

The University of North Carolina at Chapel Hill
Department of Anesthesiology
Annual Research Report
2021-2022



SCHOOL OF MEDICINE
Anesthesiology

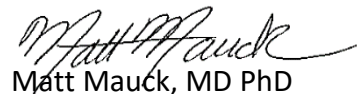
Dear Colleague:

Welcome to our 2021-2022 UNC Department of Anesthesiology Annual Research Report. I hope that this summary gives you an understanding of the exciting research work being conducted in our Department. Our goal is to serve our patients through innovation and discovery, and we have had a very productive year.

The research success summarized within this report is achieved by three main factors. First, we are fortunate to have gathered together an incredible group of faculty and staff in the department. Second, these individuals excel at working together in collaborative, multidisciplinary teams to achieve innovations and discoveries that advances science and improves our patients lives. Finally, we have a Chair and a Department who fully embraces the mission of the university to reduce suffering and improve outcomes through research. The substantial support provided by the Department has provided necessary infrastructure for transformative research.

I encourage you to check back often and keep up with our department research activities via our website. Also, if you have any questions regarding our research or work, don't hesitate to email me any time at Matt.Mauck@med.unc.edu.

Sincerely,



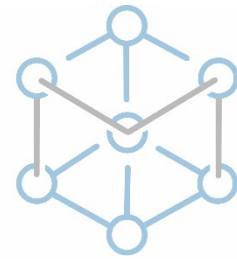
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1. Areas of Departmental Research Focus

A. The Mauck Lab is focused on preventing chronic pain following major traumatic injury as well as advancing care of patients experiencing chronic low back pain. Work is actively underway to better understand the mechanisms of underlying chronic pain development in the aftermath of major thermal burn injury. Nearly 500,000 individuals seek care after burn injury each year in the US, and approximately 40,000 sustain major thermal injuries requiring hospitalization. A significant number of these individuals go on to experience chronic pain. The Mauck Lab has teamed up with surgeons in the Jaycee Burn Center at UNC, as well as with leading burn centers from around the United States, to improve our understanding of the mechanisms responsible for chronic pain and suffering experienced by survivors of major burn injuries. Results from an observational study conducted by the research group have indicated that deficiency in Vitamin D around the time of burn injury has been shown to contribute to chronic pain and racial disparities in chronic pain outcomes following burn injury.



MAUCK LAB



Matthew Mauck, MD, PhD

The Mauck Lab has also shown through the Burn Recovery Trail, a pilot, randomized controlled trial to assess the efficacy of Vitamin D and Fish Oil in the prevention of chronic pain development following burn injury (NCT03313076) that administration of Vitamin D for 6 weeks following burn injury reduced chronic pain and narrowed racial disparity. This result has led to planning of a follow-up study to investigate novel immune mechanisms that contribute to Vitamin D treatment effects. This trial is funded by an NIH K23 Career Development Award from the National Center for Complementary and Integrative Health (NCCIH) and will be actively recruiting patients in 2022.

Given these exciting results in burn injury survivors, the Mauck Lab has an exciting new pilot, multicenter randomized controlled trial to prevent chronic pain and reduce racial disparity in pain outcomes following motor vehicle collision that has been funded by the National Institute on Minority Health and Health Disparities via an R21 funding mechanism. This work

has been possible with strong collaborations with Dr. McLean in the Department of Psychiatry.

Mauck is also involved in the NIH Back Pain Consortium as the lead PI for the Biomarkers for Evaluating Spine Treatments (BEST) trial. This is one of the largest precision medicine trials to be conducted to date and aims to advance the care of patients with chronic low back pain by coupling evidence-based interventions and comprehensive phenotyping. The BEST trial will lead to a novel precision medicine algorithm that will enable of the best sequence of chronic low back pain interventions to be selected given a patient's unique characteristics or phenotype. This trial will occur across 12 sites in the US, including UNC. Dr. Mauck is working alongside Dr. Brooke Chidgey in the Pain Medicine Division to lead the UNC site along with an outstanding team of coordinators and students.



Brooke Chidgey, MD

2021-2022 Related Publications:

Mauck MC, Aylward AF, Barton CE, Birckhead, B, Carey T, Dalton DM, Fields AJ, Fritz J, Hassett, AL, Hoffmeyer A, Jones SB, McLean SA, Mehling WE, O'Neill CW, Schneider MJ, Williams DA, ; Zheng P, Wasan A. Evidence-based interventions to treat chronic low back pain: treatment selection for a personalized medicine approach. *PAIN Reports*. 2022 Accepted for Publication on 5/26/2022.

2020-2021 Related Publications

Mauck MC, Linnstaedt, SD, Bortsov, A, Kurz, M, Hendry, PL, Lewandowski, CL, Velilla, MA, Datner, E, Pearson, C, Domeier, R, Fillingim, RB, Beaudoin, FL, Ting, JP, McLean SA. Vitamin D Insufficiency Increases Risk of Chronic Pain Among African Americans Experiencing Motor Vehicle Collision . *Pain*. 2020; 161(2): 274-280.

Mauck MC, Barton CE, Tungate A, Shupp JW, Karlnoski R, Smith DJ, Williams FN, Jones SW, McGrath KV, Cairns BA, McLean SA. Peritraumatic Vitamin D levels predict chronic pain severity and contribute to racial differences in pain outcomes following Major Thermal Burn Injury. *J Burn Care Res*. 2021. Epub ahead of print. PMID: 33564878.

Mauck MC, Barton CE, Tungate AS, Shupp JW, Karlnoski R, Smith DJ, Williams FN, Jones SW, Sefton C, McGrath K, Cairns BA, McLean SA. Peritraumatic plasma Omega-3 fatty acid concentration predicts chronic pain severity following thermal burn injury. *J Burn Care Res.* 2021 Epub ahead of print. PMID: 33895836.

Linnstaedt SD, Mauck MC, Son EY, Tungate AS, Pan Y, Rueckeis C, Yu S, Lechner M, Datner E, Cairns BA, Danza T, Velilla MA, Pearson C, Shupp JW, Smith DJ, McLean. Peritraumatic 17 β -estradiol levels influence chronic posttraumatic pain outcomes. *Pain.* 2021. Epub ahead of print. PMID: 34028234

B. The Women's Health Study: Influence of PTSD Symptoms on Chronic Pain Development after Sexual Assault (1R01AR064700-01A1, PI McLean)



Better Tomorrow Network

The mission of the Better Tomorrow Network is to conduct high-quality research studies that yield continuously improved understanding, treatments, and services for sexual assault survivors. We conduct this work to achieve a world in which effective treatments exist so that no sexual assault survivor will experience chronic reductions in physical health, mental health, or quality of life due to sexual assault.

Women's Health Study: Disseminating the Results of a First-in-Kind Study



Since completing data collection in April 2020, the Better Tomorrow Network team has been hard at work analyzing and publishing results from the 706 women who participated in this observational study on the impact of sexual assault on survivors' physical and emotional wellness.

Findings from the Women's Health Study will shape emergency care providers' ability to screen for likely post-traumatic stress risk and deliver preventive interventions in the immediate aftermath of sexual assault. We continue to feel deep gratitude for the contributions of the Women's Health Study's participants, who have made this progress possible.

Short Trauma and Anxiety Research (STAR) Lab



Dr. Nicole Short, an Assistant Professor in the Department of Psychology, leads the STAR Lab, where she broadly studies the etiology, prevention, and treatment of trauma- and anxiety-related disorders via a translational approach. Specifically, Dr. Short is interested in identifying and characterizing cognitive-affective and other risk factors (e.g., anxiety sensitivity, sleep disturbance) for the development of posttraumatic stress and related symptoms (e.g., anxiety, depression,



substance use disorder); better understanding how these risk factors relate to underlying biological processes; and utilizing this knowledge to develop novel preventions and treatments for these disorders, particularly by leveraging technology-based interventions. She employs a variety of methods to study these areas, such as ecological momentary assessment (EMA), elicitation and assessment of the human stress response, and advanced quantitative methods.

Currently, under the mentorship of Dr. Samuel McLean, Dr. Short is testing RISE Guide, a novel cognitive-behavioral preventative intervention to reduce risk for posttraumatic stress after sexual assault.

The STAR Lab proudly hosts four graduate and eight undergraduate students, whose contributions include data analysis, study coordination, manuscript preparation, participant communications, and more!



RISE Pilot and Randomized Control Trial (RCT) Studies: Putting Data into Action



When presenting for emergency care in the immediate aftermath of sexual assault, survivors are typically offered prophylaxes for pregnancy and sexually transmitted infections, but not for the more common outcome of posttraumatic stress disorder. To address this issue, Dr. Nicole Short began designing RISE Guide, a smartphone-based intervention designed to prevent the development of anxiety sensitivity (AS) and posttraumatic stress symptoms (PTSS) following sexual assault, in 2018. The digital intervention is based on cognitive-behavioral techniques for preventing and treating AS and PTSS. Smartphone-based delivery allows this intervention to be

disseminated at the time of emergency care and does not require additional visits, aiding uptake and ease of use.

