Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
Total Program Element	-	98.097	114.790	112.242	-	112.242	100.603	113.059	117.160	120.594	-	-
BT-01: *BIOMEDICAL TECHNOLOGY*	-	98.097	114.790	112.242	-	112.242	100.603	113.059	117.160	120.594	-	-

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This Program Element is budgeted in the applied research budget activity because it focuses on medical related technology, information, processes, materials, systems, and devices encompassing a broad spectrum of DoD challenges. Bio-warfare defense includes the capability to predict and deflect evolution of natural and engineered emerging pathogen threats, and therapeutics that increase survivability within days of receipt of an unknown pathogen. Continued understanding of infection biomarkers will lead to development of detection devices that can be self-administered and provide a faster ability to diagnose and prevent widespread infection in-theater. Other battlefield technologies include a soldier-portable hemostatic wound treatment system, capability to manufacture field-relevant pharmaceuticals in theater, and a rapid after-action review of field events as a diagnostic tool for improving the delivery of medical care and medical personnel protection. Improved medical imaging will be approached through new physical properties of cellular metabolic activities. New neural interface technologies will reliably extract information from the nervous system to enable control of the best robotic prosthetic-limb technology. To allow medical practitioners the capability to visualize and comprehend the complex relationships across patient data in the electronic medical record systems, technologies will be developed to assimilate and analyze large amounts of data and provide tools to make better-informed decisions for patient care. In the area of medical training, new simulation-based tools will rapidly teach increased competency in an open and scalable architecture to be used by all levels of medical personnel for basic and advanced training. Advanced information-based techniques will be developed to supplement warfighter healthcare and the diagnosis of post-traumatic stress disorder (PTSD) and mild traumatic brain injury (mTBI). This project will also pursue applied research efforts for dialysis-like therapeutics.

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	110.900	114.790	123.742	-	123.742
Current President's Budget	98.097	114.790	112.242	-	112.242
Total Adjustments	-12.803	-	-11.500	-	-11.500
• Congressional General Reductions	-0.140	-			
• Congressional Directed Reductions	-14.288	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	4.343	-			
• SBIR/STTR Transfer	-2.718	-			
• TotalOtherAdjustments	-	-	-11.500	-	-11.500

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

Change Summary Explanation

FY 2013: Decrease reflects Congressional reductions for Sections 3001 & 3004, sequestration adjustments, and the SBIR/STTR transfer offset by reprogrammings.

FY 2015: Decrease reflects the end of the Revolutionizing Prosthetics program.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Autonomous Diagnostics to Enable Prevention and Therapeutics (ADEPT)	12.175	28.852	23.550

Description: The overarching goal of the Autonomous Diagnostics to Enable Prevention and Therapeutics (ADEPT) program is to increase our ability to rapidly respond to a disease or threat and improve individual readiness and total force health protection by providing centralized laboratory capabilities at non-tertiary care settings. ADEPT will focus on the development of Ribonucleic Acid (RNA)-based vaccines, potentially eliminating the time and labor required for traditional manufacture of a vaccine while at the same time improving efficacy. Additionally, ADEPT will develop methods to transiently deliver nucleic acids for vaccines and therapeutics, and kinetically control the timing and levels of gene expression so that these drugs will be safe and effective for use in healthy subjects. ADEPT will also focus on advanced development of key elements for simple-to-operate diagnostic devices. A companion basic research effort is budgeted in PE 0601117E, Project MED-01.

FY 2013 Accomplishments:

- Demonstrated increased humoral and cellular responses with RNA-based vaccines as compared to benchmark vaccines in vivo.
- Demonstrated increased efficacy of RNA-based vaccines in vivo in small and large animal models.
- Developed device components (sample preparation and detection components) to enable diagnostic device capabilities in low-resourced settings.
- Developed device components (fluidic delivery and multiplex assay module) to enable diagnostic device capabilities designed for the remote clinic.

