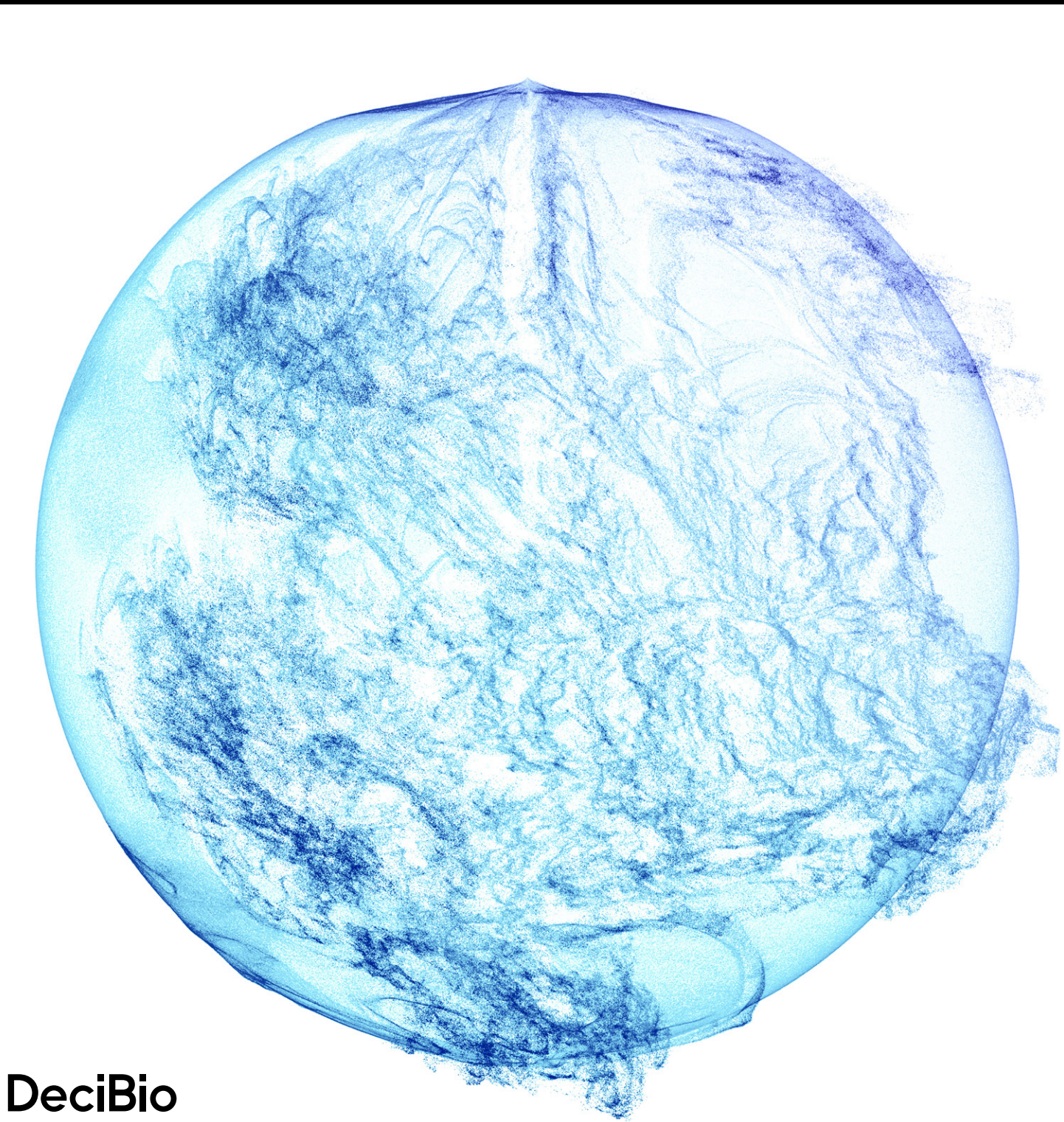
Pharma Investment Trends in Precision Oncology R&D

August 2023



DeciBio

Table of Contents

Executive Summary

Advancement in precision oncology is driven by a virtuous cycle of innovation – innovations in research and clinical tools, technologies, data, and services contribute to the discovery and development of novel therapies, creating value that gets re-invested in novel tools, technologies, data, and services to fuel the next wave of innovation.

To understand the current state of investment in this innovation ecosystem, we conducted interviews with 25 leaders and decision-makers in pharma R&D to evaluate critical areas of investment, and perceived ROI, today and in the near term (over the next 3 years). Our discussions reveal that companion diagnostics, genomics research and diagnostic tools, clinical trial enablement solutions, and informatics / AI are the areas of greatest pharma investment and perceived ROI today and are expected to remain so in the near future, with liquid biopsies and real-world data also playing increasingly important roles in drug development.

Over the next few years, multiple market forces and trends, including increasing regulation of diagnostic tests, the shift of precision medicine into earlier lines of cancer care, innovation in early cancer detection, and the emergence of novel therapeutic modalities are expected to influence pharma investments throughout the precision oncology development value chain.

In the increasingly competitive pharma research market, and in an economic environment where capital efficiency is vital, understanding pharma's priority investment areas and levers is critical to strategic planning for research and diagnostic tools, technology, data, and service providers looking to play a leading role in precision oncology innovation ecosystem.

Background

An emerging segment of the pharma pipeline 10 years ago, precision oncology is now one of the most significant categories in all of drug development – precision medicine strategies are being explored or implemented in a majority of drug programs in oncology, the largest segment of the drug development pipeline. [1,2] To fuel innovation in precision oncology, pharmaceutical companies spend $10s-of-billions annually on R&D across an increasingly diverse range of tools, technologies, and services. These investments support an innovation ecosystem that is symbiotic – the competition for pharma R&D dollars drives innovation in research and clinical tools, technologies, and services, which in turn fuels innovation and competition in drug discovery and development, driving greater investment in R&D tools and technologies.

To better understand the investments that pharma companies make across this ecosystem to bring precision medicines to market, and how that is expected to change in the near-mid term, we conducted a mix of interviews and surveys with 25 oncology pharma leaders and decision-makers, capturing information about the R&D investments that pharma companies make in the development of precision medicines, as well as the perceived ROI of those investments. Details of the stakeholder mix are outlined below.

The findings indicate clear areas of high investment and ROI for pharma, as well as pain points and areas of unmet need where research and diagnostic tools and services developers can target to develop innovative solutions.

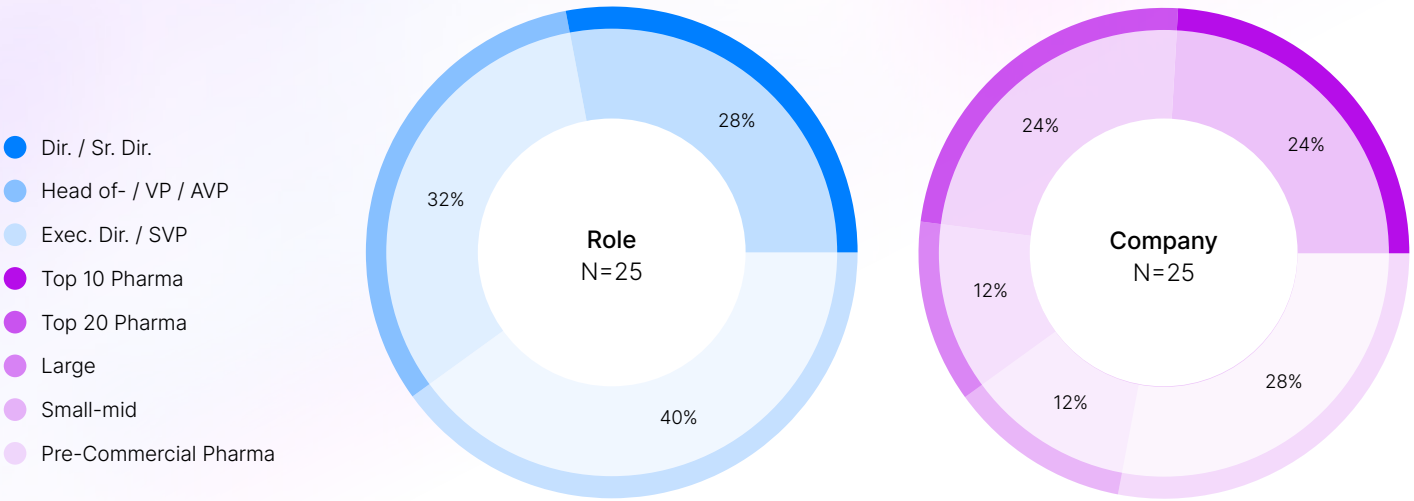


Figure 1.
Study Participants.

