LOCUST WALK®

Driving life science innovation through transactions

LOCUST WALK
2023 YEAR-IN-REVIEW REPORT

Global Trends in Biopharma Transactions

TABLE OF CONTENTS

Comments

Global/US

Europe

Asia

About Locust Walk

Biopharma public market conditions improved towards the end of the fourth quarter, concurrent with a slew of >$1B acquisitions by large pharma, though private fundraising activity remained depressed

The XBI rose above $90 a share to its highest levels since February 2023, while the S&P 500 ended the year up 24%

- After a relatively sharp decrease in October, the XBI closed up 8% over the last 12 months, finishing the year above $90 a share and erasing the large slumps observed in March and October
- The S&P 500 rose 16% over the final quarter of the year, as the Fed held rates steady and indicated three potential cuts in 2024
- An additional positive indicator for the biotech sector, the number of companies trading below cash dropped 17% in December after holding steady with Q3 levels in October and November
- Increased XBI and S&P 500 performance shows signs of lessening macroeconomic headwinds; indicating the potential for a gradual biotech recovery as total M&A and licensing deal aggregate value increases

While IPO volume decreased relative to Q3, follow-on offering volume increased by 125% with performance for these companies generally positive

- Q4 saw the greatest number of follow-on offerings since Q1 2021 (e.g., 18 follow-ons >$75M); While IPO volume decreased, post-IPO performance on average was up 15%, suggesting a softening of the challenging public market environment in 2023

While venture financing volume in Q4 decreased, 2023 aggregate deal value remained consistent with values achieved in 2022 (e.g., $10.2B vs $11.0B)

- New investor interest in Series D & Later saw the greatest growth, with data suggesting new investor interest expanded through all series stages
- Average round size decreased substantially this quarter (i.e., -33% decrease over average deal value from Q3 to Q4), as the total volume of rounds >$20M decreased from 39 in Q3 to 32 in Q4

The end of the fourth quarter saw numerous multi-billion-dollar big pharma acquisitions (i.e., 7 deals >$1B in December 2023), suggesting positive momentum for the biotech transaction landscape moving into 2024

- Of the 20 M&A deals that occurred in Q4, 11 were >$1B+ in value, and the aggregate quarterly M&A deal value of $60B was the greatest observed since Q4 2020

While the thawing of biopharma public markets and significant volume of billion-dollar large pharma acquisitions represent much needed positive indicators, Locust Walk contends that the overall recovery will be gradual and will likely take longer than many are anticipating

Sources: Locust Walk Analysis.

