


10-YEAR ANNIVERSARY EDITION

DETERRENCE & DEFENSE RESEARCH

A DECADE OF IMPACT TO FORTIFY THE FUTURE

NSRI
NATIONAL STRATEGIC
RESEARCH INSTITUTE
at the University of Nebraska





Dr. Christopher Yeaw (right), NSRI associate executive director, participating as a senior advisor with the U.S. Department of State in negotiations with the Russian Federation in July 2020 in Vienna, Austria.

TRUSTED AGENTS READY TO RESPOND

In July 2020, Dr. Christopher Yeaw, associate executive director for strategic deterrence and nuclear programs at the National Strategic Research Institute (NSRI) at the University of Nebraska, traveled to Vienna, Austria, as a senior advisor for the U.S. Department of State to support active negotiations with the Russian Federation regarding future nuclear arms control options.

The challenge for those at the enormously long negotiating table: to forge a comprehensive nuclear treaty that would truly reduce the threat of even limited nuclear war.

On day one, a mere three hours into the debate, Dr. Yeaw delivered a carefully scripted, hour-long address to the Russian delegation.

Designed to answer nearly 40 very specific questions posed by the Russian representatives, Dr. Yeaw's speech aimed to be enlightening yet sharp. Long before Russian President Vladimir Putin unleashed war in Ukraine in 2022, he was rattling the nuclear saber. In March of 2018, he unveiled his long-developed additional nuclear capabilities, showcasing an enormous

investment of resources over two decades to build a force designed to compel rivals at the theater level and, if necessary, to fight and win a limited nuclear war. A pointed response was clearly warranted.

Dr. Yeaw's speech was the culmination of several months of work for an NSRI team he led of more than a dozen senior consultants. As trusted agents to the federal government, they had provided responsive and weekly advice, recommendations and products given directly to the President's Special Envoy for Arms Control, the National Security Council and the Acting Assistant Secretary for Arms Control, Verification and Compliance.

The team's supportive efforts bolstered the negotiation process and produced substantial impact at the national and international levels. The desired treaty did not come to fruition, but the event demonstrated NSRI's ability to enhance the mission and capabilities of the U.S. government through tenacity, knowledge and agility under pressure.

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“I’m deeply grateful for the trust and confidence the Department of Defense and U.S. Strategic Command have placed in NSRI and the University of Nebraska to support their mission. Time and again over the last decade, the university, through NSRI, has delivered innovative research and development to protect our nation and the women and men who serve. NSRI has helped to harness the expertise and excitement of faculty and researchers across the university system to advance national security, and I look forward to many more years of partnership and success.”

TED CARTER

President, University of Nebraska System

“The researchers and students at NSRI and the University of Nebraska are an integral part in informing and shaping the strategic deterrence mission. This partnership is critical to our ability to maintain insight and foresight for strategic deterrence within evolving national security challenges. We must continue to be innovative in how we harness the intellectual capacity of our teams in order to be prepared for the future.”

ADM. CHARLES RICHARD

Commander, U.S. Strategic Command,
Sponsor of NSRI as a University
Affiliated Research Center



MESSAGE FROM THE EXECUTIVE DIRECTOR

RICK EVANS

MAJ. GEN., USAF (RET.)



Summarizing the last two years is a difficult challenge. Despite the ups and downs of operating during uniquely dynamic times, our team responded to ongoing COVID-19 mitigation efforts, delivered critical national security research, retooled training, grew our expertise and launched promising new partnerships and programs. While it is impossible to quantify my pride in this team and our partners who pulled together to find solutions, this report crystallizes NSRI's impact throughout the past two years and celebrates the anniversary milestone of a decade of this institute.

In January 2021, I humbly accepted the NSRI leadership baton from Lt. Gen., USAF (Ret.) Bob Hinson, our founding executive director. It is an honor to be entrusted with the institute he built from one employee to a team of more than 60 researchers and staff in five facilities across the nation. Thank you, Bob, for your service and foresight to turn a vision into reality and create a unique partnership between the University of Nebraska System (NU) and U.S. Strategic Command (USSTRATCOM).

Ten years ago, USSTRATCOM selected NU as its University Affiliated Research Center (UARC). Out of that relationship grew NSRI, which harnesses leading research, capabilities, technology and workforce development resources to address some of the toughest national security challenges.

At this moment, some challenges are all too real. Mitigation of COVID-19 continues and USSTRATCOM's primary mission of strategic deterrence is being tested with Russia's invasion of Ukraine. These events remind us daily that we must continue improving our understanding of deterrence dynamics and how they evolve with multiple nuclear-capable adversaries.

NSRI's creative problem solvers stand ready to deliver solutions.

During this reporting period, our team and nearly 150 university researchers and students provided insights and recommendations to federal government customers. We developed, verified and tested threat detection devices and tools. We trained hundreds of active-duty military personnel, first responders and medical professionals.

Thanks to NSRI efforts, new talent is entering this mission space. A new fellows program welcomed 123 NU researchers. An independent research and development program provided more than \$350,000 in seed funding across the chemical, biological, radiological and nuclear threat spectrum. Internship opportunities continue to increase, with several alumni going on to national security careers.

Our contributions also fueled ongoing and new trusted partnerships. In 2020, USSTRATCOM awarded NSRI its third indefinite delivery, indefinite quantity (IDIQ) contract vehicle valued at \$92 million over five years. That also came with renewal of its UARC sponsorship through 2025. The Department of Energy National Nuclear Security Administration awarded NSRI a \$25 million IDIQ contract and the Defense Threat Reduction Agency continued to rely on NSRI, providing more than \$24 million in awards for research projects.

As NSRI enters its second decade of service to USSTRATCOM and the Department of Defense, we know our capabilities will be needed to address a rapidly evolving national security landscape. We know academia will play an important role in meeting the challenges ahead, and we cannot fail — the men and women of the Armed Forces are counting on us to deliver.

We look back on a decade of success and growth with pride in the important role NSRI has fulfilled as a responsive, trusted partner of the federal government. Looking forward, I am excited about the future and the opportunities we have to grow our work and make an impact.

As the pandemic has abated, NSRI's trajectory has returned, and we are ready and able to provide innovative, customer-focused research and development solutions for complex national security requirements. Join us as we address the pressing national security challenges throughout the next decade.



BOB HINSON

Lt. Gen., USAF (Ret.)
NSRI Founding Executive Director
2012 – 2020

“We created NSRI with an unrelenting commitment to helping better prepare U.S. Strategic Command and our soldiers, sailors, airmen, marines and first responders by tapping into the University of Nebraska’s tremendous research and strategic potential. The same passion and urgency we felt in the beginning must continue to guide the efforts, resources and investments of this UARC. I’m tremendously proud of how far the institute has come and grateful to have been part of that journey. Charge forward! We need to dig deeper and reach further to help our nation’s strategists and warfighters prevail in this next era of global conflict.”

RESPONSIVE TO NEW REALITIES OF NATIONAL DEFENSE

The United States stands at a critical moment in its 245-year history, a moment characterized by threats emanating from not one, but two, nuclear rivals. China has pursued unprecedented nuclear expansion and Russia is completing a massive nuclear modernization program. Both of these nuclear rivals have developed the capabilities and doctrines to execute any form of nuclear strategy they so choose, including nuclear coercion at any and every level of escalation.

China is accelerating its development of strategic nuclear warheads with recent revelations indicating construction of at least 250 new missile silos, for example. In the case of Russia, its invasion of Ukraine in February 2022 created a scenario that the international community had not considered since the Cuban Missile Crisis: potential use of nuclear weapons in conflict. The weapons potentially at play are nonstrategic nuclear weapons. Russia's arsenal of this type of weapon is ten times greater than the size of the United States'.

Yet, nuclear threats were not the only concern brought forward in the war in Ukraine. The potential use of both chemical and biological weapons of mass destruction caused the international community to go on high alert. All of this while the COVID-19 pandemic that had plagued the globe for two years was still abating.

The collision of these scenarios across the threat spectrum triggered a preponderance of the resources and assets of the National Strategic Research Institute (NSRI) at the University of Nebraska (NU).

Within this reporting period of July 1, 2020, through June 30, 2022, NSRI's role in national defense expanded even further as it activated research projects and personnel across its entire portfolio to support deterrence, mitigation and response to unthinkable chemical, biological, radiological, nuclear and explosive threats in real time.

After a decade of development and growth, NSRI was ready. Its researchers, faculty fellows, students, partners, trainers and collaborators responded to these realities with clarity, ingenuity and purpose.



Lt. Gen., USAF (Ret.) Bob Hinson, NSRI founding executive director, and Ted Carter (right), NU president, announce the third IDIQ contract vehicle between NSRI and U.S. Strategic Command — \$92 million. September 15, 2020, Lincoln, Nebraska.

PURPOSEFUL STRATEGY

NSRI has served as the University Affiliated Research Center (UARC) of U.S. Strategic Command (USSTRATCOM) and NU since September 2012. Only 14 academic institutions in the nation currently hold this designation from the Office of the Assistant Secretary of Defense.

In September 2020, NU received its third USSTRATCOM indefinite delivery, indefinite quantity (IDIQ) contract vehicle through NSRI — a \$92 million vehicle that brought the institute’s total contract and grant awards since 2012 to \$298 million. As a UARC, NU through NSRI serves as a trusted agent to the U.S. federal government, a distinction allowing for close partnerships and highly responsive contracting between researchers and federal government agencies working on national security missions.

USSTRATCOM’s primary mission is to deter strategic attack on the U.S. and its allies. NSRI provides strategic leadership and expertise

to support this mission, connecting university researchers and resources with key command partners to find and fill gaps, assess and assert links, explore and solve problems.

While adversarial nuclear deployment certainly qualifies as a strategic attack, it is not the only type of strategic threat. The COVID-19 pandemic and Russia’s invasion of Ukraine illustrate the reality that future threats very likely will extend beyond the nuclear capabilities of adversaries, illuminating the need for constant assessment and reassessment for strategic attack prevention, mitigation and response across the threat spectrum.

As USSTRATCOM’s UARC, NSRI has and will continue to think through the entire range of strategic attack scenarios — nuclear and nonnuclear, kinetic and nonkinetic — to offer USSTRATCOM, the Department of Defense (DOD) and the nation the research and solutions required to successfully execute the mission of deterring strategic attack.

CONVENER, CATALYST, EXPERT

In its role as a high-level defense resource, NSRI is helping anticipate and confront threats across the entire spectrum. Examples include:

RESEARCH FOR STRATEGIC DETERRENCE

Focused on the geopolitical features of the new tripolar era, NSRI is convening NU researchers and providing expertise and solutions to the USSTRATCOM Commander's 2022 Analytical Agenda.

AIRCRAFT AIRFLOW TESTING TO COMBAT COVID-19

NSRI scientists' rapid response to U.S. Transportation Command led to the testing of seven military aircraft in seven days in 2020. This work ensured the DOD could safely transport warfighters home during the pandemic.

FULL-SCALE CHEMICAL AND EXPLOSIVE TRAINING

NSRI trainers and scientists hosted and facilitated chemical and explosive training exercises for more than 100 active-duty personnel from multiple organizations to advance participants' knowledge on threat synthesis, precursors and equipment.

DEVICE DEVELOPMENT FOR PERIMETER DEFENSE

NSRI convened NU students and researchers to create and demonstrate a rapidly deployable network of early-warning detectors and collectors of biological agents.

DEVELOPMENT OF MILITARY MEDICAL PERSONNEL ASSESSMENT TOOLS

Thanks to NSRI's UARC status, an NU researcher rapidly completed a contract with a DOD entity to create assessment tools that measure the skills of frontline military medical personnel.

NU is uniquely equipped to collaborate with USSTRATCOM and the broader DOD and national security industry through NSRI. The University of Nebraska at Kearney (UNK), University of Nebraska–Lincoln (UNL), University of Nebraska Medical Center (UNMC) and University of Nebraska at Omaha (UNO) offer an established network of leading researchers, laboratories, strategic centers and technology.

Working alongside the experts who lead these efforts has allowed NSRI to grow into the distinguished national defense resource it is today. To continue building its capabilities, NSRI launched three premier engagement programs during this reporting period:

NSRI FELLOWS PROGRAM

To amplify NU's ability to support national security missions, NSRI appointed 123 researchers as fellows. They bring forward deep expertise to build multidisciplinary research teams and leverage the facilities, technologies and students convened across NU's four campuses. Details on page 44.

NSRI INDEPENDENT RESEARCH AND DEVELOPMENT (IRAD) PROGRAM

To develop and advance technical capabilities and competencies, NSRI launched the NSRI IRAD program in September 2021. At the time of this report, more than \$350,000 of NSRI funding has been invested in 12 projects. Details on page 46.

