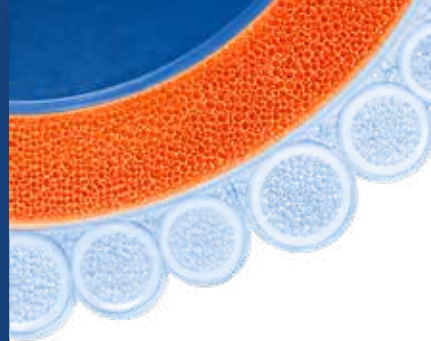


**Syngene**

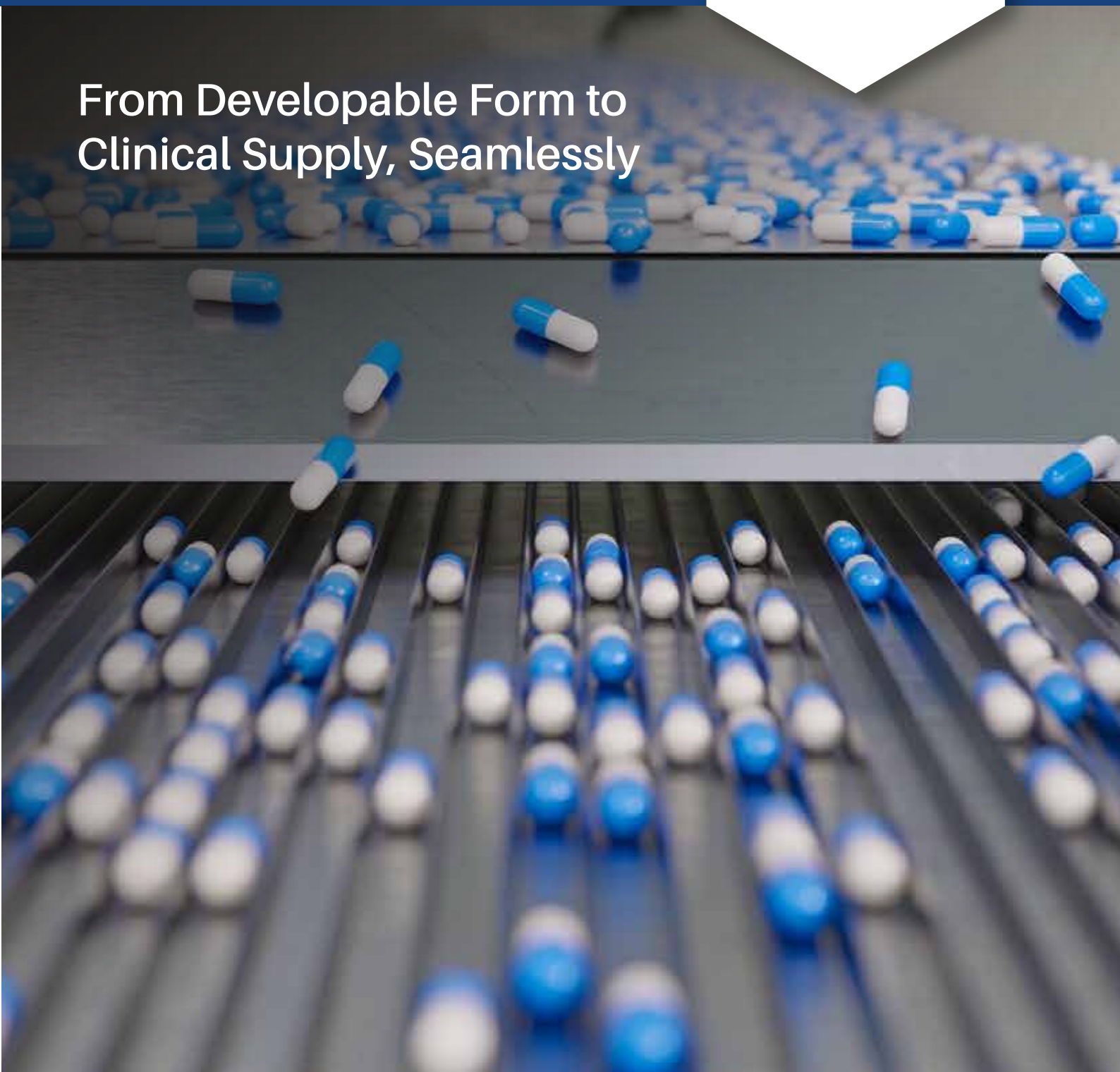
Putting Science to Work



Science  
For People  
**ADVANCING  
INNOVATION**

# Formulation Development & Drug Product Manufacturing

From Developable Form to  
Clinical Supply, Seamlessly



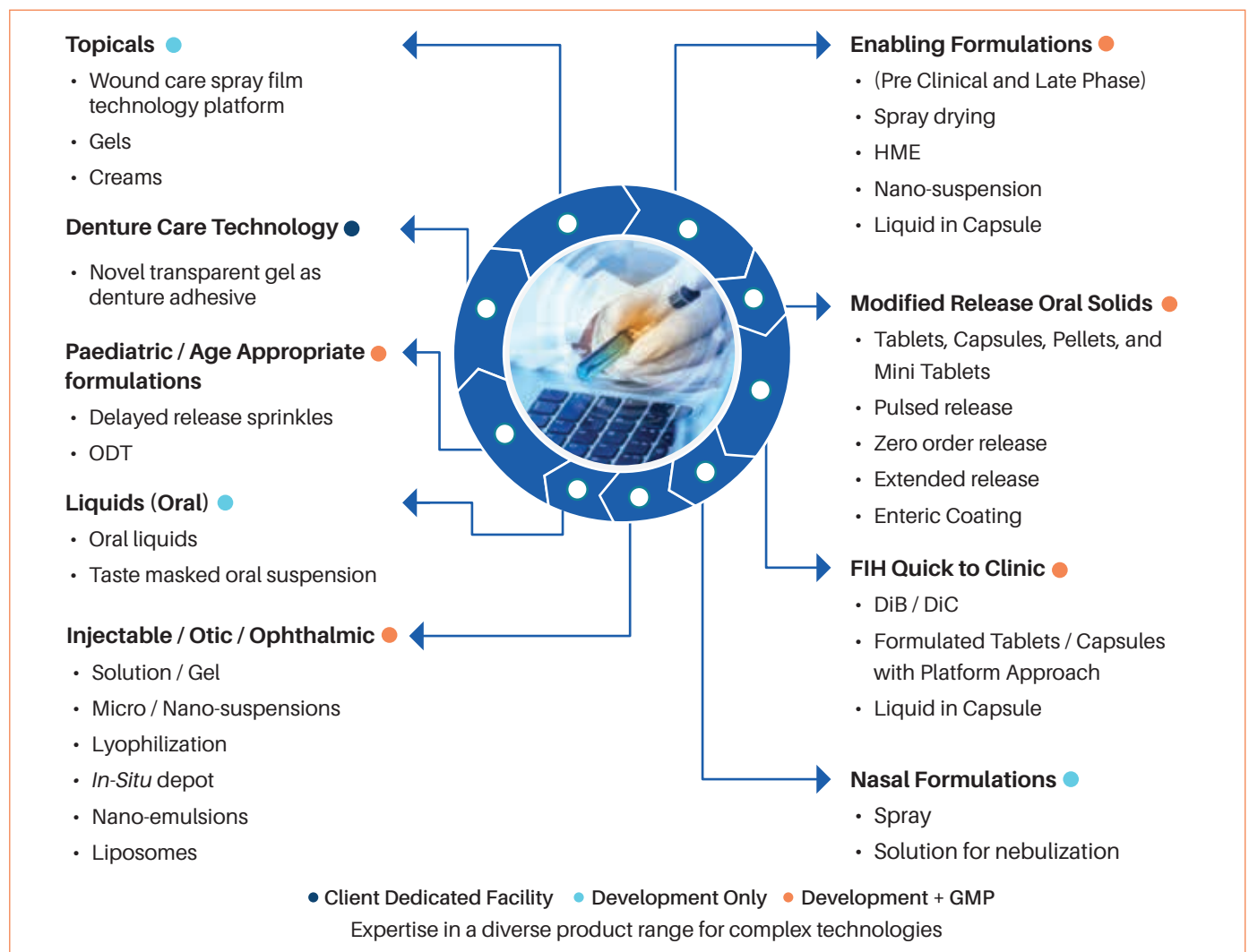
# Putting Science to Work

Syngene's FDC provides an integrated, end-to-end pathway for oral small-molecule drug products – from discovery pharmaceuticals and physical-form selection to phase-appropriate GMP manufacturing, analytical life-cycle management, and late-phase scale-up up to commercial manufacturing. Our co-located Drug Substance (DS), Drug Product (DP), and analytical teams, backed by digital quality systems and a strong global inspection history, help de-risk development and accelerate first-in-human (FIH) and pivotal milestones.



## Development & Manufacturing Overview

### Formulation Technologies Established at Syngene





- **Dosage-Form Focus:** Oral solids (immediate and modified release tablets / capsules) with enabling delivery platforms for poorly soluble molecules. We complement this with experience across liquids and semisolids when programs require bridging
- **Enabling Technologies:** Spray-Dried Dispersions (SDD), Hot-Melt Extrusion (HME), nanosuspensions, micro / nano-emulsions, and liquid-in-capsule
- **GMP Oral Solids Facility:** Phase-appropriate batch sizes from 1 kg - 120 kg (Phase 1 - 3) with an expansion pathway to 200 kg - 400 kg within the same building footprint; OEL  $\geq 1 \mu\text{g}/\text{m}^3$  (non-cytotoxic). Primary packaging in HDPE bottles and blisters (cold / thermo-form). Immediate and modified-release presentations supported
- **Track Record:** First U.S. commercial batch manufactured in March 2021. In the last 3 years, Syngene supported multiple registrations including ~15 ANDAs / NDAs, with one product commercialized and additional launches planned

## Facilities & Operations

- 16,000 sq. ft. multi-product oral solids GMP area; capable of running up to three products in parallel
- Granulation: top-spray fluid-bed and high-shear; roller compaction for dry granulation; pellet coating via Wurster columns
- Compression / Coating: mini-tablets (~2 mm) to large formats (up to ~14 mm); film / enteric coatings; capsule filling (gelatin / cellulose; supports capsule sizes 5 through 000), including blinding studies
- Primary packaging: HDPE bottles and blister packs; clinical pack / label as per protocol

