DEFENSE HEALTH AGENCY
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Research and Engineering

MEMORANDUM FOR ALL RESEARCH AND ENGINEERING DIRECTORATE PERSONNEL

SUBJECT: Distribution of Approved Defense Health Agency Strategic Research Plan for Musculoskeletal Injury

This memorandum signifies my approval of the Defense Health Agency (DHA) Strategic Research Plan (SRP) for Musculoskeletal Injury (Attachment). The DHA manages the Defense Health Program (DHP) medical research, development, test, and evaluation (RDT&E) appropriation. The DHA Research and Engineering (R&E) Directorate provides oversight and management of the DHP Science and Technology (S&T) annual budget to support research across critical investment areas.

The DHA Deputy Assistant Director (DAD), R&E will utilize SRPs to inform DHP S&T investments. SRPs outline the requirements deemed high priority based on assessments of current and future medical and operational needs and existing research gaps of the military medical community. Adherence to SRPs will ensure the Program Objective Memorandum and spend plans are aligned to prioritized joint and Service requirements.

My point of contact for the DHA SRPs is Dr. Emma Gregory, Branch Chief, Science & Technology Portfolio Management (dha.ncr.j-9.mbx.stmp@health.mil). Thank you for your continued support.

Sean Biggerstaff, Ph.D.
Deputy Director
Research and Engineering (R&E)

Attachment:
As stated

cc:
Surgeon General of the Army
Surgeon General of the Navy
Surgeon General of the Air Force
President, Uniformed Services University of the Health Sciences

June 2024

Defense Health Agency Strategic Research Plan: Musculoskeletal Injury

REVISION HISTORY

Revision	Entered by	Reason	Date

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FIGURES

TABLES

1. OVERVIEW AND ORGANIZATION

The Defense Health Agency (DHA) Research and Engineering (R&E) Directorate leads the discovery of innovative medical solutions responsive to the needs of Combatant Commands, the Military Services, and the Military Health System (MHS). DHA R&E provides oversight and management of a Science and Technology (S&T) annual budget of approximately $500 to $800 million to support research across critical investment areas. The cornerstones of the DHA S&T management approach are as follows:

- Portfolio Managers directly accountable for the health and performance of their research Portfolios
- Alignment of research investments to validated and prioritized Joint Capability Requirements (CR)
- Identification of the Capabilities needed to work toward fulfilling priority CRs
- S&T (Budget Activity [BA] 6.1, 6.2, and 6.3) efforts that focus on areas where Defense Health Program (DHP) investments can make the most impact and accelerate delivery of knowledge and materiel products to end users
- Informing multi-year research investment plans that allow adaptation to emerging (or declining) requirements

The DHA Deputy Assistant Director (DAD) for R&E employs Strategic Research Plans (SRPs) to inform and describe how Department of Defense (DoD) medical capabilities will be developed over time. These SRPs will drive investment recommendations for Future Years Defense Program (FYDP) plans and serve as a critical tool for aligning investments with military medical health priorities. SRPs include information that will enable DHA R&E to perform the following activities:

- Develop, on an annual basis, the FYDP plans in alignment with CRs and anticipate the resources that will be required for the respective Program Objective Memorandum (POM) cycle
- Provide the oversight and concurrence of Year of Execution (YOE) spend plans that Program Managers will be responsible for developing as a recommendation to DHA R&E
- Facilitate discussion with leadership and stakeholders regarding the research activities required to address CRs

SRPs are organized into four levels:

- **Capability Areas** (CAs) reflect the highest structural elements that encompass broad areas of medical research within an SRP
- **Capability Requirements** (CRs) are derived from key source documents [e.g., Joint Capabilities Integration and Development System (JCIDS)] and outline Capabilities (knowledge or materiel) required to meet current or future military medical needs
- **S&T Paths** (STPs) describe the high-level research activities needed to support the transition of Capabilities to product development or other end users
- **Capabilities** describe the S&T knowledge and/or materiel products to be transitioned to product development or end users

Figure 1-1 shows the hierarchical relationship between the components of the SRP, with the associated reference schema.