N = 25 senior-level pharma stakeholders were interviewed or surveyed for this analysis. Interviewees were screened for budget authority within their department as well as budget visibility across their organization. Participants represented a diversity of functional areas, including discovery, translational research, clinical, medical affairs, informatics, and companion diagnostics roles. Participants also spanned a variety of companies by size, ranging from pre-commercial (developmental and clinical stage) to Top-10 pharma organizations (based on revenues; "Large" pharma defined as pharma companies with revenues >$1B but outside the Top-20; "Small - Mid" pharma defined as commercial-stage companies with revenues of <$1B).

Key Pharma Investments and ROI

To understand where pharma makes its investments, it's critical to understand why. The stakeholders surveyed revealed that the primary motivators of R&D investments within their organizations are 1) Reducing development timelines and/or "time-to-decision"; and 2) Increasing discovery / analytical productivity (i.e., increasing the scale of data / insight generation).

Unsurprisingly, the value of bringing therapies to market sooner, thus maximizing the commercialization window under patent protection, is top-of-mind for all pharma R&D stakeholders. While "operational efficiency" was also identified as a key driver of investment, many noted that research and discovery is inherently inefficient, and that, in the discovery and validation stages, optimizing for research and analytical output over efficiency is often warranted. While timeline and research output / productivity were the clear drivers of investment decisions, some stakeholders also cited improvement of the patient journey and patient experience (e.g., bringing diagnostics and treatments closer to the patient's home, minimizing the sampling burden, reducing side effects) as key investment drivers within their organization.

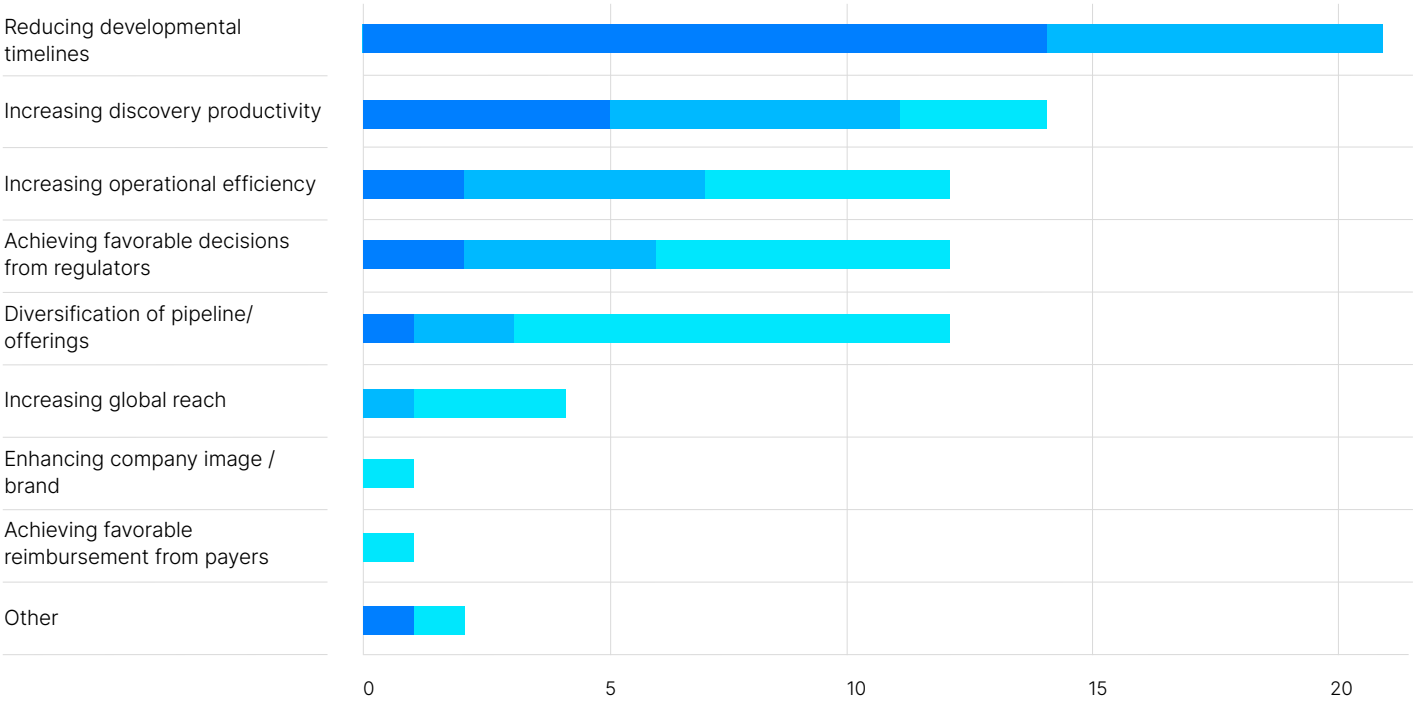


Figure 2. Drivers of Pharma R&D Investment

Interviewee / survey rankings of the top-3 drivers of R&D investment within their organization. Respondents were provided with these options and given the chance to identify and elaborate open-ended on "Other" drivers.

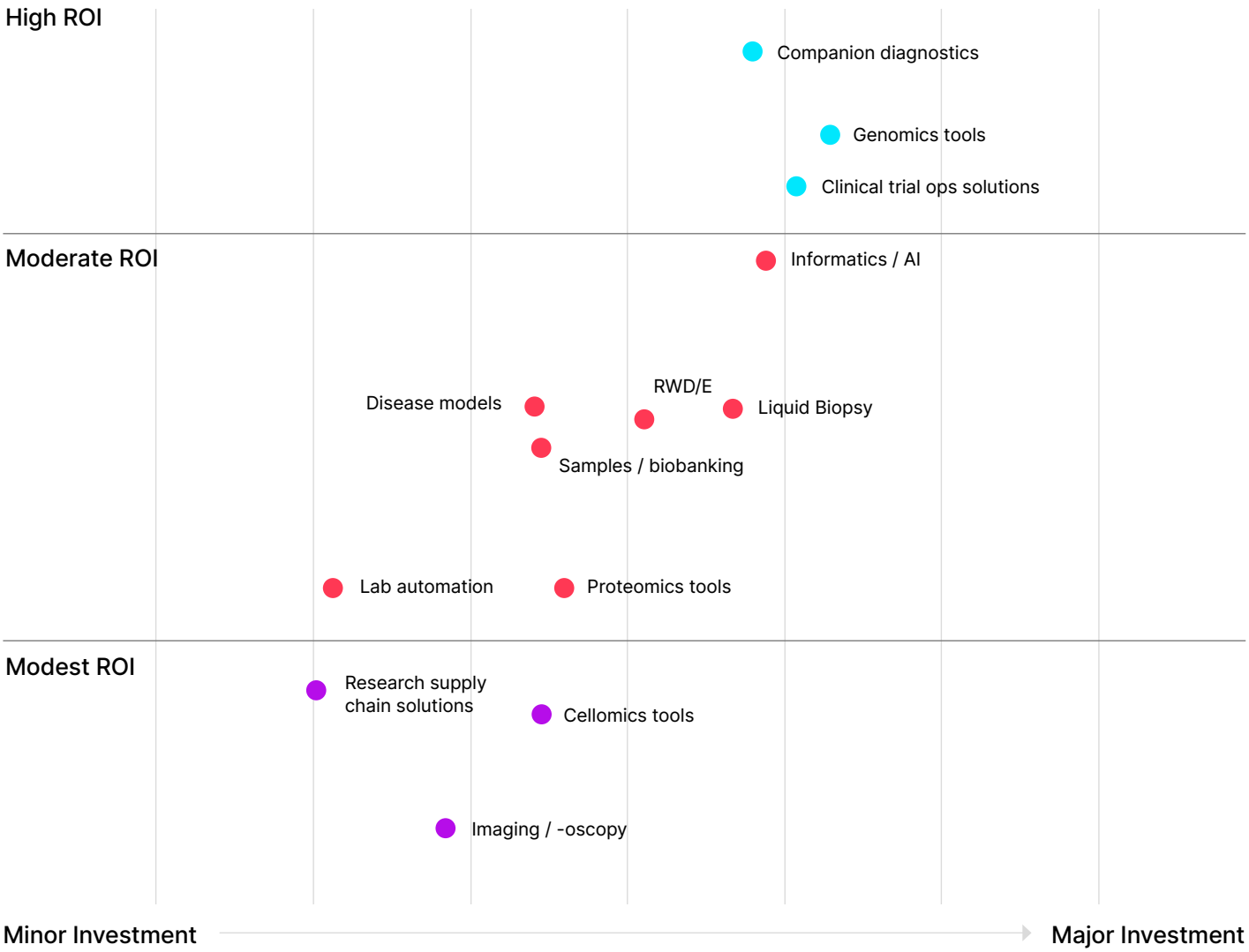


Figure 3.
Level of Investmentand Perceived ROI in R&D Tools and Services

Interviewee / survey ratings (N = 25) of the level of investment in each of these categories (on a 1 – 5 scale, in which 1 = No investment at all, 2 = Minor investment – not a material share of budget, 3 = Moderate investment – an average share of the budget, 4 = Material investment – material share of budget, approaching a top investment, 5 = Significant investment – one of the largest investments / shares of budget). Interviewees also rated the areas by perceived ROI (e.g, "Highest ROI", "High ROI", "Moderate ROI", "Low ROI"), which were converted into a point score. ROI positioning reflects the relative average ratings of each category. "Genomics", "Proteomics", and "Cellomics" correspond to cell / tissue-based methods, while "Liquid Biopsy" includes all -omics modalities in liquid samples.