## Quality Systems & Digitization

Our Quality Management System encompasses change control, deviations / CAPA, OOS, and complaint handling (TrackWise), with in-process QA oversight during manufacturing and final batch disposition by QA. Materials are controlled through SAP with QR-enabled warehousing for traceability and segregation. Facilities, utilities, and equipment are qualified and maintained with calibration, preventive maintenance, and pest control programs.

Digitized labs use LabWare LIMS integrated with Electronic Lab Notebook (ELN) for method, instrument and sample management; EDMS and LMS streamline document control, training, issuance, and review enabling paper-lite operations, and strong data integrity.

## Regulatory & Certifications (Function / Site-Specific)

Multiple successful inspections / assessments by USFDA (CDER / Office of Compliance) and Health Canada.

## Early-Phase Development

Our early-phase framework aligns discovery pharmaceuticals, solid-state science, and phase-appropriate formulation to establish a robust foundation for IND / IMPD. We have expertise in small-scale, information-rich experiments to rapidly determine developable form, dosing vehicle, and analytical strategy.

## Developability & Pre-Formulation

| Solution-State                                                                                 | Solid-State                                                                                                                                     | Amorphous API as SDD                                                                                                                                    |
|------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| pKa, logD, aqueous solubility, pH-solubility profile, oxidative / light stability in solution. | Melting point / Tg, hygroscopicity (DVS), moisture sorption-desorption, PSD, microscopy, PXRD; stress stability under temperature / RH / light. | Glass transition (Tg), physical / chemical stability, dissolution / precipitation behavior in biorelevant media for biopharmaceuticals risk assessment. |

## Salt & Polymorph Screening

We tailor screening depth to phase and material availability: in-situ salt screens to rank counter-ions by solubility / propensity; mg-scale salt synthesis with g-scale confirmation; and comprehensive polymorph screens using cooling / anti-solvent crystallization, slurry conversion, hydrate / solvate generation, and humidity / thermal stress. Characterization typically includes DSC / TGA, PXRD, microscopy, solution pH / solubility, ion chromatography, and impurity profiling, culminating in a recommended form for development.

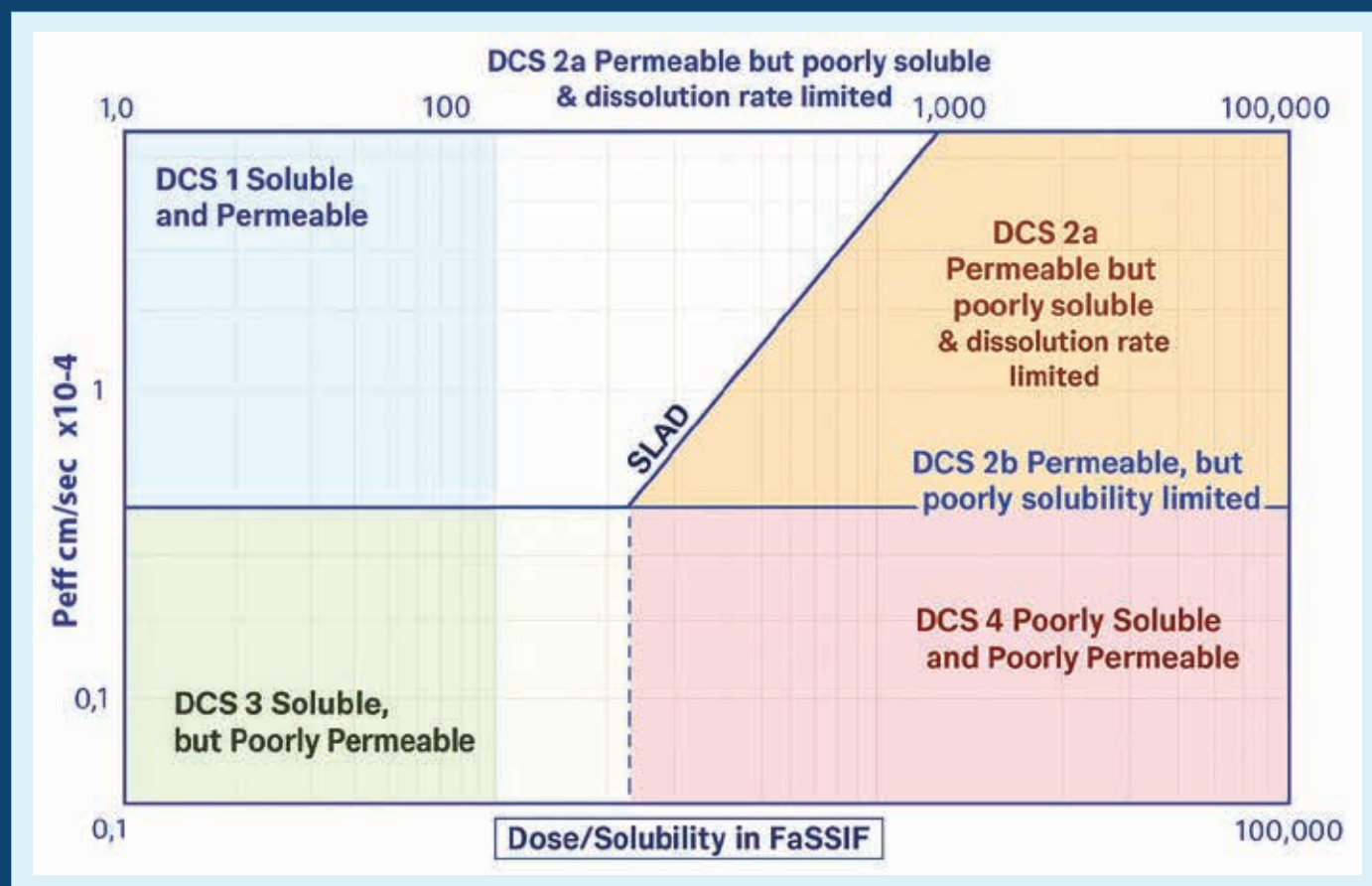
- We have a state-of-the-art solid state characterization lab which houses miniature equipment which can generate data in pre-formulation studies with minimal material generated in discovery stages (as low as 100 mg).

