

Peer Reviewed Orthopaedic Research Program

Strategic Plan

INTRODUCTION

The Congressionally Directed Medical Research Programs (CDMRP) represents a unique partnership among the U.S. Congress, the military, and the public to fund innovative and impactful medical research in targeted program areas.

In 2015, an ad hoc committee of the National Academies of Sciences, Engineering, and Medicine was assembled to evaluate the CDMRP’s two-tier review process and its coordination of research priorities with the National Institutes of Health (NIH) and the Department of Veterans Affairs (VA). As part of their final report,¹ the committee recommended that each CDMRP program “... develop a strategic plan that identifies and evaluates research foci, benchmarks for success, and investment opportunities for 3–5 years into the future,” and that these strategic plans “should specify the mission of the program, coordination activities with other organizations, research priorities, how those priorities will be addressed by future award mechanisms, how research outcomes will be tracked, and how outcomes will inform future research initiatives.”

In response to these recommendations, this document presents the current strategy for the CDMRP’s Peer Reviewed Orthopaedic Research Program (PRORP). The PRORP Strategic Plan identifies the high-impact research goals most important to its stakeholders while providing a framework that is adaptable to changes in the medical research environment to address those goals. This plan has been formulated to provide greater clarity of the program’s goals over time to the public and other stakeholders. Funding for the PRORP is congressionally appropriated on an annual basis; therefore, there is no guarantee of future funding. The PRORP Strategic Plan will be reviewed during the program’s annual Vision Setting meeting and updated as necessary.

RESEARCH AND FUNDING ENVIRONMENT

The PRORP was initiated in fiscal year 2009 (FY09) to provide support for research of exceptional scientific merit focused on optimizing recovery and restoration of function for military personnel with orthopaedic injuries sustained in combat or combat-related duties. Since FY09, a total of \$368.5 million (M) has been appropriated to the program by Congress (**Figure 1**). The initial investment in the PRORP for \$112M originated from two appropriations acts: \$61M from the Consolidated Security, Disaster Assistance and Continuing Appropriation Act, 2009, and \$51M from the Supplemental Appropriations Act, 2009.²

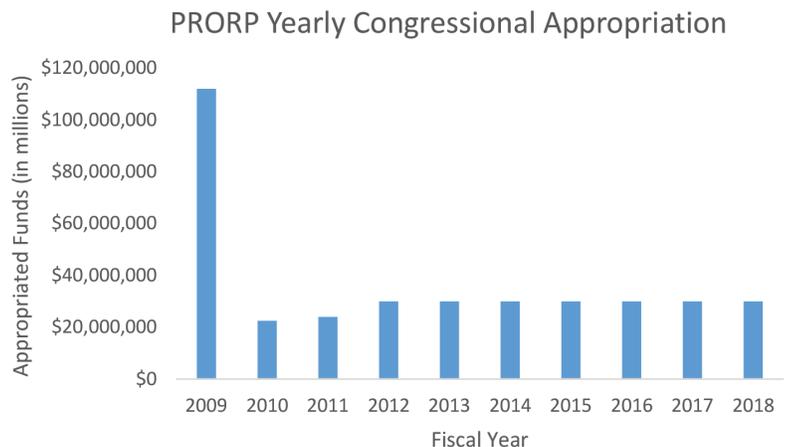


Figure 1. Congressional Appropriations to the PRORP by Fiscal Year

A stakeholders meeting was held in May 2009 to direct the initial PRORP appropriation and consider future investments. During that meeting, a list of perceived orthopaedic care gaps, related military injuries, and opportunities for advancement was created. The program grouped these gaps into focus areas related to acute battle injuries, definitive care of



battle injuries, rehabilitation, and prosthetics/orthotics and included these focus areas in the program's initial solicitation of research projects. The focus areas have been modified over time through yearly Vision Setting meetings and categorized into surgical care and rehabilitation topics, resulting in an evolution of the type of research funded from more early-stage technologies to manage bone and cartilage damage to more integrated therapies for clinical management of disease.

