BIOGRAPHICAL SKETCH

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NAME: Gennaro, Maria Laura

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POSITION TITLE: Professor of Medicine Professor of Medicine

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
London School Hygiene Tropical Medicine	M.Sc.	06/1981	Medical Microbiology
University of Palermo Medical School, Italy	M.D.	07/1977	Medicine

A. Personal Statement

My programs have integrated fundamental, translational, and clinical approaches to studies on host-pathogen interactions. Since the mid-90s, I have conducted tuberculosis research. I have led biomarker discovery projects funded by the NIH and through the Bill and Melinda Gates Foundation leading to numerous publications, including a seminal publication in *PNAS* in 2010 that defines the sero-proteome of *Mycobacterium tuberculosis*, and multiple grants, including two R01s on the use of RNA flow cytometry to study antigen-specific T cell activation in latent and active tuberculosis. One of these R01s was an academia-industry partnership grant to establish a new diagnostic platform, which was published in *Nature Protocols* in 2017. My work with M. tuberculosis proteins also led to seven patents for proteins and genes useful as vaccines and diagnostic reagents for *M. tuberculosis* that have generated $10M in licensing income, and I was awarded the Thomas Alva Edison Patent Award in 2009.

Throughout my career I spearheaded and contributed to multidisciplinary research. I have been the PI of a systems biology program studying latency in tuberculosis in collaboration with physicists and mathematical modelers. Work initiated in that program and continued in a subsequent R01 investigated the dysregulation of lipid metabolism of macrophages during tuberculosis and its links to inflammation and disease outcome. With this work, my laboratory established a new paradigm in foam cell biology, showing that biogenesis of foam cells occurs through disease-specific mechanisms, and not just by the mechanisms discovered in atherosclerosis research. This realization is important well beyond tuberculosis biology and has opened research directions both in the area of tuberculosis treatment and foam cell biology in other infectious and non-infectious diseases. Since the start of the COVID-19 pandemic, I have participated in a leadership role in establishing a longitudinal healthcare worker cohort and conducting the serological component of the study. In addition, I have collaborated with pulmonologists, critical care physicians, pediatricians, epidemiologists, hematologists, clinical trialists, and various basic scientists across the two Rutgers medical schools and two teaching hospitals affiliated with Rutgers. I am MPI on one of eight PreVAIL sites funded by NICHD to study manifestations of pediatric SARS-CoV-2 infection and a site PI on the CLOCK pediatric consortium that has been selected for the Phase II of the NIH RECOVER initiative on post-acute sequelae of COVID-19. I also serve as Inaugural Chair of the Microbiology Committee, one of six Pathobiology Multi-Disciplinary Task Force Committees coordinated by the RECOVER Clinical Science Core.

COVID-19 publications
Coauthor:

Radbel J. *et al. J Mol Diagn.* 2020, 22:871-875. doi: 10.1016/j.jmoldx.2020.04.209. PMID: 32405270
Barrett E.S. *et al. BMC Infect. Dis.* 2020, 20:853. doi: 10.1186/s12879-020-05587-2. PMID: 33198725
Barrett E.S. *et al. Open Forum Infect Dis* 2020 2020, 7:ofaa534. doi: 10.1093/ofid/ofaa534. PMID: 33403219
Staquicini D.I. *et al* bioRxix 2021.03.15.435496. doi.org/10.1101/2021.03.15.435496
Horton D., Barrett E.S. *et al J Infect Dis*. 2021 Aug 13:jiab411. doi: 10.1093/infdis/jiab411. PMID: 34387310

Senior author:
Raymond H.F. *et al* J Racial Ethn Health Disparities. 2021 Nov 8:1-8. doi: 10.1007/s40615-021-01175-5.
Mishra P.K., Bruiners N. *et al* medRxiv https://doi.org/10.1101/2021.04.11.21255153
Datta P., Ukey R. *et al J Immunol Methods*. 2021 Dec;499:113165. doi: 10.1016/j.jim.2021.113165.
Ukey, R., Bruiners N. *et al BMC Medicine*, 2022 20:32 doi: 10.1186/s12916-022-02252-0
Bruiners N. *et al* (submitted for publication)

