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Defense Health Agency Strategic Research Plan: Sensory Systems



REVISION HISTORY

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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
- Identification of Capabilities needed to fulfill prioritized 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
- Multi-year (3 to 5 years) research investment plans and budgets 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 DoD medical capabilities will be developed over time. SRPs outline only the prioritized CRs, identified based on assessment of current and future medical and operational needs of the military community. SRPs include information that will enable the Portfolio Manager to perform the following activities:

- Develop annual Future Years Defense Program (FYDP) plans in alignment with prioritized CRs and Capabilities and to anticipate resources that will be required for the respective Program Objective Memorandum (POM) cycle
- Provide oversight and concurrence of Year of Execution (YOE) spend plans developed by Program Managers (PMs)
- Facilitate discussion with leadership and stakeholders regarding the research activities required to address CRs
- Define the state of the science to leverage innovative technology solutions

The DHA Sensory Systems Portfolio SRP is organized into 5 levels:

- **Capability Area (CA)** reflects the highest structural element that encompasses broad areas of medical research within a Portfolio
- **Capability Requirement (CR)** outlines Capabilities (knowledge or materiel) required to meet current or future military medical needs that are specifically aligned to source documents (e.g., JCIDS)
- **S&T Path (STP)** describes high level research activities needed to support transition of Capabilities to product development or other end users

- **Capability** describes the S&T knowledge or materiel product to be transitioned to product development or other end users
- **Modality** describes the component or type of sensory research applicable to each Capability Area, Capability Requirement, S&T Path, and Capability

The sensory system is naturally organized into modalities, each with a diverse array of specialized receptors designed for transducing external stimuli into electrochemical signals. Each modality is finely tuned to detect and encode specific sensory information, with subsequent neural processing and interpretation of these signals culminating in the perception and comprehension of the external environment. For this reason, the DHA Sensory Systems Portfolio SRP differs from other DHA Portfolio SRPs in that it utilizes a 5th level of organization (Sensory Modality), which encompasses multiple distinct components of sensory medical S&T research. This level of organization allows for distinctions between the prioritized elements (CA, CR, STP, and Capability) of each sensory modality. Within the SRP, the umbrella terms *Auditory (A)*, *Ocular (O)*, *Pain (P)*, and *Vestibular (V)* are used to describe all components of a sensory modality (see [Appendix E](#) for full definitions).

The DHA Sensory Systems Portfolio focuses on injury or illness to sensory systems including research to characterize basic mechanisms and to advance assessment, diagnosis, monitoring, and treatment. Prioritized CRs are organized into 3 major CAs, as shown in [Table 1-0](#).

Table 1-0 Capability Areas Included in the SRP Iteration

Capability Area	Capability Area Description
<u>Characterize</u>	Characterize mechanisms and risk factors for sensory injury or illness [2,4,8]
<u>Assess, Diagnose, Monitor</u>	Develop practices or tools that aid diagnosis of sensory injury or illness, assess the health of sensory systems, and develop fitness standards [2-6,8,11]
<u>Treat</u>	Provide treatment for sensory injury or illness at/near the point-of-injury (POI), in-transit, and acute care [1-6,8,9]

The prioritized CRs are listed in [Table 2-0](#), with each priority CR denoted via an S number (i.e., S1, S2, S3, S4). [Appendix C](#) describes the prioritization process. [Section 2](#) describes the STPs leading to defined Capabilities for each CR. It is important to note that this numeric labeling schema (S1 – S4) is not meant to represent relative priority and is simply intended to logically organize the CRs for ease of use.