FY 2014 Plans:

- Demonstrate ability to manipulate the type of immune response induced by RNA-based vaccines.
- Demonstrate ability to target delivery of RNA-based vaccines to specific cell types.
- Develop novel methodologies to deliver nucleic acid constructs encoding one or hundreds of antibodies identified from immunized or convalescent patients.
- Demonstrate delivery of nucleic acids that transiently produce multiple antibodies.
- Perform quantitative comparison of room temperature assay methods appropriate for integration in devices for low-resourced settings.
- Demonstrate initial component integration and define performance metrics for advanced diagnostic device prototypes suitable for operations in remote clinic and low-resourced settings.

FY 2015 Plans:

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
- Demonstrate ability to control the time duration of the therapeutic response suitable for clinical use and rapid public health responses. - Investigate targeted delivery of nucleic acid constructs to specific cell types. - Demonstrate feasibility for controlling pharmacokinetics and immunity modulation components to enable a more potent and broader immune response. - Develop designs for RNA-based vaccines to enable transition to human clinical trials. - Develop designs for initial diagnostic device prototypes, based on highest performing components. - Produce first-generation, integrated diagnostic prototypes designed for remote clinic and low-resourced settings. - Measure quantitative performance of first-generation, integrated diagnostic device prototypes and determine modifications required for performance improvements.			
Title: Tactical Biomedical Technologies	13.188	13.321	12.000
Description: The Tactical Biomedical Technologies thrust will develop new approaches to deliver life-saving medical care on the battlefield. Uncontrolled blood loss is the leading cause of preventable death for soldiers on the battlefield. While immediate control of hemorrhage is the most effective strategy for treating combat casualties and saving lives, currently no method, other than surgical intervention, can effectively treat intracavitary bleeding. A focus in this thrust is the co-development of a materials-based agent(s) and delivery mechanism capable of hemostasis and wound control for non-compressible hemorrhage in the abdominal space, regardless of wound geometry or location within that space. This thrust will also investigate non-invasive techniques and equipment to use laser energy to treat intracranial hemorrhage through the skull and tissues in a pre-surgical environment. Finally, in order to address logistical delays associated with delivering necessary therapeutics to the battlefield, this thrust will also develop a pharmacy on demand that will provide a rapid response capability to enable far-forward medical providers the ability to manufacture and produce small molecule drugs and biologics. ***FY 2013 Accomplishments:*** - Demonstrated a combined hemostasis agent and delivery mechanism that achieves hemostasis in less than four minutes and does not interfere with standards of care. - Assessed manufacturing costs and processes required for pilot-scale production of a Wound Stasis System. - At laboratory scale, synthesized in continuous flow the following Active Pharmaceutical Ingredients (APIs): Diphenhydramine, Diazepam, Lidocaine, Fluoxetine, Ibuprofen, Atropine, and Doxycycline. - Demonstrated continuous flow synthesis of Diphenhydramine, Diazepam, Lidocaine, and Fluoxetine using an integrated manufacturing platform. - Designed and tested drug product crystallization and formulation for Diphenhydramine, Diazepam, Lidocaine, and Fluoxetine in an integrated manufacturing platform. - Expressed protein therapeutics via fed-batch fermentation in both cell-free and cell-based systems.			