TABLE OF CONTENTS

Comments

Global/US

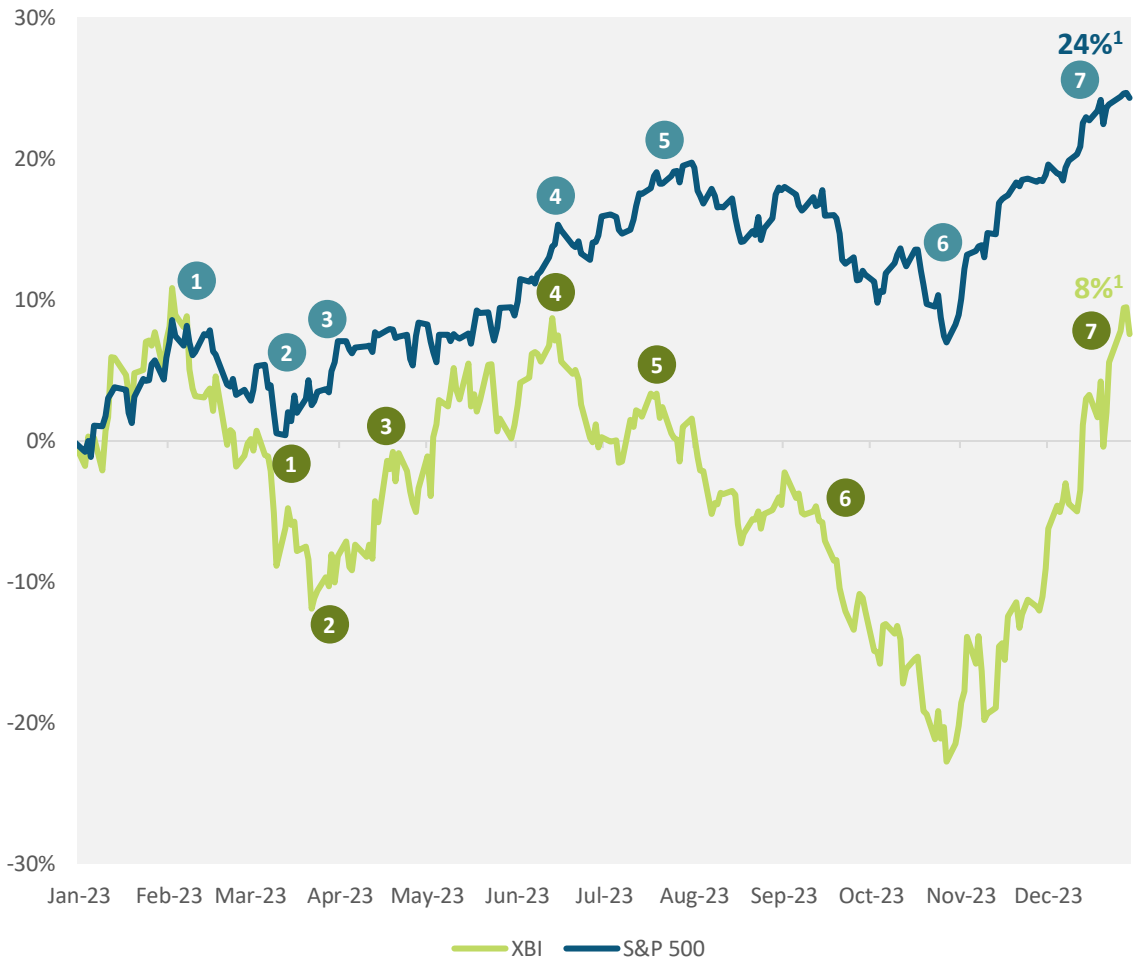
Europe

Asia

About Locust Walk

While the XBI is up 8% over the last 12 months and has rebounded significantly in Q4, the index continues to be outperformed by the S&P 500 which is up 24% over the last twelve months

XBI vs S&P 500 Performance (LTM)



