DEFENSE HEALTH PROGRAM (DHP)
16.3 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

The DHP SBIR Program seeks small businesses with strong research and development capabilities to pursue and commercialize medical technologies.

Broad Agency Announcement (BAA), topic, and general questions regarding the SBIR Program should be addressed according to the DoD SBIR Program BAA. For technical questions about the topic during the pre-release period, contact the Topic Authors listed for each topic in the BAA. To obtain answers to technical questions during the formal BAA period, visit https://sbir.defensebusiness.org/sitis.

Specific questions pertaining to the DHP SBIR Program should be submitted to the DHP SBIR Program Management Office (PMO) at:

E-mail - usarmy.detrick.medcom-usamrmc.mbx.dhpsbir@mail.mil
Phone - (301) 619-5047

The DHP Program participates in two DoD SBIR BAAs each year. Proposals not conforming to the terms of this BAA will not be considered. Only Government personnel will evaluate proposals with the exception of technical personnel from Geneva Foundation, Universal Consulting Services and Capitol IT Solutions will provide Advisory and Assistance Services to DHP, providing technical analysis in the evaluation of proposals submitted against DHP topic numbers:

- DHP163-006 Point of Injury Device to Maintain and Stabilize Moderate-Severe Traumatic Brain Injury (TBI) Casualties
- DHP163-007 Point of Injury Therapy to Maintain and Stabilize Moderate-Severe Traumatic Brain Injury (TBI) Casualties
- DHP163-008 Flight Medic Ultra-Wideband Microphone Toggle (UMT) Device

PHASE I PROPOSAL SUBMISSION

Follow the instructions in the DoD SBIR Program BAA for program requirements and proposal submission instructions at http://www.acq.osd.mil/osbp/sbir/solicitations/index.shtml.

SBIR Phase I Proposals have four Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Do not duplicate the electronically generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 20-page limit.

Only the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 20-page limit. The CCR is generated by the proposal submission website, based on information provided by small businesses through the Company Commercialization Report tool. Technical Volumes that exceed the 20-page limit will be reviewed only to the last word on the 20th page. Information beyond the 20th page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not

contained in the first 20 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

Companies submitting a Phase I proposal under this BAA must complete the Cost Volume using the on-line form, within a total cost not to exceed $150,000 over a period of up to six months.

The DHP SBIR Program will evaluate and select Phase I proposals using the evaluation criteria in Section 6.0 of the DoD SBIR Program BAA. Due to limited funding, the DHP SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Proposals not conforming to the terms of this BAA, and unsolicited proposals, will not be considered. Awards are subject to the availability of funding and successful completion of contract negotiations.

PHASE II PROPOSAL SUBMISSION

Phase II is the demonstration of the technology found feasible in Phase I. All DHP SBIR Phase I awardees from this BAA will be allowed to submit a Phase II proposal for evaluation and possible selection. The details on the due date, content, and submission requirements of the Phase II proposal will be provided by the DHP SBIR Program Office either in the Phase I award or by subsequent notification.

Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (https://sbir.defensebusiness.org/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DoD SBIR/STTR Help Desk at (1-800-348-0787) or Help Desk email at sbirhelp@bytecubed.com (9:00 am to 6:00 pm ET).

The DHP SBIR Program will evaluate and select Phase II proposals using the evaluation criteria in Section 8.0 of the DoD Program BAA. Due to limited funding, the DHP SBIR Program reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Small businesses submitting a proposal are required to develop and submit a technology transition and commercialization plan describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal. DHP SBIR Phase II Cost Volumes must contain a budget for the entire 24-month Phase II period not to exceed the maximum dollar amount of $1,000,000. These costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site), and may be presented side-by-side on a single Cost Volume Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the proposed cost.

DHP SBIR Phase II Proposals have four Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 40-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically generated Cover Sheets or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 40-page limit.

Technical Volumes that exceed the 40-page limit will be reviewed only to the last word on the 40th page. Information beyond the 40th page will not be reviewed or considered in evaluating the offeror's proposal. To the extent that mandatory technical content is not contained in the first 40 pages of the proposal, the evaluator may deem the proposal as non-responsive and score it accordingly.

PHASE II ENHANCEMENTS

The DHP SBIR Program has a Phase II Enhancement Program which provides matching SBIR funds to expand an existing Phase II contract that attracts investment funds from a DoD Acquisition Program, a non-SBIR/non-STTR government program or private sector investments. Phase II Enhancements allow for an existing DHP SBIR Phase II contract to be extended for up to one year per Phase II Enhancement application, to perform additional research and development. Phase II Enhancement matching funds will be provided on a dollar-for-dollar basis up to a maximum $500,000 of SBIR funds. All Phase II Enhancement awards are subject to acceptance, review, and selection of candidate projects, are subject to availability of funding, and successful negotiation and award of a Phase II Enhancement contract modification.

DISCRETIONARY TECHNICAL ASSISTANCE

The DHP SBIR Program does not participate in the Discretionary Technical Assistance Program. Contractors should not submit proposals that include Discretionary Technical Assistance.

The DHP SBIR Program has a Technical Assistance Advocate (TAA) who provides technical and commercialization assistance to small businesses that have Phase I and Phase II projects.

RESEARCH INVOLVING ANIMAL OR HUMAN SUBJECTS

The DHP SBIR Program discourages offerors from proposing to conduct human subject or animal research during Phase I due to the significant lead time required to prepare regulatory documentation and secure approval, which will significantly delay the performance of the Phase I award.

The offeror is expressly forbidden to use or subcontract for the use of laboratory animals in any manner without the express written approval of the US Army Medical Research and Material Command's (USAMRMC), Animal Care and Use Review Office (ACURO). Written authorization to begin research under the applicable protocol(s) proposed for this award will be issued in the form of an approval letter from the USAMRMC ACURO to the recipient. Furthermore, modifications to already approved protocols require approval by ACURO prior to implementation.

Research under this award involving the use of human subjects, to include the use of human anatomical substances or human data, shall not begin until the USAMRMC's Office of Research Protections (ORP) provides authorization that the research protocol may proceed. Written approval to begin research protocol will be issued from the USAMRMC ORP, under separate notification to the recipient. Written approval from the USAMRMC ORP is also required for any sub-recipient that will use funds from this award to conduct research involving human subjects.

Research involving human subjects shall be conducted in accordance with the protocol submitted to and approved by the USAMRMC ORP. Non-compliance with any provision may result in withholding of funds and or termination of the award.