## Preclinical Formulation for Pharmacokinetics / Dose Response Finding / GLP Toxicology Studies

Species and route-appropriate vehicles (oral / IV) are designed from solubility, stability, and permeability data. Solubilization hierarchies include pH modulation, co-solvency, surfactants, cyclodextrins, or combinations. Where needed, enabling systems (nanosuspension, ASD, lipidic supersaturating systems) are deployed. Prototype selection and readiness for study dosing can often be achieved in ~3–4 weeks.

# Enabling Technologies & Manufacturing

We match formulation approach to absorption risks using the Developability Classification System (DCS) and solubility-limited absorbable dose concepts. DCS IIa programmes leverage micronization / co-micronization to address dissolution-rate limits; DCS IIb programs favor amorphous solid dispersions (SDD / HME), lipid-based or self-emulsifying systems to elevate apparent solubility and, where relevant, leverage lymphatic uptake; DCS III / IV programs may combine permeability enhancers and efflux-modulating excipients with solubilization strategies.

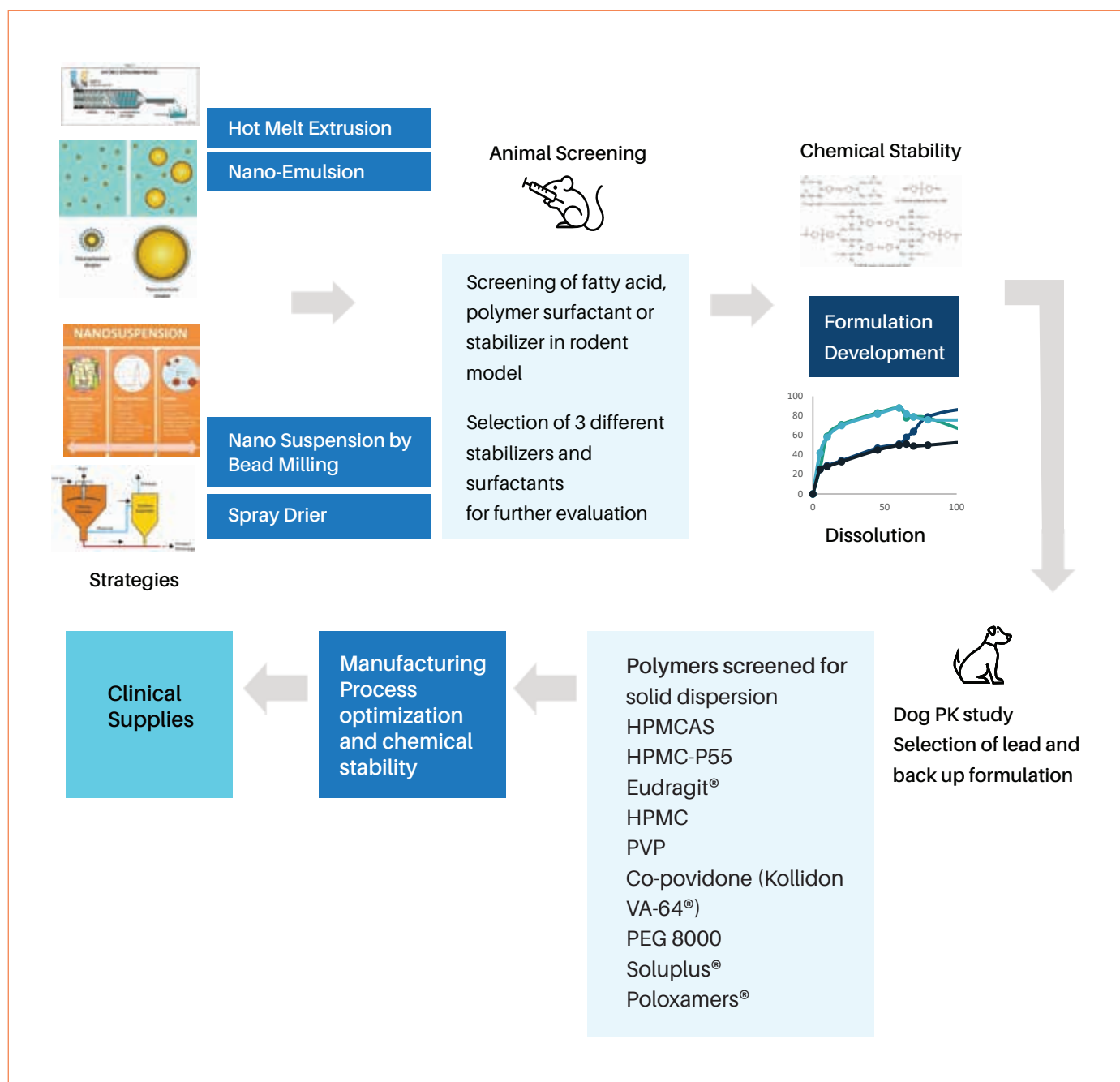


Calculating the solubility limited absorbable dose (SLAD) proposed as part of the DCS, may help to determine whether it is reasonable to attempt to use a crystalline presentation of the drug candidate in early clinical trials.