FOOD, AGRICULTURE AND ENVIRONMENT SECURITY PROGRAM

To leverage NU's deep roots in food, agriculture and environment research, NSRI created a new focus area to apply the university's expertise to the countering weapons of mass destruction (CWMD) mission. Details on page 20.

RESOURCES & ROLES FOR THE FUTURE

As NSRI developed, the institute leveraged new partnerships and contracts to respond to increasingly complex national security challenges presented by the DOD and federal government. From senior-level intergovernmental advisement to cooperative research and development agreements and memorandums of understanding with national and international universities, the institute actively connects the DOD with the experts it needs.

In addition to receiving its third IDIQ contract vehicle with USSTRATCOM, NSRI created significant new partnerships during this reporting period, such as a five-year, \$25 million IDIQ contract vehicle with the Department of Energy National Nuclear Security Administration to support strategic deterrence and nuclear threat reduction efforts.

A highly experienced leadership team is driving new programs and partnerships forward with key hires demonstrating NU's understanding and commitment to the DOD, and specifically to USSTRATCOM. Recent additions to the expert team include:

MAJ. GEN., USAF (RET.) RICK EVANS, EXECUTIVE DIRECTOR

Upon the retirement of Lt. Gen., USAF (Ret.) Bob Hinson, founding executive director, in December 2020, Evans was named executive director. His experience in senior USSTRATCOM positions includes: Mobilization Assistant to the Director of Global Operations and Deputy Director for Joint Electromagnetic Spectrum Operations; Deputy Commander for Joint Functional Component for Global

Strike; Mobilization Assistant to Deputy Commander and Commander; and Director of Reserve Forces. Evans also served as Acting Deputy Commander and Program Manager for USSTRATCOM's new Command and Control Facility.

VADM, USN (RET.) DAVID KRIETE, BOARD OF DIRECTORS

Kriete, former USSTRATCOM deputy commander, joined VADM, USN (Ret.) Carl Mauney and Maj. Gen., USAF (Ret.) Roosevelt Mercer Jr. on the NSRI Board of Directors.

CAPT., USN (RET.) ADAM CARLSTROM, RESEARCH DIRECTOR, USSTRATCOM PROGRAMS; COL., USAF (RET.) ALLEN GEIST, DIRECTOR, ELECTROMAGNETIC SPECTRUM OPERATIONS (EMSO); PATRICK RHOADS, DIRECTOR, NUCLEAR WEAPONS ENTERPRISE SUPPORT

To increase its support physically at USSTRATCOM headquarters and with key command partners, NSRI hired former USSTRATCOM operators Carlstrom and Geist, as well as Rhoads, a former federal senior executive.

MARTY SIKES, ASSOCIATE EXECUTIVE DIRECTOR, CHEMICAL & BIOLOGICAL DEFENSE PROGRAMS

Sikes rejoined NSRI after serving as a senior level advisor for the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense.

Ultimately, people are the greatest resource NU and NSRI can offer to USSTRATCOM, the DOD and the nation.

LEADERSHIP

NSRI TEAM

400+ YEARS OF COMBINED EXPERIENCE

working with or in the Department of Defense and other federal agencies.



RICHARD EVANS
Maj. Gen., USAF (Ret.)
Executive Director



JOSHUA SANTARPIA, PH.D.
Science and Technology
Advisor



MARTY SIKES, MS
Associate Executive Director,
Chemical and Biological
Defense Programs



JOHN TENCER, MBA
Associate Executive
Director, Operations



**NEAL WOOLLEN, DVM,
PH.D., MSS**
Associate Executive Director,
CWMD Allied Programs



CHRISTOPHER YEAW, PH.D.
Associate Executive Director,
Strategic Deterrence and
Nuclear Programs



ADAM CARLSTROM, MBA
Research Director,
USSTRATCOM Programs



WES CARTER
Research Director, Field
Operations and Training



DILLON CUNNINGHAM
Research Director, Biological
Defense Programs



ALLEN GEIST, MAS
Director, EMSO Programs



KATELYN IDEUS, MA
Director, Communications
and PR



ADAM LOWTHER, PH.D.
Director, Strategic
Deterrence Programs



THOMAS MUELLER, PH.D.
Research Director, Chemical
Defense Programs



ANNA RAVNHOLDT, MPA
Director, Security
Compliance



PATRICK RHOADS, MS
Research Director, Nuclear
Enterprise Support



TAMI THOMPSON, PH.D.
Strategic Advisor

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Vice Admiral, USN (Ret.)

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Vice-Chairman of the Board
Maj. Gen., USAF (Ret.)

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Vice Admiral, USN (Ret.)

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Vice Chancellor for Research
University of Nebraska Medical Center

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U.S. Senator, Nebraska
2001–2013

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Vice President and General Counsel
University of Nebraska System

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Vice Chancellor for Research & Economic Development
University of Nebraska–Lincoln

UNIVERSITY OF NEBRASKA SYSTEM

TED CARTER

President
University of Nebraska System

DOUG KRISTENSEN, J.D.

Chancellor
University of Nebraska at Kearney

RONNIE GREEN, PH.D.

Chancellor
University of Nebraska–Lincoln

JEFFREY GOLD, M.D.

Provost, University of Nebraska System
Chancellor, University of Nebraska Medical Center

JOANNE LI, PH.D.

Chancellor
University of Nebraska at Omaha



“For over a decade, NSRI has filled an important role among the Department of Defense and in particular, U.S. Strategic Command, and the university — engaging, building understanding and aligning needs with capabilities of Nebraska’s researchers to solve tough national security challenges. I congratulate the NSRI and university team for dedicating their energy, strong cultures of innovation and deep skills bench so effectively, and I look forward to an exciting future.”

VADM CARL MAUNEY

Chairman, NSRI Board of Directors

PRIME LOCATIONS FOR DOD ACCESS

NSRI NCR LABORATORY & CONFERENCE CENTER

ANNAPOLIS JUNCTION, MD



NATIONAL SECURITY
AGENCY (NSA)
FORT MEADE, MD

10 MILES

20 MILES

30 MILES

THE PENTAGON
ARLINGTON, VA

VIRGINIA

MARYLAND

NSRI and NU invest in facilities and laboratories conveniently located for federal government access. For example, the 12,000-square-foot NSRI National Capital Region Laboratory and Conference Center established in 2016 boasts leading collaboration technology and multiple meeting rooms for closed-door discussions. A 4,300-square-foot flex space is often used for scenario-based exercises, tabletop exercises, workgroup discussions, laboratory trainings and programs and technology reviews and demonstrations. The facility is located approximately five miles from Fort Meade, 20 miles from the Pentagon and 30 miles from the headquarters of the Defense Threat Reduction Agency (DTRA).

NSRI's headquarters is also located within minutes of USSTRATCOM's headquarters at Offutt Air Force Base in Omaha, Nebraska.

During this reporting period, NSRI opened the Collaborative Biosecurity Laboratory in partnership with the Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln to pursue research for agricultural and natural resources security, defense and countermeasures.

NSRI LOCATIONS

HEADQUARTERS

Scott Technology Center, Omaha, NE

RESEARCH OFFICE AT U.S. STRATEGIC COMMAND

Offutt Air Force Base, Omaha, NE

⊙ NATIONAL CAPITAL REGION (NCR) LABORATORY & CONFERENCE CENTER

Annapolis Junction, MD

SPACE COAST FIELD OFFICE

Melbourne, FL

FREDERICKSBURG FIELD OFFICE & LABORATORY

Fredericksburg, VA

COLLABORATIVE BIOSECURITY LABORATORY

Institute of Agriculture and Natural Resources
University of Nebraska–Lincoln, Lincoln, NE

FIELD OFFICE AT NEBRASKA INNOVATION CAMPUS

Lincoln, NE

CONTRACTING & BUSINESS PROCESS

As a UARC, NSRI accesses an indefinite delivery, indefinite quantity (IDIQ) contract vehicle through USSTRATCOM that shortens the timeline from identification of need to contract award and creates trusted, collaborative relationships. The benefits of doing business with NSRI include:

- ▶ Comprehensive knowledge of sponsors' requirements and problems
- ▶ Broad access to defense-applicable information, including proprietary data
- ▶ Vast corporate knowledge
- ▶ Independence and objectivity
- ▶ Quick response capability
- ▶ Current operational experience
- ▶ Freedom from real and/or perceived conflicts of interest

3-STEP IDIQ CONTRACTING PROCESS

NSRI's integrated team process significantly reduces the contracting timeline and increases responsiveness to requirements. Three contract-implementing stakeholders play roles in the following three-step contracting process.

KEY

- ▶ Requesting Sponsor ▶ NSRI ▶ 55th Contracting Squadron

USSTRATCOM facilitates and assists throughout the process.

STEP 1: PERFORMANCE WORK STATEMENT (PWS)

- ▶▶▶ Identify requirements and budget
- ▶▶▶ Draft PWS through collaborative process
- ▶▶▶ Commit funding
- ▶▶▶ Create independent government estimate
- ▶▶▶ Identify Contracting Officer Representative (COR)
- ▶▶▶ Draft proposal

STEP 2: REQUEST FOR PROPOSAL (RFP)

- ▶▶▶ Formal PWS review
- ▶▶▶ Release of RFP
- ▶▶▶ Proposal submission

STEP 3: PROPOSAL REVIEW & AWARD

- ▶▶▶ Perform technical and cost analysis
- ▶▶▶ COR training
- ▶▶▶ Contract team reviews
- ▶▶▶ Negotiations
- ▶▶▶ Process award documentation

NSRI also accepts funding from direct contracting vehicles, other transaction agreements, cooperative agreements and grants. Details at nsri.nebraska.edu/business.

NSRI MISSION

**ENABLE DETERRENCE OF,
PREPAREDNESS FOR AND
RESPONSE TO STRATEGIC NATIONAL
SECURITY THREATS ACROSS
MULTIPLE DOMAINS THROUGH
RESEARCH AND SUPPORT**

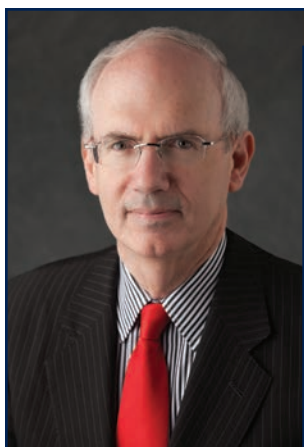
WATCH

NU President Ted Carter
and NSRI Executive Director
Rick Evans share NSRI's
motivation and purpose at
nsri.nebraska.edu/mission.



IMPACT METRICS

ALL TIME

JULY 1, 2020 –
JUNE 30, 2022**147****CONTRACTS AWARDED****65****ACTIVE PROJECTS****48****SPONSORING AGENCIES****78****NU RESEARCHERS
LEAD OR CONTRIBUTE
TO PROJECTS****\$207.5
MILLION****TOTAL AWARD VALUE
FOR RESEARCH
CONTRACTS****64****NU STUDENTS
CONTRIBUTE
TO PROJECTS**

“The strategic partnership between the university and U.S. Strategic Command is priceless, catalyzing research and development that has landed in the hands of warfighters and first responders and providing tremendous opportunities to students to launch careers in national security. Our aim is to enhance the exponential impact of this work going forward.”

JEFFREY GOLD, M.D.

NU Provost, UNMC Chancellor

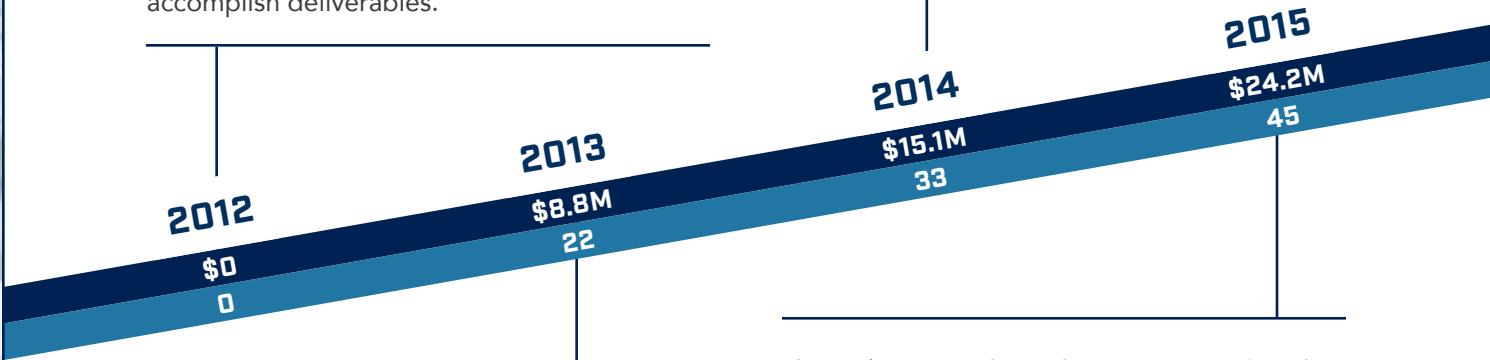
MISSION MILESTONES

KEY

- Running Total of Contract Awards
- Running Total of Contracts

The University of Nebraska System (NU) competes in a national open call for and is selected as a University Affiliated Research Center (UARC) designated by the U.S. Office of the Secretary of Defense. NU establishes NSRI as an affiliated but independent 501(c)3 organization to carry the UARC designation. U.S. Strategic Command (USSTRATCOM) awards NSRI its first indefinite delivery, indefinite quantity (IDIQ) contract vehicle worth \$84 million. NSRI begins connecting NU researchers with federal agency customers to accomplish deliverables.