To assess the safety and usability of RISE Guide, the Better Tomorrow Network launched the RISE Pilot in May 2020 and recruited participants from UNC Medical Center in Chapel Hill, NC and UC Health Memorial Hospital in Colorado Springs, CO. The Pilot enrolled a total of 12 participants, and thus far, responses to the Guide have been positive. According to our measures, two-thirds of participants used the information they learned, were at least slightly interested in the Guide, and would recommend it to other women recently experiencing sexual assault. The majority of participants indicated that the RISE Guide is very logical and at least somewhat useful. Participants also stated, “I liked the videos and the coping skills I learned,” and “It was simple and straightforward.”

A randomized control trial (RCT) assessing the efficacy of RISE Guide in mitigating post-sexual assault AS and PTSS launched in December 2021. As of September 2022, 21 participants have been enrolled from UNC Medical Center in Chapel Hill, NC and SAFE Austin in Austin, TX.

Athena Pilot Study



Athena
Study

The Athena Study builds upon the Women’s Health Study by adapting to and learning from adolescent survivors of sexual assault (ages 13 to 17). In collaboration with Brown University’s Dr. Nicole Nugent, this study aims to not only gain insight into the recovery process of adolescents, but it will uniquely examine how digital interactions, such as

Facebook and texting, play a role in recovery. Survivors’ parents will also enroll, giving a more complete picture of the social context in which these survivors heal.

To prioritize the safety of young survivors of sexual assault, the Athena Pilot Study was placed on hold during the height of the COVID-19 pandemic. We are eager to resume progress on this impactful study and happy to announce that there will be a new launch meeting this Fall.

Grants awarded since 2021

2020, Mechanisms underlying sleep and substance use risk among women trauma survivors: A multimodal intensive longitudinal pilot study | UNC Sleep Innovation Grant (\$10,000)

2021, A Randomized Controlled Trial of an Online Intervention to Prevent the Development of Chronic Pain in Sexual Assault Survivors | MayDay Fund (\$165,236.80)

Presentations since 2021

Burud GB, Short NA, Thomas R, Lechner M, Bell K, Black J, Buchanan J, Reese R, Ho J, Reed G, Platt M, Riviello R, Rossi C, Nouhan P, Phillips C, Martin SL, Liberzon I, Rauch SM, Bollen K, Kessler RC, McLean SA. Research among women sexual assault survivors presenting for emergency care is justified: Results from a multi-site, prospective observational cohort study. Poster presentation at Society of Biological Psychiatry's 2021 Annual Meeting. Virtual, May, 2021.

McLean BM, McLean SA, et al. "They helped me the best they could": Experiences of women sexual assault survivors with police in the early aftermath of assault and associations with past trauma history and acute psychological responses. Poster presentation at Society of Biological Psychiatry's 2021 Annual Meeting. Virtual, May, 2021.

Rodriguez S, McLean SA, et al. Latinas have worse mental and physical health outcomes following sexual assault, but are less likely to receive health care. Poster presentation at Society of Biological Psychiatry's 2021 Annual Meeting. Virtual, May, 2021.

Short NA, An X, Ji Y, D'Anza T, Lechner M, Greene S, Bell K, Black J, Buchanan J, Reese R, Ho J, Reed, Tungate A, Bollen K, Martin SL, Liberzon I, Rauch SAM, Sullivan M, McLean SA. Patient-Centered Classifications of Mental and Physical Health Symptoms after Sexual Assault: Results from a Large Prospective Study. In A. Basu & S. A. McLean (chairs), Understanding Lifetime Trauma Profiles, Multidimensional Posttraumatic Sequelae, and Treatment Implications from Large Cohort US Emergency Departments. Symposium presented at the annual meeting of the International Society for Traumatic Stress Studies: November, 2020, Atlanta, GA.

Short NA, Tungate AS, Bollen KA, Witkemper KD, Lechner M, Bell K, Black J, Buchanan J, Reese R, Reed GD, Liberzon I, Rauch SAM, Kessler RC, McLean SA. Acute stress symptoms mediate the transition from acute to persistent pain after sexual assault. In A. Rogers & N. A. Short (chairs), Improving treatment outcomes for comorbid chronic pain and posttraumatic stress: Recent translational findings. Symposium presented at the annual meeting of the Association for Behavioral and Cognitive Therapies: November, 2020, Philadelphia, PA.

Publications since 2021

Short NA, Evans MK, Raudales AM, Shapiro MO, Weiss NH, Schmidt NB. Anxiety sensitivity and cannabis use motives among trauma-exposed young adult cannabis users. *Am J Addict*. In press.

Shapiro MO, Short NA, Raines AM, Franklin CL, Constans JI. Pain and posttraumatic stress: Associations among women Veterans with a history of military sexual trauma. *Psychol Trauma: Theory Res Pract Policy*. In press.

Shapiro MO, Thompson JS, Short NA, Schmidt NB. Uncertainty after sexual assault: Understanding associations between IU and PTSD within a treatment-seeking sample. *Curr Psychol*. In press.

Short NA, Austin AE, Wolfson A, Rojo-Wissar DM, Munro CA, Eaton WW, Bienvenu OJ, Spira AP. The association between traumatic life events and sleep disturbance among men and women: Results from the Baltimore Epidemiologic Catchment Area follow-up study. *Sleep Health*. In press.

Austin AE, Naumann RB, Short NA. Associations of Medicaid expansion with suicide deaths among nonelderly adults. *Am J Epidemiol*. In press.

Short NA, Tungate AT, Bollen K, Sullivan J, D'Anza T, Lechner M, Bell K, Black J, Buchanan J, Reese R, Ho J, Reed G, Platt M, Riviello R, Rossi C, Martin SL, Liberzon I, Rauch SAM, Kessler RC, Nugent N, McLean SA. Pain is common after sexual assault and posttraumatic arousal/reactivity symptoms mediate the development of new or worsening persistent pain. *PAIN*. In press.

Short NA, Zvolensky MJ, Schmidt NB. A pilot randomized clinical trial of Brief Behavioral Treatment for Insomnia to reduce problematic cannabis use among trauma-exposed young adults. *J Subst Abuse Treat*. In press.

Lechner M, Bell K, Short NA, Martin SL, Black J, Buchanan JA, Reese R, Ho JD, Reed GD, Platt M, Riviello R, Rossi C, Nouhan P, Phillips C, Bollen KA, McLean SA. Perceived Care Quality Among Women Receiving Sexual Assault Nurse Examiner Care: Results from a 1-Week Postexamination Survey in a Large Multisite Prospective Study. *J Emerg Nurs*. 2021;47(3):449-458. doi:10.1016/j.jen.2020.11.011

Short NA, Uhde TW, Paquet C, Milanak M, Rheingold AA, Wilkerson A. An investigation of the rate and predictors of initiating and attending group cognitive behavioral therapy for insomnia after referral. *Cogn Behav Pract*. In press.

Buchbinder M, Brassfield ER, Tungate AT, Witkemper KD, D’Anza T, Lechner M, Bell K, Black J, Buchanan J, Reese R, Ho J, Reed G, Platt M, Riviello R, Rossi C, Nouhan P, Phillips CA, Martin SL, Liberzon I, Rauch SAM, Bollen K, McLean SA. “I Still Feel So Lost”: Experiences of Women Receiving SANE Care during the Year after Sexual Assault. *JACEP Open*. 2021;2(4):e12464. doi.org/10.1002/emp2.12464

Austin AE, Naumann RB, Short NA. Associations of Medicaid expansion with suicide deaths among nonelderly adults. *Am J Epidemiol*. 2021 May 4; kwab130.

Christensen KA, Short NA. The case for investigating a bidirectional association between insomnia and eating pathology. *Int J Eat Disord*. 2021; 54(5):701-707.

Gilmore AK, McKee G, Flanagan J, Leone R, Oesterle D, Kirby C, Short NA, Gill-Hopple K. Medications at the emergency department after recent rape. *J Interpers Violence*. 2021 Mar 18.

Margolies SO, Patidar SM, Chidgey BA, Goetzinger A, Sanford JB, Short NA. Growth in crisis: A mixed methods study of lessons from our patients with chronic pain during the COVID-19 pandemic. *Journal of Contextual and Behavioral Science*. 2021 Jan; 19: 12-16.

Short NA, Lechner M, McLean BS, Tungate A, Black J, Buchanan J, Reese R, Ho J, Reed G, Platt M, Riviello R, Rossi C, Nouhan P, Phillips C, Martin SL, Liberzon I, Rauch SAM, Bollen K, Kessler RC, McLean SA. Health care utilization by women sexual assault survivors after emergency care: results of a multisite prospective study. *Depress Anxiety*. 2021; 38(1): 67-78.

Short NA, Allan NP, Saulnier K, Preston TJ, Joiner TE, Schmidt NB. Factor mixture modeling of the Insomnia Severity Index in psychiatric outpatients. *J Psychopathol Behav Assess*. 2021; 43: 227-239.

Short NA, Lechner M, Bell K, Black J, Buchanan J, Ho J, Reed G, Corzine A, Riviello R, Martin SL, Liberzon I, Rauch SAM, McLean SA. Anxiety sensitivity prospectively predicts increased acute posttraumatic stress and related symptoms after sexual assault. *J Trauma Stress*. 2020 Nov 11; 33(6): 1111-1120.

Austin AE, Short NA. Sexual violence, mental health, and prescription opioid use and misuse. *Am J Prev Med*. 2020; 59(6):818-827.