## Platforms & Toolkits

- **Amorphous Solid Dispersion (Spray Dried Dispersion / Hot Melt Extrusion):** Polymer screening (e.g., HPMCAS, HPMC-P55, Eudragits, HPMC, PVP / VA-64, PEG 8000, Soluplus, Poloxamers). Process development via spray-drying or hot-melt extrusion with downstream conversion to tablets / capsules
- **Nanosuspensions / Nano-emulsions:** Bead-milling / microfluidization; control of PSD, zeta potential, and physical stability; conversion to solid dose via top-spray or high-shear granulation, or spray-drying
- **Milling / Micronization:** Air-jet (dry), ball-mill, and high-shear homogenization (wet) to increase surface area, and wettability
- **Spray Drying:** Lab and GMP units from the same make for smooth scale-up; broad solvent handleability

## Development Approach



## Delivery Experience

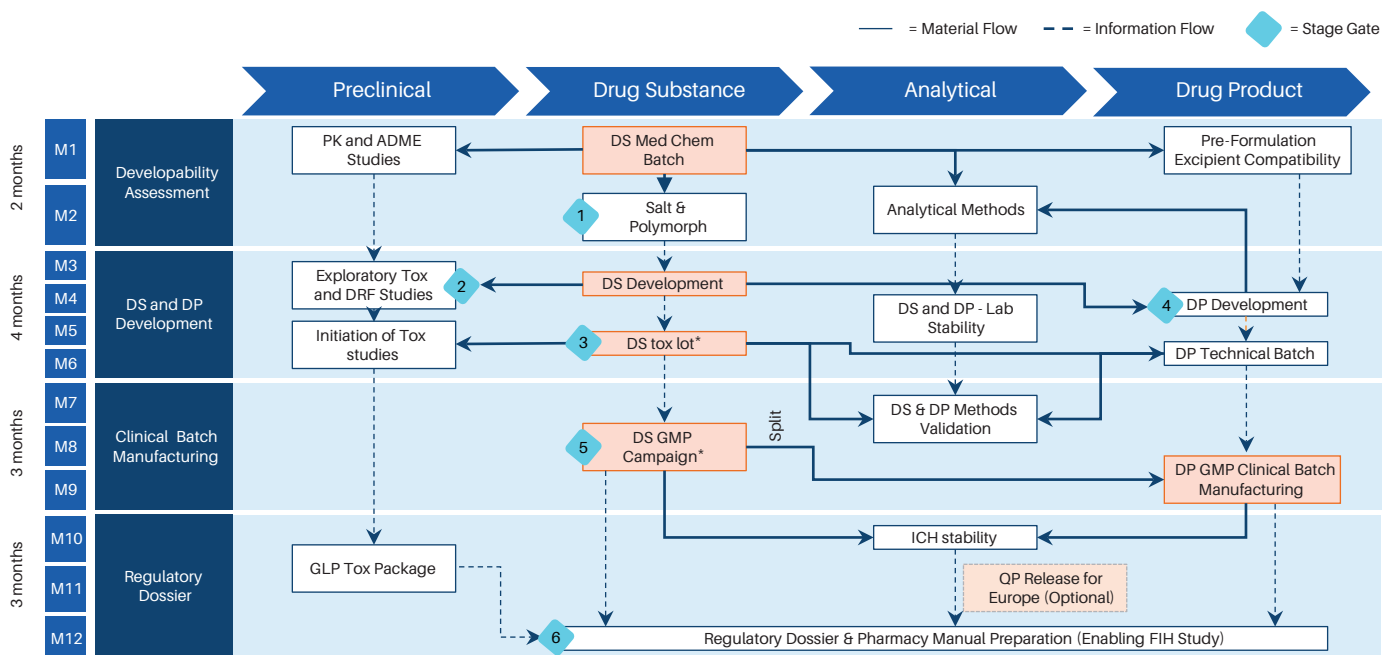
Syngene has advanced multiple NCE and complex generic / 505(b)(2) programs through clinical phases using enabling formulations (SDD / HME) nanosuspensions, lipidic systems, and liquid-in-capsule delivery platforms.

## Integrated CMC Approach

Our early-phase framework aligns discovery pharmaceuticals, solid-state science and phase-appropriate formulation to establish a robust foundation for IND / IMPD. We have expertise in small-scale, information-rich experiments to rapidly determine developable form, dosing vehicle and analytical strategy.

# Our Integrated Approach to Early Phase CMC Development

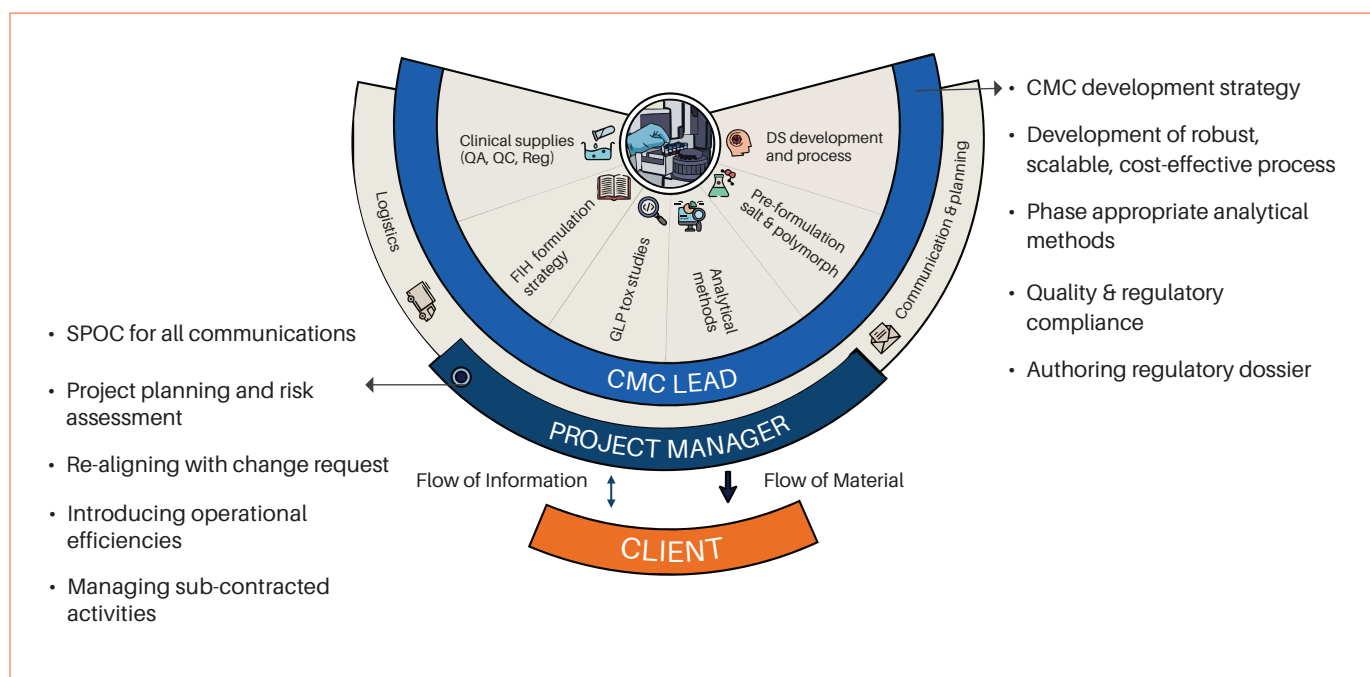
Developability assessment to Regulatory Dossier preparation possible in 12 months.



\*Split lot / single lot strategy can be used – for tox and FIH GMP campaign of DS.

A single, program-level timeline coordinates DS, DP, and analytical workstreams from developability assessment through dossier authoring, enabling FIH in approximately 12 months in suitable scenarios. Dedicated project management, stage-gate governance and risk registers are reinforced by cross-functional focus groups (chemical / physical form, biopharmaceutics risk, genotoxicity, lab-to-tox-to-GMP bridging, TPP / TMP, specification templates, and overall quality / regulatory risk).