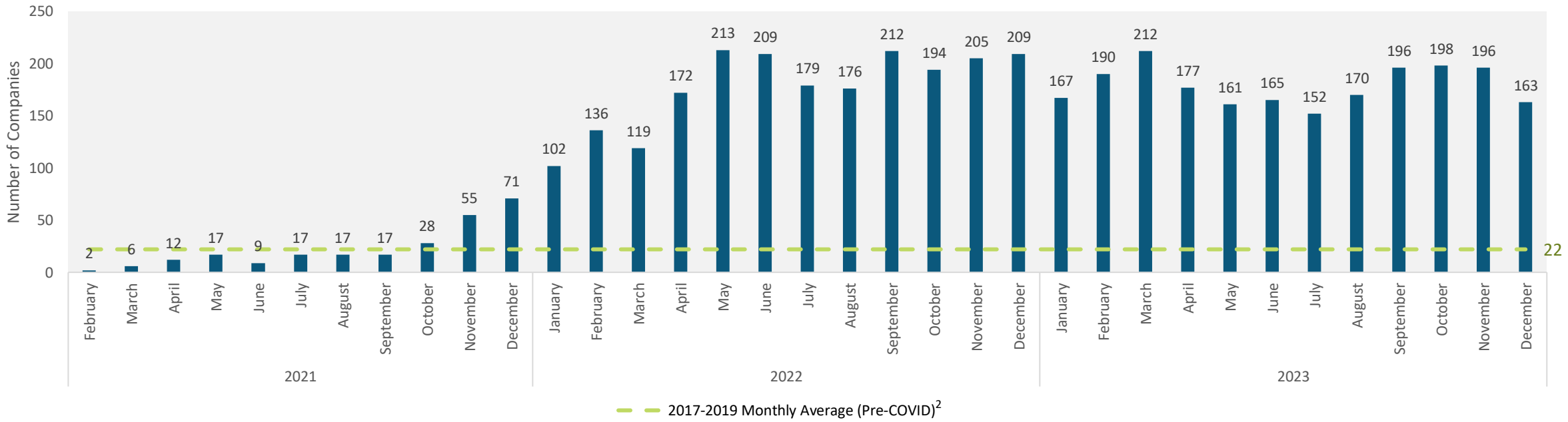
Event	Date	Subject	Summary
Macro Events			
1	2/2/23	Federal Reserve	January CPI reports inflation at 6.4% YoY; Fed raises rates 25 bps
2	3/10/23	Silicon Valley Bank	Silicon Valley Bank fails after bank run
3	3/23/23	Federal Reserve	February CPI reports inflation at 6.0% YoY; Fed raises rates 25 bps
4	6/13/23	Federal Reserve	June CPI reports inflation at 4.0% YoY; Fed does not change rates
5	7/26/23	Federal Reserve	July CPI reports inflation at 3.2% YoY; Fed raised rates by 25 bps, but market strategists predict rate hikes to be finished end of year
6	10/31/23	Federal Reserve	10-year Treasury yields neared 5% for the first time since 2007
7	12/13/23	Federal Reserve	Fed holds rates steady, indicates expectation for three cuts coming in 2024
Biotech Events			
1	3/13/23	Pfizer; Seagen	Pfizer announces acquisition of Seagen for $43B
2	3/27/23	Codiak Biosciences	Codiak Biosciences files for bankruptcy
3	4/16/23	Merck; Prometheus	Merck announces acquisition of Prometheus Biosciences for $10.8B
4	6/12/23	Novartis; Chinook	Novartis acquires Chinook Therapeutics for $3.5B
5	7/28/23	Biogen; Reata	Biogen signs agreement to acquire Reata for $7.3B
6	9/15/23	Neumora; RayzeBio	IPO date for Neumora ($250M offering) and RayzeBio ($311M offering)
7	12/26/23	BMS; Karuna	BMS agrees to acquire Karuna Therapeutics for $14B; 6 additional >$1B acquisitions by big pharma occur in December 2023

Sources: Locust Walk Analysis; Yahoo Finance; YCharts.

Note(s): (1) Relative percent change measured from 12/30/2022. BPS = Basis Points.

The number of biotech companies trading below cash remained elevated in Q4 2023, with a ~17% dip in December indicating potential for a gradual market rebound

Number of US-Listed Biopharma Companies Trading Below Cash (Since XBI Peak)[1]



Key Takeaways:

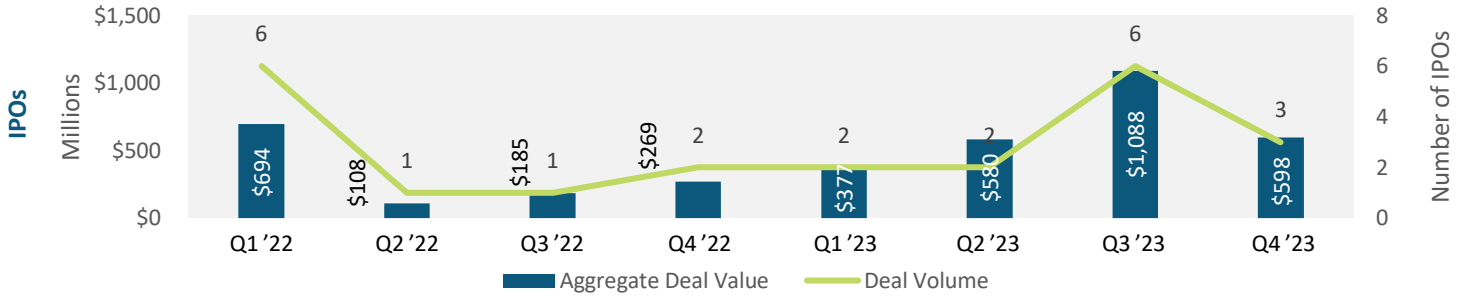
- While the number of companies trading below cash earlier this quarter remained consistent with the end of Q3, December showcased a significant decrease in companies trading below cash
- Softening of macroeconomic headwinds significantly impacted the overall positive XBI performance in December and lessened a strict capital raising environment for biotech companies trading below cash
- A trend of improvements seen in metrics like PIPE / secondary offering volume and value continue to suggest the potential for gradual market rebounds, contingent on the continued improvement in the interest rate environment and other macro stability