Table 2-0 Capability Requirements Included in the SRP Iteration

S#		
S1	<u>Mechanistic Characterization</u>	Develop improved models of sensory injury or illness, describing the etiology, mechanism(s), progression, and potential targets for prevention [2,4,8]
S2	<u>Assessment Tool Development</u>	Develop knowledge and materiel solutions for diagnosing and quantifying sensory injury or illness (in clinical testing and operationally relevant function) [2-6,8,11]
S3	<u>Stabilization Tool Development</u>	Optimize stabilization solutions and point-of-injury care of sensory injury to preserve function and readiness [1-6,8,9]
S4	<u>Treatment Tool Development</u>	Develop knowledge and materiel solutions for the repair or mitigation of sensory injury or illness [2-5,9]

Figure 1-0 shows the hierarchical relationship as described, with the associated reference schema. Modality is displayed as the lowest level of the hierarchy for ease of organization.

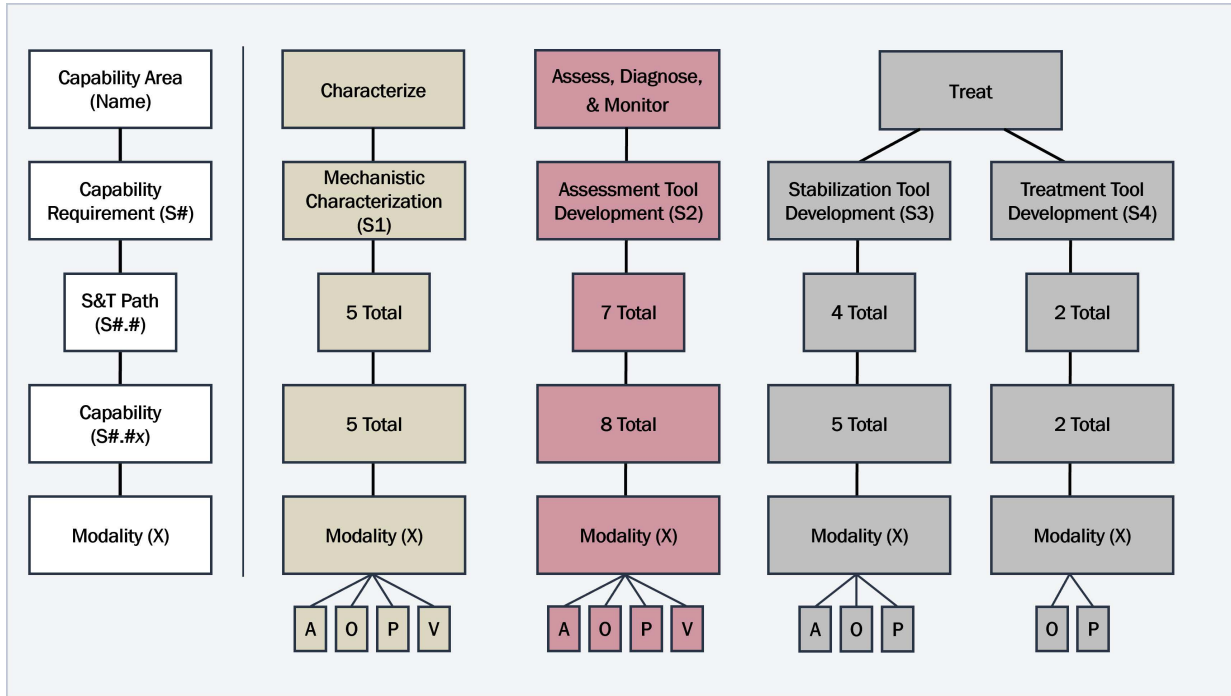


Figure 1-0 SRP Hierarchy

2. CAPABILITY REQUIREMENTS AND ASSOCIATED S&T PATHS

This section outlines the CRs, the detailed STPs that describe research activities associated with CRs, and Capabilities expected to transition to product development or other end users (e.g., members of the clinical and/or operational communities) to fulfill the CR. The Capabilities represented will transition to product development or other end users when they reach the appropriate technology or knowledge readiness level (TRL or KRL). Product development will then perform, as appropriate, additional development activities required to mature these Capabilities for clinical or operational use by the intended end user. Each of the sensory modalities and their respective CRs, STPs, and Capabilities, are graphically depicted as follows:

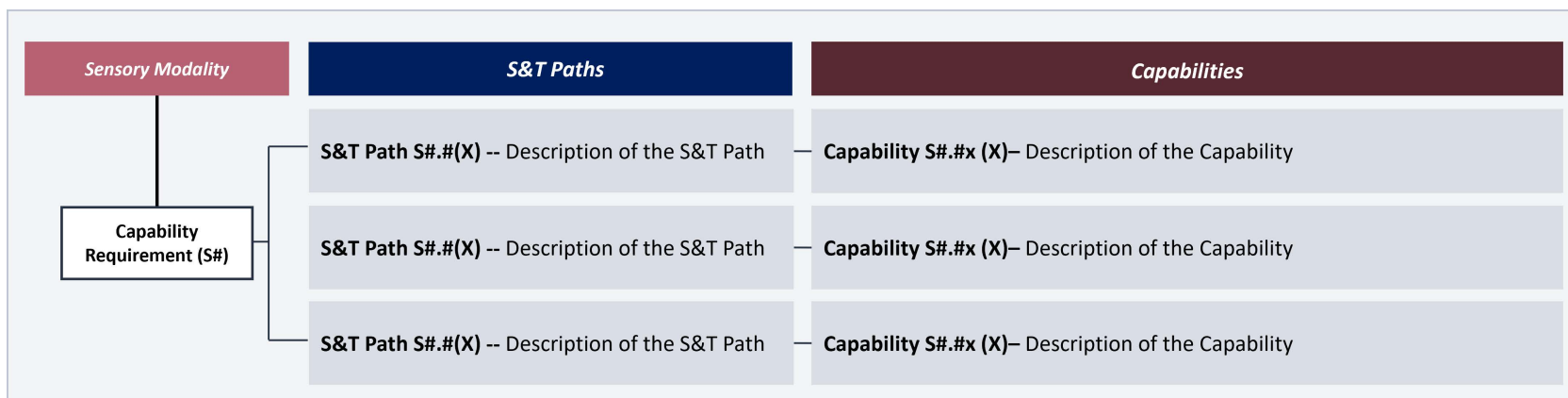


Figure 2-0 Modality Graphic Example

The CRs, STPs, and Capabilities outlined in this section focus on addressing DoD-specific, validated joint-service medical S&T needs. The SRP is limited to activities that are unlikely to be resolved through S&T activities outside of the DHA—specifically, where military exposures or injuries are unique, or where potential solutions may differ from or not be adequately addressed by efforts elsewhere. Similarly, Capabilities of shared interest that are being pursued by other, non-DHA entities (e.g., Veterans Affairs, National Institutes of Health) were not included as a priority in the SRP. Finally, modalities of sensory research that have little, if any, direct applicability to DoD needs (e.g., smell, taste) were not included in the SRP. Inclusion as a priority was determined through input from DoD stakeholders and other federal agency partners, as well as analysis of the Research Landscape (RL), described in [Appendix C](#) and [Appendix D](#), respectively.

2.1 Auditory

Auditory CRs seek to resolve deficiencies in knowledge and materiel solutions concerning the nature of auditory injuries (S1), auditory assessments and monitoring (S2), and the stabilization of acute auditory injuries (S3). S1 addresses the limited understanding of auditory injuries likely to be incurred during military service [2,4,8]. S2 addresses specific military relevant needs related to prehospital injury and fitness for duty assessments that can be utilized across multiple military operational environments [2-6,8,11]. S3 focuses on stabilizing acute auditory injury or illness to maintain operational effectiveness in a combat or prehospital environment [1-6,8,9]. Non-acute (e.g., restorative, rehabilitative) auditory treatments which are not unique to the needs of the DoD or are the subject of significant research efforts by other entities were not included as a priority in the SRP.