DHP SBIR 16.3 Topic Index

DHP163-001	Improved Human Machine Interface Usability for Clinical Healthcare Providers to Enter Data into Electronic Health Records
DHP163-002	Scene Registration Augmented Reality as an Educational Tool to Identify Underlying Anatomy during Medical Simulation Training
DHP163-003	Delivery System for Cryopreserved Eukaryotic Cell Vaccines
DHP163-004	Automated Tick Collecting Device
DHP163-005	Pathogen-specific and serotype-independent antibody reagents for diagnosis of Shigella spp. and non-typhoidal Salmonella
~~DHP163-006~~	(This topic has been removed from this Announcement)
~~DHP163-007~~	(This topic has been removed from this Announcement)
DHP163-008	Flight Medic Ultra-Wideband Microphone Toggle (UMT) Device
DHP163-009	Methods of Target Maintenance until Reinnervation after Peripheral Nerve Injury

DHP SBIR 16.3 Topic Descriptions

DHP163-001 TITLE: Improved Human Machine Interface Usability for Clinical Healthcare Providers to Enter Data into Electronic Health Records

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: The objective of this initiative is to develop innovative and unique technologies that doctors, nurses, medics EMTs and other health care providers can use to keep working with their patients, and still document in the Electronic Health Record in a hands-free manner. Currently, healthcare providers have to stop what they are doing and type into a keyboard to document patient care. The desired hands-free solution will facilitate clinical providers/first responders' ability to document on-site patient intake, assessment, point of care treatment and patient data to enable clinical data entry into the patient Electronic Health Record (EHR). Many busy healthcare providers, EMTs, first responders, and those military medical providers in dispersed military operations may not have the advantage of the organized logistics and casualty care systems and rely on memory until access to data entry is possible. This topic seeks new and innovative alternative data entry approach for Healthcare Providers to enter Electronic Health Record data into a computerized documentation system while keeping their hands completely free to work with patients.

DESCRIPTION: The Department of Defense (DOD) has recognized a critical process deficiency for combat medics to maintain clinical care, workflow and provide needed documentation surrounding response to crisis situations and point of care/point of injury treatment. The same need exists in the civilian sector, where busy doctors, nurses, nursing assistants and other care providers have to stop taking care of their patients, and then turn to the keyboard of their computers to enter information in the electronic health record. "Fat fingering", i.e. using a keyboard to type in notes, select from drop down menus, and enter numerical values takes away significant amounts of time from patient care, and absorbs large amounts of clinician productivity that could better be applied elsewhere to actually take care of patients and their families. While certain providers, such as radiologists, do use natural language processing, this only works with repetitive blocks of information, (i.e. "readings" that use common language repeatedly) and when used in quiet environments, i.e. the radiologists cubicle or office. In a busy hospital emergency room, ward, operating room, or in a military field environment, natural language processing has not been a viable solution heretofore because of ambient noise which impacts accuracy, as well as the need for nurses and doctors to be speaking to their patients and colleagues as they work.

The experience of recent military conflicts indicates that medical emergency responders, personnel and combat casualty care physicians, at all levels in the theater, from the far-forward to field hospital to rehabilitation centers, are able to save lives of wounded soldiers at unprecedented rates. However, warfighter and combat medics in specific Areas of Responsibility (AOR) are unable to access tools for documenting needed initial clinical intake information. Clinical data regarding care, treatment and/or investigation of emergencies, incident victims to track and provide crisis and incident statistics, patient health status, physical and mental clinical state and responder point of care treatment.

PHASE I: Design/develop an innovative concept for improved Usability for Human Machine Interface for Clinical Healthcare Providers to enter Data into Electronic Health Records. The initial prototype shall be aimed toward a fixed facility. Anticipated approaches for unanticipated environments include any type of passive non hands used data entry techniques. The effort should clearly analyze the scientific, technical and commercial merit as well as feasibility of using a hands-free data entry capability for use by civilian and military medical personnel in all echelons of medical care arenas, particularly useful in combat environments. Proposed work should products and/or services for hands-free electronic record data entry for medical / clinical / biological purposes even if the solution is not currently in use with medical systems. The effort should seek innovative and novel ideas to provide a realistic, low cost and high usability solution that is intuitive, and requires minimal to no training for persons to use. The research will explore solutions that will not degrade workflow, will be operable and reliable in complex, noisy environments, and should demonstrate a high-degree of usability to avoid interference with the flow of hands-on patient care, which can be interrupted with using keyboards or using handheld devices. Especially in military

operational environments with high tempo, the ability to enter data/document care in a hands free manner is critical. Keeping providers hands available for caring for casualties, moving patients for evacuation, and administering life-saving/limb saving treatments is imperative. The solution should work in common operating environments with presence of noise, fluids, and with providers using disposable gloves/sterile technique, and in various temperatures (i.e. in hospitals, a cold operating room and warm burn unit patient room; in first responder situations wind, rain, cold). The proposed solution should adhere to/ use technical standards to insure wide usage/acceptability and interoperability.

The offeror shall identify innovative technologies reviewed and considered, technical risks of the selected approach; costs, benefits and schedule associated with development and demonstration of the prototype. The final report shall include design of the innovative and improve human-machine interface for clinical providers to offer hands-free capability for clinical data entry, including performance goals, associated metrics, and conceptual validation through simulation, testing or other means. Determine future technological barriers with integrating / implementing the improve human-machine interface for clinical providers to enter hands-free data entry into electronic health records in various civilian and military medical environments, and identify probable risk mitigation strategies.

PHASE II: Based on the Phase I design and development feasibility report, the performer shall produce a prototype demonstrating potential medical utility in accordance with the success criteria developed in Phase I. The performer will then develop the prototype for the DOD evaluation. The performer shall deliver a demonstration of the prototype, and prepare a report describing the design and operation of the prototype. The intent of this phase is for the developer to deliver a well-defined prototype (i.e., a technology, product or service) meeting the requirements of the original solicitation topic which can be made commercially viable. The prototype shall effectively provide an improved, high usability, hands-free documentation capability and demonstrate validation of technology that enables data entry/data capture to the electronic patient record at point-of-care while the doctor, nurse or medic keeps working, and without the use of hand-operated keyboards, or hand-operated input devices. Expect to demonstrate prototype in military exercise field environment. The theater/operational medicine capabilities are expected to function in all or some of the environments noted:

1) low/no communication environment (i.e. no or low bandwidth environments)

2) first responder capabilities including immediate lifesaving measures at the point of injury in deployed/operational environments such as EMTs or firefighters on calls or combat medics in the field

3) common hospital environments such as operating rooms, emergency rooms, wards, where there is noise, presence of fluids, and where providers are using disposable gloves/sterile technique

4) EnRoute Care - care required to maintain the treatment initiated prior to evacuation and the sustainment of the patient's medical condition during evacuation. Care can range from in-flight skilled nursing care up to invasive Critical Care services from Critical Care Air Transport Teams (CCATT)

PHASE III DUAL USE APPLICATIONS: Follow-on activities shall include a demonstration of the application of this system in a civilian healthcare setting or to the Military Health System in deployed and non-deployed environments, civilian hospitals, ambulatory, training programs and/or with other military medical personnel. The performers shall demonstrate effectiveness and generate a profile of the innovative, high usability, hands free data entry solution that will synch, transfer or provide data to the Cerner electronic health record. The study will provide the clinical evidence for un-interrupted clinical workflow when treating patients using the proposed solution. Effectiveness shall be measured in terms accuracy of data entry in common operating environments with presence of noise, fluids, and using disposable gloves/sterile technique, and in various temperatures (i.e. in hospitals, a cold operating room and warm burn unit patient room; in first responder situations wind, rain, cold), and demonstration of usability using commonly accepted functional and technical metrics, and adherence/ use of technical standards to insure wide usage/acceptability. Anticipate working with other Advanced Developers such as MC4.