C. Linnstaedt Lab



Summary:

The main goals of the Linnstaedt Lab are to a) identify risk factors of chronic pain development following trauma exposure and b) discover potential therapeutic targets for the prevention of chronic pain following trauma. Over the past year we



have made significant progress towards these goals by progressing three key lines of research.

The first line of research has been focused on the role that stress system pathways play in chronic pain development following trauma exposure. We have recently shown that inhibition of a key regulator of the glucocorticoid stress system, FKBP51, reduces the onset and duration of chronic pain behavior following traumatic stress exposure. Additionally, we have shown that the timing of inhibition of FKBP51 following traumatic stress influences the effectiveness of pain prevention (PMID35296422). In a second line of research related to this topic, we have shown, using data from the large UK Biobank dataset, that individuals with risk alleles in *FKBP5*, a smaller hippocampus, and a history of childhood trauma are most likely to have chronic pain as an adult (PMID35444168). Finally, in a third line of research related to this topic, we have examined methylation levels in trauma survivors and showed that differences in the methylation of stress system genes predicts pain recovery following trauma exposure (manuscript under review). For this line of research, we are fortunate to be supported by two grants, a Rita Allen in Pain grant and an R01 through NINDS.

The second line of research has been focused on understanding why women are more vulnerable to chronic pain following trauma exposure versus men. We published a body of work showing that a woman's circulating level of 17β -estradiol at the time of trauma exposure predicts their pain recovery over the subsequent year (PMID34028234). This relationship between 17β -estradiol and chronic pain replicated across three trauma cohorts, and more recently we showed the same results in a fourth cohort of women. Further, we have now shown that administration of 17β -estradiol following traumatic stress exposure in animals prevents the onset of enduring hyperalgesia. We are currently working to understand the mechanism through which 17β -estradiol protects against chronic pain development and whether additional sex hormones (e.g. progesterone and testosterone) also influence posttraumatic chronic pain development. This work was funded over the past year by a K01 grant through NIAMS and we currently have two grants pending to continue this line of research.

The third line of research has been focused on identifying clinical, demographic, and molecular predictors of chronic pain development following trauma exposure. We recently published a manuscript describing these efforts and showing that a distinct set of questions asked of trauma survivors in the emergency department show good accuracy in predicting chronic pain outcomes following motor vehicle collision trauma (PMID35775366). In this work we used machine learning methods and validated our findings on an external dataset. Future efforts related to this work will focus on determining whether we can improve accuracy of prediction by incorporating additional factor (e.g. molecular and genetic factors). This work is funded by the DoD and by a collaborative U01 through NIMH.

Overall, we feel very fortunate to have been able to collaborate with amazing scientists and clinicians and to have received the necessary funding to be able to perform research centered around our goals of helping improve pain outcomes for trauma survivors.

Personnel:

We have been fortunate to engage in our lab with a diverse, knowledgeable, hard-working, and kind and compassionate group of research scientists. We are a team of one postdoctoral scholar, Dr. Lauren McKibben, one graduate student, Erica Branham, two full-time research scientists, Liz Albertorio-Saez and Jacqueline Mickelson, one part-time research scientist, Gehao (Leo) Pang, multiple undergraduate research assistants including Rhea Arora, Ishani Deliwala, Esther Son, Tina Lin, Sophia Kuhl-Chimera, Simran Bhatia, Miranda Layne, Namit Luthra, and one high school research assistant, London Burnham.



Linnstaedt Lab, 2021-2022

From top to bottom, left to right: Brandon Yoo, Sarah Linnstaedt, Tina Lin, Liz Albertorio-Saez, Jarred Lobo, Ryan Kalo, Erica Branham, Simran Bhatia, Rhea Arora, Kaila Hamm, Jacqueline Mickelson, Lauren McKibben, Ishani Deliwala, Esther Son. Not pictured: Raphael Kim, Leo Pang, Sophia Kuhl-Chimera, Miranda Layne, Namit Luthra, London Burnham, and Connie Chen.

Lab Space:

We are excited to have recently moved into a new lab space and would love to welcome anyone interested in joining us for a journal club or informal meeting. You can find us at 120 Taylor Hall on UNC Chapel Hill's main research campus.

2021-2022 Grants/funding

Rita Allen Scholar in Pain awarded to Dr. Linnstaedt to support high risk research projects in the lab. \$150,000 over three years

R01 via NINDS and the HEAL initiative for the lab's work on FKBP51. Grant title: FKBP51 antagonism to prevent chronic pain: optimizing efficacy & evaluating safety and mechanisms.

K01 via NIAMS for our group's sex-differences in pain research. Grant title: Key molecular mechanisms of chronic pain vulnerability in women experiencing MVC.

U01 via NIMH (in collaboration with Dr. Sam McLean and others) for our group's predictive biomarker research. Grant title: Longitudinal Assessment of Post-traumatic Syndromes

2021-2022 Abstracts

Stevens JS, Linnstaedt SD, Michopoulos V, Seligowski AV, Harnett NG, Lebois LAM, van Rooij SJH, Murty V, Mclean SA, Jovanovic T, Ressler KJ. Estradiol influences on threat neurocircuitry in trauma-exposed women and men. Poster presentation at the 2022 Conference of the *International Society for Traumatic Stress Studies*. Atlanta, GA. November 2022.

McDermott TJ, Webber TK, Noble NC, Merker JB, Hinrichs R, Davie W, Wiltshire C, Ressler KJ, Linnstaedt SD, McLean SA, Jovanovic T, Seligowski AV. Estradiol is associated with greater sympathetic activity in trauma-exposed women. Poster presentation at the 2022 Conference of the *International Society for Traumatic Stress Studies*. Atlanta, GA. November 2022.

Wanstrath BJ, Deliwala IH, Mickelson J, McLean SA, Zhao Y, Bauder M, Hausch F, Linnstaedt SD. Duration of reduction in enduring stress-induced hyperalgesia via FK506-binding protein 51 inhibition depends on timing of administration relative to traumatic stress exposure. Poster presentation at the 2022 Conference of the *US Association for the Study of Pain*. Cincinnati, OH. May 2022.

Branham EM, Deliwala IH, Mauck MC, Zhao Y, Lee A, Zannas A, McKibben LA, Spencer AB, Cairns BA, Lechner M, Danza T, Kurz MC, Velilla MA, Hendry PL, Pearson C, Datner E, Peak DA, Jones J, Rathlev NK, Lewandowski C, McLean SA, Linnstaedt SD. DNA methylation levels in hypothalamic-pituitary-adrenal axis genes predict chronic pain outcomes following trauma exposure. Poster presentation at the 2022 Conference of the *US Association for the Study of Pain*. Cincinnati, OH. May 2022.

Kim R, McKibben LA, Lin T, Pang G, Liu Y, Tungate AS, Hendry PL, Kurz MC, Peak DA, Jones J, Rathlev NK, Swor RA, Domeier R, Velilla MA, Lewandowski C, Datner E, Pearson C, Lee D, Mitchell PM, McLean SA, Linnstaedt SD. Risk prediction for posttraumatic stress symptoms following trauma exposure. Poster presentation at the 2022 *Society for Biological Psychiatry Meeting*, New Orleans, LA. April 2022.

Polanco K, Li Q, An X, Beaudoin F, Zeng D, Stevens J, Linnstaedt SD, Jovanovic T, Neylan T, Clifford GD, Ressler K, Koenen K, Kessler R, McLean SA, for the AURORA Study Group. Anxiety sensitivity is a leading risk factor of severe or widespread pain three months after motor vehicle collision. Poster presentation at the 2022 *Society for Biological Psychiatry Meeting*, New Orleans, LA. April 2022.

Lobo JJ, Ayoub L, Moayed M, Linnstaedt SD. Hippocampal volume, FKBP5 genetic risk alleles, and childhood trauma interact to increase vulnerability to chronic multisite musculoskeletal pain. Poster presentation at the 2022 *Society for Biological Psychiatry Meeting*, New Orleans, LA. April 2022.

Son E, Lobo J, Zhao Y, Arora R, Albertorio L, Stevens J, Jovanovic T, Koenen K, Kessler R, Ressler K, McLean SA, Linnstaedt SD. MicroRNA-Mediated Protective Effects of Peritraumatic 17 β -Estradiol on Posttraumatic Chronic Pain in Women. Poster presentation at the 2022 *Society for Biological Psychiatry Meeting*, New Orleans, LA. April 2022.

Hernandez H, Rawls A, Wang Y, Zhang X, Chen J, Pan Y, Dang H, Slade G, Linnstaedt SD, Parisien M, Diatchenko L, Nackley A. Tissue-specific regulation of miR-374a-5p and its mRNA targets associated with pain in humans and mice. Submitted for presentation at *Society for Neuroscience*, Chicago, IL October 2021.

Ayoub LJ, Lobo JJ, Linnstaedt SD, Moayed M. Hippocampal volume, FKBP5 genetic vulnerability, and childhood trauma compound risk for chronic multisite pain in the UK Biobank cohort. Submitted for presentation at *Society for Neuroscience*, Chicago, IL October 2021.