With these criteria in mind, pharma stakeholders elucidated the investments that their organizations make in precision medicine development and the perceived ROI of these investments (Figure 3).

Not surprisingly, there is a general positive correlation between the level of investment and the perceived ROI of the investment, suggesting that pharma stakeholders amplify their investments in solutions that effectively address their needs. While spend and perceived ROI of certain investments differed by size, maturity, and strategy of the company (e.g., no spend on clinical trial operations solutions among pre-clinical companies or on CDx development among companies without a CDx program), most stakeholders surveyed were able to comment on the majority of investment categories, and all had visibility into how their organization's spend across all categories would change in the near-mid term. Across all categories, stakeholders generally perceived a positive ROI of their investments, albeit to significantly varying degrees.

Research tools and services

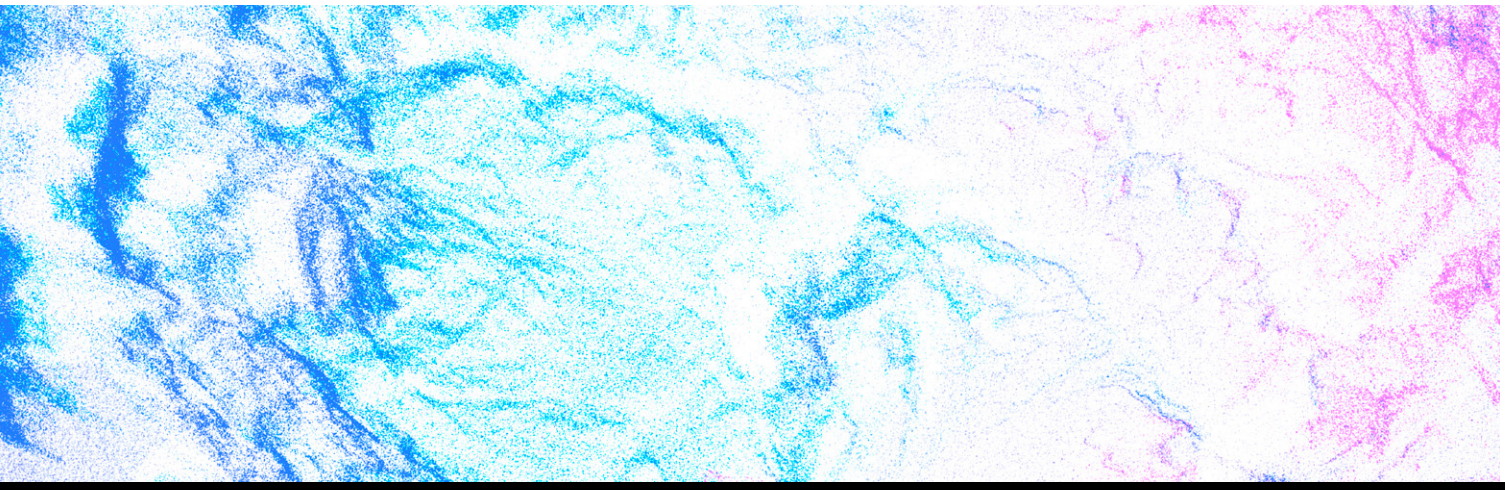
Collectively, investment in research tools (e.g., genomics, proteomics, cellomics, liquid biopsy, microscopy / imaging) is the largest investment that the pharma stakeholders surveyed make in precision medicine development. Advances in research tools have enabled pharma to capture more data per sample, at higher sensitivity / resolution, and at more time points than ever before. Among the research tools categories, genomics receives the highest investment and ROI ratings.

Given the perception of cancer as a "disease of the genome", and the increasing accessibility and decreasing cost and complexity of next generation sequencing, genomics analyses are ubiquitous across all stages of R&D and clinical development. Additionally, many emerging tools and modalities (e.g., liquid biopsy, single-cell / spatial transcriptomics, high-plex proteomics assays) leverage NGS as a readout. The attention and success of the Human Genome Project drove significant levels of investment and technology development in genomics tools, methods, and technologies over the years, and, as a result, genomics tools have become robust (e.g., highly sensitive, scalable, reproducible, standardizable) and increasingly accessible and affordable, making them ideal tools for both research and diagnostic applications. While still critical parts of the R&D process, investment levels in proteomics and cellomics are somewhat lower than genomics, due in part to the increased molecular and biological complexity and dynamics of these analytes compared to nucleic acids, and the lack of technologies that can profile these analytes at the scale / resolution that can be done for nucleic acids. For example, routine de-novo sequencing of the entire proteome is not feasible like it is for the genome or transcriptome (though protein sequencing is an emerging area of technological development).

These technical barriers limit the utility of the current generation of advanced proteomics and cellomics tools as potential diagnostic solutions, which consequently limits the scale of investment. Nonetheless, many researchers believe that proteins and functional cell assays represent a more accurate "ground truth" when it comes to cancer biology, and that, at this point, there are more groundbreaking discoveries to be made in the proteome and cellome than the genome. Estimates for the share of pharma R&D that is outsourced vary, but it is generally estimated that approximately half of pharma R&D spend is outsourced to CROs and specialty technology services companies. [3, 4] Given the rapid pace of advancement of some research tools (e.g., spatial biology platforms, single cell analysis solutions) pharma has shown a preference to pilot and validate multiple solutions before adopting technologies in-house, andwith "CROs and specialty reference labs enable this. While pharma has generally been content to outsource research, the bar for 'partner sophistication' is rising faster than some service providers are able to keep up with. Some stakeholders in our study hinted at growing pain-points when working with external service providers, especially as it relates to their ability to implement novel technologies in prospective studies, particularly registrational studies, where the data quality and management requirements are higher, prompting some companies to expand investment in internal analytical capabilities.

"...We're looking to bring these technologies in house. We ran into an issue that's becoming more prevalent, which is that the CRO is not capable of supporting a primary or secondary endpoint for novel assays. It's usually a quality issue, that their software systems or instrumentation are not validated to guarantee data integrity for secondary endpoints. Because remember, the secondary and primary end points, they go on to the FDA..."

Senior Director Bioanalytical and Biomarker Sciences, Large Pharma



Liquid biopsy

Another area of significant investment is liquid biopsy (LBx). While not mutually exclusive with the other categories (as a testing modality, rather than an application or -omics class, liquid biopsy can be used as both a research and diagnostic tool that can assess any analyte), pharma stakeholders indicated heavy levels of investment in liquid-based analyses, especially blood-based analyses.