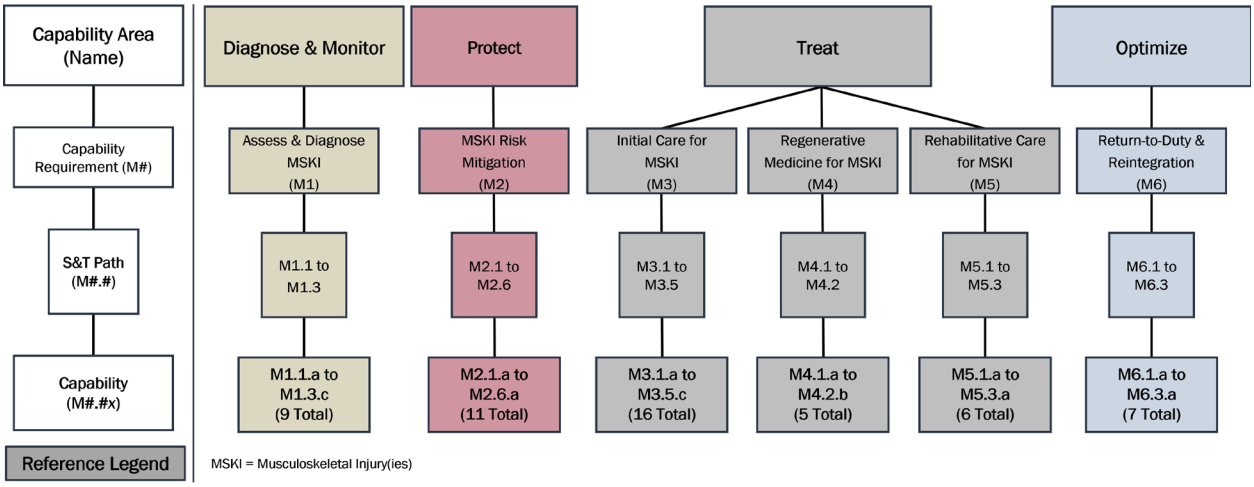

Figure 1-1 SRP Hierarchy

The Musculoskeletal Injury (MSKI) SRP is focused on DoD-specific, validated Joint-service medical S&T needs for the advancement of musculoskeletal injury management, across the entire continuum of care and injury severity spectrums. Musculoskeletal injury care encompasses multiple domains including musculoskeletal injury risk identification and mitigation, initial and definitive treatments, and optimization of post-musculoskeletal injury outcomes. This SRP is inclusive of these domains and musculoskeletal injuries across the severity spectrum. The goal of the SRP is to address identified requirements for musculoskeletal injury risk mitigation and treatment and the effective reintegration of service members with musculoskeletal injuries. The prioritized MSKI CRs represent the existing research gaps of the military medical community based on assessment of current and future medical and operational needs (see Appendix A for additional details regarding the selection of the prioritized CRs). Inclusion of a CR in the SRP does not guarantee funding will be aligned to its respective STPs. The prioritized MSKI CRs in this SRP are organized into four (4) CAs, as shown below.

- **Diagnose and Monitor:** Develop solutions to diagnose and track musculoskeletal injuries, musculoskeletal injury care, and musculoskeletal injury outcomes
- **Protect:** Decrease the incidence of musculoskeletal injuries in service members
- **Treat:** Develop effective medical treatments for musculoskeletal injuries
- **Optimize:** Develop solutions to identify when service members can safely return-to-duty/activity following musculoskeletal injury

Prioritized MSKI CRs are listed in Table 1-1, with each CR noted via an M number (e.g., M1, M2). The numeric labeling schema is intended to organize the CRs for ease of use and does not represent relative priority of the CRs. Section 2 describes the STPs leading to defined Capabilities for each CR.

Table 1-1 Capability Requirements Included in the MSKI SRP

M No.	Capability Requirement Name	Capability Requirement Description
M1	Assess and Diagnose Musculoskeletal Injuries	Diagnostic decision support tools for musculoskeletal injuries. [1–4]
M2	Musculoskeletal Injury Risk Mitigation	Countermeasures to mitigate primary musculoskeletal injury risk factors in service members. [1,2,5–8]
M3	Initial Care for Musculoskeletal Injuries	Initial musculoskeletal injury treatment strategies, technologies, and techniques to mitigate sequelae and optimize service member outcomes in garrison and forward deployed settings. [1,2,4,7,9–13]
M4	Regenerative Medicine for Musculoskeletal Injuries	Regenerative medicine approaches to augment musculoskeletal injury care and treatment to optimize service member outcomes. [1,11,14]
M5	Rehabilitative Care for Musculoskeletal Injuries	Rehabilitative care to mitigate sequelae and optimize service member outcomes. [10,11,14–16]
M6	Return-to-Duty and Reintegration	Return-to-duty screening and decision support tools to optimize military unit reintegration. [7,12,14]

2. CAPABILITY REQUIREMENTS AND ASSOCIATED S&T PATHS

This section outlines the MSKI SRP prioritized CRs, STPs and Capabilities. The Capabilities described are expected to transition to product development or other end users (e.g., members of the clinical or operational community) to aid in fulfillment of the requirement when they reach the appropriate Technology Readiness Levels/Knowledge Readiness Levels (TRL/KRL). A product development team will then perform, as appropriate, additional development activities required to mature these Capabilities to the extent to which they can be delivered for full clinical or operational use by the intended end user. Each CR in the sections that follow is depicted as a figure in the format shown in Figure 2-1.

