NICOLE D. MUSZYNSKI

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539A Hamilton Ave
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Multidisciplinary engineer. Experience working with Defense Advanced Research Projects Agency (DARPA), Department of Defense. Clinical research experience, measuring electromagnetic fields of the gastrointestinal system for disease characterization. Strong background in writing and verbalizing science effectively. Demonstrated technical skills and project leadership across several science and engineering fields.

EDUCATION

PhD Vanderbilt University, Biomedical Engineering (3.7) Aug 2019 – May 2023
Committee: John P. Wikswo (chair), L. Alan Bradshaw, Cynthia Reinhart-King
Richard Caprioli, Fredrick Haselton, Sari Acra MD

BS Lipscomb University, Molecular Biology (3.2) Aug 2008 – May 2012
Minors: Psychology and Chemistry

HONORS AND AWARDS

Young Investigator Award, American Gastroenterological Association 2016
"*High-density electrogastrogram identifies spatial dysrhythmias in adolescent patients with chronic idiopathic nausea: a preliminary study"*

Benjamin Franklin Fellowship (declined) 2016
US Department of State, Washington DC

Robert Stern Award, International Gastrointestinal Electrophysiology Society 2015
"Experimental Recording and Analysis of Mucosal and Serosal Slow Wave Activity in Porcine Colon"

98th Percentile, American Chemical Society 2010
National Organic Chemistry Exam

RESEARCH EXPERIENCE

Project 1: Gastrointestinal SQUID Technologies Laboratory May 2011 - Present
Biomedical Engineer, Research Scientist, Clinical Research Coordinator
Advisor: L. Alan Bradshaw, Vanderbilt University Medical Center

- Clinical Research in neonates, children, and adults
- Participated in the design and execution of bio-electro-magnetic methods as a noninvasive clinical screening tool for improving the care of patients suffering from gastrointestinal (GI) disorders
- Installed, tested, and calibrated various biomedical equipment, including a superconducting quantum interference device (SQUID) and helium cryocooler
- Developed digital signal processing methods to detect and classify GI electrical propagation patterns for diagnosing gastric dysrhythmias
- Utilized mathematical modeling of gastrointestinal electrophysiology to validate gastric dysrhythmias
- Wrote MATLAB code to analyze gastric dysrhythmias in LabView
- Negotiated institutional-wide helium contact

Project 2: DARPA Rapid Threat Assessment for ChemBio Warfare Defense June 2014 – April 2021
Engineering Team Lead, Biomedical Engineer, Research Scientist
Advisor: John P. Wikswo, Richard Caprioli, Vanderbilt University

- Developed a system for rapidly heating and/or cooling cells+toxin to achieve metabolic cessation
- Fabricated a microfluidic system for rapidly mixing and exposing cells to toxin in the seconds to milliseconds range

- Validated microfluidic system using mathematical and computational modeling
- Built analytics reports using data extracted from fabricated systems to report to DARPA monthly
- Strategized timeline of goals and tactics to reach DARPA's annual milestones

Project 3: Organ-on-a-Chip Dec 2018 – Present
Biomedical Engineer, Research Scientist
Advisor: John P. Wikswo, Vanderbilt University

- Currently developing openable gut-on-a-chip for multi-omic analyses of host-pathogen interactions
- Utilizing human-derived intestinal stem cells from tissue explants
- Developed standard operating procedures for microfluidic platform

TEACHING EXPERIENCE

Scientist in the Classroom Partnership July 2021 - May 2022
Collaboration with NIH and Metro Nashville Public Schools K-12

PATENTS

1. Caprioli, Richard, John Wikswo, John McLean, Eric Skaar, Jeremy L. Norris, Dana Borden Lacy, Stacy Sherrod, James Pino, Danielle Gutierrez, Nicole D. Muszynski, Melissa Farrow. 2020. "High-throughput, multi-omics approach to determine and validate de novo global mechanisms of action for drugs and toxins." United States US10607721B2, filed September 22, 2016, and issued March 31, 2020. https://patents.google.com/patent/US10607721B2/en.

PEER-REVIEWED PUBLICATIONS

1. Pino J, Harris A, Lubbock A, Gutierrez D, Farrow M, Muszynski N, et al. "Extracting biological knowledge from multi-omics data sets by combining network and enrichment analyses with multiple signaling databases." In preparation.

2. J. D. Olson, S. Somarajan, N. D. Muszynski, A. C. Russell, L. S. Walker, S. A. Acra, and L. A. Bradshaw, "Automated machine learning pipeline approach for classification of pediatric chronic nausea using high resolution electrogastrogram," *IEEE Transactions on Biomedical Engineering*. In review, 2021.