NSRI brings in its tenth customer. Projects demonstrate a breadth of capabilities and capacity. Through a key project, "Low-Dose Radiographic Systems," University of Nebraska-Lincoln (UNL) physicists will demonstrate that laser-produced X-rays can penetrate steel much thicker than cargo container walls and detect an even smaller amount of uranium than the minimum required by inspection standards.



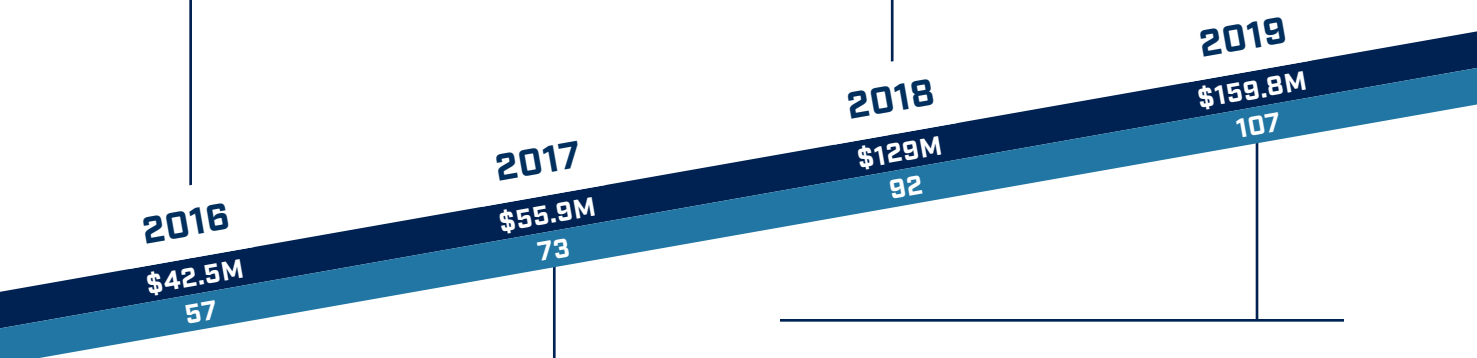
With \$600,000 of startup funding from NU, NSRI secures 22 task orders totaling nearly \$9 million. USSTRATCOM alone launches \$4 million worth of projects, including "Nanogel-Based Bioagent Sensing System," "Decision Support Capabilities for National Leadership" and "Standoff Detection of Nuclear Materials." This immediate success validates the demand for national defense support and capabilities from NU and NSRI.

The 25th project through NSRI is completed and, in total, 24 NU researchers have served as principal investigators through NSRI. Projects launched this year include immunomics unit research support (\$5.3 million), traffic-calming elements for entry control facilities to delay and contain threats (\$1 million) and a next-generation sequence training module (\$1 million).

Total contract award value is the highest one-year total to date at \$18.3 million. NSRI scientists with extensive Department of Defense (DOD) experience are brought on board and begin work on a \$9.3 million, three-year contract involving biological field and laboratory support.

In this year alone, five contract awards total more than \$8 million each. Several projects enter a second phase, including, "En Route Care Acute Respiratory Distress System Mitigation Using Oxygenated Microbubbles" and "Medical Countermeasure Drug Discovery and Development."

To keep pace with demand, USSTRATCOM awards NSRI its second IDIQ contract vehicle, this one for \$92 million.



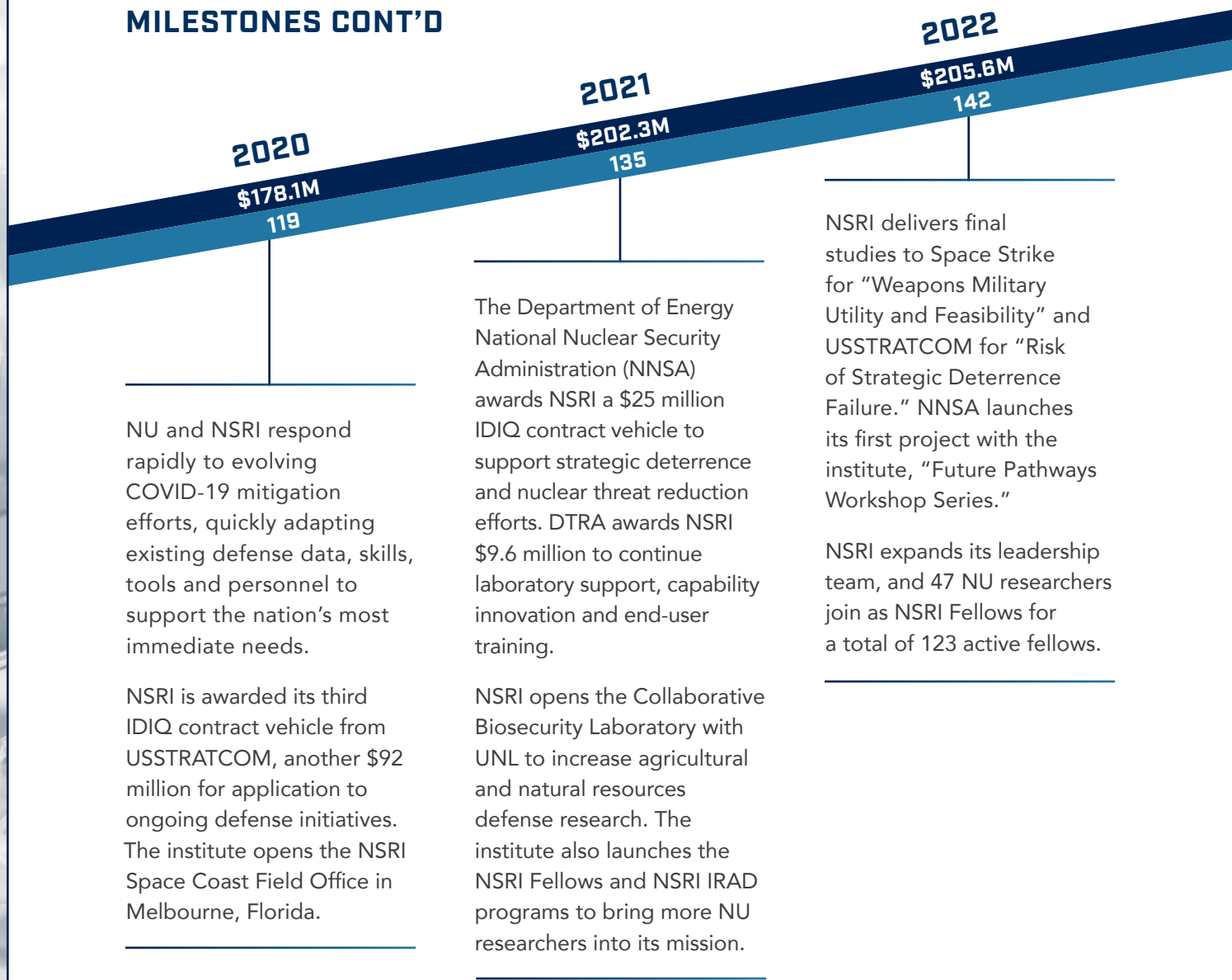
NSRI begins expanding its physical footprint beyond Nebraska to better support defense customers. The NSRI National Capital Region Laboratory and Conference Center opens in Annapolis Junction, Maryland, and the NSRI Fredericksburg Field Office and Laboratory opens in Fredericksburg, Virginia.

A cross-campus partnership launches the Nebraska Drug Discovery and Development Pipeline through a \$7.3 million contract. The pipeline will go on to assist in development of drugs to mitigate and/or counteract effects of Acute Radiation Syndrome.

NSRI has now served more than 40 defense customers. Key projects launched during this year include "Research and Development to Support Advanced Detection and Decontamination" for the Defense Threat Reduction Agency (DTRA), "Fixed VTOL Sensor Emplacement" for USSTRATCOM and "Chemical and Biological Defense Technology Implementation and Guidance of Operational Research" for the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense.

CONTINUED...

MILESTONES CONT'D



WATCH

See our animated timeline at nsri.nebraska.edu/mission.



NU CAMPUS INVESTMENTS IN NATIONAL SECURITY

To meet the requirements and needs of the federal government, the University of Nebraska campuses have made multiple notable investments throughout the last few years in human capital and key facilities.

NEW INITIATIVES

- ▶ Project NExT from the University of Nebraska Medical Center (UNMC) to improve readiness of the U.S. health system to respond to a catastrophic disaster, another pandemic, accidents or overt attack
- ▶ The Nebraska Drug Discovery & Development Pipeline (ND³P) designed to harness NU's capabilities
- ▶ Partnership with the Department of Homeland Security (DHS) to grow the DHS workforce in critical areas related to national security
- ▶ Seed funding for a University of Nebraska at Omaha (UNO) Big Idea focused on security and intelligence studies as part of the university's strategic planning process

NEW LABORATORIES

- ▶ Collaborative Biosecurity Laboratory at the University of Nebraska–Lincoln (UNL) with NSRI to provide foresight regarding weapons of mass destruction in the food, agriculture and environment sectors
- ▶ Second Biosafety Level-3 (BSL-3) at UNMC to meet research need for characterization of SARS CoV-2; previous BSL-3 for select agent research is a Tier 1 select agent program certified by the Center for Disease Control

- ▶ Emerging Pathogens Laboratory at UNMC
- ▶ Behlen Laboratory renovation at UNL for research at a higher security level

NEW FACILITIES

- ▶ State-of-the-art instrumentation and operation of shared facilities at UNL, including Nebraska Center for Materials and Nanoscience, Nano-Engineering Research Core Facility and Holland Computing Center
- ▶ Global Center for Health Security Clinical Research Unit at UNMC
- ▶ National Training, Simulation and Quarantine Center at UNMC
- ▶ Ron Rhoden Business Innovation Center addition to UNO Mammel Hall
- ▶ Biomechanics Research Building at UNO
- ▶ Engineering Research Center and construction of Kiewit Hall at UNL

NEW & RENEWED PROGRAMS

- ▶ USSTRATCOM Fellows Program, renewed annually since 2014
- ▶ UNMC Combat Casualty Care Research Program
- ▶ Military-Connected Resource Center to expand resources for UNO students
- ▶ Scott Scholars Summer Design Internship pairing students with USSTRATCOM

RESEARCH HIGHLIGHTS

With a deep understanding of the Department of Defense (DOD) and the strategic deterrence landscape, the National Strategic Research Institute (NSRI) activates the nexus of expertise, technology and facilities throughout the University of Nebraska System (NU) to identify national security gaps, fulfill requirements and anticipate challenges. The following pages demonstrate how, in collaboration with NU, NSRI puts solutions directly into the hands of decision makers, operators and first responders.

To accomplish its objectives, NSRI operates across and within five focus areas derived from the core competencies it was assigned when it became a DOD-designated University Affiliated Research Center (UARC) in 2012.

UARC CORE COMPETENCIES

- ▶ Active & Passive Defense Against Weapons of Mass Destruction
- ▶ Nuclear Detection & Forensics
- ▶ Consequence Management
- ▶ Detection of Chemical & Biological Weapons
- ▶ Mission-Related Research

RESPONSE & FORESIGHT

Within this reporting period, NSRI and NU, along with several federal government partners, redirected resources to help mitigate the spread of COVID-19 and glean understanding about the virus for ongoing prevention. Because of the extraordinary impact of these shifts, highlights from NSRI's response to COVID-19 are featured in the following pages.