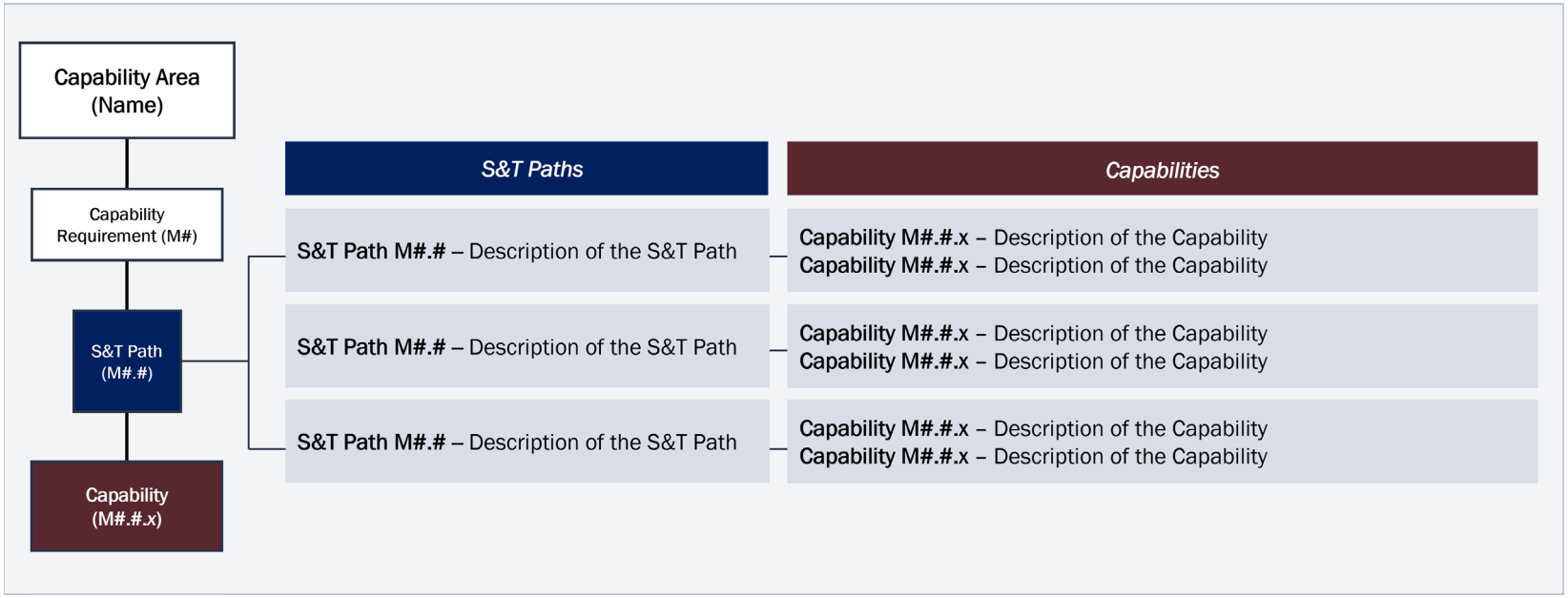

Figure 2-1 Capability Requirement Graphic Example

2.1 Assess and Diagnose Musculoskeletal Injuries (M1)

Musculoskeletal injuries compromise service member health, wellness, and medical readiness and pose a significant public health problem for the military. The Assess and Diagnose Musculoskeletal Injury CR focuses on developing or identifying solutions to facilitate the assessment and diagnosis of musculoskeletal injuries to optimize musculoskeletal injury care. Solutions include minimally or non-invasive point-of-care decision support tools for use in resource constrained, forward-deployed environments. It is also critical to develop solutions to easily document information about the patient and musculoskeletal injury at the point of injury, as these data can provide actionable information for healthcare providers and operational commanders regarding musculoskeletal injury risk assessments, treatment, return-to-duty, and combat effectiveness.

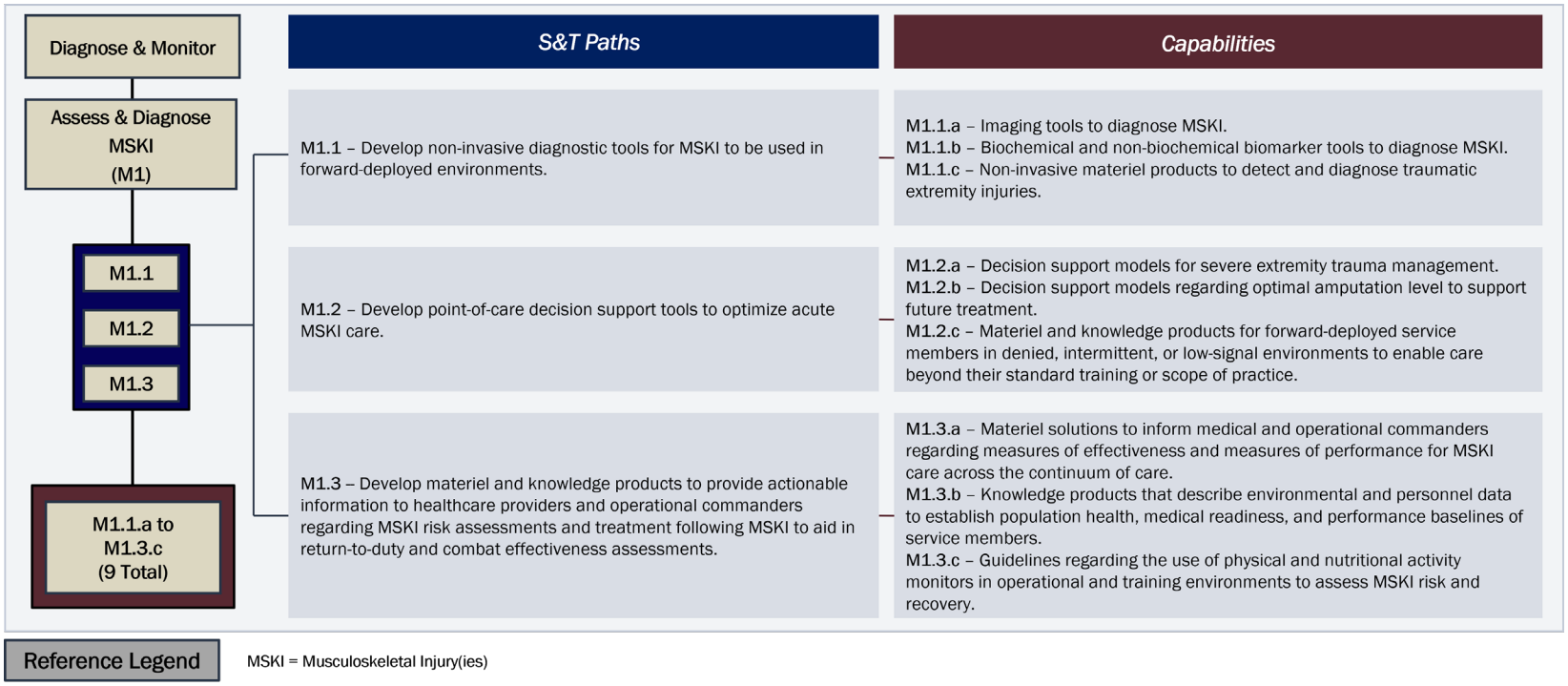

Figure 2-2 Assess and Diagnose Musculoskeletal Injuries S&T Paths and Capabilities

2.2 Musculoskeletal Injury Risk Mitigation (M2)

Combat and other service-related musculoskeletal injuries inflict a substantial physical burden on service members that significantly reduce Force medical readiness and strain DoD and MHS resources. A comprehensive musculoskeletal injury risk mitigation strategy is paramount to ensuring the medical readiness of the Joint Force. The Musculoskeletal Injury Risk Mitigation CR focuses on identifying or developing knowledge and materiel products to mitigate musculoskeletal injury risks in service members. Musculoskeletal injury risk mitigation strategies must be holistic in nature, such that they account for a variety of modifiable and non-modifiable physical and non-physical factors. These solutions will reduce the occurrence and severity of musculoskeletal injuries, fostering a healthier and more resilient Force.