REFERENCES:

1. Gabriel Aldaz, Lauren Aquino Shluzas, David Pickham, Ozgur Eris, Joel Sadler, Shantanu Joshi, Larry Leifer, (April 22, 2015), “Hands-Free Image Capture, Data Tagging and Transfer Using Google Glass: A Pilot Study for

Improved Wound Care Management" http://journals.plos.org/plosone/article?id=10.13

2. Jeffrey J. Jacobsen, "Headset Computer With Handsfree Emergency Response" (2014) http://www.google.ch/patents/US20140031001

3. Joshua E. Richardson and Joan S. Ash, "Effects of Hands Free Communication Devices on Clinical Communication: Balancing Communication Access Needs with User Control" (2008) http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2656106/

4. Ed Crow, Janet Jonson "Wireless Handheld Electronic Devices Assisting Emergency Medical Field Personnel" (2000) https://www.arl.psu.edu/documents/ME9110_fin_rep_16aug00.pdf

5. AHIMA e-HIM workgroup, Speech Recognition in the Electronic Health Record (AHIMA Practice Brief) (2003) http://library.ahima.org/xpedio/groups/public/documents/ahima/bok1_022107.hcsp?dDocName=bok1_022107

KEYWORDS: Human Machine Interface, Usability, Hands-Free Data Entry, Electronic Health Record Usability, Point of Injury Clinical Documentation

DHP163-002 TITLE: Scene Registration Augmented Reality as an Educational Tool to Identify Underlying Anatomy during Medical Simulation Training

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: Develop, demonstrate, test, and evaluate a scene registration educational tool that registers/transmits/updates from a simulated patient's position/orientation using information to correlate accurately with 3-D anatomical dynamic models replicating position/orientation.

DESCRIPTION: Standardized patients and medical mannequin simulators are helpful medical educational tools used during training. To complement the benefits of these simulation tools, the topic calls upon performers to leverage augmented reality (AR) technology for scene registration for use in medical training. The tool should accurately and appropriately link position and orientation of training models using accurate anatomical overlays over a 3D surface to enhance the understanding of the relationship of landmarks with its underlying anatomy.

The goal of this topic is to create a system to augment a dynamic 3D scene registration using AR technology in order to produce a tool to that can recognize fiducial markers on a patient simulator or standardized patient. The performer can develop their own system or, if available, use existing or expected to be released technology (i.e. sensors, fiducial markers) that can be purchased and placed directly on/in a mannequin, attached or applied to a standardized patient or use technology already inserted into part task trainers or full body mannequin simulation systems to create a dynamic 3D scene registration using AR technology.

The scene registration AR software should be easily downloaded and be able to be used on existing mobile devices or anticipated to be released mobile devices.

The developed software should accurately and appropriately register the detection technology when the mobile device's existing camera is aimed at a standardized patient or a medical mannequin. The software should recognize and display the gross characteristics upon detection of the anatomical markers. Accurate and appropriate representation of models representing different layers of the underlying anatomy should be designed and displayed on a mobile device and correlate with the registration data and emphasis should be placed upon dynamic models where fiducial markers change their position and orientation in space. The dynamic models should reflect the orientation and position of the standardized patient or mannequin. The developed software should display models from any anatomical position and orientation (e.g. anterior, posterior, lateral, and oblique views). The user should

have the ability to lock and rotate models regardless of view.

Software development should focus on the development, technical feasibility, and demonstration of a low-cost tool that will complement the instructor's ability to teach and implement realistic simulation practice procedures enhancing the learning experience at all experience levels. The instructor should have the option to become a master controller and easily share images captured with students on their mobile device. The instructor should have the ability to add/remove static/dynamic model layers.

The proposed development effort should:

- Accurately and appropriately track and register an array of different anatomical positions and orientations either placed on standardized patients or mannequins, and/or ones that are already embedded in mannequins
- Allow for quick capture of the underlying anatomy via mobile device and save as an image on the mobile device
- Include static/dynamic models
  - Display models from any angle of the human anatomy
  - Display models from any anatomical position and orientation
- Include removable 'layer-by-layer' models shown from any angle of human anatomy and any anatomical position and orientation
- Allow instructor to control and share the scenes seen during the instruction
- Incorporate simulated trauma models (i.e. burns, blast, penetrating, blunt, and/or crush injuries) and other pathologies as a part of the static/dynamic repository
- Allow the ability to add complex pathology and traumatic (military relevant) models for more advanced learners.

PHASE I: Phase I will develop a proof of concept scene registration AR education application/tool. A justification describing the accuracy and sensitivity of the tool(s) used for the scene registration concerning data registration is required. The development will need to prove that registration, tracking, and accuracy of data transmitted and received can reflect different anatomical positions, orientations, and joint movement (i.e. flexion, extension). The proof of concept will need to demonstrate the animated model's ability to coordinate anatomical positioning with that of a standardized patient or mannequin.

The performer shall deliver a report describing the software and operation of the initial software package. The requested anatomy for Phase I proof of concept is either the neck (cricothyroidotomy2) or the shoulder (axillary artery and its tributaries).

The performer is encouraged to use resources from the Advanced Surgical Skills for Exposure in Trauma (ASSET1). ASSET can be utilized as an example of where the demonstration of scene registration AR may be useful and is congruent with current military medical training curricula.

The intent of this phase is for the performer to produce an initial software, application design, and proof of concept that demonstrates the new innovation of the tool that is being tested and indicate the types of risk anticipated. The performer will submit a final report and provide an initial demonstration (video) describing the stage of the software development and application, along with details of what will be further developed in Phase II.

PHASE II: Building upon the development and lessons learned of Phase I, Phase II will focus on expanding the registration capabilities of the detection tool(s) over broader areas (X, Y, Z plane & respective tissue planes). Phase II will begin incorporating dynamic models of the anatomy to align with the standardized patient or mannequin's position, orientation, and joint movement. Phase II will show an increase in detail concerning the static and the animated underlying medical anatomical models. Layer-by-layer addition/removal of anatomy dependent upon its respective position, orientation, and joint movement will need to be incorporated.

Sophistication of the software application will continue to be developed to include an instructor blackboard or whiteboard concept in which the instructor can become the Master operator; as a result, models being studied can be focused upon layer-by-layer and can be shared with the students' individual mobile devices. Phase II should build upon the basic medical images in Phase I and begin incorporating more complex models to include the chest, abdomen, and pelvis. Some anatomical variations should be included in the final deliverable.

Phase II product will need to demonstrate its usefulness (i.e. survey) with an appropriate user sample.