3. Pino, James C., Alexander L. R. Lubbock, Leonard A. Harris, Danielle B. Gutierrez, Melissa A. Farrow, Nicole Muszynski, Tina Tsui, et al. 2020. "A Computational Framework to Explore Cellular Response Mechanisms from Multi-Omics Datasets." BioRxiv, March, 2020.03.02.974121.

4. S. Somarajan, N. D. Muszynski, J. D. Olson, A. Comstock, A. C. Russell, L. S. Walker, S. A. Acra, and L. A. Bradshaw, "The effect of chronic nausea on gastric slow wave spatiotemporal dynamics in children," *Neurogastroenterology and Motility*, Nov 20, 2020.

5. S. Somarajan, N. D. Muszynski, J. D. Olson, A. Comstock, A. C. Russell, L. S. Walker, S. A. Acra, and L. A. Bradshaw, "Response to "retrograde slow wave activation: A missing link in gastric dysfunction?"," *Neurogastroenterology and Motility*, vol. 33, no. 4, Apr, 2021

6. S. Somarajan, N. D. Muszynski, D. Hawrami, J. D. Olson, L. K. Cheng, and L. A. Bradshaw, "Noninvasive Magnetogastrography Detects Erythromycin-Induced Effects on the Gastric Slow Wave," *Ieee Transactions on Biomedical Engineering*, vol. 66, no. 2, pp. 327-334, Feb, 2019.

7. S. Somarajan, N. D. Muszynski, J. D. Olson, L. A. Bradshaw, and W. O. Richards, "Magnetoenterography for the Detection of Partial Mesenteric Ischemia," *Journal of Surgical Research*, vol. 239, pp. 31-37, Jul, 2019.

8. Norris, Jeremy L., Melissa A. Farrow, Danielle B. Gutierrez, Lauren D. Palmer, Nicole Muszynski, Stacy D. Sherrod, James C. Pino, et al. 2017. "Integrated, High-Throughput, Multiomics Platform Enables Data-

Driven Construction of Cellular Responses and Reveals Global Drug Mechanisms of Action." *Journal of Proteome Research* 16 (3): 1364–75.

9. Somarajan S, Muszynski ND, Cheng LK, Bradshaw LA, Naslund TC, and Richards WO. "Noninvasive biomagnetic detection of intestinal slow wave dysrhythmias in chronic mesenteric ischemia". *Am J Physiol-Gastr L* 309: G52-G58, 2015.

10. Somarajan S, Muszynski ND, Obioha C, Richards WO, and Bradshaw LA. "Biomagnetic and bioelectric detection of gastric slow wave activity in normal human subjects-a correlation study." *Physiol Meas* 33: 1171-1179, 2012.

ABSTRACT PUBLICATIONS

1. S. Somarajan, N. D. Muszynski, A. S. Monk, J. D. Olson, A. Russell, S. Acra, L. A. Bradshaw, and H. Weitkamp, "Noninvasive Measurement of Small Bowel Slow Wave Activity in Neonates - a Pilot Study," *Gastroenterology*, vol. 158, no. 6, pp. S364-S364, May, 2020.

2. S. Somarajan, N. D. Muszynski, J. D. Olson, A. C. Russell, S. A. Acra, and L. A. Bradshaw, "Multichannel electrogastrography distinguishes gastric slow wave spatiotemporal parameter differences in pediatric chronic nausea," *Neurogastroenterology and Motility*, vol. 31, Aug, 2019.

3. Somarajan S, Muszynski ND, Russell A, Gorman BL, Acra S, Cheng LK, and Bradshaw LA. High-Density Electrogastrogram Identifies Spatial Dysrhythmias in Adolescent Patients With Chronic Idiopathic Nausea: A Preliminary Study. *Gastroenterology* 150: S356, 2016.

4. Muszynski ND, Paskaranandavadivel N, Togrye CT, Somarajan S, Williams P, Bradshaw LA, and Cheng LK. Spatiotemporal and Morphological Differences in Serosal and Mucosal Electrical Recording of Porcine Colonic Slow Wave. *Gastroenterology* 150: S350-S351, 2016.

5. Somarajan S, Muszynski ND, Richards WO, Cheng LK, and Bradshaw LA. Noninvasive Biomagnetic Assessment of the Effects of Erythromycin on the Gastric Slow Wave. *Gastroenterology* 148: S511-S511, 2015.

6. Muszynski ND, Somarajan S, Richards WO, and Bradshaw LA. Noninvasive Measurement of Gastric Slow Wave Dysrhythmia in Porcine. *Gastroenterology* 146: S616-S616, 2014.