The institute also launched a new focus area in response to a growing fear of biological attack and its potential destruction of the nation's food supply. The new NSRI food, agriculture and environment security program will leverage NU's 150 years of agricultural and environmental research to bolster the countering weapons of mass destruction (CWMD) mission.



"The National Strategic Research Institute and its academic partner, the University of Nebraska, have the critical expertise needed to tackle many of the Department of Defense's top challenges around biologic, chemical, nuclear and cybersecurity threats. We look forward to continuing to grow our partnerships with the Department of Defense for decades to come."

JENNIFER LARSEN, M.D.

Vice Chancellor for Research, University of Nebraska Medical Center
NSRI Board of Directors Member

FOCUS AREAS

STRATEGIC DETERRENCE & NUCLEAR PROGRAMS

- ▶ Weapons policy analysis: foreign threats, arms control, conceptual weapon design, strategic materials production
- ▶ Strategic conflict deterrence and escalation dynamics: tabletop exercises, wargames, model development, decision support tools
- ▶ Consequence management: nuclear detection and forensics, hazard modeling, disaster mitigation research
- ▶ Support technologies: future nuclear command, control and communications (NC3) technology exploration, advanced concepts and architecture, materials research, advanced manufacturing, nuclear certification

CHEMICAL & BIOLOGICAL THREAT DETECTION & COUNTERMEASURE DEVELOPMENT

- ▶ Development of detection, collection, identification and exploitation strategies and technologies
- ▶ Hazard detection, decontamination, mitigation and remediation
- ▶ Aerosol science: environmental characterization and dissemination
- ▶ Materials biology: substrate effects, binding kinetics and surface integration
- ▶ Threat and effects: intelligence analysis, modeling and simulation studies
- ▶ Technical collection, field exploitation and forensics
- ▶ Rapid prototyping and development
- ▶ Testing and evaluation / independent verification and validation

MEDICAL COUNTERMEASURES

- ▶ Multisystem disaster medicine readiness and response solutions for chemical, biological, radiological, nuclear, explosive (CBRNe) threats
- ▶ High-consequence, pathogen-infected patient management and training
- ▶ Vaccine, therapeutic, diagnostic capability discovery and development

THREAT-BASED TRAINING & EXERCISE SUPPORT

- ▶ Academic, hands-on, just-in-time and scenario-driven programs across the CBRNe threats spectrum conducted on site or at NSRI's secure location
- ▶ Full-scale exercise coordination challenging all levels of technical and tactical weapons of mass destruction (WMD) response teams
- ▶ Sponsor-tailored scenarios that promote multi-jurisdiction participation of mission partners during a WMD-related incident
- ▶ Facilitation of advanced development acquisition support and DOD testing and evaluation activities
- ▶ Subject matter expert support to customer-run exercises

NEW! FOOD, AGRICULTURE & ENVIRONMENT SECURITY

- ▶ Characterization and mitigation solutions for natural, accidental and intentional CBRN threats and their consequences impacting the U.S. and global food and agriculture sector
- ▶ Research solutions for environmental impacts and factors associated with CBRN incidents
- ▶ One-health perspective solutions for incidents that cross domains with human, animal, plant and environment considerations

RESPONSE TO COVID-19 PANDEMIC

For a decade, NSRI has focused on interwoven deterrence and defense projects from many angles — always with an eye to enhancing preparation and response capabilities. In the early months of the pandemic in 2020 and since, that practice was put to the ultimate test.

“Because of the need for quick answers, the research reached a point it never could have before due to past limitations on funding and interest,” said Dr. Josh Santarpia, world-leading aerosol biologist at the University of Nebraska Medical Center (UNMC) and NSRI’s science and technology advisor.

INITIAL RAPID-RESPONSE COVID TRANSMISSION RESEARCH

Dr. Santarpia led initial environmental contamination studies of COVID-19 with the first U.S. patients who were brought to the Nebraska Biocontainment Unit and the National Quarantine Unit at UNMC. This work led to a study that characterized containment care transport systems for Air Mobility Command, assessed aerosol transport in military and civilian airframes for U.S. Transportation Command and assessed viral shedding, personal protective equipment (PPE) use and viral transmission and monitoring in public schools and meatpacking plants.

Sean Kinahan, NSRI senior scientist, with colleagues, published a national journal article reporting on the airframes research. The

article, “Aerosol tracer testing in Boeing 767 and 777 aircraft to simulate exposure potential of infectious aerosol such as SARS-CoV-2,” was published in PLOS ONE in December 2021. Dr. Santarpia and Kinahan have provided several national media interviews regarding this work, including an appearance by Kinahan on ABC World News Tonight.

MULTIDISCIPLINARY SOLUTIONS AND FORWARD INNOVATION

During the ventilator shortage of early 2020, NSRI principal investigator Dr. Keely Buesing, a UNMC surgeon, and colleagues repurposed the tools developed through an NSRI project to safely ventilate two patients on one machine. The team’s extensive work on therapies to treat lung ailments such as acute respiratory distress syndrome, commonly signaled by inflammation and fluid buildup, allowed for a quick pivot to COVID-19 applications.

NSRI’s new independent research and development (IRAD) program, described on page 46, also launched several COVID-related projects in 2021. From addressing educational strategies for respiratory protection to characterization of SARS-CoV-2 mutant viruses to the development of a self-administered rapid-acting anti-infective, researchers understood the needs, leveraged NU facilities and technology and joined forces with colleagues to not only respond but level up their efforts.

Dillan Cunningham, NSRI research director for biological defense programs, watches fluorescent tracer particles in real time on a computer during airflow testing of military aircraft in April 2020. NSRI scientists and colleagues would go on to publish the article, “Aerosol tracer testing in Boeing 767 and 777 aircraft to simulate exposure potential of infectious aerosol such as SARS-CoV-2” in December 2021. U.S. Air Force photo by Senior Master Sgt. Shannon Nielsen.

ADAPTIVE TRAINING AND CREATIVE RETOOLING

NSRI teams quickly adapted existing experiential learning tools to remain responsive to government partners. The 2021 NSRI strategic deterrence interns converted a complex limited nuclear conflict tabletop exercise to a virtual format, ensuring select DOD and federal government leaders could continue to access the experience from a distance.

The NSRI field operations and training team transitioned a chemical downrange equipment, procedures and training course to conduct a COVID-facing hybrid in-person/online course with a Combat Capabilities Development Command Chemical Biological Center risk-reduction team. Trainees learned to adapt what they already had for chemical response, acquire new tools and extend these resources to a biological incident.

Dr. Santarpia suggests that, from a perspective of scientific discovery, COVID-19 not only added a higher level of urgency, including through NSRI, but also added an element of practicality that was missing from many scientific research projects. He believes the result could — and should — constitute a sea change in scientific research across the board.

“I hope we’ll look back on this and see it as a paradigm shift to looking at things in a more interrelated way, with the public having a better view of scientists,” he said. “We can use what we have learned to dramatically improve how people, including warfighters, live and work and stay healthy.”

STRATEGIC DETERRENCE & NUCLEAR PROGRAMS

FIRST-EVER TRIPOLAR GLOBAL THEATER DEMANDS NEW THINKING

In summer 2021, Dr. Christopher Yeaw, with a team of subject matter experts, delivered two critical papers pro bono in less than three months to the highest levels of U.S. Strategic Command (USSTRATCOM). The four experts brought forward an expansive understanding of nuclear weapons design, policy analysis, and military and nuclear intelligence, tapping roughly 130 years of combined experience in strategic deterrence.

Driving this intensity was development of the nuclear arsenals of both Russia and China, a matter that falls squarely on the shoulders of USSTRATCOM. The NSRI team made significant headway in exploring the escalatory attraction of limited nuclear employment and the challenge of Russia's nonstrategic nuclear weapons.

"The U.S. has entered a phase of geopolitical climate in which we must deter two nuclear-armed peers, each posing an existential threat to this nation, and both in alliance with each other," Dr. Yeaw said. "This new territory demands new thinking, new planning and new solutions to generate the deterrence necessary for the foreseeable future. And that is the primary reason NSRI exists as USSTRATCOM's UARC."

Russia's unprovoked territorial assault on Ukraine in February 2022 unearthed concerns about a live nuclear event that had lay latent since the 1962 Cuban Missile Crisis. It also brought forward a significant public conversation about nonstrategic nuclear weapons, or "tactical" nuclear weapons, where the U.S. is significantly outgunned by Russia by as much as ten or more to one. The escalated threat imposed by the tripolar dynamic is further compounded by the continued efforts

of smaller nuclear players, such as North Korea and Iran.

These security threats raise significant research and policy questions at the highest levels — questions that highlight USSTRATCOM's pivotal role in our nation's national security. Challenges faced by those at the Command range from strategic indications to tactical warning, from deterrence to escalation management, from detection to attribution, from mitigation to resilience, from response to consequence management and from the reestablishment of deterrence to war termination.

USSTRATCOM calls upon leading experts to bring forward advancing technology and new theory that can keep pace with the challenges.

BUILDING FOR LONG-TERM STABILITY

During this biennial reporting period, NSRI, as USSTRATCOM's UARC, grew its network to match the evolving challenge, aligning with both USSTRATCOM's primary mission, strategic deterrence, and the Command's top priority, modernizing the triad.

STRATEGIC LEADERSHIP

From the executive director and board of directors through the research strategy leaders, NU and the NSRI made several strategic hires to boost support to USSTRATCOM. See page 9 for details.

AMPLIFIED EXPERTISE

NSRI's new leaders bring forward expertise and experience, specifically in Joint Electromagnetic Spectrum Operations (JEMSO), a critical component of NC3 and an area USSTRATCOM leads advocacy for within the DOD.



Dr. Christopher Yeaw (right), NSRI associate executive director, introduces a discussion panel entitled “Strategies for deterring two nuclear-armed peer competitors” at the USSTRATCOM Deterrence Symposium in July 2022. U.S. Air Force photo by TSgt. Taylor Drzazgowski.

NSRI also further built out its bench of senior-level nuclear consultants with hundreds of years of combined expertise across nuclear policy, nuclear weapons design, intelligence and nuclear safety and security. This bench is accessible for ad hoc working groups and research teams as needed by customers.

NNSA PARTNERSHIP

Through a \$25 million indefinite delivery, indefinite quantity (IDIQ) contract vehicle with the Department of Energy National Nuclear Security Administration (NNSA), a strategic partner of USSTRATCOM, NSRI is providing nuclear weapon mission space and design parameters, iterative wargaming, warhead technical verification, policy research, wargaming knowledge management and more.

RESEARCHER ENGAGEMENT

Several of the 123 NSRI Fellows have worked on projects within this space and many more stand ready to support. Through NSRI IRAD, four projects have been seed-funded to contribute to strategic deterrence research: multi-actor deterrence analysis methodology and laboratory; modeling and visualization of competing escalation dynamics; how neuroscience can inform nuclear security; and nuclear deterrence theory for a multipolar world. See pages 44 and 46 for program details.

RESEARCH HIGHLIGHTS

RESEARCH FOR STRATEGIC DETERRENCE IN THE TRIPOLAR ERA

Admiral Charles Richard, USSTRATCOM commander, sponsored a Strategic Multi-Layer Assessment (SMA) reachback analytic effort to inform senior leaders on decision-making strategies now needed to address two determined nuclear rivals. NSRI researchers were key players on the SMA team, going on to research, analyze and recommend strategies centering on geopolitical issues.

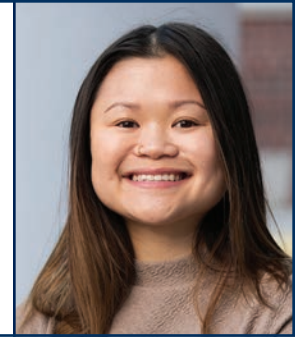
WARGAMING FOR NNSA

Kicking off its new partnership with NNSA, NSRI is designing, developing and executing a wargame as an analytic correlate to a warhead design seminar series. While the seminar series, being conducted in parallel, will consider a wide range of possibilities for nuclear weapon missions and design implications, the analytically linked wargaming series will attempt to introduce a selection of those future mission and design possibilities into the context of conflict and explore the effects on deterrence and escalation dynamics.

“The NATO project was my first exposure to deterrence and national security, even a little bit of intelligence. Now I am open to both international relations and national security work.”

JOSIE NELSON

Undergraduate Research Assistant, University of Nebraska at Omaha



**INTERNATIONAL SECURITY
IMPLICATIONS RESEARCH**

Through NSRI, Dr. Michelle Black, University of Nebraska at Omaha (UNO) assistant professor of political science, led a team of students for the institute’s first North Atlantic Treaty Organization (NATO) research contract. The research team developed a methodology that could be adapted to future challenges within a complex international system. They also worked closely with NATO colleagues to begin testing the methodology and are developing further experimentation opportunities.

