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NAMRU-SA MISSION

"To conduct medical, craniofacial, and biomedical research, which focuses on ways to enhance the health, safety, performance, and operational readiness of Navy and Marine Corps personnel and addresses their emergent medical and oral/facial problems in routine and combat operations."

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NAVY SG TOURS VIBRANT R&D AT NAVAL MEDICAL RESEARCH UNIT-SAN ANTONIO



Vice Adm. C. Forrest Faison, surgeon general and chief, Bureau of Medicine and Surgery (left) met with Cmdr. Forest Sheppard, U.S. Navy trauma surgeon, and Head of NAMRU-SA's Expeditionary and Trauma Medicine Department (front, right) and his team of Navy scientists to learn more about NAMRU-SA's life-saving research in shock, resuscitation, and testing and evaluation of hemorrhage control devices.

(Courtesy of NAMRU-SA Public Affairs)

NAMRU-SA Public Affairs

SAN ANTONIO-- Navy Surgeon General and Chief, Bureau of Medicine and Surgery (BUMED), Vice Adm. C. Forrest Faison spent a half day meeting with Navy researchers at the Naval Medical Research Unit – San Antonio (NAMRU-SA) during a tour of the facilities, Feb. 19, part of his two-day visit with Navy Medicine commands in San Antonio.

In attendance with Faison was Force Master Chief (FMF/SW/AW) Terry Price and director of the Hospital Corps.

Faison received an overview of current projects from NAMRU-SA's Commanding Officer, Capt. Elizabeth Montcalm-Smith and senior leaders in meeting with various teams of Navy researchers.

"As a ready medical force, making sure we can save lives and keeping our specializations strong is critical to Navy Medicine's success, and you are central to both those efforts," said Faison.

Faison also toured the world-class Tri-

Services Research Laboratory to learn more about research in the evaluation of interventions to stem and control hemorrhage and provide resuscitation.

Cmdr. Forest Sheppard, Navy trauma surgeon, and Head of NAMRU-SA's Expeditionary and Trauma Medicine Department explained how investigations are underway to develop and test in-laboratory assays to help understand the molecular aspects of the immune response to shock and long-term effects of shock in warfighters.

Scientists on Sheppard's team discussed their exploration of the capacity of a service member's immune system to respond to injury (immune-typing) before an injury happens and how this has the potential to be a profoundly invaluable tool for clinical decision-making.

"Your work extends the capabilities to keep a combat casualty alive and enables us to send them back home to mom and dad," said Faison.

(continued on page 2)

NAMRU-SA SCIENTIST RECEIVES TOP PAPER OF THE MONTH



Randy Crossland, Ph.D. (right), a key researcher in NAMRU-SA's Expeditionary and Trauma Medicine Department received a Combat Casualty Care Research Program coin from Lt. Col. (Dr.) Kevin Chung, Research Director, U.S. Army Institute of Surgical Research (left), for earning the Top Paper of the Month in February 2016. (Photo by Sgt. Nguvan Uhaa)

NAMRU-SA Public Affairs

SAN ANTONIO - Randy Crossland, Ph.D., a key researcher in NAMRU-SA's Expeditionary and Trauma Medicine Department received a Combat Casualty Care Research Program coin from Lt. Col. (Dr.) Kevin Chung, Research Director, U.S. Army Institute of Surgical Research (ISR) at Joint Base San Antonio, Fort Sam Houston, for earning the Top Paper of the Month on 5 February 2016.

Every month ISR celebrates the dissemination of research knowledge in the form of published manuscripts. The translation of knowledge gained

through pre-clinical and clinical experiments to optimize combat casualty care is core to both the ISR and NAMRU-SA missions. NAMRU-SA also shares actual office/lab space within ISR.

NAMRU-SA submitted three papers in response to the monthly call for published manuscripts. In addition to Crossland's work on the rapid assessment of shock as the *Top Paper of the Month*, NAMRU-SA researcher in immunology, Philip J. Vernon, Ph.D.'s work on maladaptive immune response was selected as one of the top three papers of the month. Also, NAMRU-SA researcher Antonio R. Macko, Ph.D. was recognized for his translational research on hemorrhage.