2021-2022 Talks

Linnstaedt SD. Promising therapeutic strategies for the prevention of chronic posttraumatic pain: insights from translational studies in humans and rats. USASP annual meeting, Symposium speaker. Cincinnati, OH. May 20, 2022

Linnstaedt SD. FKBP51 antagonism to prevent posttraumatic persistent hyperalgesia. 51TaValP meeting. Darmstadt Germany. April 25, 2022.

Linnstaedt SD. FKBP51 as a promising therapeutic target for the prevention of chronic posttraumatic pain. 3rd Annual National Institutes of Health HEAL Initiative Investigator Meeting. Symposium speaker. April 12, 2022

2021-2022 Publications

Jones WC, An X, Ji Y, Liu M, Zeng D, House SL, Beaudoin FL, Stevens JS, Neylan TC, Clifford GD, Jovanovic J, Linnstaedt SD, ..., Kessler RC, McLean SA. Derivation and validation of a brief ED-based prediction tool for posttraumatic stress after motor vehicle collision. *Annals of Emergency Medicine*. Accepted August 4, 2022.

Harnett NG, Finegold KE, Lebois LAM, van Rooij SJH, Ely TD, Murty VP, Jovanovic T, Bruce SE, House SL, Beaudoin FL, An X, Zeng D, Neylan TC, Clifford GD, Linnstaedt SD, ..., Ressler KJ, Stevens JS. Structural covariance of the ventral visual stream predicts posttraumatic intrusion and nightmare symptoms: a multivariate data fusion analysis. *Translational Psychiatry*. Accepted July 20, 2022.

Tanriverdi B, Gregory DF, Olino TM, Ely TD, Harnett NG, van Rooij SJH, Lebois LAM, Seligowski AV, Jovanovic T, Ressler KJ, House SL, Beaudoin FL, An X, Neylan TC, Clifford GD, Linnstaedt SD, ..., Stevens JS, Murty VP. Hippocampal threat reactivity interacts with physiological arousal to predict PTSD symptoms. *Journal of Neuroscience*, Accepted June 17, 2022.

Kim R, Lin T, Pang G, Liu Y, Tungate AS, Hendry PL, Kurz MC, Peak DA, Jones J, Rathlev NK, Swor RA, Domeier R, Velilla MA, Lewandowski C, Datner E, Pearson C, Lee D, Mitchell PM, McLean SA,

Linnstaedt SD. Derivation and validation of risk prediction for posttraumatic stress symptoms following trauma exposure. *Psychological Medicine*. Accepted June 6, 2022.

Lobo JJ, Ayoub LJ, Moayed M, Linnstaedt SD. Hippocampal brain volume and *FKBP5* genetic risk interact to influence chronic musculoskeletal pain: analysis of 36,822 UKBB participants. *Scientific Reports*. Accepted March 30, 2022.

Sterina E, Michopoulos V, Linnstaedt SD, Neylan TC, Clifford GD, Ethun KF, Lori A, Wingo AP, Rothbaum BO, Ressler KJ, Stevens JS. Time of trauma prospectively affects PTSD symptom severity: the impact of circadian rhythms and cortisol. *Neuropsychopharmacology*. Accepted March 16, 2022.

Wanstrath BJ, McLean SA, Zhao Y, Mickelson J, Bauder M, Hausch F, Linnstaedt SD. Duration of reduction in stress-induced hyperalgesia via FKBP51 inhibition depends on timing of administration after traumatic stress exposure. *Journal of Pain*. Accepted March 8, 2022.

Maihofer AX, Choi KW, Coleman JRI, ... Linnstaedt SD, ..., Nievergelt CM. Enhancing Discovery of Genetic Variants for Posttraumatic Stress Disorder Through Integration of Quantitative Phenotypes and Trauma Exposure Information. *Biological Psychiatry*. 2021 Sep 28;S0006-3223(21)01632-2. PMID: 34865855

Stevens JS, Harnett NG, Lebois L, van Rooij S, Ely TD, Roeckner A, Vincent N, Beaudoin FL, An X, Zeng D, Neylan TC, Clifford GD, Linnstaedt SD, ... Ressler KJ. Brain-based biotypes of psychiatric vulnerability in the acute aftermath of trauma. *The American Journal of Psychiatry*, 2021 Nov;178(11):1037-1049. PMID 34645277

Germine LT, Passell E, Scheuer L, Martini P, Hwang I, Lee S, Sampson N, Barch D, Kessler R, Joormann J, ... Linnstaedt SD, ..., McLean SA. Neurocognition after motor vehicle collision and adverse post-traumatic neuropsychiatric sequelae within 8 weeks: Initial findings from the AURORA study. *Journal of Affective Disorders*. 2022 Feb 1;298(Pt B):57-67. PMID: 34800569

Joormann J, Ziobrowski HN, King A, ..., Linnstaedt SD, ..., Kessler RC. Prior histories of posttraumatic stress disorder and major depression and their onset and course in the three months after a motor vehicle collision in the AURORA study. *Depression and Anxiety*. 2022 Jan;39(1):56-70. PMID: 34783142

Harnett NG, Dumornay NM, Delity M, ..., Linnstaedt SD, Germine LT, Datner EM, Chang AM, Pearson C, Peak DA, Merchant RC, Domeier RM, Rathlev NK, O'Neil BJ, Sergot P, Bruce SE, Miller MW, Pietrzak RH, Joormann J, Barch DM, Pizzagalli DA, Sheridan JF, Smoller JW, Luna B, Harte SE, Elliott JM, Ressler KJ. Prior differences in previous trauma exposure primarily drive the observed racial/ethnic differences in posttrauma depression and anxiety following a recent trauma. *Psychological Medicine*. 2022 Jan 31:1-10. PMID: 3509471

D. An Lab



Summary: Research from An Lab mainly focus on the development of statistical models and computational techniques/algorithms for complex multimodal high dimensional temporal-spatial data analysis and their applications for the study of adverse posttraumatic neuropsychiatric sequelae (APNS), such as pain and PTSD. These applications include the development of risk prediction tools, derivation and validation of objective biomarkers, and identification of subtypes of

APNS with homogenous structures/relationships. Over the past year, we have made great progress and significant contributions to the field.

Innovative statistical and machine learning method: working with a collaborator from NC State University, we developed two innovative statistical and machine learning techniques for the analysis of high-dimensional data and applied them to address important research questions related to APNS using data collected from the AURORA study. The first technique is a combination of factor analysis model and hidden Markov model (HMM) and it can be used to identify subtype (states) of APNS based on high dimensional longitudinal data and study the onset and transition of APNS over time. The manuscript generated from this project has been submitted to a top statistical methodology journal as well as an international statistical conference, and it is one of the winners of the 2022 Mental Health Statistics Section Student Paper Award competition. The second technique provides an innovative approach to learn and test heterogeneous/individual casual graphs based on the Structural equation model (SEM) framework. The corresponding manuscript has been submitted to a top machine learning conference and will very likely be accepted based on reviewers' comments and recommendations.

Development of risk prediction tools: we created a solid and robust analysis pipeline for the development of risk prediction tools and identification of top risk factors. We have applied this pipeline to study pain and PTSD after motor vehicle collision (MVC) and sexual assault trauma exposures. We developed a simple to use risk prediction tool to predict PTSD 3 months after MVC and achieved great prediction accuracy. The corresponding manuscript has been accepted by the Annals of Emergency Medicine. We have finished the analysis for pain 3 months after MCV and PTSD 6 months after sexual assault and currently working on the manuscript with collaborators.

Derivation and validation of objective biomarkers: we developed a solid analysis pipeline to derive and validate objective biomarkers from digital phenotyping data, such as heart rate, activity, and keystroke. The manuscript for activity biomarkers has been submitted to JAMA psychiatry and received positive feedback. Analysis has been finished for heart rate, keystroke, GPS, sleep, and language features, and currently working on the manuscripts with collaborators.

Identification of subtypes of APNS: we developed two analysis pipelines to identify subtypes of APNS with homogeneous growth patterns or profiles across multiple symptoms. A manuscript for homogeneous growth patterns has been submitted to Translational Psychiatry and the other one is under preparation.

2021-2022 Grants/Funding

TITLE: Longitudinal Assessment of Posttraumatic Syndromes (The AURORA Study)

Grant Type (or Number): U01MH110925
Grant Amount: \$21,009,788
Funding Agencies: NIMH
Grant Period: 2016-2022 *Note: In No Cost Extension
Grant Status: AWARDED
Role: Co-I (40% Effort)

TITLE: VENTURE Trial: Vitamin d to ENhance TraUma REcovery

Grant Type (or Number): R21MD016467
Grant Amount: \$280,158
Funding Agencies: NIMHD
Grant Period: 8/1/2021-7/31/2023
Grant Status: AWARDED
Role: Co-I (0% Effort)

TITLE: Written Exposure Therapy to Improve Outcomes after Trauma

Grant Type (or Number): Veterans Affairs
Funding Agencies: National Center for PTSD
Grant Amount: \$700,000+
Grant Period: 9/1/2020-8/30/25

Grant Status: AWARD IN PROCESS
Role: Co-I (0% Effort)

TITLE: Discovering Diagnostics, Subtypes, and Natural history of traumatic brain injury (TBI) vs. non-TBI Recovery to Gain Military advantage

Grant Type (or Number): Proposal No. TP210026, Award No. Pending
Grant Amount: \$7,999,975
Funding Agencies: CDMRP
Grant Period: 9/30/2022 – 9/29/2026
Grant Status: AWARD IN PROCESS
Role: Co-I (20% Effort)

TITLE: Prevention/Reduction of ASRs and PTSD to Sustain Warfighter Performance with Osanentan, a best-in-class NK3R Antagonist

Grant Type (or Number): Proposal No. TP210025, Award No. Pending
Grant Amount: \$2,999,771
Funding Agencies: CDMRP
Grant Period: 9/30/2022 – 9/29/2024
Grant Status: AWARD IN PROCESS
Role: Co-I (10% Effort)

TITLE: Innovative computational approaches to advance research for adverse posttraumatic neuropsychiatric sequelae based on multimodal high dimensional data.