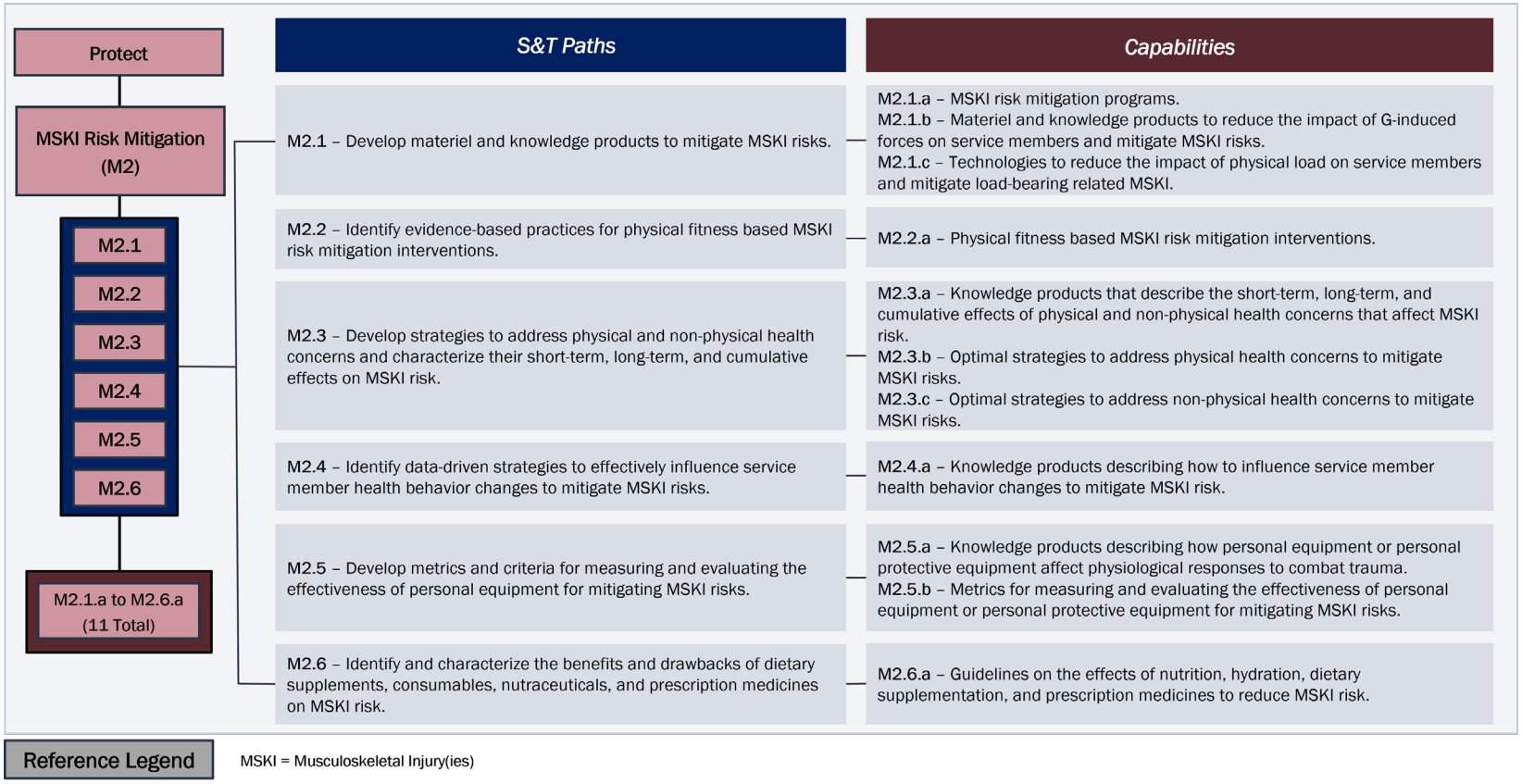

Figure 2-3 Musculoskeletal Injury Risk Mitigation S&T Paths and Capabilities

2.3 Initial Care for Musculoskeletal Injuries (M3)

Musculoskeletal injuries significantly increase the risk for future musculoskeletal injuries and can result in long(er)-term disability if they are not properly managed during the initial treatment phase. The Initial Care for Musculoskeletal Injuries CR focuses on optimal treatment strategies, technologies, and techniques to avoid musculoskeletal injury sequelae, optimize post-musculoskeletal injury outcomes, and reduce the time until service members can return-to-duty. Initial care solutions must be scalable and mobile so they can be effectively deployed at the point of injury in garrison settings to allow service members to continue to train and in forward deployed settings to enable a faster return to the fight.