This monthly celebration of science acknowledges and recognizes the collective work of investigators across the services within ISR.

Citations:

Crossland, Randy F. PhD; Mitchell, Alex MD; Macko, Antoni R. PhD; Aden, James K. PhD; Campbell, James E. PhD; Sheppard, Forest R. MD, et al. Rapid Assessment of shock in a nonhuman primate model of uncontrolled hemorrhage: Association of traditional and nontraditional vital signs to mortality risk. *J Trauma Acute Care Surg.* 2016;80 (4):610-616.

Vernon PJ, Schaub LJ, Dallelucca JJ, Pusateri AE, Sheppard FR (2015) Rapid Detection of Neutrophil Oxidative Burst Capacity is Predictive of Whole Blood Cytokine Responses. *PLoS ONE* 10 (12): e0146105.

Macko, Antoni R. PhD; Crossland, Randy F. PhD; Cap, Andrew P. MD, PhD; Fryer, Darren M.; Mitchell, Thomas A. MD; Pusateri, Anthony E. PhD; Sheppard, Forest R. MD, et al. Control of severe intra-abdominal hemorrhage with an infusible platelet-derived hemostatic agent in a nonhuman primate (rhesus macaque) model. *J Trauma Acute Care Surg.* 2016;80 (4): 617-624.

NAVY SG TOURS NAMRU-SA CONTINUED FROM PAGE 1

"There are service members out there, alive today because of the things you do right here in this lab. What you do makes a difference in survival rates and keeping people healthy."

Maj. Craig Koeller, Army veterinarian, attached to NAMRU-SA and Mr. Henry Buckley, head of the administration department, were two of the three staff recognized for significant contributions to NAMRU-SA's success by Faison and each received one of his personal coins during the all-hands call.

Faison also talked about the future of the Navy and his vision for the future of Navy Medicine.

"Cutting-edge R&D [research and development] and innovative medical education are hallmarks of military medicine and directly enable our readiness mission," said Faison. "Readiness is not just for today, but also readiness for tomorrow. Over the years, some of medicine's most important breakthroughs have come from Navy R&D programs and I am in awe of what I have seen here today."

NAVY RESEARCHERS FOCUS ON MONITORING THE IMMUNE SYSTEM TO DIAGNOSE AND TREAT TRAUMATIC INJURIES

R. Madelaine Paredes, Ph.D.

Traumatic injury is a leading cause of mortality in the military and civilian population. The loss of blood, combined with tissue damage, initiates a physiologic response that can promote both reparative wound healing and deleterious inflammation, depending on the predisposition of the affected individual's immune system.

In the department of Combat Casualty Care at Naval Medical Research Unit San Antonio (NAMRU-SA), we work towards understanding both the physiologic and molecular changes which occur in response to traumatic injury. Therefore, one of our primary focus areas is the identification of the mechanism(s) the immune system exploits to respond to injury, specifically hemorrhage and poly-trauma.

Like most other things, humans have widely varying immune systems due to a variety of factors, including genetic makeup, gender, age, lifestyle, and previous antigen exposure. Collectively, each of these factors contributes to an individual's immune system's response to insult. Our research at NAMRU-SA employs models that closely replicate militarily relevant injuries in order to translate our findings from the laboratory and into the clinical setting. Finding solutions to diagnose and treat injuries our warfighters sustain on the battlefield is our ultimate goal.

One of the tools we use to monitor the status of the immune system in conditions such as traumatic hemorrhage is immunophenotyping. This involves uncovering the contributions of different immune cell populations in terms of both their occurrence over time (kinetics) and expression of inflammatory factors (functionality). Here we use a sophisticated technique termed flow cytometry which allows us to perform exhaustive characterization of the immune response with cellular resolution required only a few microliters of sample.