The performer will submit a final report that will include the results of the survey of appropriate user sample as well as the current state of the software application. The performer will provide a demonstration of the product along with details of what will be further developed in Phase III. This demonstration most likely will occur in the Maryland, northern Virginia, or Washington, DC area.

PHASE III DUAL USE APPLICATIONS: Concluding in Phase III the performer will have built a viable, commercially available software product accessible in a downloadable application that can be used in a mobile device. The content should encompass basic models to complex dynamic scenes that can display rotating models and include specialized anatomy such as the head and neck. The ability of the software to easily reveal multilayer or stacking effect of models will be ideal. Preferably, the capability will be based on state of the art software and hardware principles, use validated data from publicly available sources, reside on DoD IT systems, and provide anatomically correct models that can be used in medical school coursework. The addition of pathologies and trauma models such as burns, blast, penetrating, blunt, and/or crush injuries will need to be incorporated.

It is anticipated that commercial markets that could benefit from this novel product can include emergency, technical, nursing, physical therapy and medical schools to include their respective residency or licensed equivalency. If technology of this product is expanded, such commercial markets could also include dental and veterinary training programs. Manufacturers of sports gear and physical therapy clinics who will want a better understanding of the relationship between external anatomical landmarks and underlying anatomy under variable anatomical positions could benefit from such a product resulting in an improvement of commercial preventative injury equipment market (helmets, braces, guards etc.).

This demonstration most likely will occur in the Maryland, northern Virginia, or Washington, DC area.

Upon completion, the performer will submit a final report describing the software application and provide a final demonstration of the product.

REFERENCES:
1. Advanced surgical skills for exposure in trauma (ASSET), https://www.facs.org/quality%20programs/trauma/education/asset

2. Campbell-Wynn, L. (2013). Understanding the capabilities and limitations of advanced interactive m&s: a cricothyroidotomy simulation case study, http://etd.fcla.edu/CF/CFE0005142/Campbell-Wynn_Lillian_201308_PhD.pdf

3. American thoracic society: patient information series. Chest tube thoracostomy, http://www.thoracic.org/patients/patient-resources/resources/chest-tube-thoracostomy.pdf?gclid=CjwKEAiAuea1BRCbn-2n7PbLgEMSJAABQvTTtD6_wSiJBtv3n4qJRpsEeyXiUX4t4xyLTHQNQfBYMhoCyZbw_wcB

KEYWORDS: Image registration, augmented reality, detection, medical simulation, medical training, anatomical 3D modeling

DHP163-003 TITLE: Delivery System for Cryopreserved Eukaryotic Cell Vaccines

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: Develop an integrated system for automated thermostabilization by cryopreservation of eukaryotic cell vaccine(s), storage and delivery to the clinic/point of use.

DESCRIPTION: A critical need of the DoD is the protection of warfighters from infectious diseases that impair ability to function and result in non-combat casualties. Parasitic organisms and particularly those transmitted by vectors, such as the agents of malaria and leishmaniasis, are a significant problem for military personnel deployed to regions endemic for these diseases. Development and availability of prophylactic highly protective vaccines is a critical need. The most significant protection against parasitic diseases has been achieved by immunization with attenuated whole parasite vaccines. However, this has been hampered by the capacity to stably store, distribute and administer these whole parasite vaccines. Cryopreservation is the only method available for thermostabilizing eukaryotic organisms and cells and currently is used only on a limited scale for anti-cancer vaccines with small numbers of patients. Whole parasite anti-parasite vaccines [3, 4] targeting military recruits and active duty personnel prior to deployment require a significantly increased scale of manufacture – a level of operation that is also unprecedented and novel in the field of human vaccinology. There is, therefore a specific need for a fully integrated vialing, storage, distribution and administration system to meet the anticipated demand. Development of such an integrated system would truly create a disruptive technology that in addition to making the world's first malaria vaccine available, would facilitate a potential revolution in the field of biologics not just limited to vaccines, and thus provide important, strong intellectual property to the developers. The steps in this integrated system include the development of a) a tamper-evident cryovial formatted for automated filling and that can be accessed by needle and syringe, b) a high throughput cryopreservation process that yields high levels of potent organisms comprising live-attenuated vaccines which is capable of being fully automated, c) a cryovial packaging system designed for storage at high density and efficiency that can be semi or fully automated, d) an integrated liquid nitrogen vapor phase (LNVP) dry shipper delivery system that can combine components of air freighting of large cryopreserved vaccine payloads with smaller LNVP dry shippers for distribution to, and as temporary repositories in, clinics or deployment centers with hold-times of at least one month, and longer for field, including ship-board, use, and e) incorporation of a thawing device for retrieval/administration in the clinic. The integrated system is expected to be applicable for the distribution of vaccines, such as against malaria [3, 4], leishmaniasis and other organisms and may also be applicable for cellular therapies [2] and anti-cancer vaccines. This integrated system is one component of the manufacturing, storage, and delivery process that needed to be developed for manufacture of aseptic, live-attenuated, purified, anti-parasite vaccines to be successful. All components were considered to be impossible to execute a decade ago – almost all have been systematically solved, and the developers have generated considerable intellectual property in doing so. The last step, and one that is not without significant technical risk, is the scaling up vialing, cryopreservation, storage and distribution process adequate for production of vaccine to meet DoD needs. This does not exist, again because it has been considered too difficult to accomplish. This SBIR is aimed at completing the task.

PHASE I: The objective of phase I is to design a new type of cryovial for cryopreservation, demonstrate that it is effective in cryopreservation, and is suitable for direct administration of a cellular based vaccine to patients. Current systems (i.e. Nunc cryovials) require transferring the material to an injector system, which adds to cost, time and requires a laminar flow hood to maintain sterility. A vial that can be stored in LNVP and is suitable for injection of the vaccine in a simple, one-step process post thawing without transferring the material to a subsequent injector system does not currently exist on the market. The new cryovial design must:
a) have a working volume that can accommodate vaccine aliquots and diluent after thawing,
b) have a septum in the cap that allows addition of diluent and withdrawal of diluted vaccine using a needle and syringe – in the same manner as a standard vaccine vial,
c) have a method for closure that is permanent and renders the cryovial 'tamper-evident',
d) be compatible with automated filling devices,
e) be compatible with an optimized automated cryopreservation methodology,
f) incorporate a final seal for protection during storage and transportation,
g) be able to be thawed under field conditions anywhere, and
h) demonstrate compatibility with the vaccine(s).

After cryopreservation in the new cryovial prototype the product must be infective and potent. Designs for the efficient storage of large cryopreserved vaccine lots in liquid nitrogen vapor phase (LNVP) and the transportation of vaccine to the clinic using a LNVP cold chain are to be developed. To advance to Phase II the work should generate

a cryovial prototype that meets the above specification, and can be used to cryopreserve parasites that are highly infective and potent after thawing. It should also generate a plan for distribution of the product in a LNVP cold chain.