PRORP-funded research projects support the vision and mission of the program and have resulted or will result in tangible products, improvements in surgical care techniques, updates in Clinical Practice Guidelines (CPGs), and other knowledge products that help support the care and rehabilitation of orthopaedically injured persons. This PRORP strategic plan both identifies unmet research needs for these patients and prioritizes the program's research goals to more effectively address the changing needs of the military. This plan also describes how the PRORP intends to allocate any future appropriated funds to meet those research goals for the benefit of Service members, Veterans, and the general public.

VISION: Provide all Warriors affected by orthopaedic injuries sustained in the defense of our Constitution the opportunity for optimal recovery and restoration of function

MISSION: Address the most significant gaps in care for the leading burden of injury for facilitating return-to-duty by funding innovative, high-impact, clinically relevant research to advance optimal treatment and rehabilitation from musculoskeletal injuries sustained during combat and combat-related activities

Through FY17, the PRORP has funded 227 projects, including three large consortia awards made to; the Bridging Advanced Development for Excellent Rehabilitation (BADER) Consortium; and the Major Extremity Trauma and Rehabilitation Consortium (METRC; formerly the Major Extremity Trauma and Research Consortium). The consortia are designed to bring military patients, leading researchers, and military treatment facility clinicians together with the infrastructure, patients, and expertise of highly qualified civilian organizations to form partnerships that will ultimately provide new solutions along the continuum of care for orthopaedic injuries.

The PRORP invested approximately 28% of its total funding in consortia efforts that have allowed for the completed and ongoing efforts of 29 collaborative orthopaedic care studies, including research topics ranging from evaluating the efficacy of perioperative oxygen in the prevention of surgical site infections to improved walking in lower-limb amputees using a virtual reality training intervention (**Figure 2**). As shown in this figure, research efforts outside of the consortia awards in Tissue Engineering and Repair, as well as the Prevention and Treatment of Complications, each comprise 24% of the PRORP's total funding. The remaining 25% of the PRORP funds support the research areas of Prosthetics and Orthotics, Pain Management and Patient-Reported Outcomes, and Rehabilitation and Biomechanics. Projects funded by the PRORP have resulted in novel devices and treatment strategies, including the intra-socket cooling element (ICE) and sensors that continually measure and adjust pressure for lower-limb prosthetic sockets; a nerve conduit with a diffusion-controlled drug reservoir; the use of SPRINT PNS System to treat post-amputation pain as an alternative to opioid medication; and an improved residual limb-lengthening device that will enhance patient comfort and allow for an earlier return to weight-bearing activities after surgery. A more in-depth summary of the PRORP's portfolio can be found in the PRORP Portfolio Summary, dated June 2017, which can be accessed on the PRORP website.³