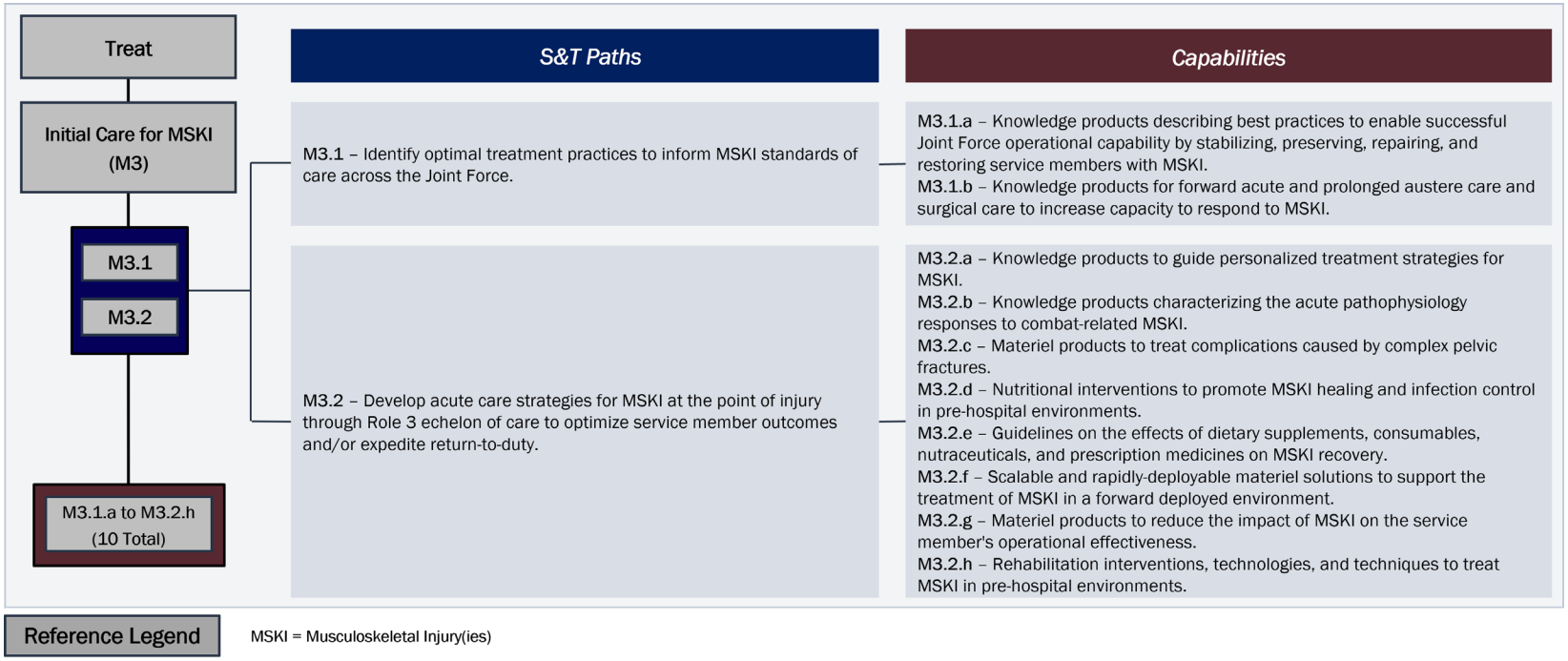

Figure 2-4 Initial Care for Musculoskeletal Injuries S&T Paths and Capabilities

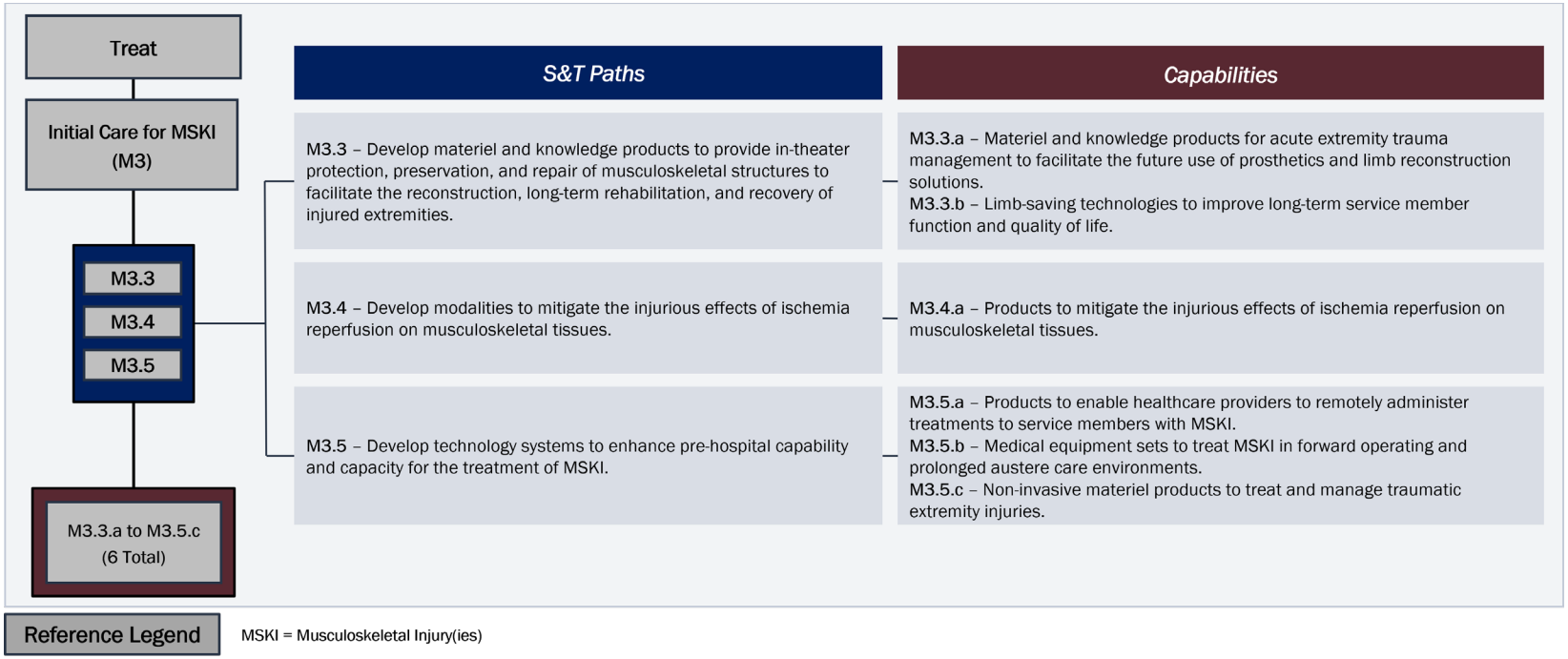

Figure 2-5 Initial Care for Musculoskeletal Injuries S&T Paths and Capabilities *(Continued)*

2.4 Regenerative Medicine for Musculoskeletal Injuries (M4)

Musculoskeletal injuries across the injury severity spectrum can result in significant limited or lost duty time. Accelerating musculoskeletal injury healing rates is key to reduce the time until a service member can return-to-duty. The Regenerative Medicine for Musculoskeletal Injuries CR focuses on the development of novel regenerative medicine solutions to enhance naturally occurring tissue healing and expedite recovery following musculoskeletal injuries. A broad range of regenerative medicine approaches already under regulatory approval for other indications could potentially be leveraged to accelerate musculoskeletal injury healing. Repurposed or new regenerative medicine approaches will optimize service member outcomes by restoring or replacing musculoskeletal elements, associated tissues, and functions affected by acute injury or chronic degeneration.