Flow cytometry utilizes the power of fluidics to pass cells in suspension through a laser beam. Physical properties of cells and particles are then captured and converted to quantifiable outputs to measure cell size and granular content. Importantly, fluorescently labeled antibodies can be employed to tag specific proteins,



Dr. R. Madelaine Paredes, researcher in NAMRU-SA's Immunodiagnostic and Bioassay Development Department demonstrates the use of the flow cytometer technique to perform single cell measurements. Flow cytometer can identify the numbers of cells that have a particular feature (size, or a specific marker in their surface or intracellular). Navy researchers can then discern what molecules are being produced by each cell type and compile an extensive inflammatory profile for that particular sample.

(Photo courtesy of NAMRU-SA Public Affairs)

such as surface receptors or intracellular molecules, permitting a nuanced and in-depth cellular analysis. We utilize flow cytometry to determine the contributions of various white blood cells (i.e. T-cells and B-cells) to the inflammatory milieu in trauma. Moreover, we discern what molecules are being produced by each cell type and compile an extensive inflammatory profile for that particular sample.

Through immunophenotyping, we can accomplish three critical goals: first, we will be able to uncover key cells and cell products required for orchestrating immunologic reactions to injury; second, foster a more complete understanding of the signaling pathways that become deranged in trauma patients; and lastly, determine which, if any, of these molecules can be exploited as therapeutic targets or opportunities for clinical intervention. These studies continue to provide vital knowledge for both research efforts and clinical decision-making within the trauma and critical care fields.

NAVY DENTAL RESEARCHERS ASSESS THE USE OF CAD/CAM RESTORATION TECHNOLOGY TO IMPROVE OPERATIONAL READINESS OF SAILORS AND MARINES



Lt. Noel Dickens, dental researcher, and Head of Epidemiology and Biostatistics Department in NAMRU-SA's Craniofacial Health and Restorative Medicine Directorate, demonstrates the new computer-aided design and manufacturing CAD/CAM restoration technology. The CAD/CAM system can rapidly produce esthetically pleasing, functional, time saving and cost-effective dental restorations to help Sailors and Marines remain fit to fight. (Photo courtesy of NAMRU-SA Public Affairs)

Lt. Noel E. Dickens, DMD

Navy dentistry's primary focus is to provide quality dental care in a timely manner that maintains a high state of operational readiness for Sailors and Marines. The Craniofacial Health and Restorative Medicine Directorate at NAMRU-SA is dedicated to assessing dental related factors that influence whether Sailors and Marines remain fit to fight.

Currently, warfighters in need of various larger dental restorations such as crowns must wait several weeks while the tooth restoration is fabricated by a technician in a dental laboratory. This delay typically leads to a reduction in operational dental readiness as active duty patients are fitted with a temporary dental crown and remain in a non-deployable status until the procedure is completed.

New computer-aided design and manufacturing (CAD/CAM) systems shorten this time by allowing for rapid scanning, designing, development, and production of dental restorations. Using this technology gives dentists the ability to provide patients with high quality esthetic treatments in a single setting, making it a potential tool to achieve high operational dental

readiness in a rapid manner.

Researchers at NAMRU-SA have been studying the longitudinal placement rates of digitally fabricated in-office esthetic restorations compared to traditional laboratory fabricated restorations by providers in Navy Dental Treatment facilities. Placement rate data used for comparison were generated by analyzing data recorded in the Navy's Dental Common Access System (DENCAS), a data repository for all dental procedures completed by US Navy Dentists.

We found that placement of CAD/CAM chairside restorations by Navy providers has increased each year since data collection of CAD/CAM restoration codes began in Oct 2011 as evident by an 84.1% increase in average monthly placement rates from 2012 (189) to 2015 (348). The increase in CAD/CAM restorations demonstrates a

growing acceptance and utilization rate by Navy dentists and also underscores CAD/CAM technology's ability to produce esthetically pleasing, functional, time saving and cost-effective dental restorations.

Digital dental technology is rapidly expanding among the dental profession and increasingly being utilized by Navy dentists both in shore-based and operational settings where dentists are assigned.

The number of CAD/CAM restorations placed is expected to continue rising as more milling devices are placed in Navy dental clinics and more dentists are trained in their use. The technology is ideal for the military health care environment where the focus is to reduce traditional delays, maintain a high state of dental readiness, and improve patient access during times of high operational tempo.