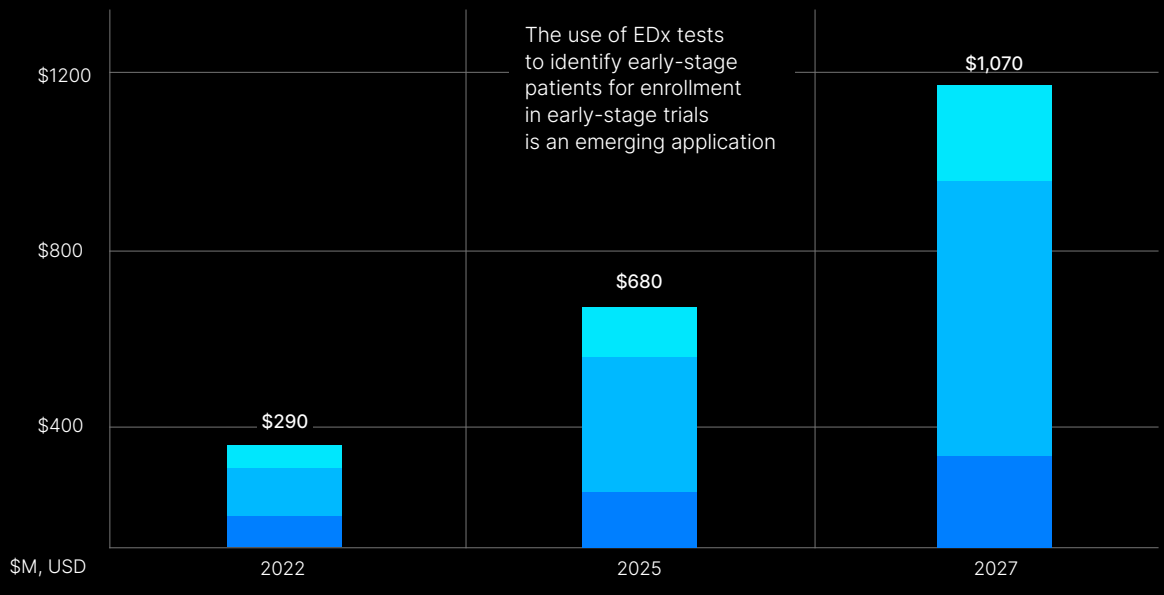


Figure 4. Pharma Spend on Liquid Biopsy Tools and Services.

Spend on liquid biopsy within pharma is expected to grow at ~29% annually through 2027, driven by significant investment in solid tumor MRD and monitoring testing as well as novel liquid biopsy tests (e.g., novel analytes, multiomics). Source: DeciBio 2022 Liquid Biopsy Market Report.

Profiling MRD / Monitoring Exploratory

DeciBio's recent liquid biopsy report estimates that pharma spends nearly $300M annually on liquid biopsies across translational and clinical R&D applications today, an amount that is expected to grow to over $1B by 2027, driven in large part by emerging applications such as MRD and monitoring.

The non-invasive nature of sampling, which makes repeat, longitudinal testing possible, combined with the increasing amount of information that can be extracted from blood (e.g., DNA variants / fragments, RNA, methylation / other epigenetics, proteins, cells, extracellular vesicles, metabolites, glycans, etc.) both quantitatively and qualitatively, makes liquid biopsies an indispensable tool for biomarker analysis. Today, liquid biopsy is used in some capacity for nearly all patients or patient samples in the translational and clinical research setting.

Additionally, there is discussion by the FDA, and belief by pharma, that ctDNA load or clearance could ultimately become an acceptable clinical trial endpoint, which is especially compelling to pharma, as this could allow pharma to design quicker, more efficient trials and make faster "go/no-go" clinical development decisions, which could lead to substantial savings. Lastly, pharma companies are increasingly adopting a tissue and liquid co-development CDx approach, ensuring that they have both solutions available to maximize access to their drugs, leading to the next investment category...

"...We have agreements to include ctDNA testing in all of our of early stage solid tumor trials...this is 10 - 15K patients per year, 3 - 4x tests per patient. Experimental right now, but we'd love to start exploring ctDNA as an endpoint as price declines..."

Head of Solid Tumor Dx, Top 10 Pharma

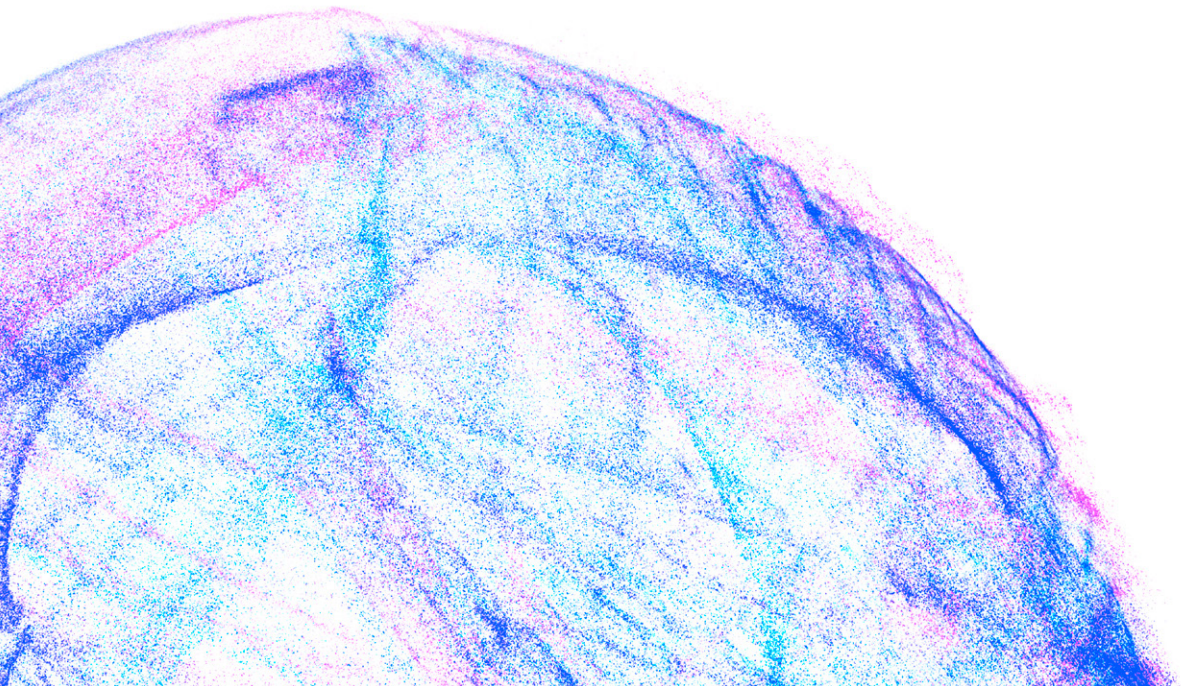
"...We're [monitoring in] pretty much all clinical trials right now . I would not say we are doing it in the best way, because we have to limit the number of time points that we are collecting ... All of us are utilizing it [for lung cancer] in various clinical trials..."

Exec. Director Translational Oncology, Top 10 Pharma

Companion diagnostics

Companion diagnostics (CDx), tests that determine which patients are candidates for specific treatments based on a biomarker or signature, are one of the ultimate implementations of precision medicine. Spend on CDx is high as there is significant effort and resources needed to identify and validate a biomarker that can successfully stratify responders, as well as develop a high-quality test that can pass regulatory muster.

Due to global differences in precision oncology testing commercial and technological infrastructure, reimbursement, and regulatory policies, pharma companies are increasingly pursuing development of multiple CDx tests for any given drug / biomarker indication, and must make informed decisions across multiple key parameters – tissue and/or liquid test, centralized lab and/or kitted offering, single biomarker and/or panel. Today, this generally requires initiating multiple CDx development partnerships, which are often between $5M - $20M, with little cost synergies. This especially apparent for NGS-based CDx tests, which are becoming increasingly important in clinical testing, but for which no single CDx strategy can address more than ~45% of patients globally (Figure 5). In an effort to address this dilemma and differentiate as potential diagnostic partners, labs and test manufacturers are exploring new market access models, including technology transfer of proprietary commercial tests to key institutions in different countries (e.g., Guardant partnerships with Vall d'Hebron Institute of Oncology in Spain and The Royal Marsden NHS Foundation Trust in the UK), and the development of hybrid centralized / decentralized Dx offerings from single providers (e.g., Foundation Medicine and Roche partnering to develop a kitted version of the popular FoundationOne CDx assay for ex-U.S. markets; LabCorp acquiring NGS kit developer PGDx to provide both a centralized and decentralizable CDx solution; Burning Rock establishing a hybrid central-lab and in-hospital model in China).