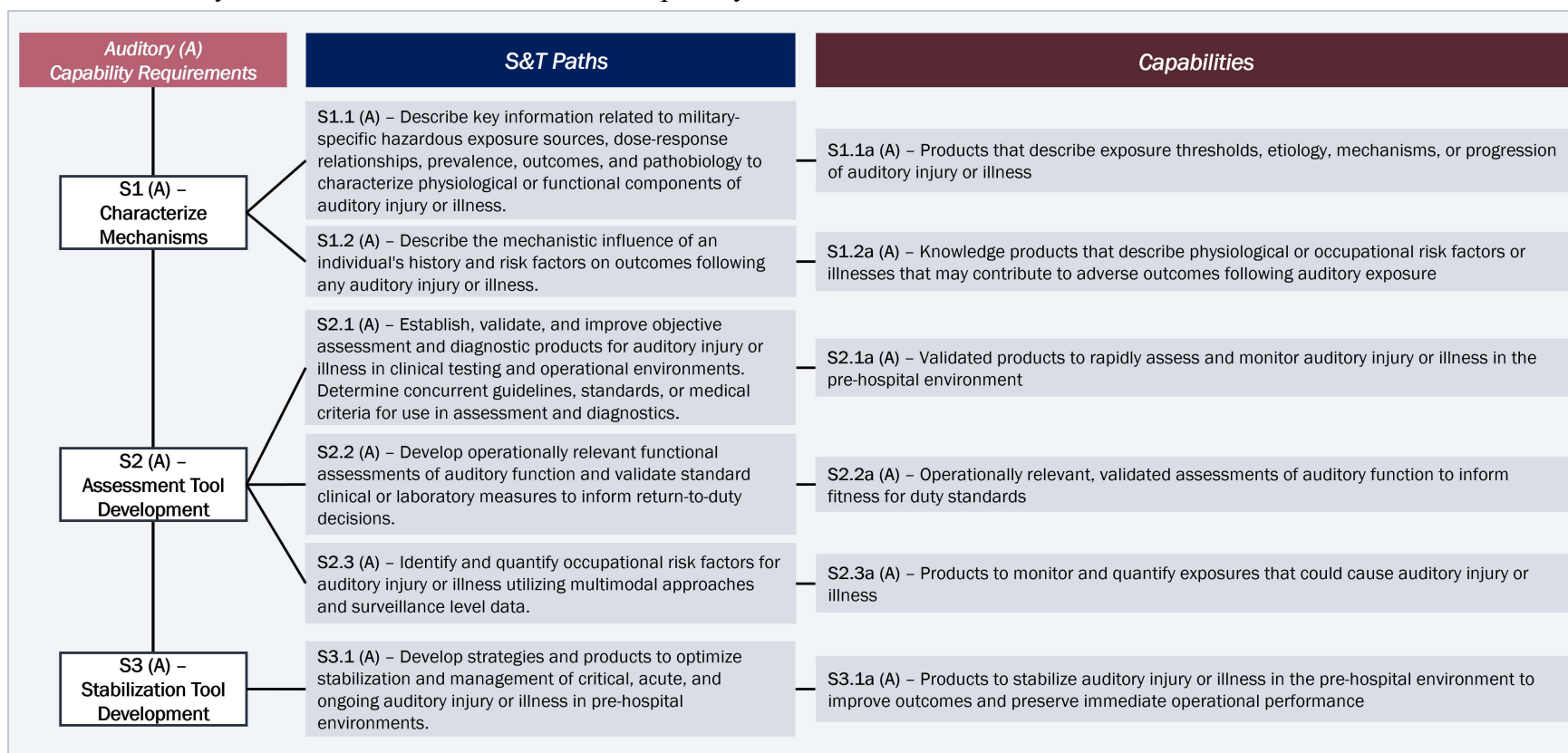


Figure 2-1 Auditory Capability Requirements, S&T Paths, and Capabilities

2.2 Ocular

Ocular CRs seek to resolve deficiencies in knowledge and materiel solutions concerning the nature of ocular injuries (S1), assessment and monitoring of ocular function (S2), and stabilization and treatment of acute ocular injuries (S3 and S4, respectively). S1 addresses the limited understanding of ocular injuries likely to be incurred during military service [2,4,8]. S2 addresses specific military relevant needs related to prehospital ocular injury and fitness for duty assessments that can be utilized across multiple operational environments [2-6,8,11]. S3 focuses on stabilizing acute ocular injuries to maintain operational effectiveness in a combat or prehospital environment [1-6,8,9]. S4 addresses the treatments needed to preserve and repair visual function following the type of acute ocular injuries that are most likely to occur in a military environment [2-5,9].