Ongoing Research Support

R01 HL149450 Gennaro (PI) 08/01/2019-06/30/2023
NIH/NHLBI
Foam cells as drug targets in tuberculosis
The goal of this program is to discover druggable targets in macrophage metabolic pathways involved in the development of foam cells-lipid-laden macrophages that are a hallmark of human tuberculosis lesions.
Role: PI

UL1 TR003017 Panettieri (PI) 03/11/2019-02/29/2024
NIH/NCATS
New Jersey Alliance for Clinical and Translational Science: NJ ACTS
Our CTSA Hub focuses on two overarching themes: the heterogeneity of disease pathogenesis and response to treatment, and the value of linking large clinical databases with interventional clinical investigations to identify cause-and-effect and predict therapeutic responses. The biomarkers core will investigate biomarkers of progression to disease (tuberculosis) and exacerbation (asthma) by RNA flow cytometry.
Role: Core Lead, Biomarkers

U01AI122285-S1 Blaser (PI) 06/1/2020-05/31/2021
NIH/NIAID
Microbial, immune, metabolic perturbations by antibiotics (MIME study)
We will establish a prospective cohort of healthcare workers in a large university-based health system in north and central New Jersey to assess the prevalence and incidence of SARS-CoV-2 infection. We will determine risk factors for infection and for severe illness, and risks for transmission to and from these healthcare workers.
Role: Co-Investigator

R01HL149450-S1 Gennaro (PI) 08/15/2020-07/31/2021
NIH/NHLBI
E*ffects of donor plasma and recipient characteristics on convalescent plasma treatment outcome of COVID-19.*
The goal of this project is correlate the clinical outcome of convalescent plasma treatment of COVID-19 with the properties of the donor plasma.
Role: PI

R61HD105619 Gennaro (MPI) 11/01/2020-10/31/2024
NIH/NICHD
COVID-19 Network of Networks Expanding Clinical and Translational approaches to Predict Severe Illness in Children (CONNECT to Predict SIck Children)
Develops models and biomarkers that predict risk for severe disease in children and adolescents by systematically integrating social science, epidemiological, genetic, biochemical, immunological, and computational approaches.
Role: MPI (Contact PI - Kleinman)

RECOVER Phase II Kleinman (PI) 08/01/2021-07/31/2025
CLOCK Consortium for PASC Phase II RECOVER Pediatric Cohort
The goal of the phase II of the NIH RECOVER initiative is to enroll 6,000 children for the study of post-acute sequelae of COVID-19. Our consortium, of which Rutgers University is the primary site, is tasked with the enrollment of 2,400 of these children.
Role: Site PI

R01AI158911 Gennaro (MPI) 09/01/2021-08/31/2024
NIH/NIAID
Cohort and biomarkers for COVID-19 severity, natural history, and reinfection
The goal of this study is to follow-up well-characterized cohorts enrolled in March-April 2020 to monitor the evolution of SARS-CoV-2 infection and its sequelae in a rapidly evolving situation, including vaccination and emergence of virus variants.

09/01/2021 – 08/31/2024
Role: MPI (Contact PI – Blaser)

R01AG053961-S2 Gluck (PI) 04/01/2021-03/31/2022
NIH/NIA
Cognitive, Neural and Immunological Consequences of COVID-19 in Older African Americans and How They Relate to Risk for Alzheimer's Disease
To investigate the cognitive, neural, and immunological consequences of COVID-19 in older African Americans and how they relate to risk for Alzheimer's disease.
Role: Co-Investigator

Danisco Horton (PI) 01/27/2021-01/26/2022
Live Microbials to Boost Anti-SARS-CoV-2 Immunity Clinical Trial (Live BASIC Trial)
This pilot randomized controlled trial will test the preliminary efficacy and tolerability of a combination of probiotics given to boost the immunity of unvaccinated persons with prior confirmed SARS-CoV-2 infection.
Role: Co-Investigator