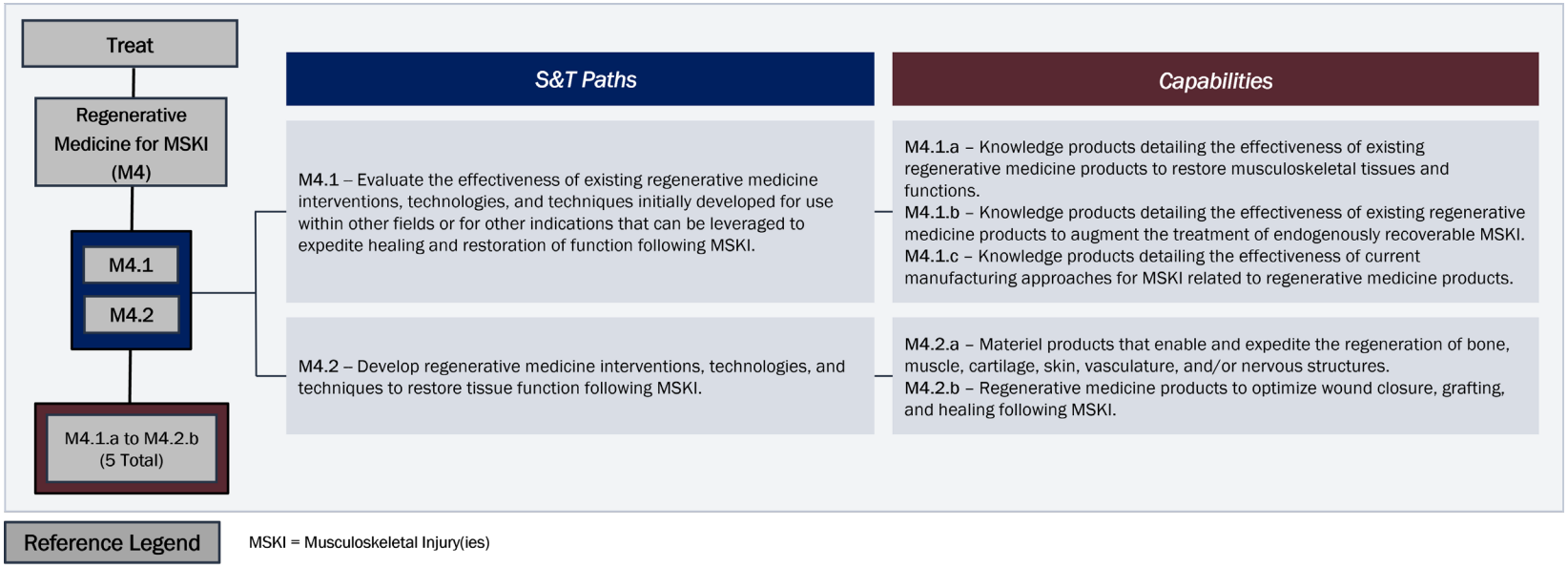

Figure 2-6 Regenerative Medicine for Musculoskeletal Injuries S&T Paths and Capabilities

2.5 Rehabilitative Care for Musculoskeletal Injuries (M5)

Rehabilitative care is essential for the management of both non-surgically and surgically managed musculoskeletal injuries to avoid musculoskeletal injury sequelae and optimize post-musculoskeletal injury outcomes. The Rehabilitative Care for Musculoskeletal Injuries CR focuses on holistic musculoskeletal injury rehabilitation approaches that address the physical and non-physical factors associated with musculoskeletal injury recovery. Additionally, musculoskeletal injury rehabilitation approaches must address the transport of post-surgical musculoskeletal injury patients and prosthesis and orthosis use, when appropriate.

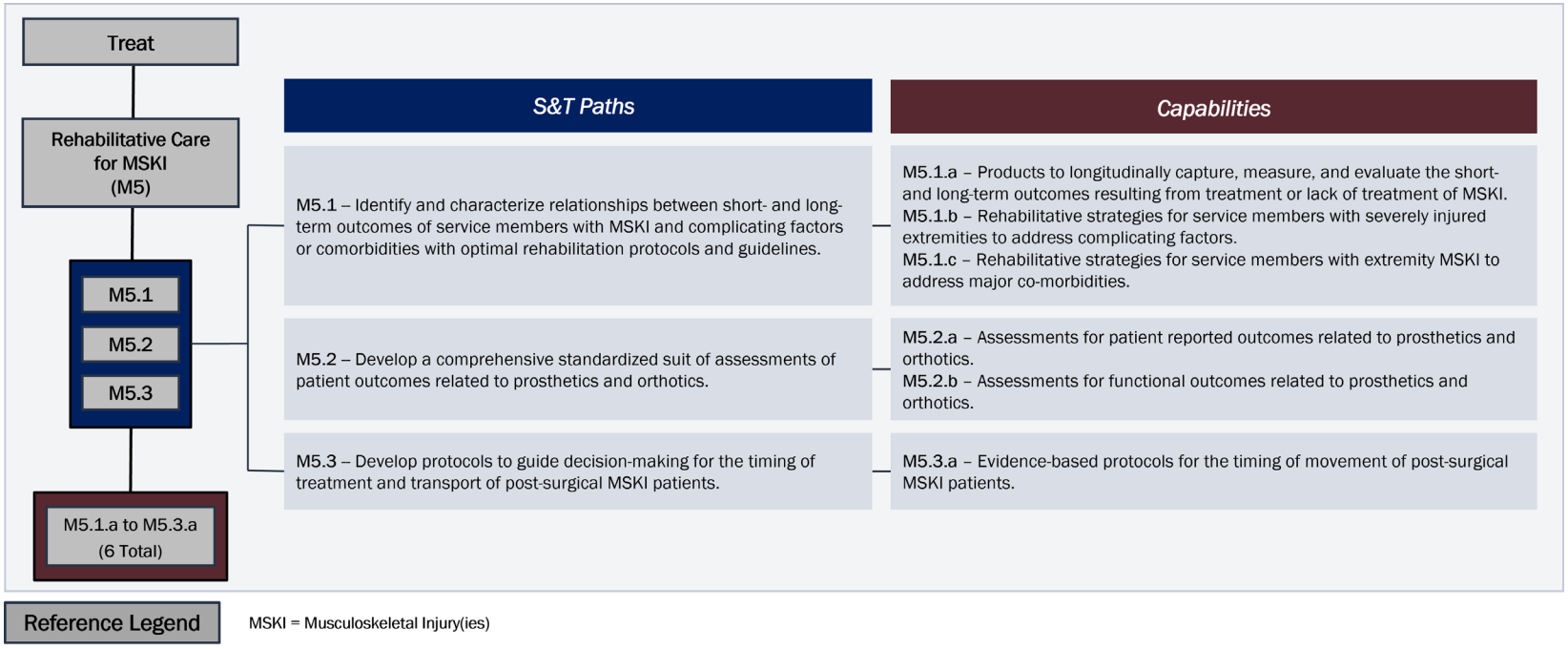

Figure 2-7 Rehabilitative Care for Musculoskeletal Injuries S&T Paths and Capabilities