Grant Type (or Number):
Grant Amount:
Funding Agencies: NIMH
Grant Status: SUBMITTED
Role: PI (15% Effort)

TITLE: Biological aging and psychiatric outcomes in the immediate aftermath of trauma

Grant Type (or Number):
Grant Amount:
Funding Agencies: NIMH
Grant Status: SUBMITTED
Role: Co-I (5% Effort)

2021-2022 Abstracts/Publications

Harnett NG, Dumornay NM, Delity M, Sanchez LD, Mohiuddin K, Musey PI Jr., Seamon MJ, McLean SA, Kessler RC, Koenen KC, Beaudoin FL, Lebois L, van Rooij SJ, Sampson NA, Michopoulos V, Maples-Keller JL, Haran JP, Storrow AB, Lewandowski C, Hendry PL, Sheikh S, Jones CW, Punches BE, Kurz MC, Swor RA, McGrath ME, Hudak LA, Pascual JL, House SL, An X, Stevens JS, Neylan TC, Linnstaedt SD, Germine LT, Datner EM, Chang AM, Pearson C, Peak DA, Merchant RC, Domeier RM, Rathlev NK, O'Neil BJ, Sergot P, Bruce SE, Miller MW, Pietrzak RH, Joormann J, Barch DM, Pizzagalli DA, Sheridan JF, Smoller JW, Luna B, Harte SE, Elliott JM, Ressler KJ. Prior differences in previous trauma exposure primarily drive the observed racial/ethnic differences in posttrauma depression and anxiety following a recent trauma. *Psychological Medicine*, 1-10. doi:10.1017/S0033291721004475

Germine LT, Joormann J, Passell E, Rutter LA, Scheuer L, Martini P, Hwang I, Lee S, Sampson N, Barch DM, House SL, Beaudoin FL, An X, Stevens JS, Zeng D, Linnstaedt SD, Jovanovic T, Clifford GD, Neylan TC, Rauch SL, Lewandowski C, Hendry PL, Sheikh S, Storrow AB, Musey PI, Jones CW, Punches BE, McGrath ME, Pascual JL, Mohiuddin K, Pearson C, Peak DA, Domeier RM, Bruce SE, Rathlev NK, Sanchez LD, Pietrzak RH, Pizzagalli DA, Harte SE, Elliott JM, Koenen KC, Ressler KJ, McLean SA, Kessler RC. Neurocognition after motor vehicle collision and adverse post-traumatic neuropsychiatric sequelae within 8 weeks: Initial findings from the AURORA study. *J Affect Disorder*. 2022 Feb 1;298 (Pt B):57-67. doi: 10.1016/j.jad.2021.10.104. Epub 2021 Nov 17. PMID: 34800569.

Joormann J, Ziobrowski HN, King A, Lee S, Sampson N, House SL, Beaudoin FL, An X, Stevens JS, Zeng D, Neylan TC, Clifford GD, Linnstaedt SD, Germine LT, Bollen KA, Rauch SL, Haran JP, Storrow AB, Musey PI Jr., Hendry PL, Sheikh S, Jones CW, Punches BE, McGrath ME, Hudak LA, Pascual JL, Seamon MJ, Chang AM, Pearson C, Peak DA, Domeier RM, Rathlev NK, O'Neil BJ, Sanchez LD, Bruce SE, Miller MW, Pietrzak RH, Barch DM, Pizzagalli DA, Harte SE, Elliott JM, Koenen KC, McLean SA, Kessler RC. Prior histories of posttraumatic stress disorder and major depression and their onset and course in the three months after a motor vehicle collision in the AURORA study. *Depression and Anxiety*. *Depress Anxiety*. 2021 Nov 15. doi: 10.1002/da.23223. Online ahead of print. *Depress Anxiety*. 2021. PMID: 34783142

Ziobrowski HN, Kennedy CJ, Ustun B, House SL, Beaudoin FL, An X, Zeng D, Bollen KA, Petukhova M, Sampson NA, Puac-Polanco V, Lee S, Koenen KC, Ressler KJ, McLean SA, Kessler RC, and the AURORA Consortium. Development and Validation of a Model to Predict Posttraumatic Stress Disorder and Major Depression After a Motor Vehicle Collision. *JAMA Psychiatry*. 2021 September 1. doi:10.1001/jamapsychiatry.2021.2427. Epub ahead of print.

Steuber ER, Seligowski AV, Roeckner AR, Reda MH, Lebois LA, van Rooij SJ, Murty VP, Ely TD, Bruce SE, House SL, Beaudoin FL, An X, Zeng D, Neylan TC, Clifford GD, Linnstaedt SD, Germine LT, Rauch SL, Lewandowski C, Sheikh S, Jones CW, Punches BE, Swor RA, McGrath ME, Hudak

LA, Pascual JL, Chang AM, Pearson C, Peak DA, Domeier, RM, O'Neil BJ, Rathlev NK, Sanchez LD, Pietrzak RH, Joormann J, Barch DM, Pizzagalli DA, Elliott JM, Kessler RC, Koenen KC, McLean SA, Ressler KJ, Jovanovic T, Harnett NG, Stevens JS. Thalamic volume and fear extinction interact to predict acute posttraumatic stress severity. *Journal of Psychiatric Research*. 2021 Sep;141:325-332.doi: 10.1016/j.jpsychires.2021.07.023. Epub 2021 Jul 14. *J Psychiatr Res*. 2021. PMID: 34304036

Seligowski AV, Steuber ER, Hinrichs R, Reda MH, Wiltshire CN, Wanna CP, Winters SJ, Phillips KA, House SL, Beaudoin FL, An X, Stevens JS, Zeng D, Neylan TC, Clifford GD, Linnstaedt SD, Germine LT, Bollen KA, Guffanti G, Rauch SL, Haran JP, Storrow AB, Lewandowski C, Musey Jr. PI, Hendry PL, Sheikh S, Jones CW, Panches BE, Kurz MC, Murty VP, McGrath ME, Hudak LA, Pascual JL, Seamon MJ, Datner EM, Chang AM, Pearson C, Peak DA, Merchant RC, Domeier RM, Rathlev NK, O'Neil BJ, Sanchez LD, Bruce SE, Miller MW, Pietrzak RH, Joormann J, Barch DM, Pizzagalli DA, Sheridan JF, Luna B, Harte SE, Elliot JM, Koenen KC, Kessler RC, McLean SA, Ressler KJ, Jovanovic T. A prospective examination of sex differences in posttraumatic autonomic functioning. *Neurobiology of Stress*. *Neurobiol Stress*. 2021 Aug 21;15:100384. doi: 10.1016/j.ynstr.2021.100384. eCollection 2021 Nov. *Neurobiol Stress*. 2021. PMID: 34485632.

Stevens, J. S., Harnett, N. G., Lebois, L., van Rooij, S., Ely, T. D., Roekner, A., Vincent, N., Beaudoin, F. L., An, X., Zeng, D., Neylan, T. C., Clifford, G. D., Linnstaedt, S. D., Germine, L. T., Rauch, S. L., Lewandowski, C., Storrow, A. B., Hendry, P. L., Sheikh, S., Musey, P. I., Jr, Haran, J.P., Jones, C.W., Panches, B.E., Lyons, M.S., Kurz, M.C., McGrath, M.E., Pascual, J.L., Datner, E.M., Chang, A.M., Pearson, C., Peak, D.A., Domeier, R.M., O'Neil, B.J., Rathlev, N.K., Sanchez, L.D., Pietrzak, R.H., Joormann, J., Barch, D.M., Pizzagalli, D.A., Sheridan, J.F., Luna, B., Harte, S.E., Elliott, J.M., Murty, V.P., Jovanovic, T., Bruce, S.E., House, S.L., Kessler, R.C., Koenen, K.C., McLean, S.A., & Ressler, K. J. (2021). Brain-based biotypes of psychiatric vulnerability in the acute aftermath of trauma. *The American Journal of Psychiatry*, appiajp202120101526. Advance online publication. <https://doi.org/10.1176/appi.ajp.2021.20101526>

Rabadey, J.R., Ji, Y., An, X., Walsh, K., He, K., Lechner, M., Bell, K., Black, J., Liberzon, I., Rauch, S., Riviello, R., Kessler, R., Rossi, C., McLean, S.A. (2022, April 28-30). Development of a brief risk assessment tool to predict posttraumatic stress six months after Sexual Assault. Poster presentation at the 2022 Society for Biological Psychiatry Meeting, New Orleans, LA, United States.

