist. They worked to identify genetic risk factors for gut colonization leading to invasive *Klebsiella pneumoniae* infection in humans. Their work resulted in a publication that led to an NIH funded R01 to study host and microbial risk factors for invasive infections. Dr. Rao has published 50 peer-reviewed articles, and has continuous and robust

grant funding from the National Institutes of Health, the Agency for Health Research and Quality, and industry. He has been invited to present his research on 30 occasions, most notably on the subject of *Clostridium difficile*.

Recent and Significant Publications:

Dieterle MG, Putler RKB, Perry DA, Menon A, Abernathy-Close L, Perlman N, Penkevick A, Standke A, Keidan M, Vendrov K, Berfin IL, Young VB, Rao K: Systemic inflammatory mediators are effective biomarkers for predicting adverse outcomes in *Clostridioides difficule* infection. *mBio* 11(3), 20202.

Li BY, Oh J, Young VB, Rao K, Wiens J: Using machine learning and the electronic health record to predict complicated *Clostridium difficile* infection. *Open Forum Infect Dis* 6(5), 2019.

Ulrich RJ, Bott J, Imlay H, Lopez K, Cinti S, Rao K: *Clostridioides difficile* enteritis in patients following total colectomy- a rare but genuine clinical entity. *Open Forum Infect Dis* 6(11), 2018.

Martin RM, Cao J, Wu W, Zhao L, Manthei DM, Pirani A, Snitkin E, Malani PN, Rao K, Bachman MA: Identification of Pathogenicity-Associated Loci in *Klebsiella pneumoniae* from Hospitalized Patients. *mSystems* 3(3), 2018, 15-18.

Rao K, Santhosh K, Mogle JA, Higgins PDR, Young VB: Elevated Fecal Calprotectin Associated with Adverse Outcomes from *Clostridium difficile* Infection in Older Adults. *Infectious Diseases* 48(9):663-669, 2016.

Service: Dr. Rao is an active infectious diseases specialist who sees patients on the inpatient consult service as well as in the outpatient clinic. Through his patient oriented, translational research which is focused on *Clostridioides difficile* infection (CDI), Dr. Rao has developed broad expertise within this area. He co-founded the Fecal Microbiota Transplantation program at Michigan Medicine and remains the medical director, and in this role reviews every case of CDI which is referred to the ID clinics. Dr. Rao also serves as co-chair of the *Clostridium difficile* Guidelines Committee, a member of the Pharmaceuticals and Therapeutics Committee and Ex-Officio Committee Member for the Antimicrobial Stewardship Committee. Since 2016, Dr. Rao has been a co-Chair of the National Institutes of Health U01 Clinical Working Group. He serves on the American Society for Microbiology Microbe Program Committee and the Infectious Diseases Society of America Research Advisory Committee. His expertise in the field is recognized through his peer-reviewed service for top-tier journals such as *Open Forum Infectious Disease*, *JAMA*, and *Infection Control and Hospital Epidemiology.* He has established a national reputation as evidenced by his service as the editor for *mSphere* and he is an editorial advisory board member for *Open Forum Infectious Diseases*. In 2019, Dr. Rao served as an ad hoc study section member of the NIH Host Interactions with Bacterial Pathogens and as on the peer-reviewed Medical Research Program for the Department of Defense Congressionally Directed Medical Research Programs.

External Reviewers:

Reviewer A: "The most recent work from Dr. Rao's group is using innovation machine learning tools to uncover predictive features of CDI. In addition, he is contributing to our understanding of microbiome replacement, fecal microbiota transplant. These examples and numerous others have impacted treatment guidelines for the common and emerging disease. Although still a relatively 'junior' investigator, he is widely considered an international leader in the study of CDI."

Reviewer B: "Dr. Rao has published an impressive 47 peer reviewed manuscripts. Demonstrating the quality of his work, all of his publications are within what would be consider the top tier of journals for his areas of study. Dr. Rao's research has had a significant impact on our understanding of novel methods to predict which patients are most likely to develop CDI, and, among those who develop CDI, predict those at increased risk for adverse outcomes due to CDI."

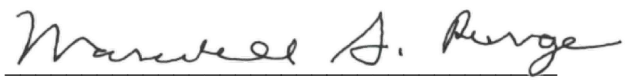
Reviewer C: "[Dr. Rao] is also building a strong presence in the broader scientific community as a member of the ASM Microbe Program committee and the IDSA Research Advisory Group, and he participated in study section meetings in 2019. In the past year, he has given three invited lectures nationally, including at the Fred Hutchinson Cancer Research Center's biennial Symposium on Infectious Diseases in the Immunocompromised Host."

Reviewer D: "His research centers on *Clostridioides difficile*, an important bacterial pathogen. He has recently been awarded an R01 to evaluate date driven interventions to reduce the incidence of *C. difficile*…He has delivered 28 invited extramural presentations and seven seminars, and published 47 peer reviewed journal articles, mostly centered on *C. difficile*…In my opinion, Dr. Rao would meet criteria for promotion to associate professor at [my institution]."

Reviewer E: "One of the most notable papers published by Dr. Rao as senior author is "*Systemic inflammatory mediators are effective biomarkers for predicting adverse outcomes in Clostridiodes difficile infection*" published in mBio earlier this year (MBio 11(3).PMID:32371595). In this tour de force report Dr. Rao used standard clinical measures and predictors of severity along with a panel of inflammatory biomarkers, in part validated in the mouse model of *C.difficile* infection. It is notable that the area under the curve for predicting severe outcome was 90% which is that best that we have."

Summary of Recommendation:
Dr. Rao is an exceptional clinician scientist who is making broad strides in the understanding of *C. difficile*. He is valued faculty member with strength in teaching, mentorship and research endeavors. I am pleased to recommend Krishna Rao, M.D., M.S. for promotion to associate professor of internal medicine, with tenure, Department of Internal Medicine, Medical School.

Recommended by:



Marschall S. Runge, M.D., Ph.D.
Executive Vice President for Medical Affairs
Dean, Medical School

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