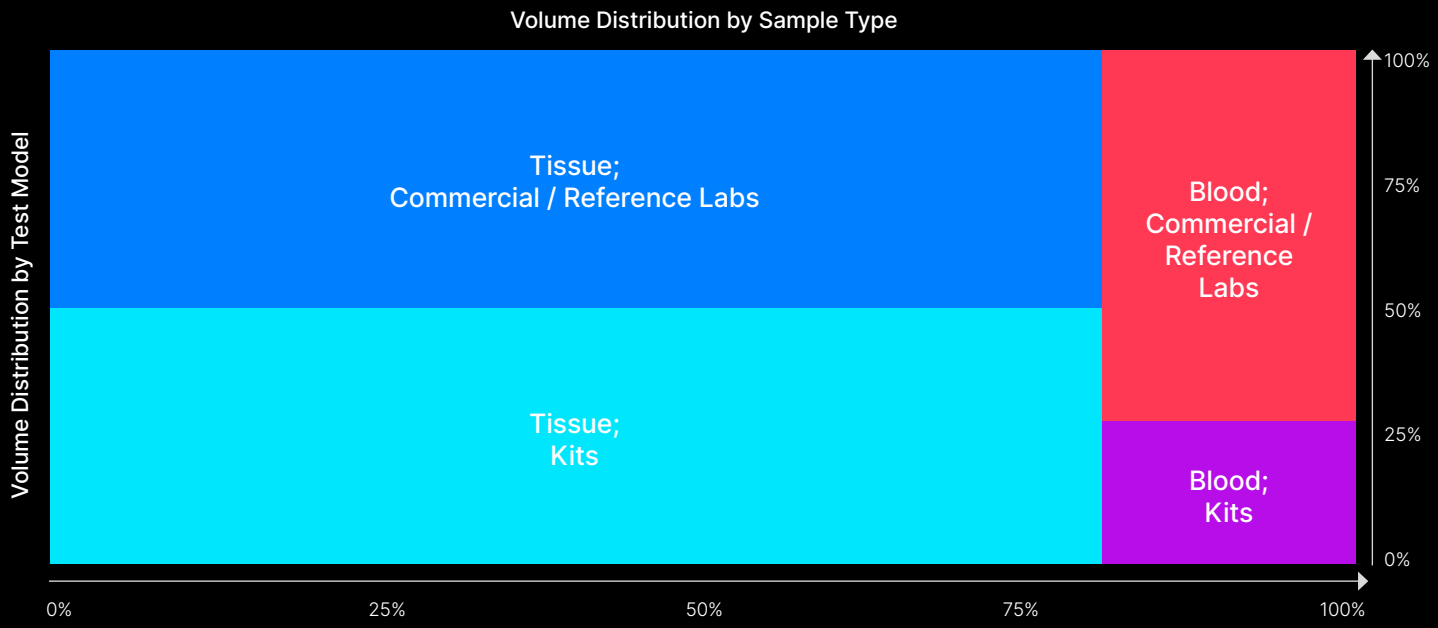


Figure 5. Clinical Oncology NGS Market Segmentation by Sample Type and Testing Model.

NGS is established as the primary genomics diagnostics modality in the U.S., and is quickly becoming so in Europe as well. Differences in testing infrastructure (e.g., centralized vs. decentralized) and sample type often necessitate multiple different NGS test partnerships for a single indication to ensure maximal drug access. The areas of each box correspond to the approximate share of NGS testing volumes performed using each modality and sample type.

Tissue – Globally, tissue is preferred for biomarker testing when available

- Commercial / Reference Labs: In the U.S., the majority of NGS testing is performed by a small number commercial reference labs which run proprietary tests; this commercial testing infrastructure exists to a lesser extent ex-U.S., with some notable exceptions (e.g., China)
- Kits: Ex-U.S., where the commercial testing infrastructure is limited and cost sensitivity is higher, most testing is performed in select advanced academic medical centers within each country or through other specialty research networks using laboratory-developed tests or off-the-shelf kits developed by assay manufacturers
  - While commercial labs can and do run kits developed by assay manufacturers, most are opting for proprietary offerings today

Blood – In 20-25% of patients, unavailable or insufficient tissue and/or expeditiousness necessitates blood testing

- Commercial / Reference Labs: Like tissue, blood-based NGS testing is more complicated and resource intensive than most hospital labs are willing to bear, resulting in the outsourcing of most liquid biopsy testing to commercial reference labs, which largely operate out of the U.S.
- Kits: While various liquid biopsy kits are available, blood-based genomic profiling is still nascent ex-U.S., and adopted primarily in sophisticated academic labs and for select patients and clinical situations

Despite the costs, the ROI for investments in CDx development is considered high because a CDx (or a sufficiently validated assay) is often a requirement for approval, reimbursement, and/or clinical uptake for those therapies for which biomarker stratification is deemed necessary. Additionally, studies suggest that biomarker-directed therapeutic programs have a 2- 6x higher likelihood of success compared to those without biomarkers [5 - 7]. Lastly, as cancers become increasingly molecularly stratified, it becomes more challenging for “all-comer” therapies to outperform biomarker-directed treatment. For these reasons, pharma is increasingly incorporating biomarker exploration or CDx strategies into new programs – stakeholders estimate that, industry-wide, 50-70% of oncology programs incorporate a biomarker strategy, with multiple large oncology players (e.g., AstraZeneca, Bayer, Pfizer, among others) citing a biomarker strategy for every program in their pipeline.

Clinical trial operational solutions

The increasing implementation of biomarker- and CDx-directed trials, and the emergence of multiple new classes of therapies, means the complexity of clinical trials and demand for patients is increasing rapidly, creating the need for-, and investment in clinical trial operational solutions.

Pharma cites improved patient access and representation of diverse patient populations in clinical trials as one of the most critical aspects of precision medicine development, warranting investment in solutions and services for patient recruitment.

This includes investment in service providers that specialize in patient recruitment, whether through manual traditional outreach or AI-based methods, as well as investments in decentralized trials solutions that seek to reach more patients in their own communities, lowering the barrier to clinical trial enrollment. Any solutions or technologies that move the needle on patient recruitment and retention rates are considered some of the highest ROI investments pharma can make, however, multiple stakeholders cited mixed experiences with different service providers or tools that do not deliver on their promise.

Ultimately, pharma recognizes that novel trial designs and solutions are needed to meet the increasing demand of patients for precision medicine trials.

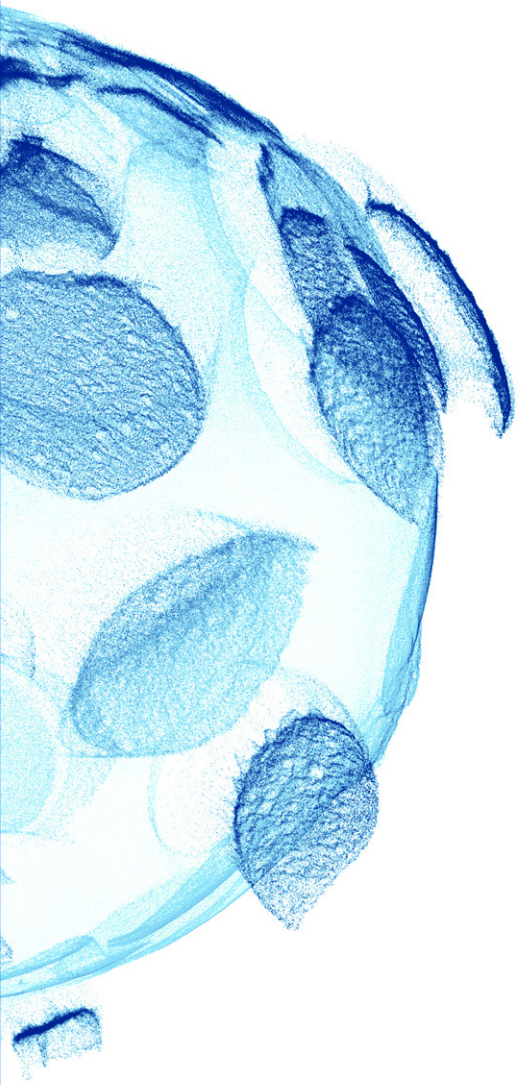
"...Some of patient identification and recruitment tools, from an oncology side, definitely we have made significant investments...there have been a lot of campaigns to really get more participants all together in the clinical trials, especially in the underrepresented population. There's been a lot of push, and actually publications from some of the leadership within the company about what has been the successes so far, and what are the targets of goals for the next two to five years, to really have a more representative population included in clinical trials..."

Executive Director Translational Oncology, Top 10 Pharma

"...We have ramped up our investment in this space [clinical trial operations] within the past two years, and that's largely for enhancing U.S. representation into clinical trials, as well as trying to maximize underrepresented patient populations. And so that's requiring us to partner up and work out new solutions for bringing trials to patients."

Head of Diagnostics, Top 15 Pharma

Informatics / AI



One of the areas of strongest consensus was the increasingly critical role of-, and level of investment in informatics solutions / AI across the R&D value chain. In the context of pharma R&D, "informatics" encompasses multiple types of products and services, ranging from software tools for analyzing the data generated by research instruments (e.g., secondary / tertiary genomics analysis solutions), to digital tools that connect and integrate data and facilitate research collaboration across an entire organization (e.g., electronic lab notebooks, laboratory information management systems), to custom AI algorithm development services (e.g., digital pathology image analysis algorithms).