Macchio LD, Guichard L, Ji Y, An X, Neylan T, Clifford G, Li Q, Stevens J, Jovanovic T, Myers L, Ressler K, Koenen K, Kessler R, and McLean S for the AURORA Study Group. "Ask your heart what it doth know": 100+ heart rate variability-based biomarkers of mental and physical health identified in a large cohort of trauma survivors. Poster presentation at the 2022 Society for Biological Psychiatry Meeting, New Orleans, LA. April 2022.

Polanco, K., Li, Q., An, X., Beaudoin, F., Zeng, D., Stevens, J., Linnstaedt, S., Jovanovic, T., Neylan, T., Clifford, G.D., Ressler, K., Koenen, K., Kessler, R., McLean, S.A. (2022, April 28-30). Anxiety sensitivity is a leading risk factor of severe or widespread pain three months after motor vehicle

collision. Poster presentation at the 2022 Society for Biological Psychiatry Meeting, New Orleans, LA, United States.

Jones CW, An X, Ji Y, Beaudoin FL, House SL, Haran JP, Lewandowski C, Musey Jr. PI, Hendry PL, Storrow AB, Punches BE, McLean SA, for the AURORA Study Group. Characteristics and Three-Month Outcomes of Individuals Presenting to the Emergency Department after Physical Assault. Abstract no. 884. American College of Emergency Physicians Research Forum. Oral Presentation. Boston, MA. October 25-28, 2021.

McLean SA, An X, Ji Y, House SL, Beaudoin FL, Haran JP, Jones CW, Lewandowski C, Musey Jr. PI, Hendry PL, Storrow AB, Punches BE, Kessler RC, for the AURORA Study Group. Development and validation of a simple clinical prediction tool to identify individuals in the emergency department at high risk of posttraumatic stress disorder after motor vehicle collision. Abstract no. 625. American College of Emergency Physicians Research Forum. Oral Presentation. Boston, MA. October 25-28, 2021.

Beaudoin FL, An X, Li Q, House SL, Musey Jr. PI, Hendry PL, Jones C, Lewandowski C, Storrow AB, McLean SA, and the AURORA Study Group. Associations between alcohol use and adverse posttraumatic neuropsychiatric sequelae in the early aftermath of trauma. Abstract no. 891. American College of Emergency Physicians Research Forum. Oral Presentation. Boston, MA. October 25-28, 2021.

2. Anesthesiology Clinical Trials Research Unit

The UNC Anesthesiology Clinical Trials Research Unit specializes in pain management studies involving medications or devices. Their facilities at the hospital of UNC Health Care and the Adams School of Dentistry allow them to attract a diverse patient population. They work with Department of Anesthesiology faculty to manage and conduct both industry-sponsored clinical trials and investigator-initiated studies. Their team of professionals includes two full-time research coordinators as well as regulatory and other support staff. Individual faculty studies performed in collaboration with the clinical trials team are described below.



Clinical Research Team

Left to Right: Drs. Harendra Arora, Fei Chen, Kathleen Smith, Brian Specht & Priya Kumar; Vicki Sandlin, Drs. Meena Bhatia & Concetta Lupa; Lindsey Boerger

A. Treatment of Post-Operative Pain Following Orthopedic Surgery With SPRINT® Peripheral Nerve Stimulation (PNS) System (PI: Grant)



This is a multicenter, randomized, double-blinded, placebo-controlled trial conducted by SPR Therapeutics investigating the utility of peripheral nerve stimulation in transitional surgical pain. Participants will be followed for 12 months post start of treatment. UNC began enrolling participants in June of 2021.

B. PeriOperative Ischemic Evaluation-3 (POISE-3) Trial (PI: Kumar)



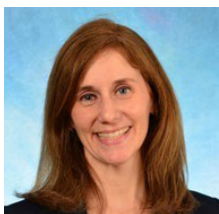
The primary objective of this study is to determine if TXA is superior to placebo for the occurrence of life-threatening, major, and critical organ bleeding, and non-inferior to placebo for the occurrence of major arterial and venous thrombotic events; and to determine the impact of a hypotension-avoidance strategy versus a hypertension-avoidance strategy on the risk of vascular death and major vascular events in patients who are followed for 30 days after noncardiac surgery.

C. Efficacy and Safety of HSK3486 Compared to Propofol for Induction of General Anesthesia in Adults Undergoing Elective Surgery (PI: Arora)



This is a multicenter, randomized, double-blinded, propofol-controlled, Phase 3 clinical study to evaluate the efficacy and safety of HSK3486 for induction of general anesthesia in adults undergoing elective surgery. UNC was selected as a site in fall of 2021 and the study enrollment was completed in spring of 2022.

D. Family Anesthesia Experience: Educating Residents and their Support Persons to Improve Relationships and Increase Wellness (PI: Martinelli)



This study aims to assess the effect of the CA-1 Family Anesthesia Day on residents' wellbeing using a mixed method approach.

E. VRAS- Virtual Reality After Surgery (PI: Specht)



Virtual Reality After Surgery. Exploring the impact virtual reality headset use has on pain scores, opioid use and overall satisfaction among post-operative pediatric patients. VR headsets will be compared to the standard of care - iPad use.

3. Resident Conference Presentations

Presenter	Title	Date	Conference/Place
CA-1 Residents			
Blake, Lauren	Intracranial Abscess in a Primagravida: An Interdisciplinary Approach	May 11-15, 2022	SOAP Annual Meeting / Chicago, IL
Wallace, Damon	Coronary Artery Embolus-Induced Peripartum MI in Parturient with Fontan Physiology	May 11-15, 2022	SOAP Annual Meeting / Chicago, IL
CA-2 Residents			
Cook, Arianna	Postoperative Cardiac Tamponade after Left Ventricular Assist Device Placement: An Interesting Case	May 14-17, 2022	SCA, 2022 Annual Meeting / Palm Springs, CA
	Postoperative Rhabdomyolysis Induced by Anesthetic Medications	Fall 2021	ASA 2021 Annual Meeting / San Diego, CA
Dengler, Erin	1. Consideration for Early ECMO Cannulation in the Parturient with Severe COVID Disease: A Case Report 2. Improving Nursing Compliance with Ventilatory Checks after Neuraxial Morphine	May 11-15, 2022	SOAP 2022 Annual Meeting / Chicago, IL
Grosshuesch, Craig	Refractory Hypoxemia on Veno-Venous ECMO in COVID-19 ARDS	May 14-17, 2022	SCA, 2022 Annual Meeting / Palm Springs, CA
Grosshuesch, Craig	Time Will Tell: An Updated Analysis of Brain Death and Adult Cardiac Transplantation Outcomes After a Change to the UNOS Allocation System	April 28, 2022	International Society for Heart and Lung / Boston, MA
Keil, Dayley	Acute Spinal Cord Injury in the Parturient: Anesthetic Management for Combined Anterior Cervical Spinal Decompression and Fusion and Cesarean Delivery.	Fall 2021	ASA 2021 Annual Meeting / San Diego, CA
Puentes, Jose	Mitral Stenosis in a Parturient with History of Non-Compliance with Anticoagulation: The Role of Timely and Diagnostic Echocardiography in Clinical Decision Making	May 14-17, 2022	SCA 2022 Annual Meeting / Palm Springs, CA
Shaffer, Jacob	Preoperative Ace Inhibitor and Angiotensin Receptor Blocker Therapy: Associations with Increased Vasopressin Use in Patients Undergoing Video Assisted	May 13, 2022	SCA 2022 Annual Meeting / Palm Springs, CA

	Thoracoscopic Wedge Resection or Lobectomy.		
Sholes, Phillip	Primary Pulmonary Hypertension in a Late Second Trimester Parturient Presenting with Hemoptysis and Dyspnea: A Role for Point of Care Ultrasound (PoCUS)?	May 11-15, 2022	SOAP 2022 Annual Meeting / Chicago, IL
Wakefield, Bryan	Delayed Postpartum Hemorrhage Requiring Transfusion Including Prothrombin Complex Concentrate	May 11-15, 2022	SOAP 2022 Annual Meeting / Chicago, IL
CA-3 Residents			
Gonzalez, Michael	Interscalene Liposomal Bupivacaine Vs. Interscalene Catheter for Arthroscopic Rotator Cuff Repair	March 31-April 2, 2022	ASRA Spring Conference / Las Vegas, NV
Greenberg, Michael	GETTING TO THE (LUNG) POINT: USING POCUS TO SWIFTLY DIAGNOSE AND MANAGE TENSION PNEUMOTHORAX	April 1-3, 2022	SPA Annual Meeting / Tampa, FL

4. Departmental Research Products

1. Published Abstracts (in alphabetical order of first author)

Bingham A, Cobb B, McKenzie C. Breastfeeding After Anesthesia: Giving the Greenlight. SOAP 54th Annual Meeting. Chicago, IL.

Blake L, Straube L. Intracranial Abscess in a Primigravida: An Interdisciplinary Approach. SOAP 54th Annual Meeting. Chicago, IL.