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Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
- Developed breadboard prototype device for treatment of intracranial hemorrhage using laser energy through the skull and tissues and demonstrated novel optical coupling technique to minimize peripheral tissue damage in porcine cadavers. ***FY 2014 Plans:*** - At laboratory scale, demonstrate continuous flow synthesis of the following APIs: Salbutamol, Ciprofloxacin, Azithromycin, Rufinamide, Etomidate, Triclabendazole, and Neostigmine. - Engage the FDA for input on Process Analytical Technologies (PAT) and current Good Manufacturing Process (cGMP) for Diphenhydramine, Diazepam, Lidocaine, Fluoxetine, Ibuprofen, Atropine, and Doxycycline. - Perform in vivo demonstration of transcranial photocoagulation of intracranial vessels in porcine model. - Perform in vivo demonstration of photo-induced vasospasm in intracranial vessels in porcine model. - Design and develop upstream and downstream components of miniaturized end-to-end manufacturing platform for protein therapeutics using cell-free and cell-based protein translation systems, including integration of protein expression and purification processes. ***FY 2015 Plans:*** - Develop novel continuous flow crystallizer, miniaturized reactors, and chemically compatible pumps for integration into a compact end-to-end manufacturing platform for the following APIs: Diphenhydramine, Diazepam, Lidocaine, Fluoxetine, Ibuprofen, Atropine, Doxycycline, Salbutamol, Ciprofloxacin, Azithromycin, Rufinamide, Etomidate, Triclabendazole, and Neostigmine. - Demonstrate continuous flow synthesis, crystallization, and formulation for Ciprofloxacin, Azithromycin, Rufinamide, Etomidate, Triclabendazole, and Neostigmine, in an integrated manufacturing platform. - Engage the FDA for input on PAT and cGMP for Ciprofloxacin, Azithromycin, Rufinamide, Etomidate, Triclabendazole, and Neostigmine. - Develop novel cell-free protein synthesis techniques using miniaturized bioreactors and microfluidics technologies. - Demonstrate end-to-end manufacturing of two protein therapeutics in a miniaturized platform, including the integration of protein expression and purification processes. - Engage the FDA for input on PAT and cGMP for protein therapeutics. - Design end-to-end manufacturing process in a miniaturized and integrated platform for an additional four protein therapeutics. - Test prototype device during in vivo pre-clinical studies for treatment of intracranial hemorrhage using laser energy through skull and tissues, and engage with the FDA on design and execution of these studies to meet FDA requirements.			
Title: Military Medical Imaging ***Description:*** The Military Medical Imaging thrust will develop medical imaging capabilities to support military missions and operations. The emergence of advanced medical imaging includes newly recognized physical properties of biological tissue, metabolic pathways, or physiological function in order to produce an image of diagnostic utility and performance. The goal of	4.216	8.000	6.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
this thrust is the capability for new, portable spectroscopic techniques that can provide information for military medical use (e.g., analysis of traumatic brain injury) that is superior to that provided by an MRI. This need is ever increasing as researchers and scientists seek to better understand anatomical, functional, and cellular-level interactions. Finally, this thrust will allow safe, non-invasive to minimally invasive detection of microscopic and functional alterations within tissues and organs of a living organism at early stages of injury. The advanced development of these tools will provide a formidable arsenal of diagnostic tools for warfighter performance and care. ***FY 2013 Accomplishments:*** - Measured the Quantum Orbital Resonance Spectroscopy (QORS) effect using the most sensitive experimental techniques to date. - Tested competing theoretical models for the physical basis of the QORS effect, and quantified the degree of hyperpolarization achieved under varying field strength, orbital angular momentum (OAM) charge, and beam array size. ***FY 2014 Plans:*** - Design and fabricate blazed, stacked, diffractive x-ray optics for integration into a pre-clinical imaging prototype. - Design and test