While informatics applications vary widely, one common underlying driver of informatics investment overall is the accelerating rate of data generation, which,
in some cases, is accelerating faster than researchers' ability to analyze and draw insights from it. For example, for high-plex spatial biology studies, a single tissue slide with spatially-resolved data for 20+ biomarkers takes 1-2 days for data generation, but weeks or months to fully analyze.

Bioinformatics tools address both of pharma's top investment criteria: 1) automating complex and / or large-scale analyses and surfacing the relevant data and insights sooner empowers researchers to make decisions quicker, and 2) AI and ML, along with rich data sets, enables pharma to extract signals and insights that would be otherwise hidden. Pharma is leveraging AI in multiple ways, including elucidating novel signatures from pathology or radiology images, analyzing linked data sets across multiple levels and modalities simultaneously (e.g., genomics, proteomics, transciptomics (including bulk and spatial), clinical outcomes, etc.), and creating in silico models for exploring molecular or biological parameters at extreme scales, speeds, and complexities. Ultimately, informatics and AI allow pharma to glean more information from each experiment or sample, including vast stores of banked samples, providing a significant boost in research and data productivity. Beyond R&D, many pharma companies, such as Sanofi, are making significant investments in informatics and AI tools throughout the enterprise, from supply chain through regulatory submission.

"... Everyone is focused on improving the instrument and the resolution of their [spatial analysis] offering. If a vendor could develop better analysis software and offer it along with the cloud storage, it would be a huge differentiator ..."

Director of Precision Oncology, Large Pharma, U.S.

Real-world data

In contrast to the consensus on the high investment and ROI for informatics / AI, the spend and perceived ROI for real-world data and evidence (RWD/E) varied widely, resulting in an overall average in the "moderate" range for both metrics.

The range in spend on RWD was among the highest of any category, with multiple interviewees indicating annual spend of >$50M, and multiple interviewees indicating no spend at all. In pharma, RWD is used for many applications, ranging from the relatively simple and "inexpensive" (e.g., natural history of disease study, biomarker prevalence study) to the complex and expensive (e.g., synthetic control arm for a single-arm registrational study). While registration-enabling or label-expansion use cases represents the ideal and highest-value use case for RWD, relatively few successful examples of this type of use-case have been demonstrated [8,9] and thus many stakeholders perceive that they are not realizing the full value that RWD can deliver. Multiple stakeholders in this study echoed a common refrain, that regulatory uncertainty and limitations in data scale and quality are prohibitive of using RWD to address some of the most pressing research questions and clinical needs.

Data incompleteness, non-standardized data, lack of data outside of major indications (e.g., lung, breast cancers), the limited number of records for patients with uncommon biomarkers, and rigid data structures and business models were all cited as factors limiting the utility and value of RWD. The market, however, is evolving, and RWD providers are offering services (e.g., prospective pragmatic studies) and business models (e.g., custom analysis projects vs. exclusively syndicated data licenses) that are increasingly addressing the needs of a growing number of pharma. Pharma companies are also evolving to maximize the value of their investments in RWD – companies are increasingly establishing centralized teams for the procurement and management of RWD across the organization, ensuring that the data investments are not siloed within any individual department or research group, and enabling for the aggregation and integration of multiple data sets (when possible). In our research, the organizations with centralized management of RWD reported higher ROI on their RWD investment.

"...There's a lot of [real-world] data out there, but the question is, can you put anything to use with it? [...] A lot of the data is fragmented, or the data you need isn't actually available. I have more RWD budget than I can spend because the data we need just isn't out there!..."

Senior Director, Large Pharma

"...We have one of the few regulatory successes using RWD [to expand a drug label], so in that case, the ROI was significant. However, overall, is it really delivering what one would like or hope? So far, RWD is more supportive than anything else, but still provides a moderate ROI..."

Executive Director, Top 10 Pharma

Near Term Investment Trends

Despite flat R&D spend in 2022 as pharma companies tightened budgets in light of macroeconomic pressures, R&D spend YTD in 2023 is ticking up (up >14% YoY through H1 of 2023 **across the top-10 oncology drug developers**). In the next 3 years, pharma stakeholders interviewed expect to increase their investment across most categories of R&D tools and services, but largely anticipate doubling-down their investment in the areas perceived as high ROI today.

Figure 6. Expected Near-Mid Term Change in Investment Levels.

Aggregate interviewee / survey ratings of the expected level of change of investment across these R&D categories over the next 3 years. For each category, respondents scored their expected change in investment as: "Significantly decrease (>50%)", "Slightly decrease (10-50%)", "Stay the same (+/- 10%)", "Slightly increase (10 - 50%)", "Significantly increase (>50%)". These ratings were converted to points (negative for "decrease" ratings, positive for "increase" ratings) and the size of the bubbles corresponds to the net sum of the scores for each category. While some interviewees cited areas of decreasing investment, the net expected spend change across categories was positive for all categories. * The dashed circle in the legend corresponds to the theoretical maximum area for the markers in the chart, which would correspond to 100% of respondents citing "Significantly Increase (>50%)" for an individual category.

In aggregate, clinical trial operations solutions, informatics / AI, and liquid biopsy are expected to see the largest increases in investment in the near term. Among stakeholders surveyed, >70% cited some level of expected increased investment in informatics / AI, while >60% expect to spend more on clinical trials operations solutions. Clinical trials solutions, as well as liquid biopsies, were most cited as the investment areas expected to increase significantly (each ranked as areas of significant investment growth by ~20% respondents). These areas of expected investment growth areas reflect how pharma stakeholders expect to most effectively realize their top investment priorities: accelerating decision-making and time-to-market, and increasing the scale of research productivity / output.

While the most consistent signals for investment growth were in the high-ROI areas, other moderate-ROI areas expect to experience investment growth as well. Proteomics, real-world data, and disease models are all perceived to have moderate R&D impact today, however, nearly all stakeholders surveyed recognize the significant potential and promise of these tools and are willing to continue to invest in these areas. Select recent examples of pharma investments in these areas include Roche's launch of its Institute of Human Biology, focused on advancing research in the field of human model systems, BMS's partnership with MEDiC to use 3D tumor models in target discovery, AstraZeneca's partnership with Kiaytec on 3D spheroid-based screening, the myriad of pharma partnerships with Tempus to leverage its RWD and organoids platforms (e.g., Pfizer, GSK, and Zentalis), Merck's and Pfizer's RWD partnerships with Syapse, and Regeneron's partnership with Olink to integrate proteomics data at scale to integrate with its genomics data. Table 1 below provides additional examples of recent large pharma R&D partnerships and investments that are expected to play out over the near-mid term.

"...RWD has not panned out for us –it's so filled up with unstandardized data. At the end of the day, RWD is not going to substitute clinical trial data...I have yet to see what info I can gain from RWD that I can't get from clinical trial studies. Even if I can get it, it will be Swiss cheese in terms of completeness..."

Dir. of Precision Medicine and CDx, Large Pharma

Table 1. Example Pharma R&D Partnerships / Investments

Pharma	Partner Org	Date	Genomics	Proteomics	Cellomics	Multiomics	LBx	Informatics / AI	CDx	Disease Models	Clin. Trial Ops.	RWD	Details
Astellas	PeptiDream	07/23											Novel protein degrader discovery
BMS	Immatics	07/23											Equity investment in cell therapy company
Multiple[1]	Illumina, Nashville Bio	07/23											Sequencing of 250K genomes for drugs discovery
GSK	Elsie Biotech.	07/23											Oligonucleotide therapy development
AstraZeneca	Tempus	07/23											NSCLC trial, multiomics profiling, and data
Sanofi, AZ[2]	SandboxAQ	06/23											AI and quantum computing for drug developmen
Merck KgGA	Foundation Medicine	06/23											Tissue and liquid CDx tests for various assets
Sanofi	Aily Labs	06/23											AI app for enterprise decision-making
BMS	MEDiC	06/23											Drug discovery via 3D tumor & CRISPR platforms
AstraZeneca	Almac	06/23											CDx development across various therapeutic areas
AstraZeneca	IMBdx	06/23											Prostate cancer LBx testing access
Janssen	Diatech Pharmacogen.	06/23											PCR-based IVD for bladder cancer
Roche	N/A	05/23											Research center (IHB[4]) for disease model research
Pfizer	Thermo Fisher	05/23											Expanding NGS testing access globally
AstraZeneca	Revvity	05/23											Gene editing for cell therapies
AstraZeneca	Kiaytec	05/23											Preclinical efficacy analysis using 3D spheroids
Sanofi	Flatiron Health	05/23											Oncology trial data management
Eli Lilly	XtalPi	05/23											AI and lab automation robotics platform ($250M)
BMS	Foundation Medicine	04/23											Tissue CDx development for repotrectini
Eli Lilly	Tempus	04/23											Genomic testing for thyroid cancer
Astellas	Mimetas	03/23											Tumor models for immunotherapy development
Incyte	Caris	03/23											Molecular profiling and analytics
Janssen	Roche	02/23											CDx development across technologies and assets
Pfizer	Tempus	02/23											RWD and AI for drug development
AstraZeneca	Sophia Genetics	02/23											Integrated data and analytics for R&D and trials
Regeneron	Olink	02/23											Proteomics analysis for R&D data integration
AstraZeneca	Tempus	01/23											Molecular profiling for SCLC clinical trial
Bayer	Google	01/23											Quantum computing to accelerate R&D
AZ[2], Daiichi	Ibex	01/23											AI image analysis in breast cancer
AstraZeneca	Thermo Fisher	01/23											Tissue & blood NGS CDx dev. for Tagrisso
Abbvie	Immunome	01/23											Antibody therapy discovery ($1.3B+)
Abbvie	Anima Biotech	01/23											Phenotypic screening for mRNA targets ($540M+)
AstraZeneca	C2i Genomics	01/23											Solid tumor MRD test validation
Sanofi	Thread	01/23											Decentralized clinical trials support / enablement
Merck	ACRP[3]	01/23											Clinical research workforce growth & diversification
AstraZeneca	Guardant	12/22											ESR1 LBx CDx development
Merck	Kelun Biotech	12/22											ADC therapy development ($9.3B+)
Sanofi	Insilico Medicine	11/22											AI-based drug discovery ($1.2B+)