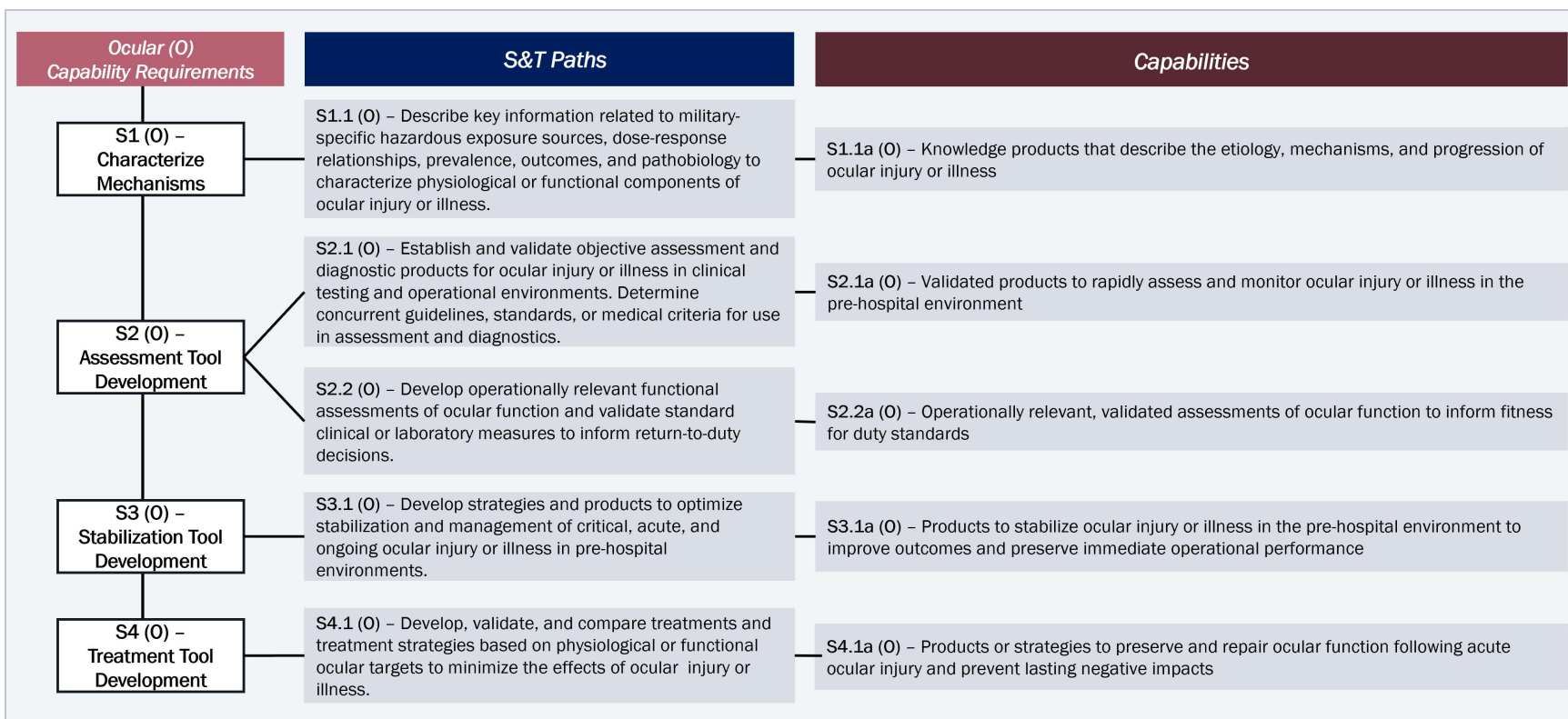


Figure 2-2 Ocular Capability Requirements, S&T Paths, and Capabilities

2.3 Pain

Pain CRs seek to resolve deficiencies in knowledge and materiel solutions concerning the development of pain (S1), pain assessment and monitoring (S2), and pain control in both the prehospital and definitive care environments (S3 and S4, respectively). S1 focuses on characterizing the etiology of pain related to military service [2,4,8]. S2 addresses the need for pain assessments, especially regarding pain that may hinder fitness for duty [2-6,8,11]. S3 focuses on the development of prehospital pain control products that suit unique military operational needs, such as maintaining operational effectiveness after the application of pain control products [1-6,8,9]. S4 addresses pain control products for use in an operational environment where support staff and other resources may be limited compared to a non-military setting (e.g., field hospital, mass casualty incident) [2-5,9].

