Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Defense Advanced Research Projects Agency	Date: February 2015
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 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total	FY 2017	FY 2018	FY 2019	FY 2020	Cost To Complete	Total Cost
Total Program Element	-	121.152	159.790	114.262	-	114.262	109.069	109.817	120.852	116.651	-	-
BT-01: *BIOMEDICAL TECHNOLOGY*	-	121.152	159.790	114.262	-	114.262	109.069	109.817	120.852	116.651	-	-

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. FY 2015 Biomedical Technology program funding includes 114.8 million of base funding and 45.0 million of Ebola emergency funding.

B. Program Change Summary ($ in Millions)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	114.790	112.242	100.603	-	100.603
Current President's Budget	121.152	159.790	114.262	-	114.262
Total Adjustments	6.362	47.548	13.659	-	13.659
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	47.548			
• Congressional Directed Transfers	-	-			
• Reprogrammings	9.755	-			
• SBIR/STTR Transfer	-3.393	-			
• TotalOtherAdjustments	-	-	13.659	-	13.659

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Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2014	FY 2015
Project: BT-01: *BIOMEDICAL TECHNOLOGY*		
Congressional Add: *Ebola Response and Preparedness Congressional Add (Emergency Funds)*	-	45.000
Congressional Add: *Biomedical Congressional Add*	-	2.548
Congressional Add Subtotals for Project: BT-01	-	47.548
Congressional Add Totals for all Projects	-	47.548

Change Summary Explanation

FY 2014: Increase reflects reprogrammings offset by the SBIR/STTR transfer.
FY 2015: Increase reflects congressional adds. The Ebola Response and Preparedness Congressional Add is non-OCO emergency funding.
FY 2016: Increase reflects expanded focus in brain and prosthetic interface systems research.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Autonomous Diagnostics to Enable Prevention and Therapeutics (ADEPT)	29.153	26.000	24.700

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 2014 Accomplishments:
- Demonstrated ability to manipulate the type of immune response induced by RNA-based vaccines.
- Demonstrated ability to target delivery of RNA-based vaccines to specific cell types.
- Developed novel methodologies to deliver nucleic acid constructs encoding one or hundreds of antibodies identified from immunized or convalescent patients.
- Demonstrated delivery of nucleic acids that transiently produce multiple antibodies.
- Performed quantitative comparison of room temperature assay methods appropriate for integration in devices for low-resourced settings.

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Demonstrated initial component integration and defined performance metrics for advanced diagnostic device prototypes suitable for operations in remote clinic and low-resourced settings. ***FY 2015 Plans:*** - Demonstrate ability to control the time duration of therapeutic response to viral, bacterial, and/or antibiotic-resistant bacterial pathogens 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 to viral, bacterial, and/or antibiotic resistant bacterial pathogens. - 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 relevance to physician office, remote clinic, and low-resourced settings. - Measure quantitative performance of first-generation, integrated diagnostic device prototypes and determine modifications required for performance improvements. ***FY 2016 Plans:*** - Optimize formulation of transient nucleic acid formats for storage stability at room temperature for at least six months. - Demonstrate continuous production of nucleic acid formats for transient immunity to viral, bacterial, and/or antibiotic-resistant bacterial pathogens for population-scale use. - Submit Investigational New Drug (IND) application for transient nucleic acid-based formats against infectious disease. - Incorporate device optimizations identified as a result of first-generation integrated diagnostic device testing. - Produce integrated diagnostic device prototypes designed for relevance to physician office, remote clinic, and low-resourced settings. - Measure quantitative performance of integrated diagnostic device prototypes.			
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.	20.000	19.492	6.073

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
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. ***FY 2014 Accomplishments:*** - Integrated biocompatible high-flow fluid manipulation and intrinsic separation technologies into a breadboard device for the treatment of sepsis. - Used 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. - Proceeded with regulatory approval process and initiated 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. - Establish a clinically relevant model of sepsis in a large animal model in order to validate efficacy of separation technologies at removing pathogens and other sepsis mediators. - Perform biocompatibility studies of each component of the device to ensure safety in the integrated system. ***FY 2016 Plans:*** - Perform safety and efficacy studies in a large-animal sepsis model. - Initiate regulatory approval submission package with safety and efficacy data.			
Title: Warrior Web	12.000	6.000	6.000
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 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			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
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 2014 Accomplishments:*** - Leveraged open source biomechanical model to iterate design. - Completed development of component technologies based on results of preliminary component technology reviews and government testing. - Initiated design of full Warrior Web system. ***FY 2015 Plans:*** - Conduct preliminary review of Warrior Web designs and refine approach as necessary. - Finalize open source biomechanical models to be leveraged for the Warrior Web system evaluation. - Mature design of Warrior Web system and continue parallel technology development. - Conduct preliminary evaluation of prototype Warrior Web systems via soldier tests in laboratory environment. ***FY 2016 Plans:*** - Revise full suit design and implementation based on laboratory evaluations. - Conduct final evaluation of prototype system through soldier tests in relevant military environments. - Coordinate military transition of the technology.			
Title: Restoration of Brain Function Following Trauma ***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 Accomplishments:***	8.000	9.700	15.800