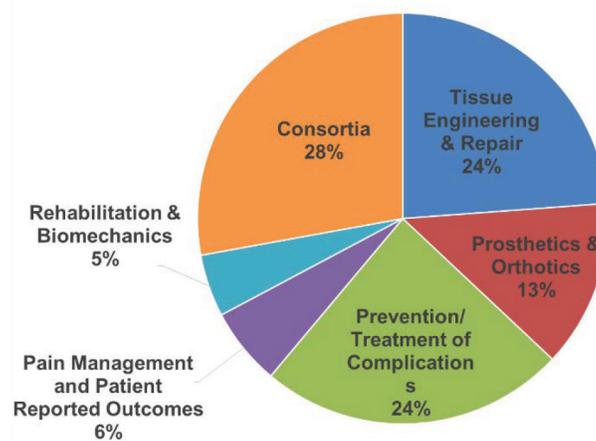


Figure 2. Overall PRORP Investment by Research Area, FY09-FY16



STRATEGIC DIRECTION

The orthopaedic field is vast; it includes topics in training, prevention, tissue engineering, pain control, surgical techniques and care, comorbid injuries/conditions, rehabilitation, prosthetics, etc. A reflection of the state of the science in any given topic area changes rapidly. The PRORP has funded research in all of the aforementioned topics and many others. In order to keep abreast of the ever-changing research landscape and clinical environment (both for the military and civilians), program staff solicit input from experts in several disciplines and across the Service branches who serve on the PRORP Programmatic Panel and Government Steering Committees; in addition, the PRORP works with various Joint Program Committees (JPCs and other federal partners. The PRORP also routinely monitors research supported by other funding agencies, including the NIH, Defense Advanced Research Projects Agency (DARPA), and VA, to coordinate research funding and priorities across organizations, eliminate research duplication, and ensure that efforts are complimentary in order to best address knowledge and capability gaps.

The PRORP maintains the Congressional intent of the program and continues to support militarily relevant orthopaedic trauma research to benefit Service members, Veterans, and the general public. Instructions from Congress clarified that the program's appropriations focus on battle-related injuries, as these injuries are often heterogeneous and complex in nature and frequently involve multiple limb trauma, open fractures, major tissue loss, and a high degree of wound contamination.⁴ Additionally, these battle-related injuries are sustained in harsh environments where access to optimal care can be limited. Importantly, findings obtained from PRORP-supported research are also applicable to and can benefit the civilian population.

The PRORP has supported, and will continue to support, research that addresses the needs of the nation's injured Warfighters and Service members, the needs of the military surgeons and medical personnel who are charged with their care and well-being, and the changing military needs of potential conflicts. The PRORP Programmatic Panel, composed of representatives from the military Services, VA, and other government, academic, and clinical practice, as well as the patient community, annually assesses the current research environment related to the short- and long-term care of orthopaedically injured patients and also reviews emerging technological developments in the field. In addition, the PRORP works with other Department of Defense and federal organizations, as well as non-federal organizations, to ensure that all parties are working together to close identified capability gaps. Other agencies and organizations that invest in orthopaedic research, training, and rehabilitation include, but are not limited to, the VA; Association of Bone and Joint Surgeons (ABJS); National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS); American Academy of Orthopaedic Surgeons/American Association of Orthopaedic Surgeons (AAOS); Clinical and Rehabilitative Medicine Research Program (CRM RP); Combat Casualty Care Research Program (CCCRP); DARPA; and Orthopaedic Research and Education Foundation (OREF). Although not all inclusive, additional organizations that are involved in orthopaedic research are included in the Helpful Resources section of this document.

The orthopaedic care field has benefited from many successes; however, many challenges still exist that prevent some injured patients from returning to their pre-injury level of fitness. Key challenges in military medicine as it relates to the orthopaedic field include identification of best practices for trauma care in a prolonged field care setting; optimization of point-of-injury care to minimize or eliminate long-term complications; evaluation of rehabilitation strategies to increase return-to-duty and return-to-work rates; development of interventions that predict and treat compartment syndrome; prevention of wound infection when access to care is limited; translation of advancements in neural-controlled prosthetics; and many others. The research field's ability to address these challenges has a direct impact on the readiness of the U.S. military, the rehabilitation and reintegration of our Veterans, and the clinical care of patients in the general public.

This PRORP Strategic Plan provides the framework for which current and near-future research investments will be made. The Programmatic Panel will continue to meet annually to review the current state of the science, priorities of the military, and immediate clinical needs in order to confirm that these priorities are still relevant and to refine the plan as needed.

STRATEGIC GOALS AND PRIORITIES

In order to construct a PRORP investment strategy (see next section) that aligns with the program's vision and mission, as well as the Congressional intent for the PRORP, the Programmatic Panel members sought to identify unanswered basic, translational, and clinical research questions in the field of orthopaedics. The Programmatic Panel members identified seven short- and long-term research priorities (listed below) into which the PRORP will invest through the solicitation of innovative and impactful research in the future (contingent upon the availability of future appropriations). These priorities will present as program focus areas in future Applied Research Award, Clinical Translational Research Award, and Clinical Trial Award solicitations for research applications.