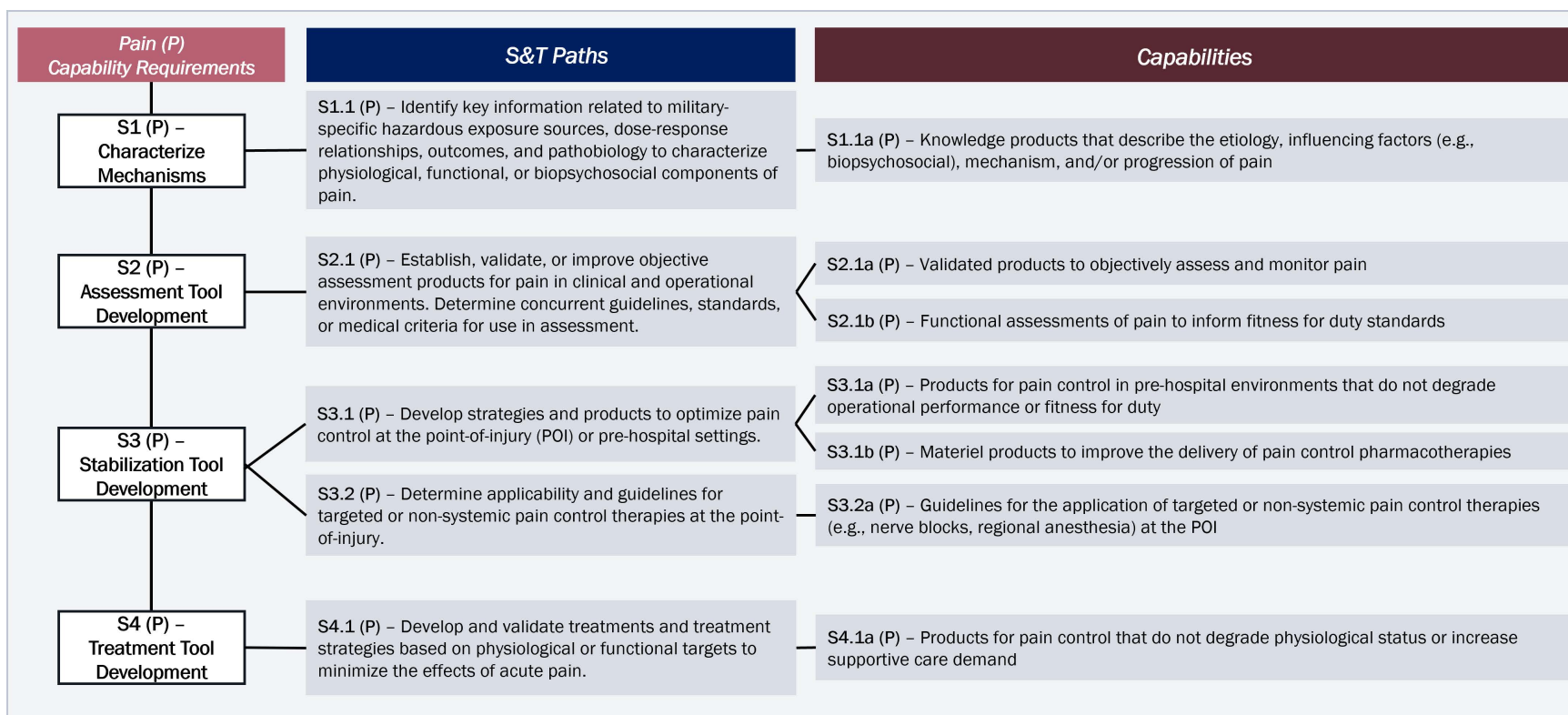


Figure 2-3 Pain Capability Requirements, S&T Paths, and Capabilities

2.4 Vestibular

Vestibular CRs seek to resolve deficiencies in knowledge and materiel solutions concerning the mechanism(s) of military relevant vestibular injury (S1), as well as the assessment of vestibular injury in prehospital military environments (S2). Stabilization or treatment of acute vestibular injuries were not included in the SRP, as resulting capabilities are unlikely to be uniquely relevant to military-specific requirements. S1 addresses capabilities intended to better describe the underlying biophysical mechanism(s) of military relevant vestibular injury [2,4,8]. S2 focuses on products to rapidly assess vestibular injury in a prehospital operational environment [2-6,8,11].