**NUCLEAR SURETY POLICY
AND GUIDANCE RESEARCH**

Leveraging NSRI’s nuclear certification expertise, collaborators led by NSRI helped update the DOD Nuclear Weapons Surety Program regarding technological shifts that have affected U.S. nuclear forces.

NUCLEAR CERTIFICATION RESEARCH

An interdisciplinary NSRI team presented research findings from their rigorous examination of the Navy and Air Force nuclear certification processes. The project identified differences in certification approaches, assessed guidance and directives and identified opportunities for improvements.

TRIPOLAR NUCLEAR GAME THEORY

Game theory was employed extensively in the Cold War but little research has been conducted to apply it in the new geopolitical environment. NSRI Fellows Dr. Dustin White, UNO assistant professor of economics, and Dr. Jacques Bou Abdo, assistant professor of cyber systems at the University of Nebraska at Kearney (UNK), received NSRI IRAD seed funding to pioneer tripolar game theory. They also led NSRI 2022 strategic deterrence interns in an effort to offer recommendations for future research to NSRI and USSTRATCOM.



“This is a fresh field and a way Nebraska can tangibly support the mission of USSTRATCOM. I am excited to have launched this work with NSRI.”

JACQUES BOU ABDO

Assistant Professor of Cyber Systems, University of Nebraska at Kearney



Lt. Gen. Thomas Bussiere, USSTRATCOM deputy commander, shakes hands with Caden Puntene, computer science major at the University of Nebraska-Lincoln (UNL), following NSRI strategic deterrence intern briefing at command headquarters, Offutt Air Force Base, Omaha, Nebraska. August 2022. Photo by TSgt. Taylor Drzazgowski.

10 YEARS OF PROGRESS

NSRI was initially created as USSTRATCOM's UARC to provide research support to the CWMD mission that the Command was charged with from 2002 through 2018. When that mission was moved, NSRI and NU quickly invested in capabilities to remain valuable to and trusted by USSTRATCOM.

A foundation for the institute's trajectory in this focus area was the development of the NSRI Limited Nuclear Conflict wargame in 2019. The experience immerses participants in an intense nuclear escalation scenario based on a Russian invasion of Ukraine, a scenario magnified by the real-world events of 2022. NSRI has used the wargame with select DOD leaders to help them expand their knowledge through lengthy discussions of nuclear signaling, strategic messaging, nuclear response options and more.

The institute has also grown its strategic deterrence internship program to invest in the future workforce for this space. Students gain an understanding of the political and military landscape that drives deterrence theory and policy while expanding their skill sets to deliver research products directly to USSTRATCOM. The interns brief top officials in person at the Command's headquarters, including Lt. Gen. Thomas Bussiere, deputy commander, in 2021 and 2022.

READY FOR FUTURE

In the coming years, in partnership with NU, USSTRATCOM, DOD, NNSA and others, NSRI will engage in projects responsive to the changing deterrence and nuclear landscape and demonstrate that the U.S. is willing to proceed credibly, judiciously and defensively.

Hypersonic weapons, space defenses, cyber defense, artificial intelligence, theater-range low-yield weapons and a sea-launched cruise missile could all be new focuses of this team. NSRI is uniquely positioned to assist through its proven role as a convener, connecting resources that actuate research, analysis and production. As the institute grows, the well into which defense agencies can dip for support from NSRI will deepen.

"It's about rethinking what we thought we knew and building a network of solutions that not only makes the U.S. ready to defend against any nuclear action but also puts our adversaries on notice," Dr. Yeaw said. "That's what deterrence is all about."



Daniel Polanski, NSRI deputy director for field operations and training, tests a compressed oxygen containment and torch system developed by NSRI and the University of Nebraska–Lincoln for an operational command.

CHEMICAL & BIOLOGICAL THREAT DETECTION & COUNTERMEASURE DEVELOPMENT

THE EASY PROBLEMS ARE SOLVED — ATTACK THE HARD ONES

In October 2021, Dr. Thomas Mueller, NSRI research director for chemical defense programs, and Daniel Polanski, NSRI deputy director for field operations and training, were in Albuquerque, New Mexico, for final tests of “Dragon’s Horn.” The project was based on an operational unit’s need for tools that require large quantities of compressed oxygen, which is not always available. The unit and its funding partner, the Defense Threat Reduction Agency (DTRA), tasked NSRI with developing a method for generating the oxygen on demand.

Led by Dr. Mueller, a team of chemists, engineers and operators from NSRI, the University of Nebraska–Lincoln (UNL) and Trinity Scientific developed the chemistry, containment system and interface required to

produce the oxygen, contain the materials and operate the cutting torch.

“There is a tremendous amount of detail, logistics and expertise that goes into each and every effort we pursue,” Dr. Mueller said. “When it comes to chemical and biological capabilities and countermeasures, the easy problems have been solved. Now we’re attacking the hard ones.”

This reporting period had its share of hard problems for biological and chemical defense. The emergence of COVID-19 shined a light on gaps that must be filled for better response to biological threats, such as communication, detection and technology. In addition, the potential use of WMDs during Russia’s invasion of Ukraine beginning in February

2022 led many U.S. national security leaders to focus on state-based actors who have access to sophisticated science and technology that can ignite chemical and biological attacks.

These momentous events demonstrated the reality that strategic attack against the U.S. and its allies can come through the nefarious use of nonkinetic chemical and biological weapons as well as accelerated strategic nuclear weapons. The threats of today and of the future are indeed more interconnected than ever before — the science should be, too.

CONVENING RESEARCH CAPACITY

NSRI brings chemists, biologists, engineers, computer programmers, data analysts, physicists, social scientists and medical professionals into the fold of its chemical and biological defense objectives.

Within this reporting period, the institute's appointment of 123 NU researchers as NSRI Fellows aimed to amplify its multidisciplinary approach for innovations of the future. The institute also provided seed funding for several projects, including a wearable sensor for detecting biological and chemical weapons. See pages 44 and 46 for details about these initiatives.

The teams NSRI catalyzes collaborate at facilities and laboratories across the University of Nebraska System and across several nationally distributed NSRI facilities, each strategically located to facilitate interactions with national, regional and local CWMD customers and end users. In this reporting period, NSRI opened the Collaborative Biosecurity Laboratory at UNL to transfer its biological expertise to the areas of food, agriculture and environment. See page 43 for details.

After serving as a senior advisor for the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense through the Intergovernmental Personnel

Act, Marty Sikes retired to NSRI to lead the chemical and biological defense team as associate executive director.

"During the initial response to COVID-19 and since, the NSRI team and many of our DOD partners switched gears to provide expertise to mitigating the pandemic," Sikes said. "But as our partners refocus their efforts, the many lessons learned and knowledge gained during COVID-19 has made NSRI and NU more ready than ever to conquer the next challenge."

RESEARCH HIGHLIGHTS

CWMD DEFENSE RESEARCH AND SUPPORT

With a focus on new and emerging threats, NSRI continues to lead independent verification and validation projects across a wide range of diagnostic and detection capabilities, platforms, assays and testing methods for DTRA. A new \$9.6 million task order was announced in September 2021.

FULL-SCALE CHEMICAL AND EXPLOSIVE TRAINING

NSRI chemical defense and field operations and training teams planned and executed a full-scale explosive training experience for more than 100 active-duty personnel. The course focused on threat synthesis, precursors and equipment, identification of hazards and appropriate precautions when encountering chemical or explosive production facilities.

BIOMEDICAL DEVICE DEVELOPMENT

NSRI is contributing its decontamination testing expertise to a new biomedical device that will allow rapid sterilization of medical equipment in theater. The concept, created and led by the Naval Surface Warfare Center Indian Head Division, with funding from the Army's Combat Casualty Research Program in the Medical Research and Development Command, includes collaboration with scientists from the Johns Hopkins University Applied Physics Laboratory.

BOLSTERING PERIMETER DEFENSE VIA EARLY WARNING

To support DTRA's perimeter defense efforts, NSRI and UNL researchers and students developed a rapidly deployable network of biological agent early warning detectors and collectors. The devices notify an end user that a potential biological attack has occurred, mapping the location, time and weather during the attack. Samples are automatically collected for additional analysis.

NSRI worked with the New York 24th Civil Support Team to deploy and demonstrate the technology during a Department of Homeland Security (DHS) Urban Threat Dispersion exercise in New York City in November 2021. The NSRI system successfully detected simulated biological attacks at each exercise location, which included Times Square, Union Square and the World Trade Center campus. End-user feedback and system testing was critical to improving the technology and pushing forward to help reach DTRA's perimeter defense biological detection goals.

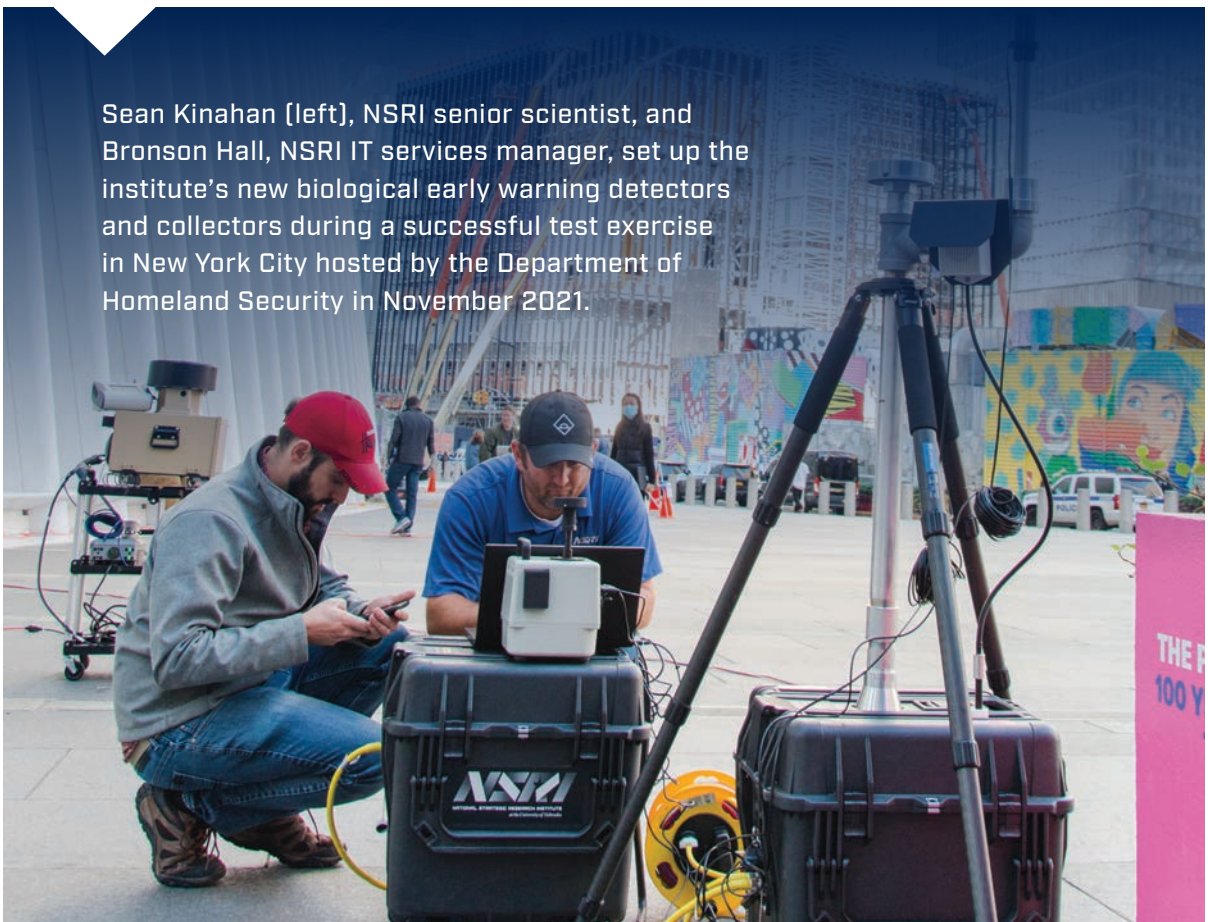


“This work has exposed me to new technologies and given me a great breadth of experiences. I have become a better software developer, critical thinker and coworker.”

SIERRA FUTTERMAN

Senior Computer Science Major
University of Nebraska–Lincoln
Project Contributor

Sean Kinahan (left), NSRI senior scientist, and Bronson Hall, NSRI IT services manager, set up the institute's new biological early warning detectors and collectors during a successful test exercise in New York City hosted by the Department of Homeland Security in November 2021.





