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From Insight to Impact: Why AI in Pharma struggles to scale - and What must change

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Across discovery, development, and manufacturing, AI proof-points are multiplying. The models are capable. The use cases are real. And yet the harder question confronts the industry now: why does AI still fail to deliver value at enterprise scale? This is not a scientific or an academic problem. It is a foundational one, and solving it requires a different kind of approach.



Across the pharmaceutical industry, AI adoption has accelerated rapidly. Models now support molecular design, clinical trial optimisation, process parameter prediction, and regulatory document generation. Individual use cases increasingly demonstrate clear value in controlled conditions.

Yet most initiatives remain confined to pilots. The anticipated gains in productivity, speed, and decision quality are not being realised consistently. Organisations invest heavily in AI capabilities without seeing proportional improvements in development timelines or operational efficiency.

This pattern is not explained by immature technology. It reflects something more structural: AI is being deployed into environments designed for manual, sequential work. It operates as a sophisticated overlay on top of disconnected data and processes, rather than as part of the core execution layer. The insight it generates stays local, within a team, a function, or a single step in a much longer workflow. It does not propagate.

The result is a paradox familiar to many in the industry: AI that clearly works in isolation, and just as clearly fails to transform at scale.

The Disconnected Workflow Problem

Consider process development for a complex injectable, a workflow central to late-stage CMC and technology transfer. Formulation scientists run design-of-experiments across dozens of variables: excipient ratios, pH profiles, fill speeds, container closure interactions. Data is generated across instruments, captured in disconnected systems, and consolidated manually into reports that inform the next experimental cycle, often days later.

When a batch deviates from specification, the investigation requires reconstructing experimental history from multiple sources, lab notebooks, instrument logs, ERP entries, and analytical system exports that were never designed to speak to each other. The process is slow, error-prone, and highly dependent on individual institutional knowledge.

AI could meaningfully accelerate this entire cycle, predicting which parameter combinations are likely to succeed, flagging deviations in real time, and compressing the iteration loop between experiment and insight. But only if the underlying data is structured, connected, and contextualised at the point of generation. Without that, even a powerful model has nothing reliable to work with.

This is not a biologics-specific challenge or a small-molecule-specific challenge. It runs across discovery, preclinical, clinical, manufacturing, and post market phases of pharma. And it points to the same root cause every time: AI is being deployed into data environments that were never built for it.

The Wet-Dry Lab Divide

A deeper structural barrier sits at the boundary between experimental science and in silico predictions, what practitioners increasingly call the wet-dry lab divide.

In principle, pharma R&D is an iterative loop: hypotheses are generated computationally, experiments are designed and executed in the lab, results are analysed, and findings feed back into the next generation of hypotheses. In practice, this loop

is broken. Wet lab scientists and data scientists often work in parallel rather than in continuous dialogue. Experimental data generated at the bench is not structured in ways that computational systems can readily consume. Insights from modelling are not automatically incorporated into the next experimental design.

The consequence is that AI, even when it performs well within one part of this cycle, rarely influences the whole. Its impact stays episodic rather than systemic.

Closing this divide is not primarily a technology problem. It requires shared data standards, workflow designs that make handoffs between experimental and computational environments explicit and structured, and critically, people who can operate fluently across both worlds. The capability to bridge wet and dry lab thinking is still nascent in pharma, and building it through industry collaboration and platform investment is important.

Compliance Is Not the Obstacle - It Is the Opportunity

Frequent narrative positions regulatory requirements as a brake on AI adoption. It is worth addressing this directly.

Pharmaceutical AI systems need to be explainable, traceable, and audit-ready, not as a concession to regulatory guidelines, but because these properties are what make AI trustworthy to the scientists and decision-makers who need to act on its outputs. An AI model that cannot explain which process parameters drove a yield prediction, or trace its recommendation back to specific experimental data, is not a useful tool in a regulated development environment. It is a liability.

Organisations that build explainability and traceability into AI architecture from the outset, rather than retrofitting them under submission pressure, gain something concrete: faster filing readiness, smoother technology transfers, and greater confidence in global submissions. In an industry where time to drug approval is a direct revenue driver, and where manufacturing partners are increasingly selected on data quality credentials, compliance-ready AI is a competitive differentiator, not a compliance cost.

Building the Foundation: Where to Start

The vision of fully connected development workflows, where AI operates continuously across the experimental cycle, data flows without manual intervention, and insights accumulate rather than reset with each project, is increasingly achievable. But it is built in steps, not in one transformation programme.

Organisations that succeed tend to share a common starting discipline. They identify a single high-value workflow and get the fundamentals right within that scope: structuring data at source, capturing scientific context alongside results, and embedding AI into the workflow rather than bolting it on afterwards. They measure the impact, demonstrate it credibly, and use that foundation to expand progressively.

Three principles matter most:

Structure data at the point of generation, not after. The instinct to clean and harmonise data retrospectively before deploying AI is understandable but ultimately limits scale. Data that is captured with consistent metadata, experimental context, and instrument provenance from the start creates a compounding asset. Data that is retrospectively curated remains perpetually behind.

Design for the full workflow, not a single step. AI that is embedded across hypothesis generation, experimental execution, analysis, and reporting, rather than deployed at one point in isolation, enables the iterative loop that makes insights accumulate. Platform environments that unify data and workflows across wet and dry lab functions are the enabling architecture for this.

Invest in the human layer. Technology platforms are necessary but insufficient. The organisations that are realising consistent AI value have also built a cohort of people who combine scientific domain expertise with data fluency, capable of translating between computational outputs and experimental decisions. This is a deliberate capability investment, not a byproduct of software deployment.

The Real Question

The pharmaceutical industry does not face a shortage of AI capability. It faces a shortage of the organisational and data foundations required to make that capability deliver consistently.

The organisations that close this gap will not simply improve their own pipelines. They will define a new standard for what rigorous, AI-enabled pharmaceutical development looks like, and in doing so, compress the time between scientific insight

and medicines reaching patients.

The question is no longer whether AI can transform pharma. It already is, in pockets.

The question is who is building the foundations to make it work everywhere.

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