## We Have Dedicated Teams for CMC Projects Fortified by Strong Project Management

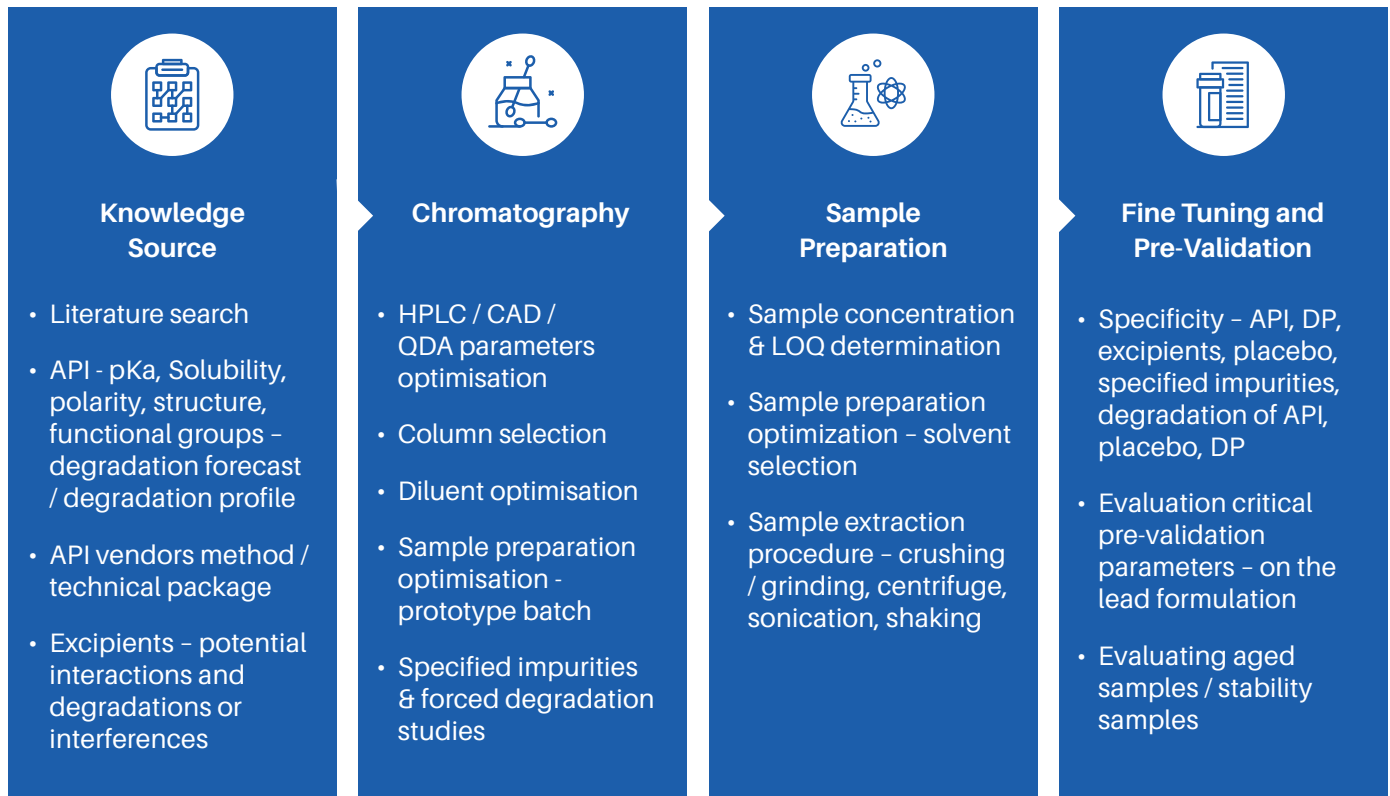


# Analytical Development Capabilities

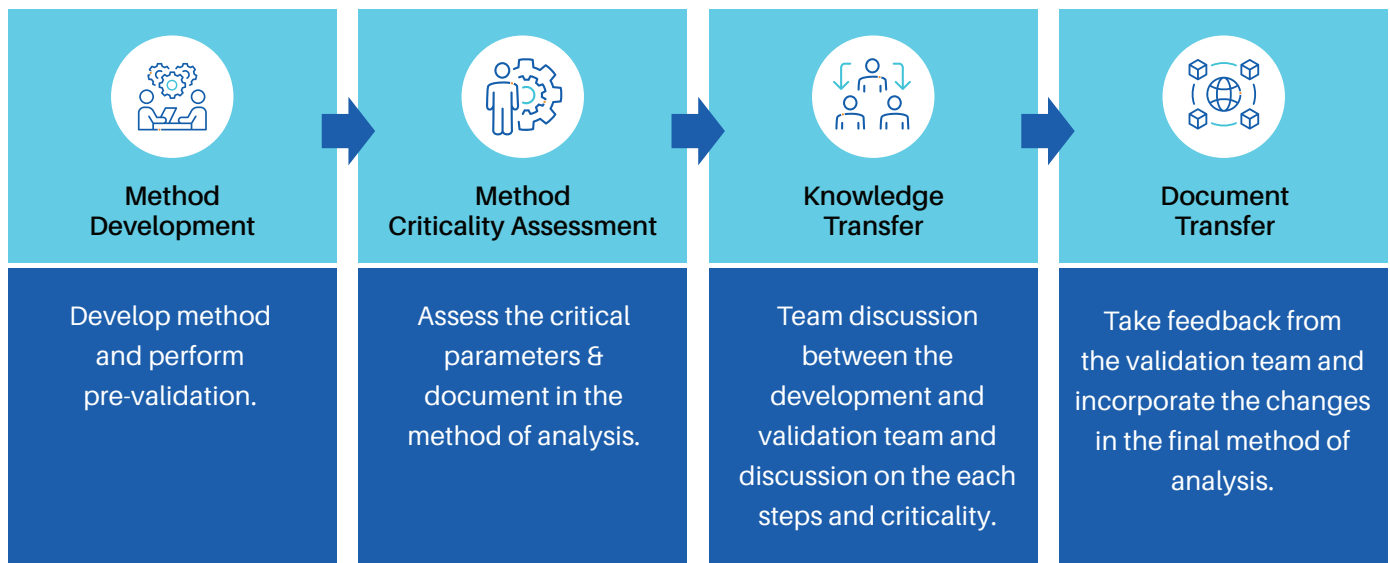
A 200+ scientist analytical organization across ~72,000 sq. ft. provides end-to-end support: assay / related substances / dissolution method development; forced degradation and excipient / packaging compatibility; release and ICH stability under cGMP; reference standard qualification; and method validation / transfer (GMP / non-GMP) with risk-based protocols and statistical comparability.

## Drug Product - Analytical Development, Validation, and Method Transfer

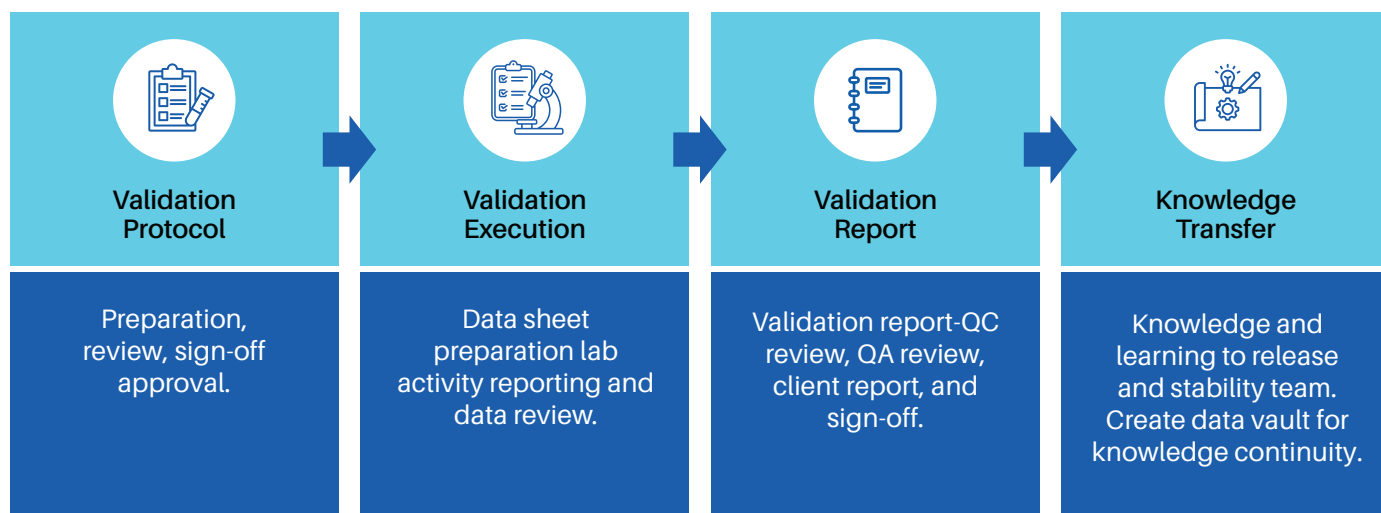
Standard approach towards analytical method development