CAD/CAM systems allow for rapid scanning, designing, development and production of dental restorations.

VISITORS AND TOURS

REAR ADM. GILLINGHAM TOURS NAMRU-SAN ANTONIO

NAMRU-SA Public Affairs

"You are contributing significant work here to support our service members on the ragged edge, serving in challenging and austere conditions, to defend our freedoms."

That was the impression left on Rear Adm. Bruce Gillingham, Navy Medicine West, after receiving a briefing and tour of the Naval Medical Research Unit-San Antonio (NAMRU-SA) and the Tri-Service Research Laboratory (TSRL), located at Fort Sam Houston, Joint Base San Antonio, Texas.

Gillingham came to San Antonio to meet with senior leaders and Navy researchers to understand the strengths and issues of NAMRU-SA, one of eight laboratories the Naval Medical Research Center (NMRC) now under the umbrella of Navy Medicine West (NMW).

"We wanted Rear Adm. Gillingham and his team to see the full range of NAMRU-SA's capabilities to deliver relevant and innovative biomedical solutions to support the survivability of our warfighters," said NAMRU-SA Commanding Officer, Capt. Elizabeth Montcalm-Smith. "I am on full receive mode," said Gillingham, as Montcalm-Smith led him on a tour of the facilities.

Researchers in NAMRU-SA's Craniofacial Health and Restorative Medicine Directorate are investigating a non-antibiotic treatment option that uses lasers and gold nanoparticles to break up bacteria cells.

"If successful, this new treatment could eradicate pathogens, regardless of their level of antibiotic resistance and give health care providers an alternative, non-pharmaceutical approach to treating combat wounds," said Montcalm-Smith.

NAMRU-SA researchers in the Combat Casualty Care and Operational Medicine Directorate also introduced Gillingham to novel advances in the evaluation of interventions to stem and control hemorrhage, and provide resuscitation for injured warfighters.

After the tour, Gillingham spoke to NAMRU-SA staff at the All Hands call. "I am impressed by the brainpower, and innovation here at NAMRU-SA," said Gillingham. "You are conducting research directly



Rear Adm. Bruce Gillingham, Navy Medicine West, learns about the NAMRU-SA investigations to eradicate biofilms and improve treatment of bacterial infections from Dr. Dickson Kirui, biomedical engineer in NAMRU-SA's Maxillofacial Injury and Disease Department.

(Photo courtesy of NAMRU-SA Public Affairs)

relating to what's required and you are well aligned to your operational mission."

Gillingham acknowledged the strong industry and inter-service collaborations in place that demonstrate jointness; and, the ground-breaking research under way to support warfighter readiness, which he sees in NAMRU-SA and across Navy Medicine West.

"To add significant and relevant value to our work and our mission, we need to perform as a high reliability organization," said Gillingham.

To achieve value through high reliability, Gillingham identified three important requirements: robust process improvement, leadership commitment, and a culture of safety.

"In our efforts to achieve high reliability, I think the research community can lead the way," said Gillingham.

Gillingham concluded his talk with questions and discussion from the NAMRU-SA staff regarding various topics from research funding to conference travel. NAMRU-SA staff was pleased to have the opportunity to meet and speak directly with their new senior commander.

"This has been an impressive and truly enjoyable visit. You are integrating the mission and right on track in making significant contributions. I am proud of the work happening at NAMRU-SA and Navy Medicine West takes great pride in supporting you. Thank you for what you do to support our warfighters," said Gillingham.

LOCAL DENTAL INTERNS FROM JUDSON HIGH SCHOOL TOURS MILITARY DENTAL CLINIC WITH NAVY DENTISTS

NAMRU-SA Public Affairs

A group of 13 dental interns from Judson High School in San Antonio, Texas visited the U. S. Army Budge Dental Clinic at Joint Base San Antonio, Fort Sam Houston, Texas, on March 23.

The tour was coordinated by Dr. John Simecek, Head of NAMRU-SA's Craniofacial Health and Restorative Medicine Directorate and lead by Cdr. David Leal, one of two Navy dental officers at Budge. Cdr. Leal is also a former researcher in NAMRU-SA's Craniofacial Directorate.