Branham EM, Deliwala IH, Mauck MC, Zhao Y, Lee A, Zannas A, McKibben LA, Spencer AB, Cairns BA, Lechner M, Danza T, Kurz MC, Velilla MA, Hendry PL, Pearson C, Datner E, Peak DA, Jones J, Rathlev NK, Lewandowski C, McLean SA, Linnstaedt SD. DNA methylation levels in hypothalamic-pituitary-adrenal axis genes predict chronic pain outcomes following trauma exposure. Poster presentation at the 2022 Conference of the US Association for the Study of Pain. Cincinnati, OH. May 2022.

Dengler E, Hart M, Straube L, Cobb B. Improving Nursing Compliance with Ventilatory Checks after Neuraxial Morphine. SOAP 54th Annual Meeting. Chicago, IL.

Dengler E, Smith K, Cobb B. Consideration for Early ECMO Cannulation in the Parturient with Severe COVID Disease: A Case Report. SOAP 54th Annual Meeting. Chicago, IL. May 12, 2022.

Duncan-Azadi, C., Chutek, A.*, Sisk, J., "Determining the best way to secure IV catheters for Pediatric Patients: A Pilot Study." SPA-AAP Pediatric Anesthesiology 2022, Society for Pediatric Anesthesiology, Tampa, FL, accepted, Poster. April 2022.

Hart M, McKenzie C, Cobb B. Successful Babor Neuraxial Analgesia in Parturient with Suspected Bernard-Soulier Syndrome. SOAP 54th Annual Meeting. Chicago, IL.

Kim R, McKibben LA, Lin T, Pang G, Liu Y, Tungate AS, Hendry PL, Kurz MC, Peak DA, Jones J, Rathlev NK, Swor RA, Domeier R, Velilla MA, Lewandowski C, Datner E, Pearson C, Lee D, Mitchell PM, McLean SA,

Linnstaedt SD. Risk prediction for posttraumatic stress symptoms following trauma exposure. Poster presentation at the 2022 Society for Biological Psychiatry Meeting, New Orleans, LA. April 2022.

Lobo JJ, Ayoub L, Moayed M, Linnstaedt SD. Hippocampal volume, FKBP5 genetic risk alleles, and childhood trauma interact to increase vulnerability to chronic multisite musculoskeletal pain. Poster presentation at the 2022 Society for Biological Psychiatry Meeting, New Orleans, LA. April 2022.

Polanco K, Li Q, An X, Beaudoin F, Zeng D, Stevens J, Linnstaedt SD, Jovanovic T, Neylan T, Clifford GD, Ressler K, Koenen K, Kessler R, McLean SA, for the AURORA Study Group. Anxiety sensitivity is a leading risk factor of severe or widespread pain three months after motor vehicle collision. Poster presentation at the 2022 Society for Biological Psychiatry Meeting, New Orleans, LA. April 2022.

Sholes P, Straube L, Smith K, Cobb B. Primary Pulmonary Hypertension in Late Second Trimester Presenting with Hemoptysis and Dyspnea: A Role for Point of Care Ultrasound (PoCUS)? SOAP 54th Annual Meeting. Chicago, IL. May 12, 2022.

Son E, Lobo J, Zhao Y, Arora R, Albertorio L, Stevens J, Jovanovic T, Koenen K, Kessler R, Ressler K, McLean SA, Linnstaedt SD. MicroRNA-Mediated Protective Effects of Peritraumatic 17 β -Estradiol on Posttraumatic Chronic Pain in Women. Poster presentation at the 2022 Society for Biological Psychiatry Meeting, New Orleans, LA. April 2022.

Wakefield B, Hart M, Mayer D, Straube L. Delayed Postpartum Hemorrhage Requiring Transfusion Including Prothrombin Complex Concentrate. SOAP 54th Annual Meeting. Chicago, IL.

Wallace D, Hart M, Straube L, Cobb B. Coronary Artery Embolus-Induced Peripartum MI in Parturient with Fontan Physiology. SOAP 54th Annual Meeting. Chicago, IL.

Wanstrath BJ, Deliwala IH, Mickelson J, McLean SA, Zhao Y, Bauder M, Hausch F, Linnstaedt SD. Duration of reduction in enduring stress-induced hyperalgesia via FK506-binding protein 51 inhibition depends on timing of administration relative to traumatic stress exposure. Poster presentation at the 2022 Conference of the US Association for the Study of Pain. Cincinnati, OH. May 2022.

2. Journal Articles (in alphabetical order of first author)

AM, Pearson C, Peak DA, Domeier RM, Rathlev NK, O'Neil BJ, Sanchez LD, Bruce SE, Miller MW, Pietrzak RH, Barch DM, Pizzagalli DA, Harte SE, Elliott JM, Koenen KC, McLean SA, Kessler RC. Prior histories of posttraumatic stress disorder and major depression and their onset and course in the three months after a motor vehicle collision in the AURORA study. Accepted to Depression and Anxiety 2021 October.

Bhatia M, Jia S, Smeltz A, Kumar PA. Right Heart Failure Management: Focus on Mechanical Support Options. JCVA. Accepted Feb 2022, In press.

Bhatia, M. Kumar, P. Extubating in the OR after cardiac surgery is not necessary. JCVA. Accepted Dec 2021. In press.

Bhatia M, Smeltz AM, Desai CS, Arora H, Kumar PA. Treatment of Type B Lactic Acidosis with NAC and L-Carnitine. Anaesthesia and Intensive Care 2022; Accepted In Press.

Blacker SN, Vincent A, Burbridge M, Bustillo M, Hazard SW, Heller BJ, Nadler JW, Sullo E, Lele AV; Society for Neuroscience in Anesthesiology and Critical Care. Perioperative Care of Patients Undergoing Major Complex Spinal Instrumentation Surgery: Clinical Practice Guidelines from the Society for Neuroscience in Anesthesiology and Critical Care. *J Neurosurg Anesthesiology*. 2021 Sep 6. doi: 10.1097/ANA.0000000000000799. Epub ahead of print. PMID: 34483301.

Brown KB, Cook A, Chen F, Martinelli SM. A Perspective on Wellness in Anesthesiology Residency Programs: A Multi-Strategy Approach. *Anesthesiol Clin* Available online 5/4/22.

Craig Grosshuesch, Cory Hrvatin, Lisa Johnson, Lavinia M Kolarczyk, Alan M Smeltz. Dollars for diagnosis: a single institutional analysis of billing for intraoperative transesophageal echocardiography exams. *Journal of Cardiothoracic and Vascular Anesthesiology*. Accepted for publication: 9/22/2021.

Dayley K, Murphy B, Cobb B. A&A Practice on April 15. Acute spinal cord injury in the parturient: A case report describing the anesthetic management for combined anterior cervical spinal decompression and fusion and cesarean delivery

Deutsch-Link, Sasha, Brown, Kenneth, Lund, Elisa, Reed, Craig. Esophageal Food Bolus Impaction Treated with Transnasal Endoscopy in a Patient with Severe microstomia, eosinophilic esophagitis and trismus pseudocamptodactyly. American College of Gastroenterology Annual Meeting, October 2021. Awarded "Outstanding Poster Presenter Award".

Doyal AS, Schoenherr J, Flynn D: Motor Evoked Potentials. StatPearls Publishing; 2022.

Doyal AS, Chouchair A, Kumar P. "Not so perfect... Radiofrequency ID chip detection failure." Journal of Cardiothoracic and Vascular Anesthesia, 2/25/2022 online ahead of press. <https://doi.org/10.1053/j.jvca.2022.02.025>

Flynn D, Doyal AS, Schoenherr J: Gastric Ultrasound. StatPearls Publishing; 2022.

Flynn DN, Eskildsen J, Levene JL, Allan JD, Bullard TY, Cobb KW. Pneumothorax following breast surgery at an ambulatory surgery center. Cureus 14(5):e24924. Submitted, accepted, and published in May 2022

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stress disorder and major depression three months after a motor vehicle collision. In press at American JAMA Psychiatry, July 2021.

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3. Invited Presentation

Arora S, Funk I, Gustafson C, Grosshuesch C, Simmers C, Smeltz AM. “Differences in Anesthetic Management of Patients with Pulmonary Hypertension by Anesthesiologists Having Completed a Cardiothoracic Fellowship Versus Those Who Have Not.” May 16, 2022. 12:30 pm - 1:30 pm.

Atieh E, Hart A, Kolarczyk L. “Massive Hemorrhage, Sepsis, and Congestive Heart Failure: A Lethal Combination in a Patient with an Atrio-Esophageal Fistula.” May 12, 2022. 5:00-6:00 PM PT

Boggess K and Enarson C. Revisions to the Guidelines for Appointments, Promotion, and Tenure to Promote DEI. Virtual Presentation, Association of American Medical Colleges Group on Faculty Affairs Town Hall (Invited). January 6, 2022.

Chuang A, Nguyen M, Enarson C. Changing Institutional culture to enhance the learning environment-a multipronged approach. Oral Presentation (Peer Reviewed). AMA CHANGEMEDED 2021 (Virtual meeting). September 29, 2021.

Cook A, Martinelli SM, Gonzalez M, Greenberg M, Bhatia M. “Postoperative Cardiac Tamponade After Left Ventricular Assist Device Placement: An Interesting Case.” May 14, 2022. 10:00 am - 11:00 am PT

Enarson, C. Moderator Small-Group Breakout Sessions (Invited): CBME and Precision Education; Transitions; Diversity, Equity, and Inclusion. ChangeMedEd 2022 Spring Consortium Meeting (Virtual Meeting). April 13, 2022.