imaging and validation protocols for pre-clinical imaging prototype. - Develop electrophysiological methods for simultaneous recording of multiple levels of abstraction in cortical/subcortical targets. - Identify candidate approaches for real-time analysis and monitoring of brain activity during performance of behavioral tasks. ***FY 2015 Plans:*** - Investigate advanced imaging technologies, such as three-photon fluorescence imaging, that will enable single neuron spatiotemporal resolution of deep brain regions. - Demonstrate proof of concept for achieving single neuron spatiotemporal resolution for recording spiking activity from 10^5 neurons in the cortex. - Investigate new indicators and effectors for single neuron spatiotemporal observation and control with high cell specificity.			
Title: Dialysis-Like Therapeutics ***Description:*** Sepsis, a bacterial infection of the blood stream, is a significant cause of injury and death among combat-injured soldiers. The goal of this program is to develop a portable device capable of controlling relevant components in the blood volume on clinically relevant time scales. Reaching this goal is expected to require significant advances in sensing in complex biologic fluids, complex fluid manipulation, separation of components from these fluids, and mathematical descriptions capable of providing predictive control over the closed loop process. The envisioned device would save the lives of thousands of military patients each year by effectively treating sepsis and associated complications. Additionally, the device may be effective as a medical countermeasure against various chemical and biological (chem-bio) threat agents, such as viruses, bacteria, fungi, and toxins.	9.000	20.000	20.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Applied research under this program further develops and applies existing component technologies and then integrates these to create a complete blood purification system for use in the treatment of sepsis. Included in this effort will be development, integration and demonstration of non-fouling, continuous sensors for complex biological fluids; implementation of high-flow microfluidic structures that do not require the use of anticoagulation; application of intrinsic separation technologies that do not require pathogen specific molecular labels or binding chemistries; and refinement of predictive modeling and control (mathematical formalism) with sufficient fidelity to enable agile adaptive closed-loop therapy. The basic research part of this program is budgeted in PE 0601117E, Project MED-01. ***FY 2013 Accomplishments:*** - Developed a systems integration plan, conducted a user needs assessment, and designed the preliminary systems architecture incorporating component separation technologies. - Developed appropriate animal models, confirmed regulatory plan, and initiated the regulatory approval process for the integrated device. ***FY 2014 Plans:*** - Integrate biocompatible high-flow fluid manipulation and intrinsic separation technologies into a breadboard device for the treatment of sepsis. - Use feedback from initial animal model testing to inform the development of an integrated device for additional safety and efficacy studies in a large-animal sepsis model. - Proceed with regulatory approval process and initiate plan for investigational device exemption submission. ***FY 2015 Plans:*** - Manufacture a prototype device that integrates label-free separation technologies, high-flow fluidic architectures, and non-thrombogenic coatings for testing. - Evaluate the efficacy of the label-free separation technologies in a small-animal model. - Refine the prototype device design based on animal testing results to inform development of a standalone benchtop integrated device. - Perform safety and efficacy studies in a large-animal sepsis model. - Initiate regulatory approval submission package with safety and efficacy data.			
Title: Warrior Web	12.150	12.000	8.992
Description: Musculoskeletal injury and fatigue to the warfighter caused by dynamic events on the battlefield not only impact immediate mission readiness, but also can have a deleterious effect on the warfighter throughout his/her life. The Warrior Web program will mitigate that impact by developing an adaptive, quasi-active, joint support sub-system that can be integrated			