Table 1. Example Pharma R&D Partnerships / Investments

GSK	Tempus	10/22												AI and RWD for R&D and trial support ($70M+)
Boehr. Ingel.	Medidata	10/22												Electronic data capture, AI for decentralized trials
AstraZeneca	Illumina	10/22												Genomic profiling and AI tools for drug discovery
BMS	ConcertAI	09/22												Comprehensive data-driven clinical trial support
Merck	Syapse	09/22												RWE across multiple tumors to assess pat. journey
Pfizer	Cytoreason	09/22												Digital disease models in R&D ($110M)
GSK	Medable	09/22												Decentralized clinical trials support / enablement
Regeneron	Mount Sinai	08/22												Genomics, RWD analysis of 1M patients
Merck KGaA	Guardant	08/22												RWD/E for R&D
Sanofi	Atomwise	08/22												Computational drug discovery / research ($1B+)
BMS	PathAI	08/22												AI-powered pathology analysis in R&D and trials
Merck	Saama Technologies	08/22												AI for clinical data management
Merck	Orna Therapeutics	08/22												Engineered circular RNA therapy R&D ($3.5B+)
Regeneron	Ultima Genomics	07/22												Next-gen sequencing platform development
Pfizer	Truveta	06/22												Real-time RWD monitoring
AstraZeneca	GRAIL	06/22												Blood-based CDx tests for early cancer detection
Novartis	Beacon of Hope	06/22												Clinical trial diversification ($17.7M)
Eli Lilly	Tempus	06/22												Access to genomic testing for NSCLC
Janssen	Illumina	05/22												Genomics, data analysis for drug discovery, CDx
BMS	Evotec	05/22												Multiomics & AI for R&D ($8B+)
Pfizer	Headlands Research	05/22												Launch and support of diverse trial sites
Merck	Amphista Therapeutics	05/22												Targeted protein degradation drug dev. ($1B+)
BMS	Amphista Therapeutics	05/22												Targeted protein degradation drug dev. ($1.25B+)
AstraZeneca	AmoyDx	04/22												HRR / BRCA CDx development
Sanofi	IGM Bioscience	03/22												IgM antibody drug development ($6B+)
BMS	Roche, PathAI	03/22												AI digital pathology algorithm development
Amgen	Plexium	02/22												Targeted protein degradation drug dev. ($500M+)
Eli Lilly	Genetic Med. Inst.	02/22												Investment in genomics research institute ($700M)
Pfizer	Sema4	01/22												Equity investment in genomics and RWD provider
Amgen	Generate Biomed.	01/22												AI-based protein therapeutic development ($1.9B+)
Amgen	Arrakis	01/22												RNA-targeted binders development ($75M+)
Sanofi	Exscientia	01/22												Drug discovery via AI and primary tissues ($5.2B+)
Pfizer	Syapse	01/22												RWD for breast cancer clinical development
Boehr. Ingel.	Lifebit	01/22												Federated data / analysis infrastructure dev.
Sanofi	Evidation	01/22												Co-development of RWD sets across diseases
Roche	Freenome	01/22												Equity investment in LBx cancer detection ($290M)
Sanofi	Protas	01/22												Clinical trial design and support

Note: Select pharma R&D, clinical trial, and other precision medicine investments and partnerships from 2022 - July 2023. Emphasis on top-20 oncology pharma players. Not exhaustive – based on publicly available information. Drug development deal sizes reflect upside potential milestone earnings. 1. Alliance for Genomic Discovery – pharma participants include: AbbVie, Amgen, AstraZeneca, Bayer, and Merck; 2. AZ = AstraZeneca; 3. ACRP = Association of Clinical Research Professionals; 4. IHB = Institute of Human Biology

Landscape Trends and Market Levers

While advances in research and clinical tools, technologies, models, and data are catalysts for driving investments in precision oncology R&D, stakeholders acknowledge that several macro-level trends will also influence the precision oncology development process and the investments they make.