PHASE II: The objective of phase II is the optimized development to pre-implementation of the new cryovial and the design of a distribution system(s) to incorporate a new format and method for packaging the cryopreserved vaccine. Development of a new cryovial should include a FDA plan element for path to licensure. The new cryovial prototype is to be translated into production of a first-pass product. A) This cryovial must conform to the required specifications for use and demonstrate feasibility, through extensive testing, with the target vaccine during manufacture and preparation for inoculation in the clinic. Vaccine is to be produced using the manufacturing line designed in phase I and the equipment and processes are to allow for scale up to high throughput manufacture of large vaccine lots. B) Operation of the cryopreservation process must be demonstrated to be scalable. C) Prototypes for the efficient LNVP storage of large cryopreserved vaccine lots and transportation of vaccine to the clinic using a LNVP cold chain are to be developed: it is envisaged that this will involve dry shippers with payload capacities compatible with military clinics and deployment centers of different sizes, and naval vessels, and incorporate a system of cryovial packaging that is novel and that integrates vaccine manufacture with vaccine logistics.

PHASE III DUAL USE APPLICATIONS: It is anticipated that within DoD, potential customers of the cryovial will be those principal investigators/funders developing eukaryotic based therapies used for disease prevention or treatment (e.g. the US Navy's Malaria Program that is collaborating on a sporozoite-based malaria vaccine [3, 4]) and clinicians specializing in fertility [1] and involved in treating cancer patients with autologous immune cells as immunotherapies [2] and vaccines. However, this will be a dual use product that will have costs offset by customers in other markets. Within the U.S. Government, the State Department and Peace Corps will be significant customers for such products, particularly a malaria vaccine. In the private sector mining and energy industry companies with large footprints in disease endemic areas, especially Africa will be significant customers, as will travelers in general through travel medicine companies, university-based travel clinics, and individual practitioners. The objective of phase III is the full implementation of the developments from phase II. A) Manufacture of the new cryovial in a GMP-compliant facility at scale is to be implemented for commercialization efforts and lots of these cryovials are to be integrated into the vaccine manufacturing processes. This will include automated liquid handling methodology with automated processes for filling, capping and sealing the new cryovial. B) An optimized cryopreservation process is to be automated. C) The logistics of vaccine delivery are to be applied: this is to include: a) implementation of the high density storage system with associated methods and equipment, b) deployment of LNVP dry shippers fully compatible with all steps in shipping, local storage in the clinic during immunizations and retrieval and handling of vaccine cryovials, and c) integration of a new device for automated thawing of cryovials into the procedure for vaccine preparation in the clinic.

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KEYWORDS: Liquid nitrogen vapor phase, cryovial, live vaccines, immunization, cryopreservation

DHP163-004 TITLE: Automated Tick Collecting Device

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: To develop a self-propelled (automated) tick collection device that is capable of operating in diverse habitats under various environmental conditions.

DESCRIPTION: In many parts of the world, tick-borne diseases pose serious health risks to troops, civilian employees, and residents at military installations. To mitigate the threat of tick-borne disease, preventive medicine personnel monitor tick vectors and implement control strategies. Surveillance (monitoring) for changes in the abundance and activity of host-seeking ticks is critical to assess public health risk for tick-borne pathogens like Lyme disease. Tick surveillance should employ efficient collection methods that accurately assess population and species diversity, as well as prevalence and intensity of infection with tick–associated pathogens.

Host detection and attachment by ticks is achieved through three main behavioral patterns: questing (stationary ambush), hunting (active movement towards host) and tick-host cohabitation. Tick collection methods used by Military Preventive Medicine can be divided into three major categories: (1) dragging; (2) trapping using carbon dioxide (CO2); and (3) collecting directly from hosts. Dragging is considered the standard method for collecting questing ticks on vegetation, and approximates human biting risks. Dragging involves moving a piece of flannel or cotton across vegetation behind the collector and allowing ticks to attach to the cloth as it passes. There are several important issues associated with the dragging method: (1) it is labor intensive, which negatively affects the sampling effort (total area/distance covered and duration of the sampling period), (2) it exposes the collector to potentially infected ticks, and (3) it only samples ticks (mainly adults) that quest on the upper layer of vegetation. The CO2 tick sampling method utilizes dry ice (CO2) which serves as bait to attract actively host-seeking ticks of all life stages (larvae, nymphs and adults) to a collection site proximate to the CO2 source. Because this method is stationary, it is not as restricted by vegetation type and density. Additionally, CO2 reduces the sampling effort, but also has the additional logistical problems of CO2 source acquisition, transport and storage. Furthermore, tick species vary in their responsiveness to CO2 with some species responding strongly (Amblyomma hebraeum); moderately (Ixodes scapularis (Lyme disease vector)); or poorly (Dermacentor variabilis (Rocky mountain spotted fever vector))(Sonenshine, 1993). Host-based sampling typically involves trapping wild animals or sampling from fresh carcasses. The advantage of this method is that the preferred hosts can be sensitive collectors of ticks at low densities. Disadvantages of this method are that it is labor intensive, requires worker protection measures, difficult to obtain large sample sizes, inconsistency in collection between workers, and requirements for animal handling approval (Cohnstaedt et al. 2012).

The purpose of this project is to develop a novel tick surveillance device to perform surveillance on medically important tick species such as Dermacentor variabilis (transmits Rocky Mountain spotted fever), Ixodes scapularis (transmits Lyme disease) and Dermacentor marginatus (transmits Crimean-Congo hemorrhagic fever). The ideal product will be well suited for Preventive Medicine deployment packages and more effective than current collection methods.

Specific objective for this product are as follows:

1. Should be able to traverse through diverse tick habitats (shrubs, weeds, short and tall grasses) via remote control or automated programing.

• Continuous and point sampling (device programming options)
- Continuous mode should have an operation time for at least 45 minutes
- Point sampling mode (example: Stationary sampling for 3 hours at one location then move to next sampling point location) should have an operation time for at least 8 hours

• Exact and random sampling (device programming options)

• Adjustable speed (1-5 mph)

• Have an internal GPS that reports the device movements to a mobile device

2. Needs to be able to collect questing and non-questing ticks

• Have an attachable flag port. An attachable flag made of flannel or Velcro can be used to collect questing ticks (Continuous sampling)

• Have a compartment to collect non-questing ticks that are attracted to a bait (CO_2)

- The compartment should be able to hold the collected ticks and keep them alive
- The compartment should have a sensor that counts the ticks as they enter the trap

• Collect a minimum of 10 ticks from infested habitat

3. Capable of carrying a minimum of 1kg of dry-ice (CO_2)

• Device should provide insulation for the dry ice
• Gas from the dry-ice should be release from the device into the environment at a rate ranging from 200-350 ml/min.

4. The device should not exceed a weight of 30 lbs.

• Needs to be portable and not require and external power source
• Easy to operate, maintain and setup

PHASE I: This phase of the SBIR should focus on developing the initial concept and design for the tick surveillance trap. Phase I proposals should demonstrate the likelihood that an effective autonomous tick sampling device can be developed that meets the broad needs discussed in this topic.