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Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
into current soldier systems. Because this sub-system will be compliant and transparent to the user, it will reduce the injuries sustained by warfighters while allowing them to maintain performance. Success in this program will require the integration of component technologies in areas such as regenerative kinetic energy harvesting to offset power/energy demands; human performance, system, and component modeling; novel materials and dynamic stiffness; actuation; controls and human interface; and power distribution/energy storage. The final system is planned to weigh no more than 9kg and require no more than 100W of external power. Allowing the warfighter to perform missions with reduced risk of injuries will have immediate effects on mission readiness, soldier survivability, mission performance, and the long-term health of our veterans. ***FY 2013 Accomplishments:*** - Completed injury assessment and component technology integration into open source biomechanical model. - Completed initial verification and validation of component technologies in military environments. - Conducted preliminary reviews of individual component technologies (e.g., energy, actuation) to assess whether they can be integrated to meet Warrior Web performance requirements. ***FY 2014 Plans:*** - Leverage open source biomechanical model to iterate design. - Complete development of component technologies based on results of preliminary component technology reviews and government testing. - Initiate design of full Warrior Web system. ***FY 2015 Plans:*** - Conduct preliminary review of full Warrior Web designs and refine approach as necessary. - Finalize open source biomechanical models to be leveraged for the Warrior Web system evaluation. - Mature full design of Warrior Web system and continue parallel technology development. - Initiate verification and validation of prototype Warrior Web system via soldier tests in military environments.			
Title: Pathogen Defeat ***Description:*** Pathogens are well known for the high rate of mutation that enables them to escape drug therapies and primary or secondary immune responses. The Pathogen Defeat thrust area will provide capabilities to predict and deflect future threats. Pathogen Defeat focuses not on the threats that are already known but rather on the threats of newly emerging pathogens and future mutations, allowing pre-emptive preparation of vaccine and therapy countermeasures. ***FY 2013 Accomplishments:*** - Developed a platform to reproducibly demonstrate the evolutionary pathway of a virus under multiple selective pressures. - Validated algorithms' abilities to predict viral evolution in the presence of one or multiple pressures.	13.221	14.617	4.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
- Predicted location(s) and nature of genetic mutation(s) responsible for antiviral failure in a cell culture model. - Predicted number of viral generations necessary for the acquisition of antiviral resistance in a cell culture model. - Demonstrated that the in vitro evolution platform accelerates evolution of drug resistance or immune escape. ***FY 2014 Plans:*** - Predict location of genetic mutation(s) responsible for failure of a monoclonal antibody to neutralize a virus. - Demonstrate that the in vitro bioreactor can be used to predict alteration in cell tropism. - Validate viral evolution platforms and predictive platforms with a live fire test. - Transition predictive algorithms and in vitro evolution platforms to the Center for Disease Control (CDC) and other interested government agencies to increase preparedness for seasonal influenza as well as other emerging pathogens. - Transition predictive algorithms and in vitro evolution platforms to the pharmaceutical industry for prediction of emergence of drug-resistant strains of commercially relevant viruses. - Focus on host species jumping, through development of predictive algorithms for receptor usage and entry. - Develop a hand-held device for rapid identification of microbial organisms, including development of diagnostic panels to be integrated into a modular, single-use microfluidics card. ***FY 2015 Plans:*** - Test predictive capabilities of algorithms using real-world samples of viral isolates. - Field test hand-held device for transition to forward-deployed troops for diagnostic purposes.			
Title: Restoration of Brain Function Following Trauma	-	8.000	9.700
Description: The Restoration of Brain Function Following Trauma program will exploit recent advances in the understanding and modeling of brain activity and organization to develop approaches to treat traumatic brain injury (TBI). Critical to success will be the ability to detect and quantify functional and/or structural changes that occur in the human brain during the formation of distinct new memories, and to correlate those changes with subsequent recall of those memories during performance of behavioral tasks. This program will also develop neural interface hardware for monitoring and modulating neural activity responsible for successful memory formation in a human clinical population. The ultimate goal is identification of efficacious therapeutics or other therapies that can bypass and/or recover the neural functions underlying memory, which are often disrupted as a consequence of TBI. This program is leveraging research conducted under the Human Assisted Neural Devices effort in Program Element 0601117E, Project MED-01. ***FY 2014 Plans:*** - Identify neural codes underlying optimal memory formation. - Optimize electrodes for chronic, indwelling recording and stimulation. ***FY 2015 Plans:***			