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Identified neural codes underlying optimal memory formation. - Optimized electrodes for chronic, indwelling recording and stimulation. ***FY 2015 Plans:*** - 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. ***FY 2016 Plans:*** - Refine computational model of memory toward distinguishing underlying neural activity related to forgotten memories in three categories (e.g., objects, places, faces) and spatial and non-spatial associations. - Identify optimal stimulation parameters for improving spatial memory. - Utilize defined biomarkers of memory encoding and retrieval to adaptively modulate patterned electrical stimulation to dynamically drive neural networks into states optimized for memory encoding and retrieval processes. - Determine the long-term signatures underlying stimulation-induced memory restoration. - Design, develop and validate both external and implantable hardware and software systems for an integrated memory restoration system. - Demonstrate the ability for a computational model of memory to use long-term neurophysiological activity to predict and restore memory. - Submit initial, novel devices for regulatory approval.			
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-	-	21.500	31.089

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
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. ***FY 2016 Plans:*** - Develop and apply data co-registration and fusion methods for neural activity, wiring and behavior. - Generate and annotate first intact neural tissue volumes to elucidate microstructure and connections in three dimensions. - Design algorithms for automatic cell identification and optical-signal estimation. - Elucidate neural circuit dynamics using structurally-informed network models. - Refine optical techniques for imaging large volumes of neural tissue. - Expand data curation architecture, databases, and analytical tools to distribute generated data to the neuroscience community. - Develop methods for automatically detecting and removing noise or contamination from datasets. - Deliver a hierarchical computational model of key brain networks that captures features relevant for psychiatric illness and its treatment. - Develop and refine neural state acquisition, classification and control algorithms to support closed-loop control in an implantable neural device. - Characterize neural network plasticity during behavioral training.			
Title: Prosthetic Hand Proprioception & Touch Interfaces (HAPTIX)	-	10.550	18.800
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			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
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 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. - 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. - Demonstrate bench-top functionality of next-generation peripheral interface technology. - Develop draft version of outcome metrics for quantifying effects of implantable and external system components on motor function, sensory function, pain, psychological health and quality of life. - Develop unified virtual prosthesis environment to simulate limb motion and forces of interaction during object manipulation. ***FY 2016 Plans:*** - Integrate interface and electronic systems technology for use in human amputees to control and receive intuitive sensory feedback from a prosthetic device. - Demonstrate closed-loop control of a government-furnished virtual prosthesis. - Perform safety and efficacy testing of integrated HAPTIX system to capture motor control signals and provide electrical sensory stimulation through the peripheral nervous system. - Demonstrate in vivo functionality of next-generation HAPTIX peripheral interface technology. - Determine HAPTIX system prosthetic limb technology, complete sensorization, and begin manufacturing of devices. - Implement draft version of outcome metrics for quantifying effects of HAPTIX technology and begin validation studies.			
Title: Performance Optimization in Complex Environments ***Description:*** The Performance Optimization in Complex Environments program focuses on leveraging advances in and integration of sensors, computation, analytics, and medicine to enable optimum human performance in complex environments. Device technology has advanced to the point where human beings can be instrumented with and connected to a broad range of unobtrusive, always-on physiological, cognitive, and contextual sensors and information systems. At the same time, body-area networks, wearable displays, haptics, and other novel forms of human-computer interfaces have advanced enough that convenient real-time multifactor analysis for neurofeedback and biofeedback are within reach. The Performance Optimization in Complex Environments program will focus on developing the necessary models, analytical tools, interfaces, and input-output modalities necessary to integrate these two advancing areas to enable optimal performance in a wide variety of activities from learning and training to specialized tasking, and to mitigate the effects of age, mental impairment, and physical injury, among	-	-	11.800