PHASE II: During the Phase II portion of this SBIR, the awardee should develop the prototype design. Once the initial prototype is developed, it should be tested in both laboratory and field environments for efficacy in collecting medically important ticks as described in the specific project objectives above. At the conclusion of Phase II, the awardee should have developed a prototype that is able to collect host-seeking and questing ticks from tick infested habitats. Specific expectations for the product are outlined above.

PHASE III DUAL USE APPLICATIONS: During this phase the selected contractor will finalize the design of a production model and commercialize the desired device.

Military Application: The developed product will be used by Military Preventive Medicine personnel operating in the continental United States and deployed environments around the world. The selected contractor should provide a report that summarizes the performance of the tick collecting device to the Armed Forces Pest Management Board (AFPMB) and a request for assignment of a National Stock Number (NSN) to this device.

Commercial Applications: The proposed SBIR has commercial applications outside of the military. In order to increase marketability, this device should be modified for indoor use and made capable of collecting bedbugs as well. Bedbug control is very expensive and often requires multiple treatments. These issues and the additional problem of pesticide resistance, makes alternatives such as the proposed trap attractive to the pest management industry. Furthermore, a novel tick collecting device as such as this would be of great value to organizations involved in tick epidemiology and research. Examples are University and Industry Entomologist, Vector Control Districts, Vector Biologist, Vector Ecologist, and Public Health agencies.

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KEYWORDS: Tick, trap, robot, drone, CO2, vector, surveillance, Lyme

DHP163-005 TITLE: Pathogen-specific and serotype-independent antibody reagents for diagnosis of Shigella spp. and non-typhoidal Salmonella

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: Develop and validate antibodies for broad-spectrum detection of Shigella spp. and non-typhoidal Salmonella enterica. The antibody or antibody mixture should be of sufficient sensitivity to bind concentrations of these bacteria that are found in stool samples from diseased patients, be readily incorporated into both ELISA and lateral flow immunoassay platforms, and be compatible with use in an austere environment (resistant to degradation in environmental extremes).

DESCRIPTION: Gastrointestinal illnesses caused by bacterial infection are a frequent cause of loss of duty days and other physiologic sequelae in Service members while deployed. In this population, the causative agents are often enterotoxigenic Escherichia coli, Campylobacter spp., Shigella spp., and non-typhoidal Salmonella; however, a significant number of cases are undiagnosed (45.6%) [Connor et al., Curr Opin Infect Dis, 2012]. The clinical symptoms include nausea, vomiting, diarrhea, and abdominal cramps. These infections are readily communicable between individuals sharing close quarters such as military camps and bases, daycares, and naval vessels. Transmission is most frequently through the consumption of contaminated food and person-to-person contact. Due to the operational environment, patients seen at the military equivalent of an outpatient clinic (Role of Care 1) must be quickly treated and returned to duty or evacuated to a medical unit with expanded diagnostic and treatment capabilities (Role of Care 2-4). Therefore, differential diagnosis on the day of symptom onset is essential. In military settings, the point of need is frequently an austere environment without, for example, access to typical laboratory infrastructure, reliable electric power, refrigeration or controlled room-temperature storage, or specially trained laboratory personnel. Contributing to the negative impact on the infected individual and the burden on the unit's mission is the lack of laboratory diagnostic capability.

There are limited FDA-cleared diagnostic devices for bacterial diarrheal pathogens (FDA, http://www.accessdata.fda.gov/scripts/cdrh/devicesatfda/index.cfm), particularly for Shigella spp and non-typhoidal Salmonella. While culture or laboratory developed tests using PCR or ELISA can be performed at heavily equipped diagnostic laboratories, these platforms are not compatible with deployment.

The military recently identified lateral flow immunochromatographic tests (ICT) as the platform of choice for rapid infectious disease diagnostics. However, critical reagents for these assays that sufficiently detect the serotypes of these pathogens are challenging to generate and no novel antibodies have been cleared by the FDA for decades. Moreover, those antibodies that do exist in have a number of deficiencies such as insufficient sensitivity and unwanted serotype-specificity. Thus, the military has a requirement for the development of "pan-Shigella" and "pan-Salmonella" antibodies that are used in ICT platforms that are sufficiently sensitive to diagnose patients infected by any serotype or species of Shigella or non-typhoidal Salmonella by rapid and direct analysis of unprocessed stool. The antibodies should be designed to minimize false positive or false negative results. Because there are many different serotypes of Shigella and non-typhoidal Salmonella that are prevalent, the antibodies should not differentiate between serotypes of the given pathogen. However, the antibodies should be pathogen-specific and be able to differentiate between Shigella and non-typhoidal Salmonella, as well as differentiate either Shigella or Salmonella from other common enteric bacterial pathogens such as Campylobacter and various E. coli virotypes (i.e. EHEC, EPEC, ETEC, EAEC, not EIEC) The proposed reagents should be developed with the application for incorporation into a diagnostic device that will be cleared by the U.S. Food and Drug Administration (FDA) for use

as a diagnostic device.

The U.S. Department of Defense is seeking innovative materiel solutions to provide pan-Shigella and pan-Salmonella reagents that can be used to diagnose gastrointestinal illnesses caused by Shigella and Salmonella spp. Development of an FDA-cleared diagnostic device is not contemplated within the scope of Phases I, II, or III of this effort.

PHASE I: Specific Aim 1: Antibodies raised against Gram-negative enteric pathogens are typically directed to the immunodominant O-antigen, making such antibodies largely serotype-specific. For the purposes of a point-of-care rapid diagnostic device, serotype-specific antibodies impart a degree of specificity that is not only unnecessary for treatment decisions, but also adds excessive complexity and cost to R&D efforts. Consequently, there is a critical need for antibodies that are specific enough to identify clinically-relevant levels of Shigella and non-typhoidal Salmonella in human stool samples, but are not restricted to particular serotypes. Recombinant antibody technology is non-animal model dependent and generates monoclonal antibodies, but there is a dearth of data and product available for Shigella and Salmonella spp. The process generally consists of (1) generation of an antibody gene library; (2) display of the library on phage coats or cell surfaces (3) isolation of antibodies against an antigen of interest; (4) modification of the isolated antibodies and (5) scaled up production of selected antibodies in a cell culture expression system. This approach has been successful in the generating antibodies that have been FDA-cleared previously, and utilizing this rational engineering approach should overcome the natural immunodominance of the bacterial O-antigens.

As part of this topic, the Contractor will demonstrate proof of concept of this technology and generate Shigella and Salmonella spp. antibodies for broad-spectrum detection against a wide range of clinically relevant samples of multiple species and serotypes using recombinant antibody technology. Deliver a report documenting the measures taken to generate these antibodies and the performance of these antibody reagents. Comparison to commercially available antibodies should also be performed.

Specific Aim 2: In the event that no suitable antibodies are identified in Aim 1, the Contractor will develop and execute alternative approaches for the generation of novel pan-Shigella and pan-Salmonella antibodies or optimization of existing reagents. The Contractor will deliver antibody reagents that are pathogen-specific and serotype-independent and a report documenting their development and initial performance.