Encarnacion A, Kumar P, Arora H, Smeltz AM. "Hypothermia and Delayed Extubation Following Thoracic Endovascular Aortic Surgery." May 17, 2022. 12:00 pm - 1:00 pm.

Grosshuesch C, Arora S, Gustafson C, Funk I, Simmers C, Liu Y, Li Q, Smeltz AM. "Identification of Predictors for Post-Induction Hypotension in Patients with Pulmonary Hypertension." May 17, 2022. 12:00 pm - 1:00 pm.

Grosshuesch C, Jia S. "Refractory Hypoxemia on Veno-Venous ECMO in COVID-19 ARDS." May 14, 2022. 11:00 am - 12:00 pm PT

Grosshuesch C, Watkins R, Liu Y, Li Q, Teeter E, Byku M, Kolarczyk L. Time Will Tell: An Updated Analysis of Brain Death and Adult Cardiac Transplantation Outcomes After a Change to the UNOS Allocation System. Presented at ISHLT Annual Meeting (virtually) 4/27/22

Gruel, A., Sisk, J. "OH STAT, I just made a BIG mistake! What now?" SPA-AAP Pediatric Anesthesiology 2022, Society for Pediatric Anesthesiology, Tampa, FL, Accepted, PBLD. April 2022

Isaak, Robert. November 18, 2021 Visiting Professor. Department of Perioperative Services. FirstHealth Moore Regional Hospital, Pinehurst, NC. Enhanced Recovery After Surgery Pathways: Design, Implementation, and Sustainability.

Isaak, Robert. December 8th, 2021 Visiting Professor. Dalhousie University, Halifax, Nova Scotia, Canada. Time Will Tell: The Academic Performance Assessment Worksheet.

Lavinia Kolarczyk MD, FASA "Enhanced Recovery After Thoracic Surgery: Update on Analgesia" Georgia State Society of Anesthesiologists Annual Meeting, Lake Oconee, Georgia, July 17, 2021

Linnstaedt SD. FKBP51 as a promising therapeutic target for the prevention of chronic posttraumatic pain. 3rd Annual National Institutes of Health HEAL Initiative Investigator Meeting. Symposium speaker. April 12, 2022

Linnstaedt SD. FKBP51 antagonism to prevent posttraumatic persistent hyperalgesia. 51TaValP meeting. Darmstadt Germany. April 25, 2022.

Linnstaedt SD. Promising therapeutic strategies for the prevention of chronic posttraumatic pain: insights from translational studies in humans and rats. USASP annual meeting, Symposium speaker. Cincinnati, OH. May 20, 2022

Susie Martinelli, MD and Fei Chen, PhD (along with John Mitchell, MD, Julie Huffmyer, MD, Sara Neeves, MD) IARS Virtual Education Webinar, Society for Education in Anesthesia (SEA) Panel: Anesthesia Education in the Time of COVID, September 14, 2021

Susan Martinelli. Effectiveness of Virtual versus In-Person Didactics, Association of University Anesthesiologists 2021 Webinar Series, 10/5/21.

Susan Martinelli, Kaitlyn Mitchell MD, Emily Peoples MD, and Manuel Pardp MD, Years as an APD—Joys and Regrets. Association of Anesthesiology Core Program Directors Annual Meeting. 11/5/21.

Martinelli, Susan - Active Learning in Anesthesiology Education

2/2/22--Duke University School of Medicine, Visiting Professor Grand Rounds

2/16/22--Beth Israel Deaconess Medical Center, Visiting Professor Grand Rounds

2/23/22--The Warren Alpert Medical School of Brown University, Visiting Professor Grand Rounds

Puentes J, Smeltz AM, Kolarczyk L. "Mitral Stenosis in a Parturient with History of Non-Compliance with Anticoagulation: The Role of Timely and Diagnostic Echocardiography in Clinical Decision Making." May 14, 2022, 10:00 - 11:00 am PT.

Smith K. Review Lecture: Obesity in Pregnancy. SOAP 54th Annual Meeting. Chicago, IL. May 12, 2022.

4. Moderated Poster Presentations

Bad ESP, Great Block? Analyzing the Safety and Efficacy of the Deep to Erector Spinae Plane Block

Chinwe Anumudu, MD; Jeremy Armbruster, MD; Maxwell Jolly, MD;; Justin Magin; Daniel McMillan, MD; Andres Rojas, MD; Bella Vishnevsky, MD; Monika Nanda MBBS, Stuart Grant, MB ChB

How does MTP block with a high volume work? An unexpected result.

Chinwe Anumudu, MD; Jeremy Armbruster, MD; Maxwell Jolly, MD; Justin Magin; Bella Vishnevsky, MD; Rose Tang, MD; Jason Stearns, MD; Monika Nanda MBBS, Stuart Grant, MB ChB

Single Injection Femoral Periosteal Genicular Nerve Block: A Cadaveric Study

Jeremy Armbruster, MD; Maxwell Jolly, MD; Chinwe Anumudu, MD; Justin Magin; Andrew Tolksdorf; Daniel McMillan, MD; Andres Rojas, MD; Rose Tang, MD; Monika Nanda, MBBS; Stuart Grant, MB ChB

Can Actual Administration of Prescribed Acetaminophen Be Used As A Pain Management Quality Improvement Measure?

Emma Burnham; Monika Nanda, MBBS, MPH; Stuart Grant, MB ChB, MMCI, FRCA

**** ASRA President's Choice Abstract****

Percutaneous glossopharyngeal nerve block: An emerging option for awake intubation?

Aaron Low, David Flynn, Stuart Grant, Monika Nanda, Chinwe Anumudu

Flexor Digitorum Plane Block: A Novel Approach To Median And Ulnar Nerve Blockade

Maxwell D. Jolly MD, Monika Nanda MBBS, Jeremy Armbruster MD, Chinwe Anumudu MD, Gisselle Maquoit MD, Andres Rojas MD, Daniel McMillan MD, James Krakowski MD, Stuart A. Grant, MB ChB

Single Pass Needle Trajectory for Pericapsular Nerve Group and Lateral Femoral Cutaneous Nerve Block
Monika Nanda, Andres Rojas, Sally Stander, Chinwe Anumudu, Jeremy Armbruster, Maxwell Jolly, Giselle Maquoit, Jay Schoenherr, Stuart Grant

Anatomic Study to Compare the Spread of Dye injection at Transversus Thoracis Plane versus Superficial Parasternal Plane

Monika Nanda, Andres Rojas, Jeremy Armbruster, Maxwell Jolly, Chinwe Anumudu, Daniel McMillan, James Krakowski, Stuart Grant

Training and Assessment of Ultrasound Guided Procedural Competency by Utilizing a Cadaveric Regional Anesthesiology Workshop
Monika Nanda, Andres Rojas, Fei Chen, Daniel McMillan, Sally Stander, Stuart Grant

Anterior Quadratus Lumborum Block and the Thoracic Paravertebral Space – Too Good To Be True?
Andres F. Rojas MD , Stuart A. Grant MB ChB , Aaron L. Low MD , Ty L. Bullard MD , Jason Stearns MD , Bella M. Vishnevsky MD , Jeremy R. Armbruster MD, Monika Nanda MB BS , Sally Stander MD , Jay W. Schoenherr MD , Daniel T. McMillan MD , James C. Krakowski MD , David N. Flynn MD

Optimal Dosing Of The Rectus Sheath Block: A Cadaveric Dissection Study
Rojas A, McMillan D, Allan J, Nanda M, Anumudu C, Armbruster J, Dunworth S , Jolly M, Magin J, Maquoit G , Tang R , Grant S

**** ASRA President's Choice Abstract****

Interscalene Liposomal Bupivacaine vs. Interscalene Nerve Catheter for Arthroscopic Rotator Cuff Repair
Jay Schoenherr MD, Michael Gonzalez MD, Ricardo Serrano MD, Kathryn Cobb MD, David Flynn, MD, Chris Howard MD, Meredith Park BS, Zachary Lee BA, Quefeng Li PhD, Stuart Grant MD, Ty Bullard MD

5. Presentations

Society for Pediatric Anesthesia Meeting in Tampa, Florida on April 1, 2022. The presentation is entitled: Methadone for Acute Perioperative Pain. Annika Barnett

Zimbabwe Anaesthetic Association on Sedation in the Pediatric Patient. The presentation was given on April 2, 2022. Jeremy Deer

PBLD: Treating Surgical Pain with Peripheral Nerve Stimulation. Stuart Grant

Visualizing Pain Beyond One to Ten. Moderator: Stuart Grant

Ask the Experts Interactive Session. Self-Dissection: Bringing to Life Structures That Live Beneath Our Needles Resident/Fellow Art Off! Moderator: Stuart Grant

Masterclass: Stump the Chump. Moderator: Stuart Grant

PBLD: Managing a Regional Anesthesia Complication: Medical and Legal Strategies. David Hardman

Block Pack: Blocks for Foot and Ankle Surgery. David Hardman

What the Expert Witness Wants You to Know. David Hardman

“Enhanced Recovery After Thoracic Surgery”. Emory University Department of Anesthesiology Grand Rounds, 3/9/22. EG Teeter