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
- Identify commonalities of neural codes underlying memory formation. - Identify distinctions between neural codes underlying different classes of memories. - Identify expert memory codes for the formation of memory associations between pairs of elements (e.g., objects, locations, actions). - Develop portable computational device with integrated computational model of human memory formation. - Demonstrate task-specific improvement/restoration of memory performance in a memory task via hippocampal stimulation.			
Title: Neuro-Adaptive Technology ***Description:*** Building upon technologies developed under the Military Medical Imaging program budgeted in this project, the Neuro-Adaptive Technology program will explore and develop advanced technologies for real-time detection and monitoring of neural activity. One shortcoming of today's brain functional mapping technologies is the inability to obtain real-time correlation data that links neural function to human activity and behavior. Understanding the structure-function relationship as well as the underlying mechanisms that link brain and behavior is a critical step in providing real-time, closed-loop therapies for military personnel suffering from a variety of brain disorders. Efforts under this program will specifically examine the networks of neurons involved in Post-Traumatic Stress Disorder (PTSD), Traumatic Brain Injury (TBI), depression, and anxiety as well as determine how to best ameliorate these disorders. The objective for this program is to develop new hardware and modeling tools to better discriminate the relationship between human behavioral expression and neural function and to provide relief through novel devices. These tools will allow for an improved understanding of how the brain regulates behavior and will enable new, disorder-specific, dynamic neuro-therapies for treating neuropsychiatric and neurological disorders in military personnel. Technologies of interest under this thrust include devices for real-time detection of brain activity during operational tasks, time synchronized acquisition of brain activity and behavior, and statistical models that correlate neural activity with human behavioral expression. ***FY 2015 Plans:*** - Develop tests that activate key brain subnetworks for each functional domain. - Develop computer algorithms/programs to automatically merge elements of multimodal brain activity across time/space. - Create statistical computational models of brain activity and corresponding behavior to support the neurophysiology of new therapeutic systems. - Train decoders on a subset of domains and cross-validate on novel scan, record, and stimulate data. - Develop hardware interface stability, biocompatibility, and motion correction for recording neural activity. - Demonstrate three-dimensional, single-cell-resolution acquisition of real-time brain activity in large volumes of neural tissue. - Submit initial, novel devices for regulatory approval.	-	-	21.000
Title: Prosthetic Hand Proprioception & Touch Interfaces (HaPTIx)	-	-	7.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: Wounded warriors with amputated limbs get limited benefit from recent advances in prosthetic-limb technology because the user interface for controlling the limb is low-performance and unreliable. Through investments in the DARPA Reliable Neural-Interface Technology (RE-NET) program, novel interface systems have been developed that overcome these issues and are designed to last for the lifetime of the patient. The goal of the Prosthetic Hand Proprioception & Touch Interfaces (HaPTIx) program is to create the first bi-directional (motor & sensory) peripheral nerve implant for controlling and sensing advanced prosthetic limb systems. With a strong focus on transition, the HaPTIx program will create and transition clinically relevant technology in support of wounded warriors suffering from single or multiple limb loss. ***FY 2015 Plans:*** - Develop and demonstrate advanced algorithms to control prosthetic limbs using signals extracted from thin-film longitudinal intrafasicular electrodes (tfLIFE), Utah Slant Electrode Array (USEA), and other commercially available or newly developed electrodes. - Develop and demonstrate micro-stimulation interface technologies that provide reliable signals into the peripheral and/or central nervous system for closed-loop prosthetic control. - Conduct clinical trials to restore lost sensation such as touch and proprioception to patients suffering from various forms of neuropathy or following amputation. - Develop and demonstrate micro-surgical techniques to increase targeted muscle reinnervation (TMR) of residual nerve fibers by separating fascicles, introducing growth factors, and/or conducting small muscle transfers. - Perform safety and efficacy testing of novel implantable interface technology which capture motor control signals and provide electrical sensory stimulation through the peripheral nervous system. - Support researchers preparing for Food and Drug Administration (FDA) investigational device exemption (IDE) application submissions in order to progress to clinical trials.			
Title: Revolutionizing Prosthetics	15.790	10.000	-
Description: The goal of this thrust is to radically improve the state of the art for upper limb prosthetics, moving them from crude devices with minimal capabilities to fully integrated and functional limb replacements. Current prosthetic technology generally provides only gross motor functions, with very crude approaches to control. This makes it difficult for wounded soldiers to re-acquire full functionality and return to military service if so desired. The advances required to provide fully functional limb replacements will be achieved by an aggressive, milestone-driven program combining the talents of scientists from diverse areas including: medicine, neuroscience, orthopedics, engineering, materials science, control and information theory, mathematics, power, manufacturing, rehabilitation, psychology, and training. The results of this program will radically improve the ability of combat amputees to return to normal function. ***FY 2013 Accomplishments:***			