PHASE II: Specific Aim 3: Based on the work in Phase I, demonstrate the performance of pan-Shigella and pan-Salmonella antibody reagents (generated using recombinant antibody technology or an alternative approach if needed) capable of detecting Shigella and Salmonella at clinically-relevant concentrations directly from a human stool matrix. Sensitivity and specificity testing using spiked stool samples should be performed. Cross reactivity against other non-Shigella and non-Salmonella bacterial species should be performed. The Contractor will deliver a report documenting the data demonstrating performance of the reagents. The Contractor will also deliver sufficient quantities of reagents to allow the DoD to perform 150 tests during a DoD in-house laboratory evaluation.

PHASE III DUAL USE APPLICATIONS: By the end of Phase III, the Contractor will have optimized and validated reagents that may be available for sale and/or licensure or establish a partnership with a diagnostic device company that develops and/or manufactures lateral flow immunoassays for bacterial diarrheal pathogens. Depending on the quality and nature of the antibodies, it is also possible that these antibodies may be evaluated for use as a therapeutic; however, therapeutic use is not the intended application of this topic.

Such a device supports the Military Infectious Disease Research Program (https://midrp.amedd.army.mil/info/PGAreas.jsp), U.S. Army Medical Research and Materiel Command, and the Pharmaceutical Systems Project Management Office, U.S. Army Medical Materiel Development Activity (USAMMDA). USAMMDA is the advanced developer of medical materiel for the U.S. Army and manages contracts for product development from after the proof-of-concept phase through initial fielding to operational units.

Further, the device may have commercial market applicability to the health care, cruise ship, and childcare industries and possibly also the airline, hospitality, and food service industries, and non-governmental and intergovernmental organizations (NGOs and IGOs) implementing public health, humanitarian assistance, and disaster relief projects in

the developing world.

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KEYWORDS: Clinical laboratories, communicable diseases, diagnosis medicine, diagnostic equipment, diarrhea, Salmonella, Shigella, antibodies, reagents, ELISA, lateral flow immunoassays, infectious diseases, laboratory equipment, laboratory tests, medical laboratories

DHP163-006 (This topic has been removed from this Announcement)

DHP163-007 (This topic has been removed from this Announcement)

DHP163-008 TITLE: Flight Medic Ultra-Wideband Microphone Toggle (UMT) Device

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: The objective of this topic is to research, develop, and demonstrate a ruggedized Ultra-wideband Microphone Toggle (UMT) communications device which will enable Flight Medics or others to direct input from their headset microphone to either the vehicle or aircraft intercom system, or to either of two secure Ultra-Wideband (UWB) applications on a Nett Warrior Smartphone aka End User Device (EUD): 1) an existing UWB Voice-to-Text application or, 2) UWB Push-to-Talk verbal communication with another Medic via their Nett Warrior EUDs.

DESCRIPTION: This topic is designed to focus on research, development, and demonstration of a ruggedized Ultra-Wideband (UWB) Microphone Toggle (UMT) communications device which will enable Medics to direct input from their headset microphone to either the vehicle or aircraft intercom system, or to either of two secure UWB applications on a Nett Warrior Smartphone aka End User Device (EUD): 1) an existing UWB Voice-to-Text application supporting the capture of information into the electronic DD 1380 / Tactical Combat Casualty Care (TCCC) card or, 2) UWB Push-to-Talk verbal communication with another Medic via their Nett Warrior EUDs.

Military Medics from the Army, Navy, and Air Force on board both ground and air MEDEVAC and CASEVAC platforms use helmet mounted military headsets with microphones to communicate via vehicle and aircraft intercom systems, depending on the vehicle. While versions of these military headsets using NATO communication jacks are available that allow a user to monitor more than one communications system at a time, they do not generally support distinct verbal communications with more than one system without manually disconnecting and reconnecting microphone cables. In order to support simultaneous monitoring of both the vehicle or aircraft intercom system and verbal communications with other Medics, as well as enable the Medic to select between the vehicle or aircraft intercom, the UWB Voice-to-Text application, or UWB Push-to-Talk verbal communications

with another Medic via their Nett Warrior EUDs, an UMT device that would enable the Medic to manually direct input from his microphone to the desired communication system is needed.

Army Medics, Navy Corpsman, Air Force Pararescuemen, and Army Flight Medics will use EUDs with the JOMIS electronic DD 1380 to capture electronic medical data on casualties treated at the point of injury and during enroute casualty evacuation, subsequently transmitting the data via military tactical networks to be uploaded to the casualty's electronic medical record. In order for the Mounted or Flight Medic to capture casualty care on the EUD, the Medic requires a UMT device that is used in-line with the existing vehicle or aircraft plug-in intercom system and the Medic's helmet. This capability addresses a current capability gap: the ability to electronically document patient injuries and treatment at point of injury and during pre-hospital evacuation. Additionally, the Pararesucuemen and Flight Medics needs to communicate with ground Medics and Corpsman via the EUD, potentially over a wireless UWB network, which provides direct Medic-to-Medic communication without encumbering any bandwidth from the ground or aircraft tactical radio command and control networks.

The UMT device should work with the military standard specifications for communication headsets, to include both stand-alone and helmet-mounted headsets already integrated with communications systems on both ground and air MEDEVAC and CASEVAC platforms. The Mounted Medic is required to wear his helmet in the ambulance even when working on a casualty. Through a modified Medic helmet with microphone, the Mounted Medic in battle should be able to communicate with other Medics over UWB or communicate with the EUD to capture and document the casualty's medical care while enroute through the UWB Voice-to-Text application. Typically the Pararescuemen and Flight Medic's helmet is designed to plug into the rotary- or fixed-wing aircraft's communication system using a standard communications jack, thereby allowing the Pararecuemen or Flight Medic to consistently hear all communications on the aircraft. When the rotary-wing aircraft lands to pick up a patient, the Flight Medic may disconnect from the aircraft communication system to assist in the loading of casualties and subsequently reconnect as soon as possible to update the aircrew the Flight Medic's status.

With the UMT device, the Flight Medic should be able to select from three options: 1) communicate with flight crew, 2) dictate to the EUD using Voice-to-Text for the JOMIS DD 1380, and 3) communicate with the Medic(s) or Corpsman on the ground using and within UWB range.

At all times the Medic needs to monitor crew transmissions.

The UMT will be no more than a half inch thick, three inches wide, three inches high, and contain the UWB electronics and battery support, a female NATO standard plug receptacle for the Pararescuremen or Flight Medic's helmet, and a NATO male plug to connect to the rotary- or fixed-wing communications system cable. When the Flight Medics desires to talk to or through the EUD, the UMT will be selected to the appropriate mode: intercom, Voice-to-Text, or EUD-to-EUD voice communications. The UWB UMT case and EUD will contain the software to execute the Voice-to-Text or EUD-to-EUD voice communications applications.