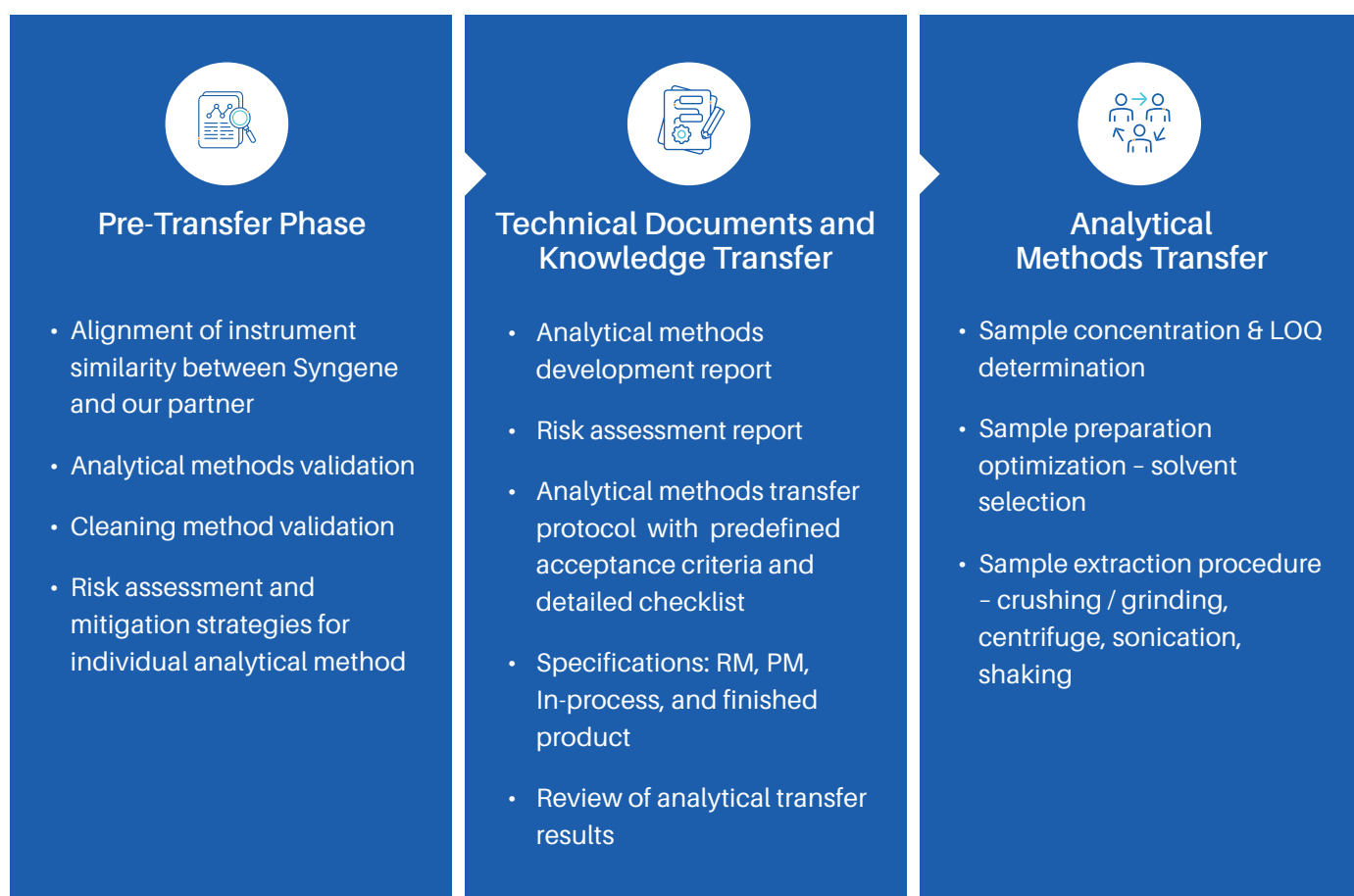
## Knowledge Transfer: Development to Validation



## Analytical Method Verification / Validation (GMP)



## Analytical Method Transfer (GMP to GMP)



## Oral Dosage Testing & Characterization

- **Tablets / Capsules:** Assay & content uniformity, related substances, residual solvents, water, dissolution (single / multi-media; biorelevant), disintegration, PSD, PXRD
- **Solutions / Suspensions / Lipidic Systems:** pH / viscosity, assay / CU, degradation, preservative / antioxidant assays, PSD, dissolution / release testing
- **Solid-State & Structural Tools:** Optical microscopy, PXRD, DSC / TGA, DVS, particle sizing; LC-MS / GC-MS / HRMS, IC, qNMR, prep / semi-prep HPLC, and SFC

## Late-Phase Development and Scale-Up

We apply quality by design as standard defining QTPP and CQAs, mapping risks via FMEA, and using DoE (Design-Expert®, Minitab®) to understand factor interactions, optimize formulation / process and establish design spaces or proven acceptable ranges. Scale-up leverages geometric / kinematic / dynamic similarity; where not possible, CPP-centric customization ensures product CQAs are maintained at target scale for first-time-right outcomes.



## Why Syngene



- One-campus integration: DS-DP-Analytical under one roof minimizes handoffs and accelerates decisions, with single-platform knowledge transfer and program management



- Speed with rigor: Early sharing of physicochemical / biopharmaceuticals risks informs phase-appropriate formulation choices to unlock exposure and dose feasibility



- On-time delivery track record of above 95 % for the past 3 years, ensuring on-time clinical study start for various complex programs for our clients across different geographies



- Digital quality backbone: EDMS, TrackWise, LMS, and LabWare LIMS-ELN ensure traceability and data integrity backed with excellent track record with regulatory agencies