Sources: EvaluatePharma; Locust Walk Analysis; YCharts.

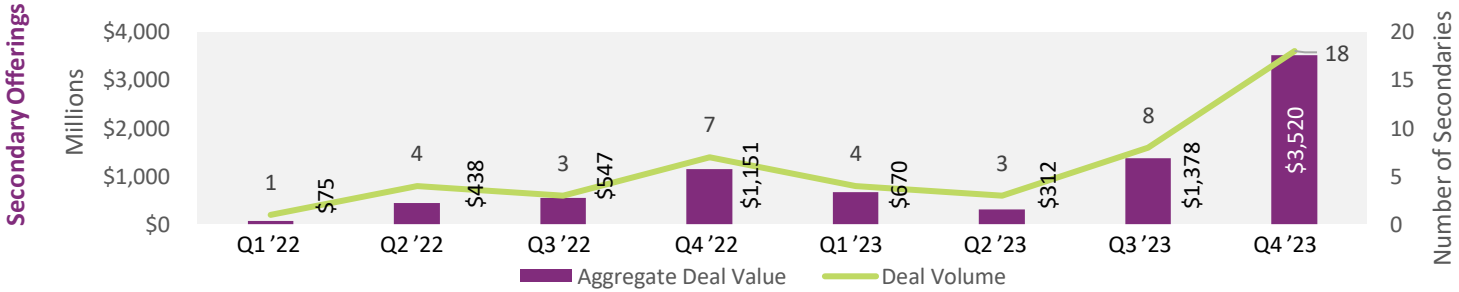
Note(s): (1) Totals calculated as of the last trading day of each month; (2) 2017-2019 monthly average of 22 companies trading below cash.

While IPO activity was similar to the 1H 2023, Q4 saw the highest secondary offering deal volume and aggregate value since the start of 2022 and meaningful PIPE activity (~3x aggregate value to Q3)

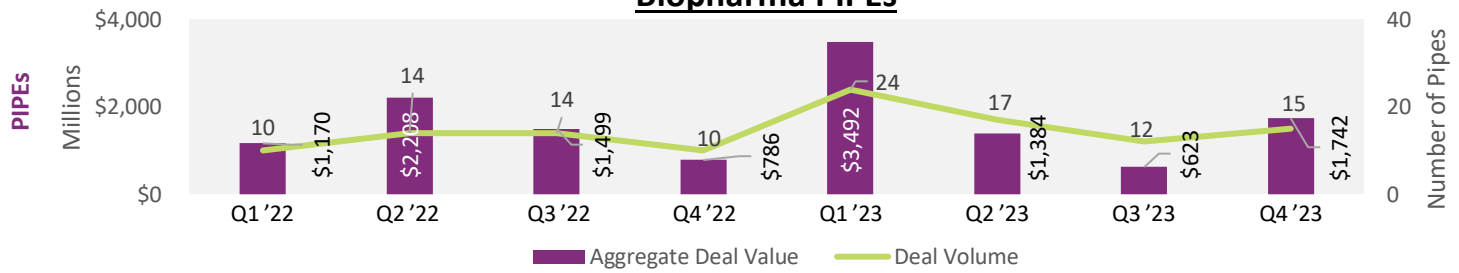
Biopharma IPOs



Biopharma Follow-On Offerings



Biopharma PIPEs



Key Takeaways:

- While IPO volume decreased 50% from the 2023 high seen in Q3, the aggregate IPO volume of 2023 saw a 30% increase compared to 2022; although the deal total remains far below the highs of 2020 & 2021 (22 & 45)
- While there were positive recovery signals from the increase in total follow-on volume to 33 from 15 in 2022, PIPE totals for the year also increased to 68 from 48 in 2022; a trend associated with challenging markets
- Similarly, average returns for the 8 follow-on offerings >$200M was 43% as opposed to -4% in Q3, again indicating a lessening of the previous challenges in the public financing environment

Sources: Pitchbook; Locust Walk Analysis.