After Phase III development, the final production model of a UMT device must be ruggedized for shock, dust, sand, and water resistance to enable reliable, uninterrupted operation in combat rotary- and fixed-wing aircraft on the move, to include operation and storage at extreme temperatures. Size and weight are important factors. It should be easy and quick to replace the battery in the device.

Quantitative values for acceptable operational and storage temperatures and power requirements should be planned to comply with applicable MIL-SPECs (pending CERDEC's release). The UMT device shall meet fleet-wide airworthy requirements set forth by Joint Enroute Care Equipment Test Standard; proponent: U,S. Army Aeromedical Research Laboratory (USAARL).

This technology is additionally applicable to civilian ambulances when underway and the noise from the sirens and road conditions make it hard for the medical technicians to verbally document their care and create an electronic medical note for the hospital.

PHASE I: Research solutions and design a prototype device that address the technical challenges for this topic as identified above for a capability that incorporates a feasible Medic's Ultra Wideband Microphone Toggle device solution.

Further develop commercialization plans that were developed in the Phase I proposal for elaboration or modification to be incorporated in the Phase II proposal. Explore commercialization potential with civilian emergency medical service systems development and manufacturing companies. Seek partnerships within government and private industry for transition and commercialization of the production version of the product.

PHASE II: From Phase I work, develop at least five near market-ready operational ruggedized UWB Microphone Toggle devices, that include an air-worthiness certificate.

In cooperation with Telemedicine and Advanced Technology Research Center (TATRC), demonstrate the operational ruggedized devices with Medics in a relevant field environment; such as a Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Ground Activity Events or Marine Corps Limited Objective Experiments (LOE), etc.

Further develop out commercialization plans contained in the Phase II proposal for elaboration or modification in Phase III. Firm up collaborative relationships and establish agreements with military and civilian end users to conduct proof-of-concept evaluations in Phase III. Begin to execute transition to Phase III commercialization potential in accordance with the Phase II commercialization plan.

PHASE III DUAL USE APPLICATIONS: Refine and execute the commercialization plan included in the Phase II Proposal. The Phase III plan shall include looking at other military service specifications, U.S. Air Force, U.S. Navy, and U.S. Marine Corps to meet their requirements for headset connections and airworthiness certification of UWB per specific airframe. The production variant may be evaluated in an operational field environment such as Marine Corps Limited Objective Experiment (LOE), Army Network Integration Exercise (NIE), etc. depending on operational commitments.

Present the product ready device as a candidate for fielding, to applicable Army, Navy/Marine Corps, Air Force, Department of Defense, Program Managers for Combat Casualty Care systems along with government and civilian program managers for emergency, remote, and wilderness Medicine within state and civilian health care organizations. Execute further commercialization and manufacturing through collaborative relationships with partners identified in Phase II.

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2. Article: Medical Applications of Ultra-Wideband (UWB), by Jianli Pan.
http://www1.cse.wustl.edu/~jain/cse574-08/ftp/uwb/index.html

3. Article: Pushing the Ultrawideband Envelope, by Henry S. Kenyon.
http://www.afcea.org/content/?q=pushing-ultrawideband-envelope

KEYWORDS: Ultra Wideband (UWB) Communications Interface, Flight Medic support, combat casualty care communications, combat Medic, Tele-Medicine, mobile device interface, push-to-talk, wireless, Personal Area Networks (PAN)

DHP163-009 TITLE: Methods of Target Maintenance until Reinnervation after Peripheral Nerve Injury

TECHNOLOGY AREA(S): Biomedical

OBJECTIVE: This topic seeks non-conduit solutions to improve functional recovery from peripheral nerve injury by addressing factors distal to the site of a peripheral nerve injury. This topic does not include nerve guide, conduit, or scaffold technology, nor factors, cells, or other adjuvants associated with same.

DESCRIPTION: Clinical methods of target maintenance until reinnervation remains an unmet need in nerve repair.

- 5-6% of all battlefield injuries involve major injury to a peripheral nerve
- Functional recovery after PNI is highly age-dependent, with the decline beginning at, or just after, puberty; <50% of those older than 50 who suffer nerve injury will regain function
- Muscle fibrosis and atrophy begins immediately after denervation and plateaus after four months when 60–80% of muscle volume has been lost. At that point, even if the muscle is reinnervated, it will not return to premorbid bulk or contractile strength.
- After two months of denervation, a reduced number of motor units is observed in muscle, while the number of muscle fibers remains constant
- The neuromuscular junction undergoes age-related changes, even without denervation/nerve transection
- In rat models, neuromuscular recovery declines after prolonged denervation, despite excellent axonal recovery, suggesting the neuromuscular junction may be implicated

Myriad neural conduits composed of various materials—PLGA, PCLF, cadaveric epineurium, tyrosine polycarbonate, decellularized nerve sheath— either with or without the addition of stem cells, have been posed as solutions to the nerve regeneration problem, but none has proven to deliver superior functional recovery to autograft, which is the current gold standard of treatment. This suggests that bridging the nerve gap is only part of what is required to optimize functional recovery.

A few strategies have attempted to address denervated target organ preservation including PEG fusion, distal electrical stimulation, growth factors, stem cell therapy, and immunosuppression with FK5061. However, while some have shown promise, none is in widespread use to date, nor has sufficient clinical data to support adoption.

PHASE I: Conceptualize and design an innovative solution for maintaining functional muscle units following peripheral motor nerve injury. Such solutions may include devices, and/or cellular, tissue or biological components meant to facilitate directional axonal outgrowth and to promote more rapid and effective functional recovery of motor nerve injury. Phase I can support early concept work (i.e., in vitro studies), or efforts necessary to support a regulatory submission, which do not include animal or human studies; such as, but not limited to, stability studies, shipping studies, etc.

PHASE II: The researcher shall design, develop, test, finalize and validate the practical implementation of the prototype therapeutic that implements the Phase I methodology to improve functional recovery after peripheral nerve injury over this 2-year, $1.0M (max) effort. Phase II should demonstrate understanding of requirements to successfully enter Phase III, including how Phase II testing and validation will support a Food and Drug Administration (FDA) submission, if necessary for the product. Phase II studies may include animal or human studies, portions of effort associated with the same, or work necessary to support a regulatory submission which does not involve animal or human use, to include, but not limited to: manufacturing development, qualification, packaging, stability, or sterility studies, etc. The researcher shall also describe in detail the transition plan for the Phase III effort.

PHASE III DUAL USE APPLICATIONS: Plans for the commercialization/technology transition and regulatory pathway should be executed here and lead to FDA clearance/approval. They include: 1) identifying a relevant patient population for clinical testing to evaluate safety and efficacy and 2) GMP manufacturing sufficient materials for evaluation. The small business should also provide a strategy to secure additional funding from non-SBIR government sources and /or the private sector to support these efforts. The technology should be designed and receive approval to allow for procurement by, and use in, military treatment facilities in the United States, as well as in civilian hospitals treating nerve injuries.

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KEYWORDS: peripheral nerve, injury, regeneration, denervation, reinnervation, neuromuscular junction, sensory, motor