During the tour students learned that military dentists provide all the same routine dental care as civilian dentists. "But one of the most important concerns in military dentistry is to reduce traditional time delays," said Cdr. Leal.

"Dental problems like a toothache or oral condition can keep a Sailor or Marine from beginning fit to fight, which is vital to mission readiness," said Dr. Simecek.

To provide functional, time saving and cost-effective dental services to warfighters the Navy utilizes cutting edge dental technology like the intraoral camera, and the new computer-aided design and manufacturing (CAD/CAM) crown restoration technology.

Cdr. Leal demonstrated the intraoral camera, which is a small video camera that takes an X-ray of the outside of the gum or tooth. Time-savings that comes with the

STEM SCIENCE, ENGINEERING AND TECHNOLOGY

intraoral camera are especially noticeable when the dentist needs to take several X-rays at one time. Intraoral camera images are easy to re-take, print and duplicate.

The Judson dental interns also got a chance to experience the time-saving benefit and esthetics of digital dentistry technology in action, as Navy dentist, Lcdr. Jason Hicks created a same-day crown with the new computer-aided design and manufacturing (CAD/CAM) restoration technology. CAD/CAM is increasingly being used by Navy dentists in military clinics and operational settings to mill a crown by computer while the patient waits, thus eliminating the second appointment and the temporary crown.

The tour of Budge Dental Clinic is part-one of a two part exposure to Navy dentistry for the Judson dental interns. "In part-two, students will have the opportunity to meet Navy research dentists at NAMRU-SA in the coming months and learn more about research dentistry as a career path," said Simecek. *(continued on page 8)*

Students learned that one of the most important concerns in military dentistry is to reduce traditional time delays.



Cdr. David Leal, Navy dentist (far left) standing next to Ms. Monica Nichols, teacher and coordinator for Judson Dental Intern Program (second from the left) with Navy dentist, Lcdr. Jason Hicks (front, center), and the Judson High School dental interns during a recent tour of the U.S. Army's Budge Dental Clinic, Joint Base San Antonio, Fort Sam Houston, Texas. (NAMRU-SA Public Affairs)

NAMRU-SA PRESENTATIONS & PRODUCTS

Brown, C., Mallory, A., (February 2016). Biological Effects of Nano-sized Dental Materials and Air Quality in Area Dental Laboratories, DoD Nano Working Group, Video Teleconference.

Zane, A., (March 2016). Antibacterial Activity and Biocompatibility of Nitrogen-doped Titanium Dioxide Nanoparticles for Use in Dental Resin Formulations., American Chemical Society Meeting, San Diego, CA.

Dickens, N., Simecek, J., Stahl, J., (March 2016). Incorporation of CAD/CAM Restorations into Navy Dentistry, American Association for Dental Research, Los Angeles, CA.

Dickens, N., Crouse, C., Lien, W., Stahl, J. (March 2016). Comparison of Two Methods for Identifying Enamel Cracks in Vitro, American Association for Dental Research, Los Angeles, CA.

Zane, A., Zuo, R., Villamena, E., Digeorge-Foushee, A., Dutta, P., Nagy, A., Tiba, A., (March 2016). TiO₂ Nitrogen-doped Particles Synthesis for Antibacterial Activity in Dental Resins, Los Angeles, CA.

Mallory, A., (March 2016). Use of Nanoparticles in Dentistry and Air Quality in Area Dental Laboratories, 24th Annual Joint Safety and Environmental Professional Development Symposium, Online.

Crossland, R., Mitchell, A., Macko, A., Aden, J., Campbell, J., Sheppard, F., (2016). Rapid Assessment of Shock in a Nonhuman Primate Model of Uncontrolled Hemorrhage: Association of Traditional and Nontraditional Vital Signs to Mortality Risk, *J Trauma Acute Care Surg.* 2016;80 (4): 610-616.