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
others. Research will also focus on understanding various forms of sensing and actuation to improve outcomes and how biofeedback over time can alter human physiology. Technologies developed through this program will provide a foundation of novel value propositions to the warfighter in terms of individual health, resilience, cognitive and physical effectiveness, and force multiplication. ***FY 2016 Plans:*** - Begin development of new algorithms for sensing and modeling of physiological and cognitive state. - Explore and identify primary sensing methods for reading biological signals. - Begin research on biological interfaces for enabling input-output of information. - Explore and study impact of various actuation mechanisms on physiological state and outcomes.			
Title: Tactical Biomedical Technologies	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 2014 Accomplishments:*** - At laboratory scale, designed continuous flow synthesis steps for the following Active Pharmaceutical Ingredients (APIs): Salbutamol, Ciprofloxacin, Azithromycin, Rufinamide, Etomidate, Nicardipine, and Neostigmine. - Engaged the Food and Drug Administration (FDA) for input on Process Analytical Technologies (PAT) and current Good Manufacturing Process (cGMP) for Diphenhydramine, Diazepam, Lidocaine, Fluoxetine, Ibuprofen, Atropine, and Doxycycline. - Performed in vivo demonstration of transcranial photocoagulation of intracranial vessels in porcine model. - Performed in vivo demonstration of photo-induced vasospasm in intracranial vessels in porcine model. - Designed and developed 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:***			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- 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, Nicardipine, and Neostigmine. - Demonstrate continuous flow synthesis, crystallization, and formulation for Salbutamol, Ciprofloxacin, Azithromycin, Rufinamide, Etomidate, Nicardipine, and Neostigmine, in an integrated manufacturing platform. - Engage the FDA for input on PAT and cGMP for Salbutamol, Ciprofloxacin, Azithromycin, Rufinamide, Etomidate, Nicardipine, and Neostigmine. - Develop novel cell-free protein synthesis techniques using miniaturized bioreactors and/or 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: Pathogen Defeat	20.678	7.000	-
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 emerging threats and the evolution of resistance of pathogens to medical countermeasures. Pathogen Defeat focuses not only on known pathogens but also newly emerging pathogens and future evolution of mutations in these pathogens, allowing pre-emptive preparation of vaccine and therapy countermeasures. ***FY 2014 Accomplishments:*** - Predicted location of genetic mutation(s) responsible for failure of a monoclonal antibody to neutralize a virus. - Demonstrated that an in vitro drop microfluidics evolution platform can be used to rapidly evolve viruses at the single event level. - Began transition discussions on in vitro evolution platforms to increase preparedness for diseases like seasonal influenza, Dengue, and other emerging human pathogens. - Began development of 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. - Explored constraints of pressures (antibodies, anti-virals) on viral evolution and effects on reassortment and recombination. ***FY 2015 Plans:*** - Test predictive capabilities of trajectories to clinical viral isolates in evolution platform. - Elucidate mechanisms to explain viral escape to different pressures. - Rapidly evolve virus strains in avian cells to select vaccine candidates with antigenic similarities.			

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Perform objective field assessment of hand-held devices for microbial and viral pathogens for clinical and environmental testing.			
Title: Military Medical Imaging ***Description:*** The Military Medical Imaging thrust developed 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 this thrust was to develop 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 allowed 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 has provided a formidable arsenal of diagnostic tools for warfighter performance and care. ***FY 2014 Accomplishments:*** - Designed and fabricated blazed, stacked, diffractive x-ray optics for integration into a pre-clinical imaging prototype. - Designed and tested imaging and validation protocols for pre-clinical imaging prototype. - Identified candidate approaches for real-time analysis and monitoring of biological activity during performance of behavioral tasks. - Developed electrophysiological methods for simultaneous recording of multiple levels of abstraction in cortical/subcortical targets.	8.000	-	-
Title: Revolutionizing Prosthetics ***Description:*** The goal of this thrust was 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 were 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 radically improved the ability of combat amputees to return to normal function. ***FY 2014 Accomplishments:*** - Conducted pre-launch activities of non-invasively controlled prosthetic arm system. - Demonstrated brain control of bilateral prosthetic arms simultaneously.	10.000	-	-

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C. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
- Incorporated design updates in prosthetic arm systems to improve reliability. - Continued human quadriplegic patient trials demonstrating longevity of cortical control.			
Accomplishments/Planned Programs Subtotals	121.152	112.242	114.262

	FY 2014	FY 2015
Congressional Add: Ebola Response and Preparedness Congressional Add (Emergency Funds) ***FY 2015 Plans:*** This program will speed the development of Ebola antibodies, vaccines, and diagnostics to enable a more rapid response to this outbreak and increase preparedness for response to future epidemics. Planned research builds on earlier investments by DARPA exploring technologies to discover, optimize, and deliver antibodies as a means to provide fast-acting protection against infectious diseases. A key component of this program is not only identifying effective antibodies to treat and prevent disease, but also defining and developing the antibody gene blueprint for transfer and production of vaccines. The Ebola Response and Preparedness Congressional Add is non-OCO emergency funding. - Conduct dose escalation study for encoded Ebola vaccine. - Demonstrate rapid discovery of potent antibodies from human Ebola survivors. - Evaluate protective efficacy of encoded Ebola antibodies in small and/or large animal models. - Test protective efficacy of encoded Ebola vaccine in small and/or large animal models. - Validate cell-free production of nucleic acid-encoded antibody or vaccine formulations.	-	45.000
Congressional Add: Biomedical Congressional Add ***FY 2015 Plans:*** This effort will further the development of restorative products and technologies as alternatives to amputation.	-	2.548
Congressional Adds Subtotals	-	47.548

D. Other Program Funding Summary ($ in Millions)

N/A

Remarks

E. Acquisition Strategy

N/A

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F. Performance Metrics

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