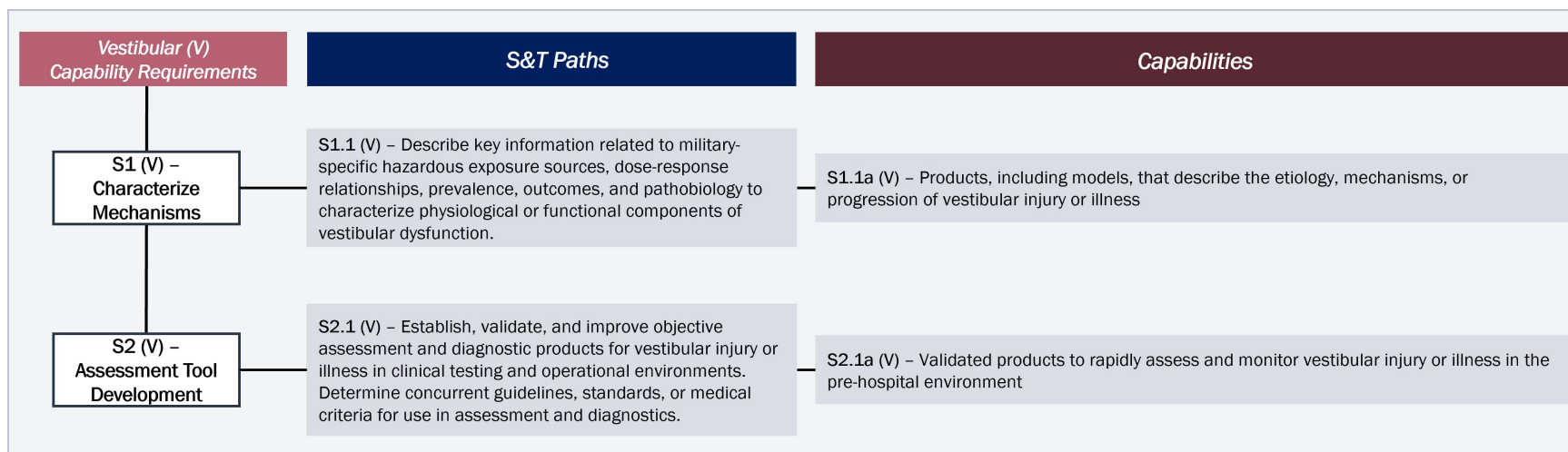


Figure 2-4 Vestibular Capability Requirements, S&T Paths, and Capabilities

3. REFERENCES

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- [12] The Johns Hopkins University Applied Physics Laboratory, AOS-L-20-0230 Defense Health Agency Science and Technology Portfolio Management Concept of Operations," Pre-decisional Draft, amended June 10, 2022
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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
Auditory	Term used to represent the entire auditory system and hearing-related functions it enables, from basic sound perception to complex speech comprehension
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 a Portfolio
Capability Requirement	Derived from key source documents, and outline capabilities (knowledge or materiel) required to meet current or future military medical needs
Interdependency	Reliance of 1 S&T progression on the outcome of another or more S&T activities
Joint Capabilities Integration and Development System	JCIDS is the process by which the military develops and validates capability requirements for joint (more than 1 Service) use and interoperability
Long-Term Rehabilitation	The potential capability to enable long-term rehabilitation of injured or wounded warfighter and mitigation of long-term and late effects that limit the RTD
Medical Readiness	Ensuring warfighters are healthy, protected from potential threats, and ready for operations or contingencies
Military Community	Warfighters, DoD civilians, and beneficiaries
Modality	The component or type of sensory research applicable to each Capability Area, Capability Requirement, S&T Path, and Capability
Multisensory	Relating to 2 or more of the senses within the scope of the DHA Sensory Systems Portfolio
Ocular	Term used to represent the entire visual system and functions it enables, from basic visual perception to complex target identification

Term	Definition
Operational Effectiveness	The ability of an individual warfighter, unit, or force to successfully conduct its assigned tasks and accomplish its mission