Macko, A., Crossland, R., Cap, A., Fryer, D., Mitchell, T., Pusateri, A., Sheppard, F., (2016). Control of Severe Intra-abdominal Hemorrhage with an Infusible Platelet-derived Hemostatic Agent in a Nonhuman Primate (rhesus macaque) Model, *J Trauma Acute Care Surg.* 2016;80 (4): 617-624.

Watters, C., Burton, T., Kirui, D., Millenbaugh, N., (2016). Enzymatic Degradation of In Vitro *Staphylococcus aureus* Biofilms Supplemented with Human Plasma, *Infection and Drug Resistance.* 2016: 9.

STEM: DENTAL INTERNS CONTINUED FROM PAGE 6

The interns were accompanied by their teacher, program coordinator and founder of the Judson Dental Internship Program, Ms. Monica Nichols, a registered and certified dental assistant with over 10 years of experience.

The Judson Dental Internship Program is a rigorous two year college level course, Nichols established at Judson High school in 2010. Students take the course in their junior and senior year of high school.

The course is designed to develop the skills necessary for students to later become certified as a Dental Assistant, which is achieved at the end of their junior year. Students learn the various skills required for a dental assistant, including first aid and CPR, clinical chairside assisting, dental tool/materials, infection control, and laboratory procedures. Also, in their junior year interns start a clinical rotation that delivers practical, hands-on dental skills.

They study head/neck/oral anatomy, tooth morphology, oral microbiology, oral pathology, embryology, histology, psychology, patient care, pharmacology, pain control, therapeutics, preventive dentistry and nutrition, basic radiology, human relations,

and job seeking skills.

The Judson Dental Internship Program is deeply rooted in its community and each year opens up their own dental lab to serve and educate the community. The program partners with area dentists to provide free preventive dental care and education to the Judson Independent School District and the surrounding communities.

"It was a pleasure to give the Judson dental interns a tour of our military dental clinic. Many of the interns want to become dentists and a few may even pursue dental research in the future. We were impressed by the program, the knowledge of the students, and the positive impact this program is having on the students career path and our local dental community," said Leal.

Many of the interns want to become dentists and a few may even pursue dental research in the future.

COMMANDING OFFICER'S CORNER

Capt. Elizabeth Montcalm-Smith, PhD, MSC, USN

NAMRU-SA's commitment to Sailors and Marines to deliver the absolute best, research-based efforts for force protection continues to grow, and NAMRU-SA's vibrant research is being acknowledged across the military research landscape.

This issue of the Science Quarterly leads with a story spotlighting The Navy Surgeon General's inspiring visit to NAMRU-SA. Vice Adm. C. Forrest Faison spent a half day meeting with NAMRU-SA researchers to learn more about the projects, capabilities and facilities at NAMRU-SA. Vice Adm. Faison expressed great awe and appreciation for the staff and the work they do to assure service members are restored and returned to duty and home.

Our Navy researchers are driving innovation in knowledge across the spectrum of trauma care as discussed in the stories on NAMRU-SA receiving Top Paper of the Month on the rapid assessment of shock research and our story on monitoring the immune system to diagnose and treat traumatic injuries.

Navy dental researchers at NAMRU-SA talk about assessing the use of computer-aided design and manufacturing as a tool to achieve high operational dental readiness in a rapid manner.

In the Visitors and Tours section, we talk about the visit from Rear Adm. Bruce Gillingham, Navy Medicine West. Rear Adm. Gillingham acknowledged the strong industry and inter-service collaborations in place at NAMRU-SA that demonstrate jointness; and the cutting

-edge research under way at NAMRU-SA to support warfighter readiness.

Navy dentists and dental researchers close this issue with an impressive STEM story that highlights the value of inspiring a group of high school dental interns toward the military research career path. I know our Navy dentists enjoyed hosting the tour for the dental interns-- just as much as the interns enjoyed the experience.

I am proud of the work happening at NAMRU-SA and these stories reflect the passion that is present in our vibrant research culture, and that passion is directly related to what is required to support warfighters and aligned to our operational mission.



TAKING THE HELM OF NAVY MEDICINE'S COMBAT CASUALTY CARE & CRANIOFACIAL HEALTH RESEARCH

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