NSRI Fellow Dr. Justin Bradley (left), associate professor in the School of Computing at the University of Nebraska–Lincoln, discusses next steps with doctoral students Daniel Rico and Chandima Fernando during a drone swarm demonstration.

DRONE SWARM ENHANCEMENTS

Led by NSRI Fellow Dr. Justin Bradley, the UNL Nebraska Intelligent MoBile Unmanned Systems (NIMBUS) Lab is developing an algorithm to control drone swarms for intelligence, surveillance, target acquisition and reconnaissance missions.

10 YEARS OF PROGRESS

From its creation, NSRI has been a productive problem-solving partner for customers across the CWMD mission space, a role conceived for the institute when it was first established as USSTRATCOM's UARC in 2012. While the Command's mission shifted, NSRI's spectrum of expertise has provided key foresight, especially given the real-world events of the last two years.

Of particular importance to the institute's impact in the chemical and biological defense space is the trusted relationship it has built with DTRA. Launched with a project entitled, "Lyophilization of Bioscavenger" in 2014, the partnership has led to 13 projects ranging from technology development to training, totaling \$75 million in funded efforts.

READY FOR THE FUTURE

The future of detecting and mitigating chemical and biological threats is difficult to predict given nearly daily advances in technology and the creativity of adversaries. The key will be proactive advancement of solutions that keep the U.S. and its allies in front.

Going forward, NSRI scientists expect to study warfare mitigation through the disciplines of artificial intelligence, machine learning, quantum computing and robotics. These and other technologies will help the nation's defenders innovate and evolve sensors with low power requirements and highly sensitive assays that are rapidly configurable, low-cost and capable of predictive algorithms necessary to stay ahead of threats.

"We live in a world where technology is pushing the threat at an exponential rate, but we shouldn't limit technology because the benefits outweigh the costs," Dr. Mueller said. "We have to adapt to meet the challenges faced by technological advances."

**MEDICAL
COUNTERMEASURES****PREVENTING
EXPOSURE
& MITIGATING
EFFECTS
TO SAVE LIVES**

After several years working directly for DOD components, Dr. Alicia Schiller became the director of combat casualty care at UNMC, leading the department of anesthesiology's human physiology research laboratory and serving as an NSRI Fellow.

Her most recent NSRI project seeks to identify the best ways for medical personnel to acquire procedural skills, such as intraosseous line and chest tube placement, especially in military populations. In conjunction with Tripler U.S. Army Medical Center in Hawaii, the project team is developing sophisticated, actionable training tools for low-frequency, high-value procedures not often performed but important to get right when they are needed.

Ensuring medical providers are ready is the kind of work that saves lives — and this readiness is needed now more than ever.

CBRNe threats are as much or more of a reality today as they have ever been. Sarin, the most widely used chemical weapon, was used as recently as 2017 in Syria. The world has not yet fully emerged from the COVID-19 pandemic. Synthetic biology makes possible the creation of pathogens that can be more infectious and more lethal than those that occur in nature. Russia and China have expanded their nuclear arsenals, and potential nuclear weapon use was the highest it has been since the Cuban Missile Crisis when Russia invaded Ukraine in Spring 2022.



NSRI Fellow Dr. Alicia Schiller (left) monitors participants during a training workshop related to her NSRI project. The participants are practicing intraosseous line placement.

Beyond the death, geopolitical and socioeconomic impacts, an unfortunate outcome of the COVID-19 pandemic that must be acknowledged is that it exposed vulnerabilities that U.S. adversaries have surely noticed. Readiness for a potential threat serves as a strategic deterrent to that threat.

PROBLEM-BASED SOLUTIONS KEY TO FUTURE SUCCESS

NSRI works collaboratively with USSTRATCOM, its UARC sponsor, other federal government customers and research scientists to fully understand gaps and needs and ultimately develop productive solutions. CBRN challenges call for solutions that match the factors of complexity and the scope of potential related outcomes. This may call for mitigation from disease surveillance, affected population management and its psychological impact, area decontamination to support continuity of operations and mortuary affairs. Often, it is necessary to leverage multiple academic disciplines.

NSRI projects throughout the last two years have included diagnostics, therapeutics, threat characterization and disaster medicine. All have built on past work in areas such as patient transport, therapeutics and aerosol threat characterization for COVID-19. NSRI and NU offer deep expertise across disaster medicine and global health security, high-consequence pathogen-infected patient management and drug discovery and development.

To enhance its ability to rapidly form research teams that possess the right skill sets to solve problems, NSRI accesses NSRI Fellows, NU researchers who were appointed during this reporting period (see page 44), and the broader university research community.

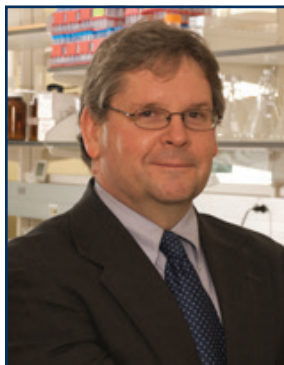
“Gaps identified are opportunities for NSRI teams to meet the equally critical needs of both the military and the civilian community,” said Dr. Neal Woollen, NSRI associate executive director. “We will continue working hand-in-hand with other NSRI researchers, from operations and training to teams targeting specific spectrum-wide threats, to determine where medical countermeasures can come into play.”

Developing future scientists for this space is also a solution to an identified future challenge. Dr. Joshua Santarpia, NSRI science and technology advisor, launched the biological defense and health security doctoral program at UNMC in fall 2020.

RESEARCH HIGHLIGHTS

RESPIRATORY RECOVERY FROM CHEMICAL AND BIOLOGICAL INJURY

Through a \$10.3 million contract with DTRA, a team of NU researchers is investigating novel therapeutic, prophylactic and pretreatment approaches for respiratory recovery and exposure to chemical and biological threats. The team is working from four NU laboratories to deliver bacterial, viral and chemical aerosol characterization studies; threat studies; and support for medical countermeasures development. The project leverages the Nebraska Drug Discovery and Development Pipeline (ND³P), discussed in the following section, to develop capabilities that can move molecules forward for drug development.



“Thanks to the expertise of the investigative team, we will be able to characterize potential chemical, bacterial and viral threats and evaluate their stability and respiratory threat potential.”

DANIEL MONAHAN

Professor of Pharmacology and Experimental Neuroscience
University of Nebraska Medical Center

TECHNOLOGY FOR MONITORING AND ANALYZING SOLDIER READINESS

Dr. Aaron Likens, UNO assistant professor in the Center for Research in Human Movement Variability, is working with the U.S. Army Combat Capabilities Development Command's Soldier Center (CCDC SC) in Natick, Massachusetts, to develop a digital readiness toolkit that analyzes soldier movement and physiological processes in the field, empowering military leaders with objective data to help them make critical decisions.

“This technology will give unit leaders and the soldiers themselves more information about how the unit is performing in real time, allowing them to make informed decisions that may impact mission success.”

DR. KARI MCKENZIE

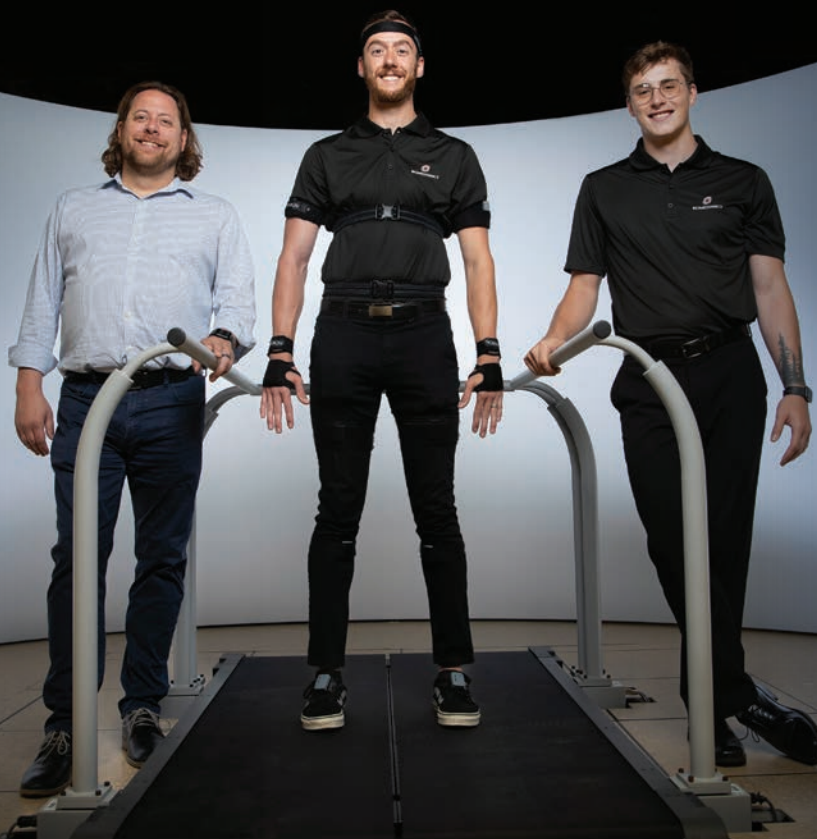
CCDC SC Technical Lead

ASSESSMENT TOOLS TO IMPROVE COMBAT MEDICAL TRAINING

Dr. Schiller and her colleagues developed novel medical simulation techniques for training, validating and maintaining combat casualty care skills. Using visual recording, software for evaluation including ergonomics and the development and use of 3D printed task trainers, the tools measure frontline military medical personnel skills acquisition, readiness and degradation. In addition, the project provided a strategic plan for implementation and assessment technology to support medic training and health care provider readiness and performance.

“Combat medics are often the first on the scene to provide trauma and medical care to injured warfighters,” said Dao Ho, Ph.D., chief of physiology in the department of clinical investigation at Tripler, upon the announcement of the project. “With this project, we hope to enhance medical skills training of combat medics and first responders to ensure the readiness of our fighting force.”

From left: NSRI Fellow Dr. Aaron Likens of the University of Nebraska at Omaha poses with graduate assistants Taylor Wilson and Kolby Brink. Wilson stands on an instrumented treadmill while wearing inertial measurement units. The equipment helps to measure movements during locomotion.



10 YEARS OF PROGRESS

NSRI's involvement in the medical countermeasures arm of deterrence and defense has bolstered the growing national cache of lifesaving medical solutions for warfighters and first responders throughout the past decade. Through the institute, NU faculty have aligned their research interests with national security priorities. Following are just a few featured researchers.



Dr. Ken Bayles, UNMC associate vice chancellor for research, has earned more than \$20.6 million in contract awards through NSRI, starting with a

next generation anthrax vaccine in 2012 and leading to the development of ND³P. ND³P brings more than 250 NU researchers together to fill a gap created by unprofitable pharmaceuticals needed for the military. It is currently addressing a critical need for prophylaxis and treatment for Acute Radiation Syndrome.



Dr. Mike Wiley launched his NSRI "career" in September 2015 with the project "Global biosurveillance technology initiative training," which

provides next generation genomic diagnostic capabilities for host nation capability and capacity enhancement. Since then he has led two additional projects for a total of nearly \$11.8 million in funding.



Also in 2015, **Dr. Keely Buesing**, UNMC professor of surgery, was invited to help develop a microbubbles therapy that delivers lifesaving

oxygenation to respiratory compromised patients through colonic or intraperitoneal administration. Dr. Buesing has engaged NSRI as NU's UARC to secure three contracts totaling nearly \$9.8 million.

READY FOR THE FUTURE

The COVID-19 pandemic is a stark wake-up call for the U.S. to take biological threats seriously. The world has learned many lessons from the pandemic, including that these types of threats can cripple the U.S. and global economies and infrastructures. In addition, chemicals represent a unique force multiplier that simply cannot be ignored in the 21st century, evidenced by their use in Syria. The war in Ukraine has also revived discussions of the strategic complexity and potential for radiation injuries that would follow a nuclear incident.

Ongoing work through NSRI and ND³P will offer a new model for academic research that bridges the gap between academia and industry, nurturing collaboration among NU, private enterprises and the U.S. government. It could mean hiring faculty with expertise in big pharma, purchasing equipment to support projects and building resources such as compound libraries. Overall, the goal is to increase bandwidth and get more people involved.

"We are building capabilities in preclinical studies and growing our expertise in clinical trials," Dr. Woollen said. He also expects continued research into microbubbles and field treatment.

As the only DOD UARC with a biomedical focus, NSRI is an ideal resource for defense stakeholders who need to talk directly with researchers about real problems that need solutions.