Note(s): All values for each quarter capture only completed IPOs & PIPEs with a deal value greater than $20M and Follow-ons with deal value greater than $75M.

Q4 IPO volume decreased from Q3 values, though performance has been mostly positive

While topline increases in IPO value and subsequent stock performance are promising, the comparatively limited volumes to historical norms and late clinical stage of companies reflect persistent market challenges.

Q4 2023 US IPOs (Total Raise >$20M)

Biopharma Issuer	Ticker	Company Description	Lead Phase	Deal Date	Price Range	Offering Price	Total Raise ($M)	Current Price (% Change[1])	Market Cap ($M)[1]
Cargo Therapeutics San Mateo, California	CRGX NASDAQ	Cargo Therapeutics is a clinical-stage biotechnology company positioned to advance next-generation, potentially curative cell therapies for cancer patients	Phase 2	11/13/2023	$15 - $17	$15	$281	$18.62 (+24%)	$767
Abbivax Paris, France	ABVX NASDAQ	Abbivax is developing innovative treatments that harness the body's natural regulatory mechanisms to modulate the immune response in patients with chronic inflammatory diseases	Phase 3	10/19/2023	$12 - $13	$11	$217	$11.00 (-5%)	$625
Lexeo Therapeutics New York, New York	LXEO NASDAQ	Lexeo Therapeutics is developing preclinical and clinical stage gene therapies focused on hereditary and acquired diseases of high unmet need	Phase 3	11/29/2023	$13 - $15	$11	$100	$13.89 (+26%)	$370

RayzeBio sold for ~4x its IPO price from Q3, highlighting a recovering IPO performance market and strengthening rationale for investors participation in biotech public offerings

Sources: Yahoo Finance; Pitchbook; Locust Walk Analysis.

Note(s): All values in USD M unless otherwise noted; (1) As of 1/1/2024.

Secondary offering volume and aggregate value was up from Q3

Large cap, late-stage, and commercial stage companies generally show higher secondary offering rounds and subsequent strong stock performance, suggesting that investors maintain limited risk appetite for earlier-stage biotechs.

Q4 2023 US Follow-On Offerings (Total Raise >$200M)