B. Positions, Scientific Appointments, and Honors

Positions and Employment

1977	Clinical Internship and Medical Board Exam Certification
1978-1980	Postdoctoral Fellow, Istituto Superiore Sanita', Roma, Italy
1980-1981	M. Sc. Student, Dept. of Microbiology, London School of Hygiene and Tropical Medicine, University of London, UK
1981-1982	Visiting Scientist, Molecular Genetics Laboratory, Centre for Applied Microbiology and Research, Public Health Laboratory Service, Porton Down, Salisbury, UK
1980-1986	Assistant Member, Laboratory of Bacteriology, Istituto Superiore Sanita', Roma, Italy
1984-1988	Associate, Department of Plasmid Biology, Public Health Research Institute, New York, NY
1989-1996	Assistant Member, Public Health Research Institute, New York, NY, and Adjunct Assistant Professor, Department of Microbiology and Sackler Institute of Graduate Biomedical Sciences, New York University Medical Center, New York, NY
1996-2007	Associate Member, Public Health Research Institute, New York, NY
1996-2011	Adjunct Associate Professor, Department of Microbiology and Sackler Institute of Graduate Biomedical Sciences, New York University Medical Center, New York, NY
2004-2011	Associate Professor of Medicine, New Jersey Medical School, UMDNJ, Newark, NJ
2007-present	Member, Graduate School of Biomedical Sciences, Rutgers, The State University of New Jersey
2011-present	Professor of Medicine, New Jersey Medical School, Rutgers, The State University of New Jersey
2017-2018	Associate Director, PHRI, NJMS, Rutgers, The State University of New Jersey
2018-2020	Director (interim), PHRI, NJMS, Rutgers, The State University of New Jersey
2020-present	Professor of Epidemiology, School of Public Health, Rutgers, The State University of New Jersey
2020-present	Full Member, Cancer Metabolism and Growth Program, Rutgers Cancer Institute of New Jersey

Awards and Honors

1977	M.D. Magna cum Laude
1978 - 1980	Postdoctoral Fellowships awarded by Istituto Superiore Sanita', Roma, Italy
2020	Inaugural Chancellor Distinguished Biomedical Researcher Award

Other Experience and Professional Membership

Reviewer:	more than 30 journals NSF: Prokaryotic Genetics and Biochemical Genetics Programs, International Programs NIH: ad-hoc (multiple cycles): NIGMS-MARC; BM1; ZA1 GB-I; CRSF; IDM-M; IDM-R; IDM-A; Indo-US Program; BACP; U-19 TBRU; IDIB-S02M. Standing member: BACP 2014 – 2018. Others: WHO (TBDI); Dept. Veterans Affairs; AIDS Research Program (Italy); Wellcome Trust (UK), Medical Research Council (UK)
Member:	American Society Microbiology, American Association Advancement of Science, New York Academy of Sciences
Advisor:	World Health Organization TB Diagnostics Initiative
Member:	New Diagnostics Working Group -- Biomarker Task Force, Stop TB Partnership
Director:	Minority High School Student Research Apprentice Program (NIH) (1992-1997)
Member:	Board of Directors, Public Health Research Institute, New York, NY (1995-1997), Rutgers

Global Health Institute Executive Committee (2018-present), NJ ACTS Advisory Board (2020), Rutgers Corona Cohort Leadership Committee (2020), Center for COVID Response and Pandemic Preparedness (CCRP2) Scientific Advisory Board (2020).

