Innovations
USP will explore the development of quality standards and other fit-for-purpose solutions to help stakeholders safeguard the quality of promising healthcare innovations that address patient and public health needs.

Year 2 Update
USP standards build trust and confidence in healthcare breakthroughs, support market access, and advance the quality of medical products to strengthen the medicines supply chain. Given the abundance of new medicine modalities and manufacturing advances, the opportunity is enormous for USP standards and related programs to help ensure quality – from product development to manufacturing, distribution, and delivery – in support of supply chain resilience. In order to achieve this goal, and better anticipate and support stakeholder needs, USP has bolstered its ability to identify and evaluate early technologies and prioritize emerging ideas and trends in pharmaceutical development.

Key areas of progress over the past fiscal year include:

Graph Database and Artificial Intelligence Capabilities – USP expanded exploration of graph database and artificial intelligence (AI) capabilities such as natural language processing and deep learning. The goal is to use these capabilities to facilitate evaluations of the impact that specific federal regulatory changes may have on current and future standards development, and improve understanding of the interconnectivity of standards to support stakeholder needs. To advance this goal, USP tested and demonstrated related capabilities through specific use cases. Examples included: 1) use of a “Regulatory Document Associator” tool to identify connections between USP standards, FDA guidance, and U.S. laws, and pinpoint areas impacted by changes in U.S. federal requirements, and 2) a dashboard to highlight connections between USP standards and related drug development information. The ongoing exploration, piloting, and implementation of capabilities such as graph database and AI will enable better linking, manipulation, and visualization of USP data assets to provide insights that drive decision-making and further optimize our ability to enhance our products and services for the benefit of stakeholders.

Pharmaceutical Continuous Manufacturing – USP advanced work on multiple fronts to lower technical and knowledge barriers to adoption of pharmaceutical continuous manufacturing
PCM technology, which can facilitate medicines supply chain resilience through efficiencies that make it more practical to make more medicines in more places, alongside traditional batch manufacturing.

- Under a strategic alliance forged in Fiscal Year 2021 with Phlow, a public benefit corporation, USP continued to develop early scientific guidelines for high-quality PCM processes and construction of the USP Advanced Manufacturing Technology Lab. During the year, the alliance worked to facilitate creation of an active pharmaceutical ingredient (API) strategic reserve, leveraging PCM technology, to provide a national stockpile of key ingredients for the domestic manufacture of essential medicines and reduce U.S. dependence on foreign supplies concentrated in only limited geographies. The work progressed on five critical APIs with a hybrid approach utilizing elements of both PCM and traditional batch manufacturing technology.

- USP acquired Pharmatech Associates in July 2021. Pharmatech remains a separate entity providing consulting services independent from USP standards-setting activities that can help manufacturers through the decision-making process on PCM adoption, production line development, and related regulatory processes.

- USP signed an agreement with the National Institute for Pharmaceutical Technology and Education (NIPTE) to co-develop a Continuous Manufacturing Knowledge Center partially funded by FDA.

### 3-D Printing of Pharmaceuticals

- USP launched a webinar series on 3-D printing of pharmaceuticals in partnership with Purdue University and sponsored by Aprecia Pharmaceuticals, the “International 3DP Pharma Technology Forum.” Attended by industry, academia, and regulatory bodies, the series included a focus on the benefits of 3-D printing of pharmaceuticals to patients, manufacturers, formulation scientists, and compounding pharmacists. Through collaboration with Purdue, USP also continued to make strides in research exploring and identifying quality considerations for 3-D printing of pharmaceuticals and related roles for quality standards. During the year, USP worked to develop a perspective paper and conducted qualitative interviews to outline the current landscape for 3-D printed pharmaceuticals and collect insights from external stakeholders on the role USP can play in advancing the quality of 3-D printing technology.

### Drug Dissolution

USP conducted studies aimed at optimizing dissolution testing using a reduced volume of dissolution media. The change would reduce the environmental impact of dissolution testing while accelerating the process and expanding test applications. Particle-induced velocimetry studies were also initiated in collaboration with the New Jersey Institute of Technology to further characterize hydrodynamics in a reduced-volume dissolution system. These studies, along with computational fluid dynamics results, may provide further guidance for optimizing the use of low-volume dissolution testing to improve analytical sensitivity while reducing the volume of solvents used.

### Quantitative Nuclear Magnetic Resonance

- USP revised and published USP General Chapters <761> Nuclear Magnetic Resonance Spectroscopy and <1761> Applications of Nuclear Magnetic Resonance Spectroscopy to facilitate use of qNMR as an analytical technique for demonstrating quality. USP continued to expand evaluation
and integration of qNMR analytical procedures in reference standard operations. USP also expanded stakeholder outreach on adoption of qNMR, including through establishment of the qNMR-China discussion group. The group brings together Chinese pharmaceutical and academic experts, along with other global experts, to discuss advancement and applications of qNMR for quality control in the pharmaceutical industry.

**Complex Generics** – Defined as drug products that have a complex active ingredient, formulation, or route of delivery, or are part of a drug/device combination, complex generics are becoming increasingly common. During the year, USP advanced initiatives to identify related standards, physical materials, and services as well as gaps and opportunities for future standards development to support our stakeholders. This included efforts to engage stakeholders so USP could better understand pain points across various complex generic product classes. Through understanding and aligning with stakeholder needs, USP is positioned to provide documentary and reference standards, physical materials, educational tools, guidelines, and consultative services to support market entry of complex generic products.

**Advanced Technology Evaluations** – USP advanced efforts to identify and evaluate technologies for advanced polymer material characterization to help ensure quality and support product innovation. This included evaluation of benchtop NMR technology, matrix-assisted laser desorption/ionization-time of flight mass spectrometry, and optical imaging capabilities. USP also initiated projects focused on identification of spectroscopic technologies for pharmaceutical assessments, including use of handheld instruments and other applications for use in advanced manufacturing technology applications.

### Planned for Year 3

- USP will complete construction of the USP Advanced Manufacturing Technology Laboratory, accelerate its work with Phlow on the strategic API reserve, and continue to build USP capabilities to lower technical and knowledge barriers to adoption of advanced manufacturing technologies including PCM.
- USP will launch the Continuous Manufacturing Knowledge Center under an agreement with NIPTE.
- qNMR-China will host a joint symposium with the qNMR-Japan discussion group, comprising industry, academia, and governmental agencies in Japan, to expand the science and application of qNMR for pharmaceutical quality testing.
- USP will continue to evaluate technologies such as spectroscopy, optical image analysis, and predictive tools to expand our capabilities for pharmaceutical characterization and other applications.
- USP will continue to identify and evaluate emerging technologies and trends to help industry, regulators, and other stakeholders ensure consistency and quality in advancing promising healthcare innovations.

**Contact**

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