ARPA-H TECHNOLOGY READINESS LEVELS (TRLS)

Last Updated: March 1st, 2024
Note: This document is subject to change.

TRL1: Basic Principles Observed and Assessed

Scientific findings are reviewed and assessed as a foundation for formulating a health solution idea and testing a hypothesis or deriving metrics for new health solutions.

TRL 2: Health Concept and/or Use-Driven Experiments

Health-focused ideas have clear research hypotheses and metrics. Feasibility studies and experimental design are developed to address scientific problem area. Underlying concepts and components are tested towards a specific application.

TRL 3: Analytical and Experimental Critical Function and/or Characteristic Proof –of-concept

Preliminary tests of the technology or solution and assessment of pre-prototype in physical laboratory or cloud/virtual development environments. Integration of components with empirical validation of foundational principles. Performing and validating *in vitro* or bench top experiments.

TRL 4: Components are Validated in a Laboratory or Test Environment

Non-GLP *in vivo* research to refine hypothesis and identify relevant parametric data for technology assessment or integration of technological components when applicable. Technological demonstration is completed with a limited number of laboratory or test models (may include animal or benchtop studies). Assessments conducted include safety, activity, design, and system parameters in a controlled test setting. Defining study endpoints and identifying any animal models (if any are proposed) or direct to human studies.

TRL 5: Solution Prototype and/or System Components are Validated and Manufacturing Initiated

Continue non-GLP *in vivo* studies and assay development as necessary. Define requirements for advanced characterization, target product profiles, manufacturing, and system parameters. Validate technology in animal model, initiate a scalable and reproducible GMP manufacturing.

TRL 6: Prototype Demonstration in Relevant Health setting, Regulatory submissions, Clinical Data

Health solution demonstrated through pilot-scale GMP manufacturing. Prepare and submit regulatory package to FDA (Investigational New Drug (IND), Investigational Device Exemption (IDE), In vitro Diagnostic (IVD), etc. as needed) and conduct Phase 1 clinical trial(s) as needed to determine the safety and pharmacokinetics of the clinical test article.

TRL 7: Integrated Product Demonstration in a Real-world Environment, Process Validation, Initiation of GMP (when applicable),

Data are collected, presented, and discussed with appropriate regulatory division with final prototype or initial GMP production and Phase 2 Clinical Trials. Trials are performed with a fully integrated prototype in a real-world environment, with ongoing studies to evaluate effectiveness, identify potential short-term adverse events and risks associated with the system prototype. Functional testing of candidate prototype is completed and confirmed, resulting in final down-selection and validation of health solution prototype.

TRL 8: Product Completed and Qualified through Test and Demonstration (FDA Clearance or Approval)

- Trials are conducted to evaluate the overall risk-benefit of use. As appropriate, finalize GMP manufacturing, complete Phase 3 clinical trials, and/or expanded clinical safety trials. Prepare and submit NDA/BLA and obtain NDA or FDA premarket approval for Class III devices.
- FDA clearance for Class I and II medical devices

TRL 9: Product Successfully in Use and Operation

Health solution's product is proven through successful use. Phase 4 post-marketing studies or post-approval reporting requirements occur, as required.