C. Contributions to Science

1. My early publications were related to epidemiological studies of infections by *Enterobacteriaceae* and other bacteria that cause diarrheal diseases. I authored the first report on the cloning and nucleotide sequencing of the enterotoxin genes of *Vibrio cholerae*, the causative agent of cholera. This information was considered critical to the development of new cholera vaccines. When I joined the laboratory of Richard Novick, a member of the US Academy of Sciences, my interest shifted to the study of DNA replication in small, multi-copy plasmids of *Staphylococcus aureus*. I discovered two novel genetic elements on the multicopy plasmid pT181 – *cmp*, a cis-acting replication enhancer, and *pre*, a site-specific recombinase. I also contributed to the characterization of the plasmid's origin of replication.
   a. **Gennaro M.L.** and Novick R.P. cmp, a cis-acting plasmid locus that increases the interaction between replication origin and initiator protein. Journal of Bacteriology.168, 160-166. (1986)
   b. **Gennaro M.L.**, Kornblum J. and Novick R.P. A site-specific recombination function in S. aureus plasmids. Journal of Bacteriology. 169, 2601-2610. (1987)
   c. **Gennaro M.L.** and Novick R.P. An enhancer of DNA replication. Journal of Bacteriology 170, 5709-5717. (1988)
   d. **Gennaro M.L.**, Iordanescu S., Novick R.P., Murray R.W., Steck T.R. and Khan S.K. Functional organization of the plasmid pT181 replication origin. Journal of Bacteriology 205, 355-362. (1989)
2. When I established my own laboratory, I first continued the characterization of the replication enhancer *cmp* and of chromosomally encoded proteins that bound to it. At the time, the discovery of a replication enhancer established a new paradigm in biology.
   a. **Gennaro M.L.** Genetic evidence for replication enhancement from a distance. Proceedings of the National Academy of Science USA 90, 5529-5533. (1993)
   b. Henriquez V., Milisavljevic V., Kahn J.D. and **Gennaro M.L.** Sequence and structure of cmp, the replication enhancer of the Staphylococcus aureus plasmid pT181. Gene 134, 93-98. (1993)
   c. Colombo D., Iordanescu S. and **Gennaro M.L.** Replication enhancer requirement for recognition of heterologous replication origin by an initiator protein. Plasmid 33, 232-234. (1995)
   d. Zhang Q, Soares de Oliveira S., Colangeli R. and **Gennaro M.L.** Binding of a novel host factor to the pT181 plasmid replication enhancer. Journal of Bacteriology. 179, 684-688. (1997)
3. In the mid-eighties, tuberculosis became rampant in New York City, prompting new interest in research on this global disease. I started working on immunological markers of tuberculosis disease. Work from my laboratory led to the realization that tuberculosis is associated with a diverse antibody repertoire, to identifying novel serodominant antigens of *M. tuberculosis*, to devising dedicated rapid serology methods, and eventually to characterizing the entire seroreactive immunoproteome of *M. tuberculosis* using high-throughput methods and systems biology data analyses. My work in biomarker research has also contributed the development of RNA flow cytometry, a novel method that achieves high-throughput measurement of single-cell gene expression by combining in-situ nucleic acid hybridization with flow cytometry. I also recently contributed to a multidisciplinary study leading to the isolation and characterization of human monoclonal antibodies against mycobacterial lipoarabinomannan.
   a. Lyashchenko K., Colangeli R., Houde M., Al Jahdali H., Menzies D. and **Gennaro M.L.** Heterogeneous antibody responses in tuberculosis. Infection and Immunity 66, 3936-3940. (1998)
   b. Kunnath-Velayudhan S., Salamon H., Wang H.-Y., Davidow A.L., Molina D.M., Huyn V.T., Cirillo D.M., Michel G., Elizabeth A. Talbot E.A., Mark D. Perkins M.D., Philip L. Felgner P.L., Liang X., **Gennaro M.L.** Dynamic antibody responses to the Mycobacterium tuberculosis proteome. Proceedings of the National Academy of Sciences USA 107:14703-14708. (2010)
   c. Kunnath-Velayudhan S., Davidow A.L., Wang H.-Y., Molina D.M., Huynh V.T., Salamon H., Pine R., Michel G., Perkins M.D., Liang X., Felgner P.L., Flynn J.L., Catanzaro A., and **Gennaro M.L.** Proteome-scale antibody responses and outcome of Mycobacterium tuberculosis infection in non-human primates and in tuberculosis patients. Journal of Infectious Diseases 206:697-705. (2012)
   d. Arrigucci R., Bushkin Y., Radford F., Lakehal K., Vir P., Pine R., Martin D., Sugarman J., Zhao Y., Yap G.S., Lardizabal A.A., Tyagi S., **Gennaro M.L.** FISH-Flow, a protocol for the concurrent detection of mRNA and protein in single cells using fluorescence in situ hybridization and flow cytometry. Nat Protoc. 12:1245-1260. doi: 10.1038/nprot.2017.039. (2017) Epub 2017 May 18.