Research Gap/S&T Gap	The lack of science and technology research activities identified through the Research Landscape
SME	An individual who has accumulated great knowledge in a particular field or topic
S&T Path	Describe the high-level research activities needed to support the transition of Capabilities to product development or other end users
Vestibular	Term used to represent the sense of balance, to include proprioception, touch, and spatial orientation

APPENDIX B. ACRONYMS

A	Auditory
AHP	Analytical Hierarchy Process
BA	Budget Activity
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
DARPA	Defense Advanced Research Projects Agency
DHA	Defense Health Agency
DHP	Defense Health Program
DoD	Department of Defense
DOERS-IH	Defense Occupational & Environmental Health Readiness System – Industrial Hygiene
EGS	Electronic Grants Systems
FY	Fiscal Year
FYDP	Future Years Defense Program
GDF	Guidance for the Development of the Force
ICD	Initial Capabilities Document
JCIDS	Joint Capabilities Integration and Development System
JSS	Joint Staff Surgeon
KRL	Knowledge Readiness Level
MED CDID	Medical Capability Development Integration Directorate

METC	Military Education and Training Campus
MHS	Military Health System
MOMRP	Military Operational Medical Research Program
NEI	National Eye Institute
NIDCD	National Institute on Deafness and Other Communication Disorders
NIH	National Institutes of Health
NRAP	National Research Action Plan
O	Ocular
P	Pain
PM	Program Manager
POI	Point-of-Injury
POM	Program Objective Memorandum
R&E	Research and Engineering
RL	Research Landscape
RPMD	Research Program Management Division
RTD	Return-to-Duty
S&T	Science and Technology
SME	Subject Matter Expert
SRP	Strategic Research Plan
STEID	Science & Technology Enterprise Integration Division
STPMB	Science & Technology Portfolio Management Branch
STPM	Science & Technology Portfolio Management
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
USSOCOM United States Special Operations Command
USUHS Uniformed Services University of the Health Science
V Vestibular
VA Veterans Affairs
WBH Warfighter Brain Health
YOE Year of Execution