7. Muszynski ND, Somarajan S, Richards WO, and Bradshaw LA. Cholecystokinin Alters Serosal EMG but Not MGG in Porcine Subjects. *Gastroenterology* 146: S616-S616, 2014.

PRESENTATIONS AND INVITED LECTURES

1. "Knowledge Graphs for COVID-19 Long Hauler and Other Post-Infection Syndromes: Contemporary Challenges in Systems Biology and Regulatory Plasticity."
   Guest Lecture, Institute for Systems Biology, May 18, **2021**
   John Wikswo and **Nicole Muszynski**

2. "COVID-19 Long Hauler and Other Post-Infection Syndromes as Problems in Systems Biology and Regulatory Plasticity."
   Guest Lecture, MIT Lincoln Laboratory, May 10, **2021**
   John Wikswo and **Nicole Muszynski**

3. "COVID-19 Long Hauler and Other Post-Infection Syndromes as Problems in Systems Biology and Regulatory Plasticity."
   Guest Lecture, Bioscience Division, Los Alamos National Laboratory, May 4, **2021**
   John Wikswo and **Nicole Muszynski**

4. "COVID-19 Long Hauler and Other Post-Infection Syndromes as Problems in Systems Biology and Regulatory Plasticity."
   DTRA DOMANE Long Hauler Syndrome / Long COVID **Workshop**, April 13, **2021**
   John Wikswo and **Nicole Muszynski**

5. "Noninvasive measurement of small bowel slow wave activity in neonates – a pilot study."
   Somarajan, **Muszynski**, Caillet, Russell, Bradshaw, Acra, Weitkamp
   Poster Presentation - American Gastroenterological Association - **2020**

6. "Bridging the Gap Between Organs-on-Chips and Multi-Omic Analysis for In Vitro Investigation of Incapacitating Agents and Medical Countermeasures."
   Wikswo (presenting), Norris, Farrow, Gutierrez, **Muszynski**, Sherrod, Lacy, McLean, Skaar, Caprioli
   Chemical and Biological Defense Science & Technology (CBD S&T) **Conference Speaker**
   Cincinnati, OH, November 18-21, **2019**

7. "Distinguishing spatiotemporal functional abnormalities in pediatric chronic nausea using high density electrogastrography."
   Muszynski et al. – **Conference Speaker**
   Biomedical Engineering Society Annual Conference. Philadelphia, PA, October **2019**

8. "Bridging the gap between multi-omic network analysis and Organ-in-a-Puck to elucidate the comprehensive mechanisms of host-pathogen interactions."
   Muszynski et al. – **Poster Presentation**
   Biomedical Engineering Society Annual Conference. Philadelphia, PA, October **2019**

9. "Multichannel electrogastrography distinguishes gastric slow wave spatiotemporal parameter differences in pediatric chronic nausea."
   Muszynski, Somarajan, Russell, Acra, Bradshaw – **Poster Presentation**
   American Neurogastroenterology and Motility Annual Conference. Chicago, IL, August **2019**

10. "The convergence of multi-omic network analysis and Gut-on-a-Chip to elucidate the comprehensive mechanisms of incapacitating agents."
    Muszynski, Farrow, et al. – **Invited Speaker**
    Epimilitaris: International Bioterrorism Conference. Ryn, Poland, April **2019**

11. "The convergence of multi-omic network analysis and Gut-on-a-Chip to elucidate the comprehensive mechanisms of incapacitating agents."
    Muszynski, Farrow, et al. – **Invited Speaker**
    Military Institute of Technology. Warsaw, Poland, April **2019**

12. "Openable Organ-in-a-Puck and Multi-Omics for In Vitro Investigation of Host-Pathogen Interactions in the Gut and Brain."
    Wikswo, **Muszynski**, Farrow, Gutierrez, Sherrod – **Invited Speakers**
    DTRA Tech Watch Seminar, Fort Belvoir, Springfield, VA, USA. July **2018**

13. "Rapid Threat Assessment: to detect, identify, and characterize the effects of chemical and biological warfare agents."
    Muszynski, Farrow – **Poster Presentation**
    American Society for Microbiology. Biothreats Conference, Washington DC, USA. February **2017**

14. "Rapid Threat Assessment: Bridging the gap between multi-omic network analysis and biological mechanism of action of drugs and toxins."
    Muszynski et al. – **Invited Speaker**
    Gordon Research Conference: Drug Safety. Easton, MA, June **2016**