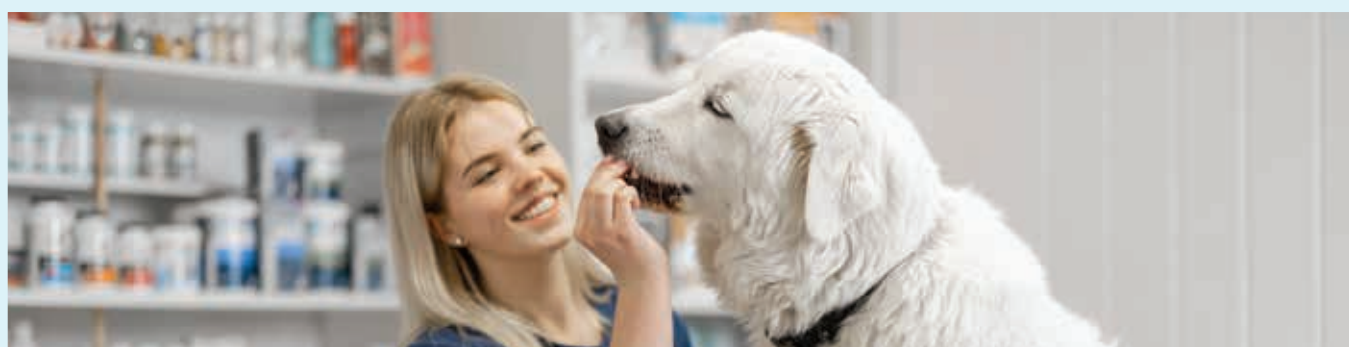
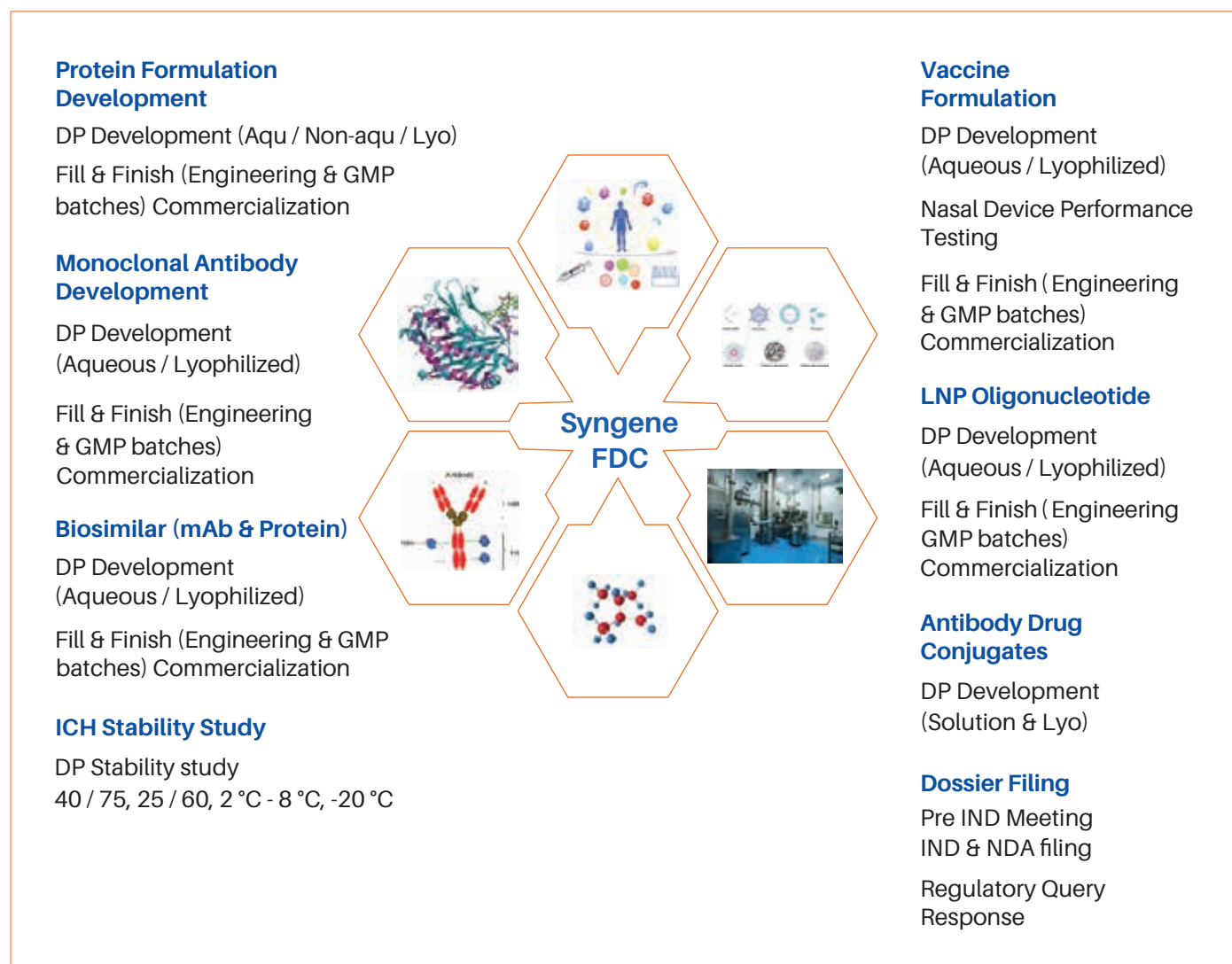
- Proven execution: Multiple programs delivered across geographies, including ~15 ANDAs / NDAs supported in the last 3 years, one product commercialized and additional launches planned



- End-to-end accountability: From salt / polymorph selection and preclinical enablement to GMP clinical supplies, late-phase QbD, and commercial manufacturing

# Animal Healthcare Drug Product Development and Manufacturing

## Overview of Capabilities



- Syngene aims to be a strategic partner for animal healthcare product development, offering end-to-end solutions from discovery to clinical and commercial manufacturing
- Expertise spans large molecules (biologics), small molecules, and chemical development for APIs (excluding antibodies and steroids)



## Manufacturing Facilities & Infrastructure



### Oral Solids Development and Manufacturing

Granulation suites, tablet compression (up to 14 mm), campaign-based manufacturing, and robust waste management.



### Sterile Fill-Finish Facility

Robotic filling for vials and pre-filled syringes, lyophilization, and batch sizes up to 25,000 vials.



### Stability Chambers

Walk-in and reach-in chambers catering to ICH requirements for various temperature and humidity zones.

## Analytical Development and Validation



Extensive analytical instrumentation (HPLC, UPLC, MS, NMR, GC-MS, dissolution apparatus, etc.) for drug product and method development.



Proven technology transfer protocols for both drug product and analytical methods, including risk assessment, cleaning validation, and regulatory support.

## Veterinary Formulation Experience & Innovation

- Experience with a wide range of veterinary dosage forms: hard / soft chew tablets, liquids, injectables, microspheres, and depot formulations
- Dedicated facilities for animal health products, including large-size tablets (up to 6 g) and impurity characterization
- Successful collaborations with top 5 global animal healthcare companies