2.6 Return-to-Duty and Reintegration (M6)

MHS healthcare providers and operational leaders have limited resources to identify when it is appropriate for service members to return-to-duty following musculoskeletal injury. The Return-to-Duty and Reintegration CR focuses on holistic musculoskeletal injury return-to-duty assessments and decision support tools that address the physical and non-physical factors associated with musculoskeletal injury recovery. These tools will provide healthcare providers and operational leaders objective data to guide post-musculoskeletal injury return-to-duty decisions; thereby optimizing return-to-duty decisions, improving service member safety upon military unit reintegration, and improving the overall health of the Force.

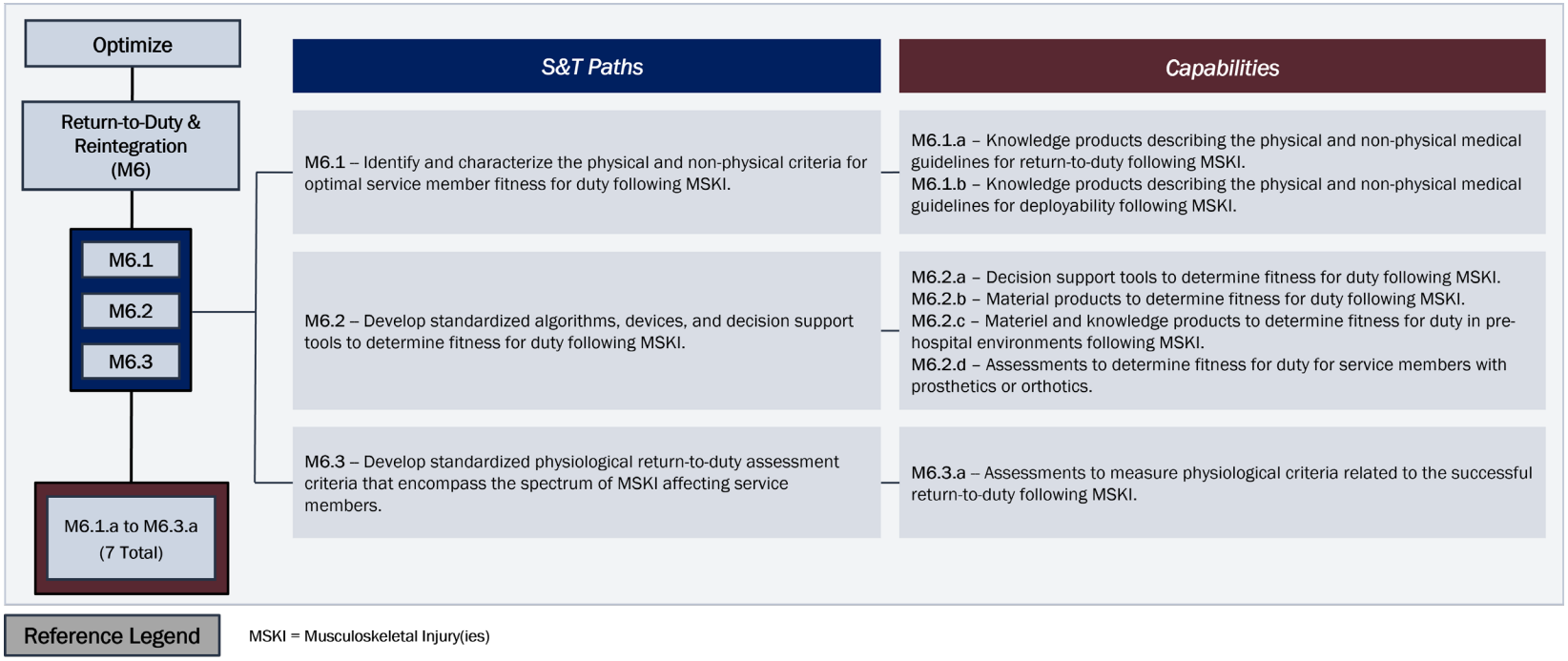

Figure 2-8 Return-to-Duty and Reintegration S&T Paths and Capabilities

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APPENDIX A. KEY DEFINITIONS

Term	Definition
6.1	Budget Activity (BA) for Basic Research increases knowledge/understanding: discovery; hypothesis testing. ~TRL 1–2
6.2	Budget Activity (BA) for Applied Research is the refinement of concepts into solutions: pre-clinical studies; drug formulation; device defined in animal model. ~TRL 2–3
6.3	Budget Activity (BA) for Advanced Technology Development is candidate solution development; proof of concept and product safety demonstrated (e.g., Phase 1–2a trials). ~TRL 3–6
6.4	Budget Activity (BA) for Advanced Component Development and Prototypes is the effort to evaluate integrated technologies, representative models, or prototype systems in high fidelity and realistic operating environments ~TRL/KRL 4-7.
Advanced Development	Performs the additional development activities required to mature Capabilities developed in S&T to the extent to which they can be delivered for full clinical or operational use by the intended end user.
Allotransplantation	Transplantation of an organ or tissue from one individual to another of the same species with a different genotype.
Austere Environment	Environments where access to clean water, electricity, and to a fixed mobile medical facility is significantly degraded or denied, and where diagnostic and treatment resources and medical personnel are unavailable or limited for extended periods of time.
Biomarkers	An objective measure that captures what is happening in a cell or an organism at a given moment.
Budget Activity	Categories within each appropriation and fund account that identify the purposes, projects, or types of activities financed by the appropriation or fund.
Capability	The S&T knowledge and/or materiel products to be transitioned to product development or other end users.
Capability Area	Reflect the highest structural element that encompasses broad areas of medical research within an SRP.
Capability Requirement	Derived from key source documents, and outline Capabilities (knowledge or materiel) required to meet current or future military medical needs.
Comorbid	Having more than one disease or condition at the same time; conditions can often be chronic or long-term.
Compartment Syndrome	A condition that occurs when pressure within the muscles builds to dangerous levels. This pressure can decrease blood flow, which prevents nourishment and oxygen from reaching nerve and muscle cells.