4. To understand how the pathogen withstands host insult, my laboratory has used in vitro and animal models to study stress responses of *M. tuberculosis*. We reported key aspects of the transcriptional remodeling of *M. tuberculosis* that occurs during mouse lung infection, including changes in mycobacterial central metabolism and respiratory pathways. These observations contribute to the identification of targets for antibacterial compounds. We recently reported a novel envelope stress response system in *M. tuberculosis* that was previously found in Gram-negative bacteria. The work provided a novel example of convergent evolution of critical bacterial stress response mechanisms. Moreover, we reconstructed the full network of regulatory interactions among *M. tuberculosis* sigma factors, proteins that drive transcriptional remodeling under stress conditions. This work uncovered regulatory network dynamics that underlie mycobacterial metabolic reprogramming during stress.
    a. Shi L., Jung Y.-J., Tyagi S., **Gennaro M.L.***, and North R. Expression of Th1-mediated immunity in mouse lung induces a Mycobacterium tuberculosis transcription pattern characteristic of nonreplicating persistence. Proceedings of the National Academy of Sciences USA 100, 241-246. (2003) (*Corresponding author)
    b. Shi L., Sohaskey C.D., Kana B.D., Dawes S., North R.J., Mizrahi V. and **Gennaro M.L.** Changes in energy metabolism in Mycobacterium tuberculosis in mouse lung and under in vitro conditions affecting aerobic respiration. Proceedings of the National Academy of Sciences USA 102:15629-34. (2005)
    c. Datta P., Ravi J., Guerrini V., Chauhan R., Neiditch M.B., Shell S.S., Fortune S.M., Hancioglu B., Igoshin O., **Gennaro M.L.** The Psp system of Mycobacterium tuberculosis integrates envelope stress sensing and envelope preserving functions. Molecular Microbiology 97:408-422. (2015)
    d. Manganelli, R. and **Gennaro M.L.** Protecting from Envelope Stress: Variations on the Phage-Shock-Protein Theme. Trends Microbiol. 2016 PMID: 27865622 DOI: 10.1016/j.tim.2016.10.001
5. We have also studied the dysregulation of macrophage lipid metabolism in *M. tuberculosis* infection, which is central to the formation of the tuberculosis granuloma (the hallmark lung lesion). We demonstrated that the antibacterial action of vitamin D is explained by a novel anti-lipogenic effect, in addition to the known induction of host antibacterial peptides. We also found that macrophages and other immune cells in lesions of the murine tuberculous lung undergo reprogramming of central metabolism, similar to that found in cancer cells (Warburg effect). Moreover, our discovery that the lipid-lowering statins have antimycobacterial effects when used to treat infected cells has led to discovering an adjunctive effect of statins in anti-tuberculosis therapy and the underlying mechanism, and opened the way to an NIH-funded clinical trial in South Africa. Thus, our work has been contributing to the burgeoning field of host-directed tuberculosis therapy. Our recent characterization of tuberculous foam cells (lipid-laden macrophages) breaks new ground in foam cell research by revealing that foam cell biogenesis in tuberculosis occurs differently from the atherogenic foam cell formation, which has been the paradigm for foam cell biology. We have recently commented on foam cell biogenesis in EVALI (vaping-associated lung injury) in *Lancet Resp Dis*.
    a. Salamon H., Bruiners N., Lakehal K., Shi L., Ravi J., Yamaguchi K.D., Pine R., and **Gennaro M.L.** Cutting Edge: Vitamin D regulates lipid metabolism in Mycobacterium tuberculosis infection. Journal of Immunology 193:30-34. (2014)
    b. Guerrini V., Prideaux B., Blanc L., Bruiners N., Arrigucci R., Singh S., Ho-Liang H.P., Salamon H., Chen P.Y., Lakehal K., Subbian S., O'Brien P., Via L.E., Barry C.E. 3rd, Dartois V., **Gennaro M.L**. Storage lipid studies in tuberculosis reveal that foam cell biogenesis is disease-specific. PLoS Pathog. **14**:e1007223 (2018) doi: 10.1371/journal.ppat.1007223. eCollection 2018 Aug.
    c. Guerrini V. and **Gennaro M.L.** Foam cells: one size doesn't fit all. Trends Immunol. (2019) Dec;40(12):1163-1179. doi: 10.1016/j.it.2019.10.002. Epub 2019 Nov 12.
    d. Bruiners N., Dutta N.K., Guerrini V., Salamon H., Yamaguchi K.D., Karakousis P.C., **Gennaro M.L.** The anti-tubercular activity of simvastatin is mediated by cholesterol-dependent regulation of autophagy via the AMPK-mTORC1-TFEB axis. J. Lipid Res. 2020 Aug 26;jlr.RA120000895. doi: 10.1194/jlr.RA120000895.

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/myncbi/maria.gennaro.1/bibliography/public/