1. Development of basic science animal models that replicate injuries or conditions that are challenging in a prolonged field care (PFC) scenario
 - a. Establishment of advanced diagnostics and therapeutics in ischemia reperfusion injury and compartment syndrome using the newly established PFC animal models



2. Evaluation of promising clinical interventions for durability in a far-forward environment, as close as possible to the point of injury, which includes:
 - a. Methods to prevent and/or control combat extremity wound infections (e.g., for long bone open fractures)
 - b. Development of novel wound protectants
 - c. Improved methods for acute pain control
 - d. Advancing surgical interventions to earlier roles of care
3. Discovery of interventions and/or rehabilitation strategies that can facilitate early return to duty for common musculoskeletal injuries, including:
 - a. Development of offloading and stability devices (e.g., braces and casting) for ligamentous injuries/small extremity fractures
 - b. Development of optimal nonsurgical and/or surgical strategies, tools, and delivery parameters to improve functional outcomes for both immediate and eventual return to duty
 - c. Development of protective equipment for treatment of non-severe, common battlefield musculoskeletal injuries
4. Translation of early research findings in surgical care topic areas to large animals and/or humans to move the research toward clinical trials and clinical practice
5. Identification of best practices to address rejection and failure of percutaneous osseointegrated prosthetic limbs
6. Development of innovative treatment pathways and technologies to optimize complex orthopaedic injury/extremity trauma management, and minimize long-term disability
7. Development of advanced tissue regeneration therapeutics for the restoration of traumatically injured extremity tissues

INVESTMENT STRATEGY

Funding allocation and award mechanisms to be solicited by the PRORP will reflect the types of research (basic, translational, or clinical) that the program plans to fund, based on the needs of the field and the amount of funds appropriated to the program by Congress. For FY18, the PRORP released three program announcements to help address the identified PRORP research priorities: the Applied Research Award (ARA), Clinical Translational Research Award (CTRA), and Clinical Trial Award (CTA).

The ARA supports applied research projects focused on advancing optimal treatment and restoration of function for individuals with musculoskeletal injuries sustained during combat or combat-related activities. Although the ARA allows basic and animal research, it is not intended to support fundamental basic research without specific application toward knowledge or tangible products. Focus areas for the FY18 ARA include topics in animal model development, device development, wound infection, and tissue regeneration. Future solicitations for the ARA will depend on the outcomes of funded research projects in the listed focus areas in order to maintain a balanced PRORP research portfolio.

The CTRA supports translational clinical research that may or may not be ready for a full-scale clinical trial. Funded projects are expected to impact the immediate and long-term standard of care, as well as contribute to evidence-based guidelines for the evaluation and care of military or Veteran patients with orthopaedic injuries. Focus areas for the FY18 CTRA include topics in treatment techniques and outcomes, wound infection, surgical care, and tissue regeneration. Future solicitations for the CTRA will depend on the outcomes of current research projects in areas of interests to the orthopaedic field or PRORP.

The CTA differs from the CTRA in that the CTRA allows clinical research projects, whereas the CTA is restricted to clinical trials only. Intended to support rapid implementation of clinical trials that can bring life-saving and -changing interventions to patients, the FY18 CTA will support research projects in surgical techniques and outcomes, rehabilitation techniques and outcomes, acute pain, improved surgical interventions, and tissue regeneration. Future solicitations for the CTA will be based on then-current research environment assessments to ensure the PRORP continues to move promising interventions into clinical practice.

This investment strategy will be re-evaluated and updated as necessary during the program's annual Vision Setting meeting. The PRORP plans to continue its commitment to addressing the identified short- and long-term research priorities by funding basic applied research, clinical studies and trials, and expansions on prior/early-stage research investments via funding opportunities, which include the Applied Research Award, Clinical Translational Research Award, and Clinical Trial Award.