## Case Studies & Success Stories

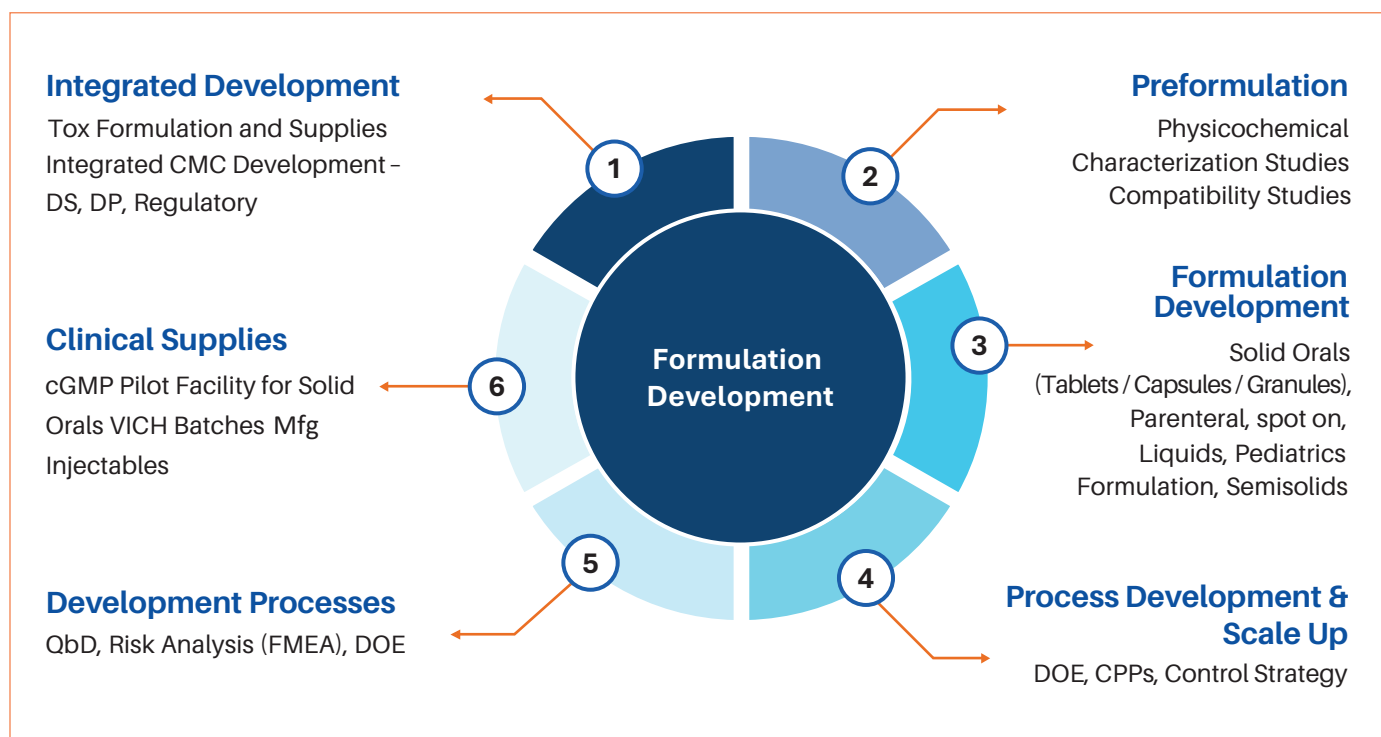
- Integrated drug development for complex combination products, including scale-up, technology transfer, and stability studies
- Development of analytical methodologies (e.g., texture analyzer for soft tablets) to differentiate and characterize products



## Parenteral Dosage Form Development & Manufacturing

Syngene offers integrated parenteral drug product (DP) development through commercial supply: end-to-end services from preformulation and analytical characterization to clinical and commercial sterile fill finish, stability, regulatory support, and technology transfer. Our capability set covers small molecules, potent compounds, and biologics (including LNPs, ADCs, oligonucleotides, and mRNA-based vaccines).

## Drug Product - Capabilities to Support Early Stage to Late Stage Development and Manufacturing





## End-to-End Services

- **Formulation Development:** Solutions, lyophilized products, suspensions, depot (LAI microspheres, in situ gels), nano-emulsions, nanosuspensions, liposomes, and LNPs. Ability to handle compounds having OEL:  $\geq 1 \mu\text{g}/\text{m}^3$
- **Clinical to Commercial Manufacturing:** Clinical batches (2 – 100 L) through commercial scales (200 – 1300 L). GMP sterile and non-sterile operations, pilot trials, and client technology transfer
- **Analytical & Stability:** Method development/validation, forced degradation, impurity isolation / qualification, ICH stability programs, and in house, extractables and leachables, microbiology / photostability testing
- **Regulatory Support:** Pre-IND engagement support, IND / NDA / ANDA dossier preparation and responses, method remediation, and lifecycle management

## Facilities, Scale, and Throughput

- **Pilot Facility:** 2 L – 100 L compounding; isolator with robotic arm; filling speeds ~30 vials/min, 15 PFS/min; pilot vial throughput in thousands to low millions per year
- **Commercial Facility:** Stainless steel (SS) and single use (SU) lines sized 200 L – 1300 L; vial and PFS lines capable of high-throughput (up to tens or hundreds of millions of vials/year depending on configuration). Grade A isolators, automated visual inspection, vial washing, autoclaves, and nested RTU presentations for vials and PFS
- **Fill / Finish Modalities:** SS lines for small molecules; SU bag systems for biologics; robotic filling for reduced human intervention; terminal sterilization (autoclave), and two-stage aseptic filtration options

## Technical Equipment and Lab Footprint

- **Key Process Equipment:** High-pressure homogenizers (Panda Plus, Microfluidizer), Silverson / Ultra Turrax high-speed homogenizers, spray dryer (lab / pilot), VirTis lyophilizer, microfluidizer, autoclaves including PFS capability, Instron for PFS functionality testing
- **Analytical Lab Scale & Tools:** 200+ scientists across ~72,000 sq. ft. of lab / stability space; HPLC (UV / PDA / ELSD / RI), LC-MS / MS, GC-MS / HS, ICP-OES, ion chromatography, PXRD, DSC, TGA, DVS, particle sizing (Malvern / Zeta), HIAC particulate counters, headspace, KF coulometry, microscopy, and NMR capabilities. LIMS, QA, SAP, EDMS, and TrackWise for data and quality management

## Potent / Biocontainment and Specialized Capabilities

- **Containment and Biosafety:** Facilities designed to OEL 4 (cytostatic) and BSL 2 operations; isolators with HEPA exhaust and scrubber, controlled AHU modes and dedicated dispensing / pass box arrangements
- **Complex Biologics:** DP development and fill / finish for vaccines, mAbs, ADCs, oligonucleotide LNPs, and biosimilars with SU sterile lines, stability testing at multiple temperature profiles (including –20 °C, –80 °C), and cold chain storage / shipment capabilities
- **Analytical Differentiation:** In house deformulation, impurity isolation / characterization and synthesis of reference impurities, trace analysis (elemental, nitrosamine, residual solvents), and end-to-end method lifecycle management to accelerate filings

## Quality, Compliance, and Operational Support

- **Quality Systems:** cGMP operations, CSV compliant labs, dedicated QC centers, method validation, and transfer, audit-ready teams, serialization & aggregation readiness for primary packaging
- **Tech Transfer & Commercialization:** Support for technology transfer from client to Syngene, scale up from pilot to commercial lines, packaging, stability program execution, and dossier support for global regulatory filings

## Key Differentiators and Implications for Partners

- Integrated bench to bedside offering combining formulation, analytical, clinical GMP manufacture, and high throughput commercial fill-finish
- Strong track record across small molecule sterile solutions / lyos, several liposome projects, and nanoparticle experience
- Ability to handle small molecules and biologics under appropriate containment with robotic isolator filling to minimize contamination and human error
- Analytical depth (impurity synthesis / qualification, deformulation) that shortens timelines for troubleshooting and regulatory submission

## Suggested Engagement Angles

- Early technical assessment or gap analysis to map your molecule's required containment, analytics, and fill format
- Pilot run to de-risk formulation and scale up using microfluidizer / homogenizer and pilot isolator
- Integrated filing package support combining analytical, stability, and GMP batch data to accelerate IND / ANDA / NDA timelines

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## About Syngene

Syngene International Ltd. (BSE: 539268, NSE: SYNGENE, ISIN: INE398R01022) is an integrated CRDMO (Contract Research, Development and Manufacturing Organization), serving the global pharmaceutical, biotechnology, nutrition, animal health, consumer goods, and specialty chemical sectors. Syngene's ~6000 scientists bring the skills and capacity to deliver great science, strong data security, and quality manufacturing, at speed, helping improve time-to-market and lower the cost of innovation. This is backed by ring-fenced dedicated centers, as well as ~3 Mn sq. ft. of specialist discovery, development, and manufacturing facilities.

For more details, visit [www.syngeneintl.com](http://www.syngeneintl.com) or write to us at [bdc@syngeneintl.com](mailto:bdc@syngeneintl.com)