Term	Definition
Continuum of Care	The concept involving an integrated system of care that guides and tracks a patient over time through a comprehensive array of health services spanning all levels of care intensity.
Dislocation	The displacement of a bone from a joint.
Evidence-based	The integration of the best available research findings considered the gold standard into clinical practice in the context of patient characteristics, culture, and preferences.
Field-expedient	A course of action used in the absence of a more suitable or traditional method to achieve an objective.
Fracture	A break in a bone or cartilage. Fracture classifications include Traumatic Acute versus Overuse; Closed (skin intact) versus Open (bone exposed skin); Complete or Incomplete ("green stick") which do not go all way through bone, or single or multiple bones.
Garrison	A military post; a permanent military installation.
G-induced neck pain	Pain in the cervical spine as a result of high G-forces.
Heterotopic Ossification	The presence of bone in soft tissue where bone normally does not exist, most frequently seen with either musculoskeletal trauma, spinal cord injury, or central nervous system injury.
Intersection	Capabilities and associated STPs in an SRP that have overlap with those in one or more other SRPs.
Ischemia-Reperfusion Injury	The paradoxical exacerbation of cellular dysfunction and death, following restoration of blood flow to previously ischemic tissues.
Joint Capabilities Integration and Development System	JCIDS is the process by which the military develops and validates capability requirements for joint (more than one Service) use and interoperability.
Limb Salvage	A surgical approach designed to optimize limb function and reduce the likelihood of limb amputation.
Materiel Solution	A new item developed or purchased to satisfy one or more CRs (or needs) and reduce or eliminate one or more capability gaps.
Medical Readiness	Ensuring service members are healthy, protected from potential threats, and ready for operations or contingencies.
Nutraceutical	A food containing health-giving additives and having medicinal benefit.
Non-materiel Solution	Changes in doctrine, organization, training, (existing) materiel, leadership and education, personnel, facilities, and/or policy (DOTmLPF-P), implemented to satisfy one or more capability requirements (or needs) and reduce or eliminate one or more capability gaps, without the need to develop or purchase a new materiel solution.
Operational Effectiveness	The ability of an individual warfighter, unit, or force to successfully conduct its assigned tasks and accomplish its mission.

Term	Definition
Operational Environment	The composite of the conditions, locations, and scenarios whereby military forces are employed to address crises and conflicts that are not limited to a geographic location.
Polymorbid	Co-occurrence of at least two chronic health conditions.
Research Gap/S&T Gap	The lack of science and technology research activities identified through the research landscape analysis.
SMEs	An individual who has accumulated great knowledge in a particular field or topic.
S&T Path (STP)	Describe the high-level research activities needed to support the transition of Capabilities to product development or other end users.
Traumatic (Acute) Injuries	Occur instantaneously from a high intensity force or abrupt movement such as from a fall, a blow to the body, an awkward twist when lifting, or a sharp pivot.
Wearables	Miniaturized technology that is worn directly or indirectly by people for several purposes or reasons.

APPENDIX B. ACRONYMS

AHP	Analytical Hierarchy Process
BA	Budget Activity
CA	Capability Area
BUMED	United States Navy Bureau of Medicine and Surgery
CCCRP	Combat Casualty Care Research Program
CDMRP	Congressionally Directed Medical Research Program
CR	Capability Requirement
CSI	Congressional Special Interest
DAD	Deputy Assistant Director
DHA	Defense Health Agency
DHP	Defense Health Program
DoD	Department of Defense
EACE	Extremity Trauma and Amputation Center of Excellence
FY	Fiscal Year
FYDP	Future Years Defense Program
ICD	Initial Capabilities Document
JCIDS	Joint Capabilities Integration and Development System
JHU/APL	John Hopkins University Applied Physics Laboratory
KRL	Knowledge Readiness Level
MED CDID	Medical Capability Development Integration Directorate
MHS	Military Health System
MHSR	Military Health System Research (MHSR)
MOMRP	Military Operational Medical Research Program
MSKI	Musculoskeletal Injury

NIH	National Institutes of Health
OJSS	Office of the Joint Staff Surgeon
OPORP	Orthotics and Prosthetics Outcomes Research Program
PDMSS	Pharmaceutical Devices and Medical Support Systems
POI	Point of Injury
POM	Program Objective Memorandum
PoP	Period of Performance
PRORP	Peer Reviewed Orthopaedic Research Program
R&E	Research and Engineering
RLA	Research Landscape Analysis
RTD	Return-to-Duty
RDT&E	Research, Development, Test and Evaluation
S&T	Science & Technology
SBIR	Small Business Innovation Research
SME	Subject Matter Expert
SRP	Strategic Research Plan
STP	Science & Technology Path
STPMB	Science & Technology Portfolio Management Branch
TBI	Traumatic Brain Injury
TRL	Technology Readiness Level
USAF/SG	Office of the United States Air Force Surgeon General
USAMMDA	United States Army Medical Materiel Development
USAMRDC	United States Army Medical Research and Development Command
USD	US Dollars
USU	Uniformed Services University of the Health Science

VA	Veterans Affairs
WEMT	Warfighter Expeditionary Medicine and Treatment
YOE	Year of Execution