MEASURING PROGRESS

The PRORP will continue to monitor the outcomes of PRORP-funded research and their impact on the field. The following metrics, categorized into short-term and mid-term outcomes, will help the PRORP assess progress made toward addressing the identified unanswered research questions and research priorities:

Short-term outcomes (3-5 years): Measurable by evaluating the amount of funding invested in each strategic goal and tracking contributions to the scientific and clinical community, including publications, patents, products, and clinical trials, which will vary based on the stage of the research project.

Mid- and long-term outcomes (6+ years): Measurable by evaluating the proportion of funded investigators receiving additional awards to continue successful research, production of commercialized products, and changes in standard of care (e.g., CPGs, evidence supporting specific treatment recommendations), point-of injury-care, return-to-duty rates, and quality of life.

REFERENCES

1. *Evaluation of the Congressionally Directed Medical Research Programs Review Process*. 2016. The National Academies of Sciences, Engineering, and Medicine. The National Academies Press. Washington, DC.
2. Congressionally Directed Medical Research Programs Annual Report 2009. Available at <http://cdmrp.army.mil/pubs/annreports/2009annrep/2009annreport.pdf>.
3. *Peer Reviewed Orthopaedic Research Program Portfolio Summary*. 2017. Peer Reviewed Orthopaedic Research Program, Congressionally Directed Medical Research Programs. Available at http://cdmrp.army.mil/propr/pbks/FY17%20Portfolio%20Summary_Standalone.pdf.
4. *Department of Defense Appropriations Bill, 2008, Report of the Committee on Appropriations*. 2007. United States House of Representatives, 110th Congress, 1st Session. House Report 110-279. Available at <https://www.gpo.gov/fdsys/pkg/CRPT-110hrpt279/html/CRPT-110hrpt279.htm>.

HELPFUL RESOURCES

1. Peer Reviewed Orthopaedic Research Program Portfolio Summary: http://cdmrp.army.mil/propr/pbks/FY17%20Portfolio%20Summary_Standalone.pdf
2. Extremity Trauma and Amputation Center of Excellence: <https://health.mil/About-MHS/OASDHA/HSPO/EACE>
3. Extremity War Injuries Symposium: <https://www.aaos.org/research/advocacy/ewi/>
4. Prolonged Field Care: [http://www.wemjournal.org/article/S1080-6032\(17\)30063-7/pdf](http://www.wemjournal.org/article/S1080-6032(17)30063-7/pdf) and http://mrmc.amedd.army.mil/index.cfm?pageid=media_resources.articles.prolonged_field_care_the_new_normal
5. American Society for Surgery of the Hand (ASSH): <https://www.assh.org/>
6. American Orthopaedic Society for Sports Medicine (AOSSM): <https://www.sportsmed.org/aossmimis>
7. Association of Bone and Joint Surgeons (ABJS): <http://www.abjs.org/>
8. National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS): <https://www.niams.nih.gov/>
9. North America Spine Society: <https://www.spine.org/>
10. OMeGA Medical Grants Association: <https://www.omegamedicalgrants.org/>
11. Orthopaedic Research and Educational Foundation (OREF): <http://www.oref.org/>
12. Ruth Jackson Orthopaedic Society (RJOS): <http://www.rjos.org/>
13. Scoliosis Research Society (SRS): <https://www.srs.org/>
14. American Academy of Orthopaedic Surgeons / American Association of Orthopaedic Surgeons (AAOS): <https://www.aaos.org/Research/>
15. Clinical and Rehabilitative Medicine Research Program: <https://crmrp.amedd.army.mil/>
16. Combat Casualty Care Research Program: <https://ccc.amedd.army.mil/Pages/default.aspx>
17. Defense Advanced Research Projects Agency: <https://www.darpa.mil/>
18. U.S. Department of Veterans Affairs: <https://www.va.gov/>