Biopharma Issuer	Ticker	Company Description	Lead Phase	Deal Date	Offering Price (% Change[1])	Total Raise ($M)	Current Price (% Change[2])	Market Cap ($M)[2]
Cerevel Therapeutics[3] Cambridge, MA	CERE NASDAQ	Cerevel Therapeutics Holdings Inc is tackling neuroscience diseases with a differentiated approach that combines expertise in neurocircuitry with a focus on receptor selectivity	Phase 3	10/12/2023	$22 (+1.7%)	$449	$42.40 (+93%)	$7,635
Nuvalent Cambridge, MA	NUVL NASDAQ	Nuvalent Inc is a clinical-stage biopharmaceutical company focused on creating precisely targeted small molecule therapies for cancer	Phase 2	10/17/2023	$56 (-8.3%)	$300	$73.59 (+31%)	$4,626
Xenon Pharmaceuticals Vancouver, Canada	XENE NASDAQ	Xenon Pharmaceuticals Inc is a clinical-stage biopharmaceutical company developing innovative therapeutics to improve the lives of patients with neurological disorders including rare CNS	Phase 3	12/4/2023	$32 (+2.6%)	$300	$46.06 (+44%)	$3,427
SpringWorks Therapeutics Stamford, CT	SWTX NASDAQ	SpringWorks Therapeutics Inc is a clinical-stage biopharmaceutical company applying a precision medicine approach to develop medicines for rare diseases and cancer	Approved	12/7/2023	$29 (+5.0%)	$274	$36.50 (+26%)	$2,704
Ultragenyx Pharmaceutical Novato, CA	RARE NASDAQ	Ultragenyx identifies, acquires, develops, and commercializes novel products for the treatment of serious rare and ultra-rare diseases, specifically genetic diseases	Approved	10/20/2023	$30 (-5.1%)	$250	$47.82 (+59%)	$3,925
Biohaven New Haven, CT	BHVN NASDAQ	Biohaven Ltd is a clinical-stage biopharmaceutical company focused on developing therapies neurological and neuropsychiatric diseases, immunology, and disease-related biology, including rare disorders	Phase 3	10/4/2023	$229 (-1.3%)	$225	$42.80 (+87%)	$3,451
EyePoint Pharmaceuticals Watertown, MA	EYPT NASDAQ	EyePoint develops and commercializes ophthalmic products for the treatment of eye diseases. They have developed FDA-approved sustained-release treatments in ophthalmology	Phase 2	12/7/2023	$17 (+9.5%)	$200	$23.11 (+36%)	$1,023
Celldex Therapeutics Phillipsburg, NJ	CLDX NASDAQ	Celldex is focused on the development of several immunotherapy technologies and other cancer-targeting biologics	Phase 2	11/8/2023	$27 (-8.7%)	$200	$39.66 (+47%)	$2,165

Sources: Yahoo Finance; Pitchbook; Locust Walk Analysis.

Note(s): All values in USD M unless otherwise noted; Only includes deals >$200M; (1) Since last closing price; (2) As of 12/29/2024; (3) Cerevel Therapeutics was acquired by AbbVie on Dec 6, 2023.

PIPE activity increased relative to Q3, with aggregate deal value up 180% from the prior quarter

Later-stage companies generally attracted higher PIPE values with strong stock performance and relatively similar total raises compared to follow-on offerings.

Q4 2023 US PIPEs (Total Raise >$100M)

Biopharma Issuer	Ticker	Company Description	Lead Phase	Deal Date	Offering Price (% Change[1])	Total Raise ($M)	Current Price (% Change[2])	Market Cap ($M)[2]
Arvinas New Haven, CT	ARVN NASDAQ	Arvinas is a biopharmaceutical company focusing on improving the lives of patients suffering from debilitating and life-threatening diseases through the discovery, development and commercialization of therapies that degrade disease-causing proteins	Phase 3	11/28/2023	$24 (+2.3%)	$350	$41.16 (+72%)	$2,240
Structure Therapeutics San Francisco, CA	GPCR NASDAQ	Structure Therapeutics Inc is a clinical-stage global biopharmaceutical company aiming to develop and deliver novel oral therapeutics to treat a wide range of chronic diseases such as GPCRs for the treatment of pulmonary and cardiovascular diseases	Phase 2	10/1/2023	$50 (+34.6%)	$300	$40.76 (-19%)	$1,949
Arcellx Gaithersburg, MD	ACLX NASDAQ	Arcellx Inc is a clinical-stage biotechnology company reimagining cell therapy through the development of innovative immunotherapies for patients with cancer and other incurable diseases	Phase 2	12/15/2023	$51 (-0.4%)	$285	$55.50 (+9%)	$2,688
Viridian Therapeutics Waltham, MA	VRDN NASDAQ	Viridian Therapeutics Inc is a clinical-stage biopharmaceutical company that engages in developing multiple product candidates to treat patients who suffer from thyroid eye disease	Phase 3	11/1/2023	$12 (+0.8%)	$185	$21.78 (+82%)	$1,109

Sources: Yahoo Finance; Pitchbook; Locust Walk Analysis.

Note(s): All values in USD M unless otherwise noted; Only includes deals >$100M; (1) Since last closing price; (2) As of 12/29/2024.