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
- Demonstrated neural control of arms with visual closed-loop feedback by spinal cord injured patients. - Demonstrated safety and stability of sensory feedback over multiple months to support use in human research participants. - Completed majority of FDA requirements, with additional human take-home trials and durability testing remaining, to gain commercial transition of non-invasively controlled prosthetic arm system. ***FY 2014 Plans:*** - Conduct pre-launch activities of non-invasively controlled prosthetic arm system. - Demonstrate brain control of bilateral prosthetic arms simultaneously. - Incorporate design updates in prosthetic arm systems to improve reliability. - Continue human quadriplegic patient trials demonstrating longevity of cortical control.			
Title: Detection and Computational Analysis of Psychological Signals (DCAPS) ***Description:*** The Detection and Computational Analysis of Psychological Signals (DCAPS) program developed automated information systems that identify group and individual trends indicative of post-traumatic stress disorder (PTSD) and anomaly detection algorithms that identify emerging physical and psychological crises. These tools complement commercial offerings that have not focused on issues specific to the warfighter. DCAPS recognizes that security and privacy are critical to user acceptance and Health Insurance Portability and Accountability Act compliance, and so incorporates strong authentication and other security mechanisms as needed to protect patient data. Furthermore, users will opt-in prior to using the DCAPS tools, ensuring controlled access to personally identifiable information. The program developed partnerships with key DoD organizations working in this area and transition activities are underway with the Veterans Affairs Center for Innovation and the Defense Suicide Prevention Office. ***FY 2013 Accomplishments:*** - Operationalized and hardened system software and obtained approvals to conduct user trials. - Performed user trials of mobile psychological health and telehealth applications in coordination with transition partners. - Modified and optimized mobile psychological health and telehealth applications based on the results of user trials.	7.100	-	-
Title: Unconventional Therapeutics ***Description:*** This thrust developed unique and unconventional approaches to ensure that soldiers are protected against a wide variety of naturally occurring, indigenous or engineered threats. The program developed approaches to counter any natural or man-made pathogen within one week. This included development of countermeasures that do not require prior knowledge of the pathogen and are broadly applicable to multiple, unrelated bacterial and/or viral infectious agents. The integration of academic research programs with pharmaceutical development efforts resulted in reducing the traditional drug development cycle timeframe.	1.107	-	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E / *BIOMEDICAL TECHNOLOGY*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: - Continued study to demonstrate 95% survival after exposure to lethal levels of an unknown pathogen in two animal models. - Identified neutralizing antibodies against newly emerging infectious diseases. - Identified genes and pathways in mouse and human peripheral blood mononuclear cells (PBMCs) that differ in inflammation models with the goal of leveraging these targets to treat and prevent inflammation.			
Title: Reliable Neural-Interface Technology (RE-NET) ***Description:*** Wounded warriors with amputated limbs do not yet benefit from recent advances in prosthetic-limb technology because the interfaces used to extract limb-control information are low-performance and unreliable. The Reliable Neural-Interface Technology (RE-NET) program developed the technology and systems needed to reliably extract motor-control information at the scale and rate necessary to control state-of-the-art high-performance prosthetic limbs. The RE-NET program also developed and demonstrated a novel interface system that overcame the leading causes of neural interface degradation and failure. Through this focus on reliability, the RE-NET program enabled patient access to clinically relevant technology, improving the lives of wounded warriors suffering from single or multiple limb loss. The effort continues under the HaPTIx program contained in this project. ***FY 2013 Accomplishments:*** - Developed and demonstrated advanced decoding algorithms which capture electromyography signals from the residual muscles in human amputees to provide simultaneous control of prosthetic limb joints. - Demonstrated amputee control of lost-limb finger-digits through successful decode of motor signals captured from residual nerve implantation of the Utah Slant Electrode Array (USEA). - Demonstrated a small implantable RF-powered electronics package capable of amplifying, processing, and wirelessly transmitting electromyography-based motor-control signals, such as those involved with targeted muscle reinnervation (TMR) and microTMR. - Commenced studies in collaboration with Walter Reed Army Medical Center through the Uniformed Health Services University using clinical-grade DARPA RE-NET-supported peripheral-interface technologies that capture motor-control intent from endogenous nerves and muscle tissue.	10.150	-	-
Accomplishments/Planned Programs Subtotals	98.097	114.790	112.242

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Defense Advanced Research Projects Agency	Date: March 2014
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602115E *I BIOMEDICAL TECHNOLOGY*

E. Acquisition Strategy

N/A

F. Performance Metrics

Specific programmatic performance metrics are listed above in the program accomplishments and plans section.