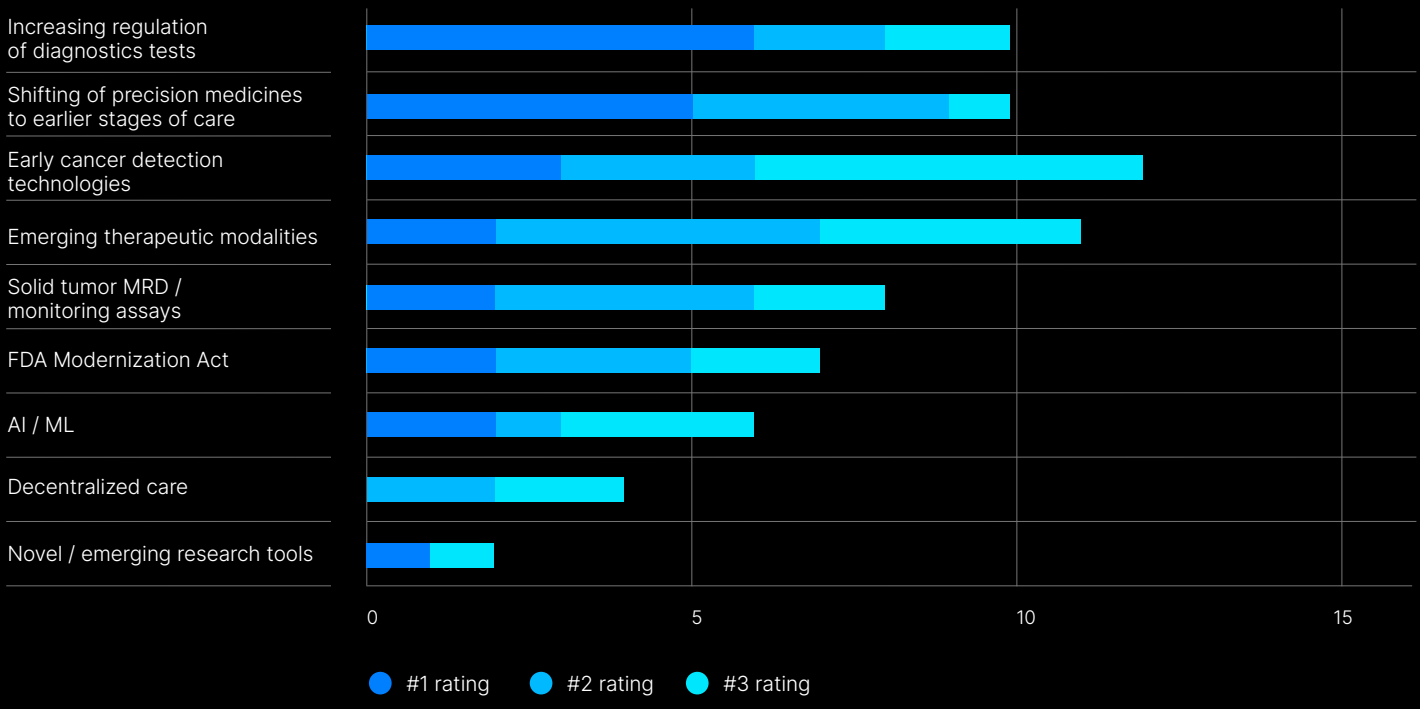


Figure 7.
Most Impactful Trends in Precision Oncology

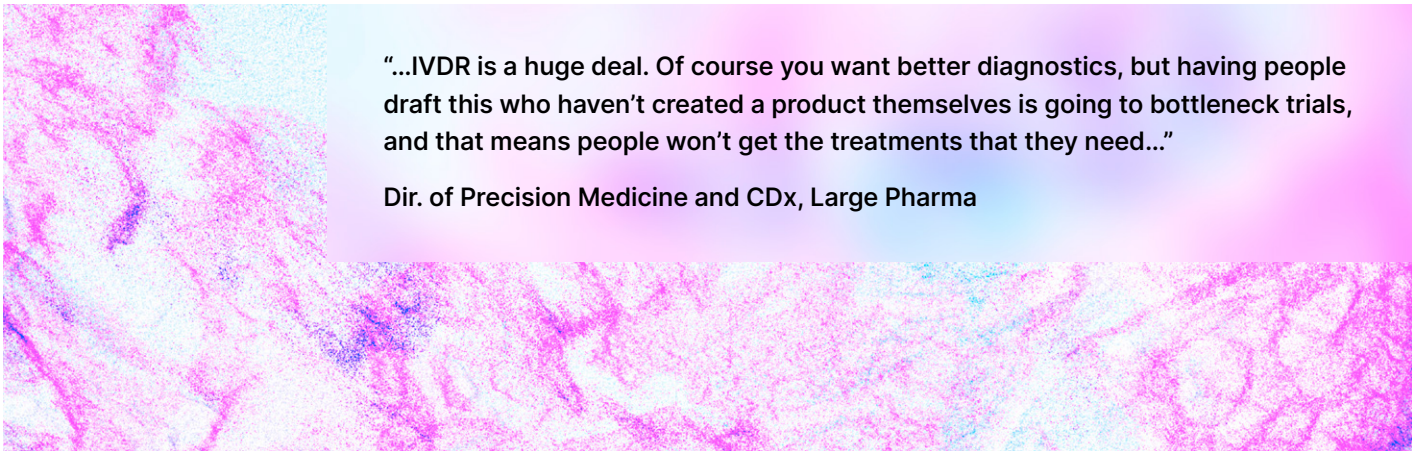
Interviewee / survey rankings of the top 3 trends impacting precision oncology development overall. Respondents were provided with these options and given the chance to identify and elaborate on "Other" trends not listed here.

Increasing regulation of diagnostic tests, for example via IVDR in Europe and potentially the VALID Act in the U.S., was ranked as the highest-impact trend on precision medicine development. Currently, implementation of precision medicines globally relies on a combination of IVDs vetted by regulators, and laboratory-developed tests (LDTs), which are developed by accredited laboratories, but with less direct regulatory oversight and validation. These LDTs are often less expensive and more customized to the needs of an individual lab than off-the-shelf IVD kits. While all stakeholders acknowledge the need for high quality tests, increased regulation of laboratory-developed tests is expected to impact access to precision medicines, as not all clinicians or labs have timely access to IVD tests, and since many tests needed for novel markers may not be readily accessible or available as IVDs in the clinic. The uncertainty about how such regulations would be implemented, especially IVDR in Europe, creates unknowns in the clinical development process that can delay trials and approvals of precision medicines.

The second most impactful trend, the shifting of targeted therapies to earlier stages of care, not only has the potential to significantly influence patient care and outcomes, but also drug and diagnostic development. For example, the sampling and turnaround time requirements for informing targeted adjuvant therapies are different than those needed to inform treatment of metastatic disease, and these sample and turnaround time requirements influence the choice of biomarker or CDx technology selection. Additionally, companies that are seeking to enroll patients for adjuvant therapy trials need tools and technologies that can help them identify which patients are more or less likely to respond to adjuvant treatment – a new clinical trial design dynamic that is being explored with technologies like ctDNA MRD assays (e.g., the ZEST and IMvigor011 trials from GSK and Genentech, respectively), with varying levels of success to date.

Related to this shift to earlier stages of care is the emergence of blood-based early cancer detection technologies. While still several years away from having an impact that registers at the epidemiological level, broad implementation of early detection technologies could lead to tangible stage-shifting, where more patients are diagnosed and treated prior to metastatic disease. Such a shift would compel more pharma companies to target and prioritize developing therapies for earlier stages of disease, which, as mentioned above, has implications on diagnostic and therapeutic strategy (e.g., treating residual disease is different than bulk tumors). Companies that are proactively pushing into earlier stages of cancer care are actively evaluating early cancer detection tests and ways to promote screening to maximize their ability to enroll patients into these trials.

Lastly, many stakeholders cited emerging novel therapeutic modalities as likely to significantly impact the future of oncology care and drug development, pointing to recent data generated for ADCs (e.g., Enhertu in breast cancer), personalized cancer vaccines (Moderna / Merck's mRNA-4157), and cell therapies (e.g., Janssen's Carvykti). Other modalities such as targeted protein / RNA degraders, molecular glues, T-cell engagers, and multi-specific / multivalent antibodies were all recognized as areas of high interest. Each new therapeutic class that has an orthogonal mechanism-of-action to existing therapeutics represents myriad new opportunities for both single-agent and combination strategies, and the potential to disrupt the status quo (much like immune checkpoint inhibitors have done in the last decade). Pharma stakeholders are aware that some of the emerging therapeutic modalities, such as cell therapies and personalized vaccines, could usher in fundamental changes to manufacturing and development that will drive significant investments in new areas (such as supply chain management systems and new sequencing and bioinformatics capabilities), and will alter trial designs and commercial infrastructure.



Conclusion

The precision oncology innovation engine continues to churn, with pharma stakeholders signaling ongoing investment in technologies and services throughout the R&D value chain. Understanding where and why pharma makes investments in the precision medicine innovation ecosystem can help tools and technologies manufacturers craft optimal strategies and develop differentiated products, empower service providers to refine and optimize their offerings and business models, and enable investors to identify and evaluate opportunities for value creation, all with the ultimate goal of improving the arsenal of tools and technologies researchers and clinicians have to combat cancer and improve outcomes and quality of life for patients.

References:

1. Citeline Clinical Pharma R&D Annual Review 2023
2. https://www.iqvia.com/insights/the-iqvia-institute/reports/global-trends-in-r-and-d-2022
3. https://www.contractpharma.com/issues/2021-10-01/view_columns/rd-outsourcing-trends-not-a-zero-sum-game/#:~:text=Big%20Pharma%20outsources%20over%2045,a%20CAGR%20of%20%3E10%25.
4. https://www.prnewswire.com/news-releases/drug-discovery-outsourcing-ddo-market-report-2021-2030-unprecedented-downsizing-of-internal-discovery-of-big-pharmaceuticals-shift-towards-biologics-surges-externalization--outsourcing-activities-301333641.html
5. https://pubmed.ncbi.nlm.nih.gov/33620160/
6. https://pubmed.ncbi.nlm.nih.gov/24419412/
7. https://pharmaintelligence.informa.com/resources/product-content/2021-clinical-development-success-rates
8. https://aacrjournals.org/clincancerres/article/28/1/27/675033/Real-World-Evidence-in-Support-of-Oncology-Product
9. https://www.sciencedirect.com/science/article/pii/S1098301522020046

Authors

Andrew Aijian
Partner

Colin Enderlein
Principal

Stephane Budel
Partner

About DeciBio

DeciBio is a strategy consulting and market research firm with the mission to accelerate innovation in precision medicine. To learn about how DeciBio can support your strategy or market intelligence needs, visit our website: https://www.decibio.com/ or email Andrew Aijian at aijian@decibio.com.

DeciBio has multiple reports that provide additional insights into the topics covered in this whitepaper. Relevant products include:

- NGS Manufacturing Market Report
- Oncology Liquid Biopsy Market Report
- Spatial Biology Market Report
- Life Science Research Tools Market Report
- Digital & Computational Pathology Market Report
- Single Cell Analysis Market Report
- Advisory Board Report: Oncology Comprehensive Genomic Profiling - Current Expert Perspectives
- Advisory Board Report: Pharma R&D Investment and ROI
- Advisory Board Report: Digital Pathology Current Pharma User Perspectives
- Advisory Board Report: MRD
- Advisory Board Report: Real-World Data (RWD) Market - Current Expert Perspectives
- Advisory Board Report: NGS Manufacturer Market
- Advisory Board Report: Advanced & Next-Gen Proteomics Ad Board

DeciBio®