15. "Rapid Threat Assessment: Bridging the gap between multi-omic network analysis and biological mechanism of action of drugs and toxins."
    Muszynski et al. – **Poster Presentation**
    Gordon Research Seminar: Drug Safety. Easton, MA, June **2016**

16. "Data-driven construction of global drug mechanisms enabled by an integrated high-throughput multi-omics platform."
    Norris (presenting), Farrow, Gutierrez, **Muszynski**, et al. – **Invited Speaker**
    64th American Society of Mass Spectrometry, San Antonio, Texas, June **2016**

17. "High-density electrogastrogram identifies spatial dysrhythmias in adolescent patients with chronic idiopathic nausea: a preliminary study."
    Muszynski - Invited Speaker
    International Gastrointestinal Electrophysiology Society. San Diego, CA, May **2016**

18. "High-density electrogastrogram identifies spatial dysrhythmias in adolescent patients with chronic idiopathic nausea: a preliminary study."
    Somarajan, **Muszynski**, et al. – **Poster Presentation, Award**
    Digestive Disease Week, San Diego, CA, May **2016**

19. "Spatiotemporal and Morphological Differences in Serosal and Mucosal Electrical Recording of Porcine Colonic Slow Wave."
    Digestive Disease Week, San Diego, CA, May **2016 - Poster Presentation**

20. "Rapid Threat Assessment: Bridging the gap between multi-omic network analysis and biological mechanism of action of drugs and toxins."
    NATO ASI: Molecular Technologies for Detection of Chemical and Biological Agents.
    Campora san Giovanni, Calabria, Italy, April **2016 - Poster, Invited Talk**

21. "A Lesson on Biomagnetism."
    New York Institute of Technology, Department of Electrical and Computer Engineering. Long Island, New York, September **2015 - Invited Talk**

22. Professional Skill Development Workshop for Cancer Biologists, Cold Spring Harbor National Laboratory. Long Island, New York, September **2015 - Meeting**

23. "Experimental recording and analysis of mucosal and serosal slow wave activity in porcine colon."
    International Gastrointestinal Electrophysiology Society, Washington DC, May **2015**
    Invited Talk, Award

24. "Noninvasive biomagnetic assessment of the effects of erythromycin on the gastric slow wave."
    Digestive Disease Week, American Gastroenterological Association, Washington DC, May **2015 - Poster**

25. "MENG reveals slow wave dysrhythmia in diabetic gastroparesis."
    Digestive Disease Week, American Gastroenterological Association, Washington DC, May **2015 - Poster**

26. "Rapid threat assessment year one."
    Defense Advanced Research Projects Agency, Department of Defense, Washington DC, February **2015**

27. "Cholecystokinin alters serosal EMG but not MGG in porcine subjects."
    International Gastrointestinal Electrophysiology Society, Chicago, IL, May **2014 - Invited Talk**

28. "Noninvasive measurement of gastric slow wave dysrhythmia in porcine."

Digestive Disease Week, American Gastroenterological Association, Chicago, IL, May **2014 - Poster**

29. "Cholecystokinin alters serosal EMG but not MGG in porcine subjects."
    Digestive Disease Week, American Gastroenterological Association, Chicago, IL, May **2014 - Poster**

30. Professional Skill Development Workshop for Women Physicists, APS, **2013 - Meeting**

31. "Noninvasive biomagnetic detection of isolated ischemic bowel segments."
    Surgery and Engineering Symposium, Vanderbilt University, Nashville, TN, December **2012 - Poster**

32. "Correlation of noninvasive magnetic and electric measurement of the gastric slow wave."
    Student Scholar Symposium, Lipscomb University, Nashville, TN, **2012 - Invited Talk**

SKILLS & INTERESTS

Skills:	Cryogenics, Public speaking, Data analysis, Biomagnetometry, Project management, Signal Processing, Microscopy, Microfluidic devices, Thermoforming, Superconduction, Fourier Transforms, Logistics
CAD Software:	Fusion 360**,** AutoCAD, Solidworks
Programming:	MATLAB, NI LabView, Canvas, Python, CorelDraw
Leadership:	DARPA RTA Engineering Team Lead Lipscomb University American Chemical Society: VP Lipscomb University Society of Physics and Engineering: VP
Volunteering:	Tennessee Environmental Council Health Talents International, Guatemala Medical Missions Co-established Clean Water Initiative, now servicing dozens of Guatemalan cities Habitat for Humanity International Justice Mission Baptist Emergency Room Intern Pi Kappa Sigma- service society Elite Sports Medicine and Orthopedics Intern Nashville Youth Soccer Coach
Interests:	Rock climbing, Backpacking, Kickboxing, Running, Nashville Women's Soccer (NAWSA)