THREAT-BASED TRAINING & EXERCISE SUPPORT

TO STAY RELEVANT, FEEL THE HEAT OF THE BLAST

After 21 years of service in the U.S. Army investigating infectious diseases, responding to outbreaks and providing WMD training, Wes Carter is keen to stay in the fray — so he creates the chaos. As the research director for NSRI field operations and training, Carter pushes the team he has led since 2016 to design the most realistic CBRNe training scenarios and courses possible for active-duty military and first responders.

“For our real-world operators, chaos is their focus — they have to be in it to learn,” Carter said. “They have to feel the heat of the blast and be out of their comfort zone.”

The U.S. leads the world in countering weapons of mass destruction (CWMD). Experienced teams from the National Guard, DHS and DOD offer skill, insight and knowledge to prepare for and mitigate crises. But during this reporting period, training shifted predominantly to response and mitigation of COVID-19. First responders also faced surging fatal drug overdoses, which reached a record high in 2021 in the U.S. — 107,000. In addition, federal authorities made what is likely the largest methamphetamine bust in U.S. history, finding 5,528 pounds of the drug.

In the global theater, Russia’s invasion of Ukraine led to increased international concerns about the production and potential use of biological and chemical weapons. There was an unsettling feeling that perhaps U.S. allies weren’t prepared to respond.

Because it constantly monitors the needs of the response teams it trains, NSRI was able to react rapidly to the aggressive pressure. At the onset of the pandemic, the team immediately moved

high-priority training courses to online and hybrid formats when possible and produced four entirely new courses in 2021 for medical response:

- ▶ Applied biosurveillance for expeditionary operations (ABE)
- ▶ Situational awareness and modality
- ▶ CBRNe medical response and transport
- ▶ Expeditionary collection for hazardous operations

Beyond training efforts, the team also backed significant research efforts for principal investigators across the institute and NU, providing extensive tactical and technical support essential to ensuring development efforts resulted in products truly fit for end users. For example, they significantly contributed to the successful testing of a perimeter defense device in New York City, which is highlighted on page 30.

The quality of the team’s work is made possible by each individual’s real-world experiences and academic background. In addition to Carter, NSRI field operations and training staff include:

- ▶ Daniel Polanski, former National Guard Civil Support Team (CST) member and support element to the intelligence community
- ▶ Paul Brantmier, former CST member and lead instructor in biodefense for the U.S. Army
- ▶ Ken Werstak, former Federal Bureau of Investigation (FBI) special agent and WMD coordinator
- ▶ Marty Sikes III, emergency management specialist



NSRI field operations and training team from left: Ken Werstak, Daniel Polanski, Paul Brantmier, Marty Sikes III. Following successful delivery of mobility and delivery training evolution for 43rd CST and mission partners at Federal Law Enforcement Training Center, Charleston, South Carolina, August 2022.

TRAINING HIGHLIGHTS

MITIGATION, RESPONSE TRAINING VIA HYBRID ONLINE/IN-PERSON DELIVERY

A team from U.S. Army Combat Capabilities Development Command Chemical Biological Center was tasked with management of SARS-CoV-2 missions and needed to adapt its existing equipment, procedures and training to ensure success. NSRI supported this need by augmenting the team's existing chemical downrange operations and equipment to accommodate biological incidents.

Fifty personnel completed a virtual training option created by NSRI, and 24 personnel went on to conduct in-person, small-group exercises in donning and doffing PPE. To meet social distancing guidelines, the groups were staggered and distributed over time during on-site training.

TEAM BUILDING AT CHEMICAL TRAINING COURSE

Personnel from CSTs and U.S. Special Operations Command participated in a socially distanced chemical signature recognition course at NSRI's 10,000-square-foot conference facility in Maryland. The course focused on detecting and identifying clandestine chemical weapons laboratories through a team-based exploration of laboratory chemical synthesis. The joint teams of participants ultimately competed to develop the best strategies to design, build and identify clandestine chemical laboratories.

"This was the most realistic training I have participated in. It was extremely informative and challenged our minds to think like the adversary."

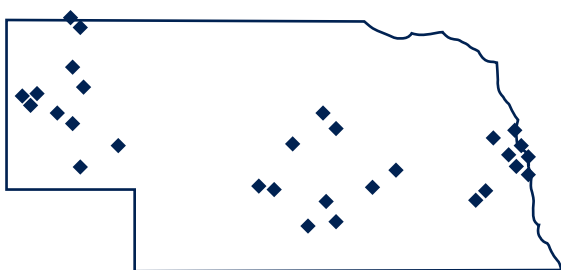
SEAN DURST

Survey Team Leader for the 24th New York Civil Support Team

325+ NEBRASKA HEALTH CARE PROVIDERS COMPLETE BURN EXERCISES

NSRI conducted five virtual mass casualty preparedness exercises for the Nebraska Healthcare Coalitions to improve communication, coordination and treatment protocols for mass casualty events that result in many burn victims. The objective of the exercises was to test each coalition's burn annex plan, which is a requirement for the Administration for Strategic Preparedness and Response (ASPR) Hospital Preparedness Program. The exercises also achieved requirements for Nebraska Medicine's \$3 million Regional Disaster Health Response Ecosystem Grant from ASPR.

The five-day event led to an action plan with innovative approaches to fill gaps for the state with recommendations to the state emergency management system medical director regarding expanded protocols for mass burn care in remote areas, enhancements of protocol distribution and engagement and identification of needs and means to train for mass casualty burn-specific management in hospital triage.



Map of the 30 communities represented by the participants.

“These types of events are essential for our state and for solidifying our communities together.”

MICHELLE HILL

Emergency Preparedness Coordinator
Panhandle Public Health District
Scottsbluff, Nebraska



Course participant collects samples during NSRI ABE course for preventive medicine military operatives from the Czech Republic.

BIOSURVEILLANCE SAMPLING FOR CZECH PREVENTIVE MEDICINE OPERATIVES

NSRI, with support and guidance from the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND), hosted its ABE course in a field environment in Missouri for preventive medicine military operatives from the Czech Republic. Within this course, participants are trained in biosurveillance sampling techniques and tasked in teams to develop and execute biosurveillance sampling plans, traveling between field and lab environments. Students receive guidance on instrument operations, sample processing and data management to produce a biosurveillance assessment report in the area of sample operations.



2021 NSRI biological production course with the 43rd National Guard Civil Support Team in South Carolina. Left: Participants discuss sampling, culturing and enumeration methods for bio-production. Right: Participants microscopically investigate bio-production samples.

10 YEARS OF PROGRESS

NSRI's field operations and training component is the result of its commitment as a DOD-designated UARC to fielding research solutions that land in the hands of soldiers and first responders. It came to fruition with the hiring of Carter in 2016 and has grown into a recognized interdisciplinary unit with extensive CWMD capabilities.

Focused on enhancing the skills of operators, the team has developed a course list of 26 scenario-based trainings, tabletop exercises, workgroup discussions, laboratory instruction and more.

Its analytical exercises span the entire process of receiving and reviewing information, acquiring and selecting samples, processing or preparing for incident response, managing data and predicting consequences. Full-scale exercises have involved hundreds of participants in venues ranging from professional stadiums to large ships and aircraft.

READY FOR THE FUTURE

Ensuring the nation's specialized CWMD response teams are prepared means providing flexible education based in scientific research and complemented by challenging "doomsday" scenario exercises.

Going forward, NSRI will continue to offer leading training and education across the CBRNe threat spectrum. To do this, the team will bring forward emerging technologies, explore scenarios utilizing the latest tools and techniques and stay relevant by remaining nimble in the face of the ever-changing threat environment.

"The WMD response community is filled with great men and women who continually train to keep their communities safe," Carter said. "It is up to organizations like NSRI to challenge their plans and promote innovation and confidence in their decision-making process based on science and technology."

FEATURED NU RESEARCH RESOURCES

To meet its mission objectives, NSRI relies upon research facilities, technology and centers available across the University of Nebraska System's four campuses and led by experienced researchers, with students engaging in many aspects of hands-on work. These pages introduce some of the many assets NSRI leveraged for national security research and solutions within the reporting period.



BIOMECHANICS RESEARCH BUILDING

UNO boasts a 56,000-square-foot Biomechanics Research Building. With labs for human biomechanics, cardiovascular/tissue biomechanics, insect biomechanics, balance and strength, virtual reality and 3D printing, researchers can collaborate and innovate with the latest technology. A design studio, machine shop, computer labs, evaluation rooms and teaching lab are also available for instructing and engaging students.

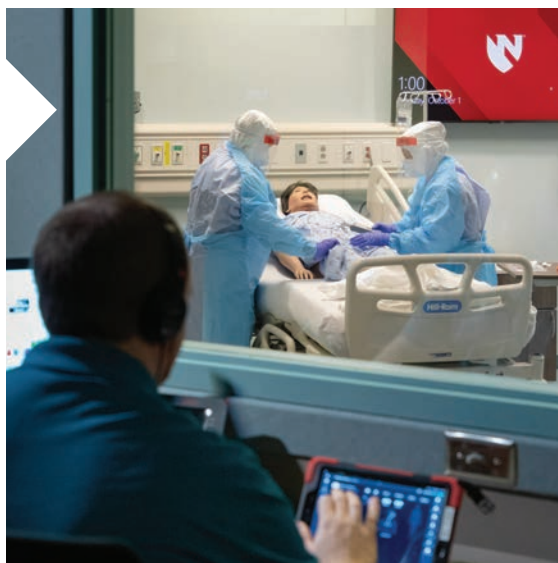


BIOSAFETY LEVEL-3 (BSL-3) CONTAINMENT LABORATORY SUITE

The BSL-3 laboratory suite at UNMC has been certified by the Federal Select Agent Program as a Tier 1 Select Agent Facility. The laboratory suite is specifically designed to provide all needed protections for scientists working with risk group 3 pathogens and other agents associated with specific safety and biosecurity concerns in research and diagnostic testing. This containment laboratory suite is used to support campus research and diagnostic activities for the Nebraska Public Health Laboratory and the Nebraska Biocontainment Unit patient care laboratory.

DAVIS GLOBAL CENTER

The Dr. Edwin G. & Dorothy Balbach Davis Global Center at UNMC is a highly advanced clinical simulation facility. It also is the home of the National Training, Simulation and Quarantine Center, which features the nation's only federal quarantine unit, as well as a six-bed simulated biocontainment unit for advanced experiential training. The National Quarantine Unit was used to monitor and treat former passengers of the Diamond Princess cruise ship — the first COVID-19 patients evacuated to the United States in Spring 2020.



NEBRASKA INTELLIGENT MOBILE UNMANNED SYSTEMS (NIMBUS) LAB

The UNL NIMBUS Lab focuses on research and technology used to develop more capable and dependable unmanned aerial vehicles. Recent lab projects include safe, precise and repeatable maneuvers; failure detection and recovery; extended flying autonomy; adaptive sensing; and teaming and coordination.

NEBRASKA VETERINARY DIAGNOSTIC CENTER (NVDC)

The NVDC at UNL employs state-of-the-art testing procedures to provide disease surveillance and diagnostic services. It is recognized nationally for its expertise in diagnosing diseases in cattle and other food animals. NVDC offers a full complement of bacteriologic, histologic, immunohistochemical necropsy, molecular diagnostic, serologic, toxicologic, electron microscopic and traditional virologic services.



THANK YOU TO OUR PARTNERS

NSRI's success in supporting the Department of Defense (DOD) with critical tools, technology and training is due to the commitment of its people and partners. NSRI celebrates the contributions of individuals and teams, as well as programs that have catalyzed and convened in unique ways to help NSRI meet its mission.

PRINCIPAL INVESTIGATORS SINCE 2012

David Adler	Carrick Detweiler	Bill Mahoney	Joshua Santarpia
Dennis Alexander	Rick Haugerud	Rupal Mehta	Mario Scalora
Ken Bayles	Steven Hinrichs	Thomas Mueller	Alicia Schiller
Misty Bensman	Scott Johnson	Jodi Neathery-Castro	April Shea
David Berkowitz	Aimee Ketner	Mehrdad Negahban	Jeyamkondan Subbiah
Michelle Black	Sean Kinahan	Laura Nolan	James Talmadge
Ben Boedeker	Emmanuel Kumfa	Stephen Obaro	James Taylor
Justin Bradley	Marilyn Larson	Lana Obradovic	Ben Terry
Paul Brantmier	Gina Ligon	Shanna Ratnesar-Shumate	Donald Umstadter
Wallace Buchholz	Aaron Likens	Laurence Rilett	Sergei Vinogradov
Keely Buesing	Sy-Hwang Liou	David Roberts	Michael Wiley
Wes Carter	Oksana Lockridge	Alex Robinson	Dusty White
Bill Charlton	John Lowe	Anthony Sambol	Tyler White
Jim Colasacco	Chris Luther	Mariano Sanchez-Lockhart	Christopher Yeaw
Dillon Cunningham	Jason MacTaggart		
Doug Derrick	Elsbeth Magilton		

FEATURED PARTNERS

INSTITUTE OF AGRICULTURE AND NATURAL RESOURCES (IANR)

NSRI and IANR at the University of Nebraska–Lincoln (UNL) began a five-year collaborative partnership to help safeguard the security of the U.S. food supply. The new Collaborative Biosecurity Laboratory brings researchers together to increase focus and deliverables for agricultural and natural resources security, defense and countermeasures. *Photo: Ribbon cutting of lab in September 2021. From left: Dr. Joshua Santarpia of NSRI, NU President Ted Carter, UNL Chancellor Ronnie Green, IANR Vice Chancellor Mike Boehm, NSRI Executive Director Rick Evans.*



NATIONAL COUNTERTERRORISM INNOVATION, TECHNOLOGY & EDUCATION CENTER (NCITE)

After completing six projects through NSRI for U.S. Strategic Command (USSTRATCOM), Dr. Gina Ligon of the University of Nebraska at Omaha (UNO) set out to apply her expertise to the needs of the Department of Homeland Security (DHS), receiving UNO's largest grant award ever at \$36 million to launch NCITE as a DHS Center of Excellence in 2020. The center leverages NSRI capabilities to serve customers fighting terrorism and targeted violence. *Photo: DHS Deputy Secretary John Tien (right) visits with Erin Grace, NCITE strategic communications manager, at UNO.*

NEBRASKA DRUG DISCOVERY & DEVELOPMENT PIPELINE (ND³P)

ND³P was created by NU researchers through NSRI to fill a gap in pharmaceutical development of critical drugs for before and after chemical, biological and radiological threat exposure. Drawing on NSRI's resources and connections as a University Affiliated Research Center (UARC), the pipeline has engaged more than 200 researchers. *Photo: NSRI Fellows Dr. Ken Bayles (left) of the University of Nebraska Medical Center and Dr. David Berkowitz of UNL present the ND³P concept to the University of Nebraska Foundation.*





Mr. Robert Taylor, USSTRATCOM director of capability and resource integration, provides the keynote address at NSRI Fellows Conference in April 2020 at the University of Nebraska-Lincoln.

NSRI FELLOWS

The NSRI Fellows program launched in May 2021 to optimize support from NU to the DOD and other federal agencies with national security missions.

By engaging and drawing on the expertise of 123 leading researchers through this program, NSRI accesses the disciplines of engineering, political science, biomechanics, molecular biology, physics, economics, finance, psychology and more. Each year, this elite cohort publishes widely throughout numerous leading academic journals, provides insights to national media and presents at top conferences. Their bodies of work push their fields forward and can help evolve deterrence and defense.



“The NSRI mission, while broad, is an important reminder of the complicated challenges that are faced when taking strategic national security threats into consideration. In meeting some of the other fellows, I hope to work together to help contribute my areas of research strengths such as cybersecurity and technology to NSRI’s mission in the areas of greatest need.”

DEANNA HOUSE, PH.D.

Assistant Professor of Information Systems and Quantitative Analysis
University of Nebraska at Omaha

Craig Allen	Brittany Duncan	James Lawler	Ben Riggan
Matt Andrews	Patrick Dussault	Xu Li	Mark Riley
Tala Awada	Robin Gandhi	Aaron Likens	Ryan Riskowski
Sina Balkir	Dario Ghersi	Jeremy Lipschultz	Matthew Rizzo
T. Lynne Barone	George Gogos	Bethany Lowndes	Eleanor Rogan
Mark Bauer	Chittibabu Guda	Dustin Loy	Michael Rosenthal
Ken Bayles	Ingrid Haas	Elsbeth Magilton	Anthony Sambol
Bill Belcher	Matthew Hammons	Deanna Marcelino	Mario Scalora
Jesse Bell	Andrew Harms	Eric Markvicka	Daniel Schachtman
David Berkowitz	Tomas Helikar	Spyridon Mastorakis	Alicia Schiller
Michelle Black	Michael Hempel	Scott McVey	Julie Shaffer
Jacques Bou Abdo	Angela Hewlett	Rupal Mehta	Hamid Sharif
Justin Bradley	Angela Hollman	Nathan Meier	Dustin Slivka
David Brett-Major	Corey Hopkins	Aaron Mohs	Paul Sorgen
Mara Broadhurst	Deanna House	Daniel Monaghan	Denis Svechkarev
Nicole Buan	Terry Howell	Martha Morton	Mark Svoboda
Keely Buesing	Qing Hui	Rod Moxley	James Talmadge
Chris Burcal	Samuel Hunter	Jody Neathery-Castro	Cornelis Uiterwaal
Ed Cahoon	Tom Jamieson	Carl Nelson	Donald Umstadter
Mehmet Can Vuran	Scott Johnson	Jill O'Donnell	Liz VanWormer
Kim Carlson	Alexey Kamenskiy	Stephen Obaro	Shari Veil
Eric Carnes	Erin Kearns	Sharon Obasi	Ashley Votruba
Elizabeth Chalecki	Victoria Kennel	Lana Obradovic	Hiep Vu
Rao Chundury	Brian Knarr	Nicholas Palermo	Brian Wardlow
Paul Davis	Kristy Kounovsky-Shafer	Angela Pannier	Dusty White
Becky Deegan	William Kramer	Gurudutt Pendyala	Tyler White
Paul Denton	Chris Kratochvil	Yi Qian	Melissa Wuellner
Doug Derrick	Ronald Krueger	Byrav Ramamurthy	Steven Yeh
Carrick Detweiler	Tess Kuenstling	St. Patrick Reid	You Zhou
Austin Doctor	Rebecca Lai	Roni Reiter-Palmon	Craig Zuhlke
Eric Dodds	Marilynn Larson	Stephen Rennard	

NSRI IRAD

Through its independent research and development (IRAD) initiative, NSRI develops technical capabilities and competencies for its sponsor, USSTRATCOM, as well as the broader DOD community. Since it launched in fall 2021, NSRI IRAD has provided more than \$350,000 in seed funding for 12 projects led by NU principal investigators and including NSRI subject matter experts.

2021 & 2022 PROJECTS

Educational strategy assessment for improving respiratory protection equipment use

Principal Investigator: Elizabeth Beam
University of Nebraska Medical Center

Phenotypic & functional characterization of newly evolved SARS-CoV-2 mutant viruses

Principal Investigator: Siddappa Byrareddy
University of Nebraska Medical Center

Multi-actor deterrence analysis methodology and laboratory

Principal Investigator: Michelle Black
University of Nebraska at Omaha

A safe, self-administered, rapid-acting anti-infective

Principal Investigator: Paul Davis
University of Nebraska at Omaha

Modeling and visualization of competing escalation dynamics

Principal Investigator: Qing Hui
University of Nebraska–Lincoln

Personal, wearable sensor platform for detecting & localizing WMDs

Principal Investigator: Eric Markvicka
University of Nebraska–Lincoln

Ideology and risk: How neuroscience can inform nuclear security

Principal Investigator: Noelle Troutman
University of Nebraska–Lincoln

Discovery of a novel bacteriophage-based treatment for multi-drug resistant combat wound infections

Principal Investigator: Eric Carnes
University of Nebraska Medical Center

Destruction of chemical warfare agent simulants using falling film plasma reactors

Principal Investigator: Barry Cheung
University of Nebraska–Lincoln

Model-guided control of nanofiber orientation in nanomanufacturing of next generation air filters

Principal Investigator: Yury Salkovskiy
University of Nebraska at Omaha

Autonomous repair and maintenance of spacecraft (ARMS)

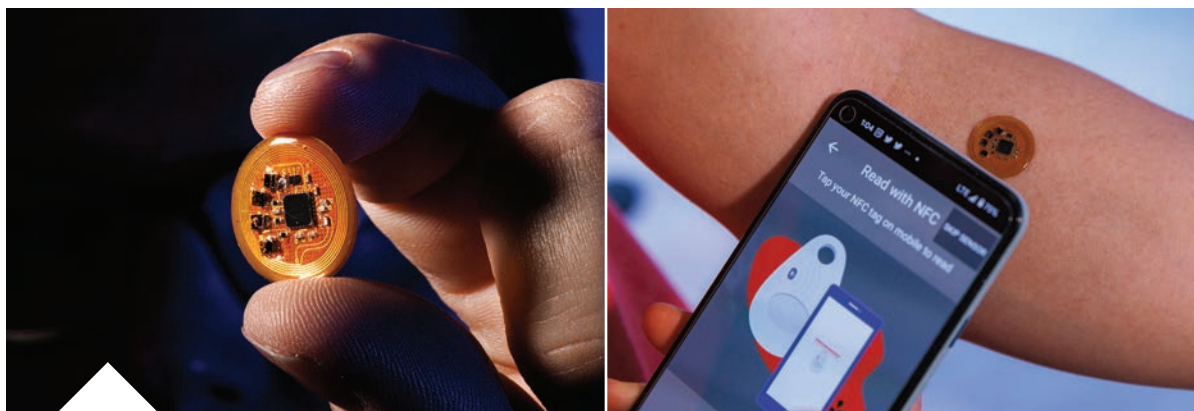
Principal Investigator: Ada-Rhodes Short
University of Nebraska at Omaha

Nuclear deterrence theory for a multi-polar world

Principal Investigator: Dusty White
University of Nebraska at Omaha

GET DETAILS

Project descriptions and updates are available at nsri.nebraska.edu/irad/projects.



FEATURED NSRI IRAD PROJECT

Personal, wearable sensor platform for detecting and localizing WMDs

Current environmental monitors typically consist of bulky, intrusive stationary or portable systems that cannot be worn comfortably on the body during physical activity. Through this NSRI IRAD project, funded in August 2021, an interdisciplinary research team of faculty and students from UNL and UNMC are developing a sensitive surveillance system in the form of a wearable electronic nose that will automatically and passively monitor the air to detect previously defined environmental and chemical threats. This new small, adhesive device transforms each person into a probe while collecting more and better data that provides decision makers with detailed, real-time information to determine threat status.

NSRI POSTDOCTORAL SCHOLARS

Since it was launched in 2018, 19 NSRI postdoctoral scholars have worked directly with the Defense Threat Reduction Agency's basic research and development program to contribute nuclear and countering weapons of mass destruction (CWMD) technologies.

ALL-TIME SCHOLARS

Tariq Alam	Ronald Gamble	Jay Joshi	Jeffrey Rolfes
Deya Banisakher	Laura Heller	Marie Kirkegaard	Fidel Ruz-Nuglo
Monte Cooper	William Hoston	Austin Ladshaw	Adam Weltz
Vincent DiNova	Helen Jackson	Richard Oates	Andrew Zeidell
Evan Eakins	Joseph Johnson	Samuel Rhodes	

#STUDENTSOFSRI

Workforce is top of mind for the highest level national security leaders. During this reporting period, NSRI connected nearly 100 students to real-world, career-defining experiences, including wargaming, direct project contributions and internships within the institute. The aim is to inspire them to pursue national security careers, and it's working. In addition to the students featured below, many have gone on to additional internships or careers in national security.



Evan Palmer started working with the UNL Nebraska Intelligent MoBile Unmanned Systems (NIMBUS) Lab as a sophomore. He immediately jumped into an NSRI project, designing and developing several components for unmanned aerial vehicles, which he continued throughout his UNL career. Upon graduation in May 2022, Evan headed to doctorate school as a National Defense Science and Engineering Graduate Fellow, a prestigious fellowship that is funded through the DOD Office of the Under Secretary for Research and Engineering and the military services to promote education in science and engineering disciplines relevant to the defense mission.



Bethany Vaillant was already in the process of obtaining a job with the Defense Intelligence Agency (DIA) when she participated in an NSRI wargame as a graduate student at UNO. It was her first experience of this type and gave her the opportunity to think more tactically about the battlespace. She went on to become an NSRI intern, developing cyber-focused wargames for private business to use to identify gaps in their networks, infrastructure and capabilities. Now an intelligence officer with DIA, Bethany continues to bring forward a key lesson she learned from her NSRI experience — commit to identifying weaknesses to create stronger future possibilities.

“

NSRI is ready and able to provide innovative, customer-focused research and development solutions for complex national security requirements. Join us as we address the pressing national security challenges throughout the next decade.”

RICK EVANS

MAJ. GEN., USAF (RET.)

NSRI EXECUTIVE DIRECTOR



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