Q4 saw 3X the number of reverse mergers closed, but mixed performance post-merger

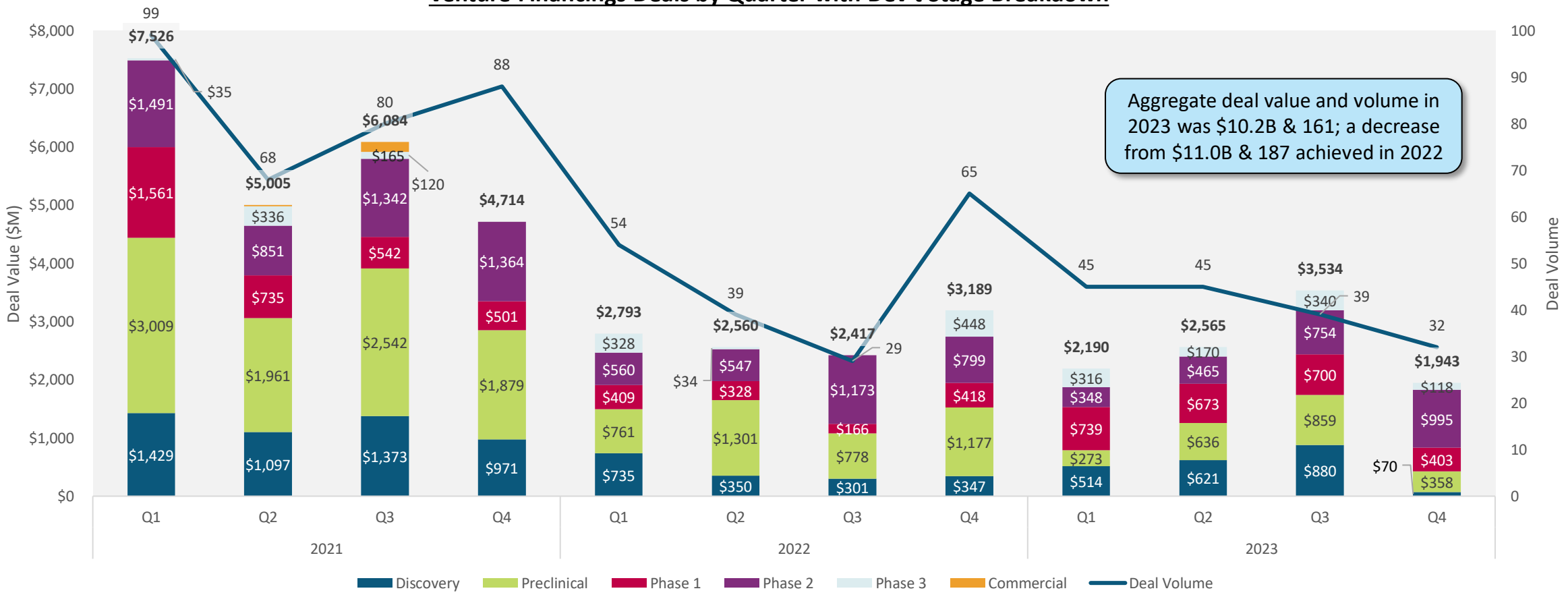
		Acquiree	Acquirer	Ticker	Targets Lead Phase	Announced Date	Completed Date	PIPE ($M)	Current Price (% Change[1])	Market Cap ($M)[1]
Reverse Merger	*Completed*	**Neurogene**	Neoleukin	NGNE NASDAQ	Phase 1/2	7/18/2023	12/19/2023	95	$19.38 (+29%)	$281
		Spyre Therapeutics	Aeglea BioTherapeutics	SYRE NASDAQ	IND-enabling	6/22/2023	11/28/2023	210	$21.52 (+48%)	$787
		Cartesian Therapeutics	Selecta Biosciences	RNAC NASDAQ	Phase 2	11/13/2023	11/12/2023	60	$0.68 (-22%)	$109
		Korro Bio	Frequency Therapeutics	KRRO NASDAQ	Discovery	7/14/2023	11/6/2023	117	$47.93 (+210%)	$405
		Tourmaline Bio	Talaris Therapeutics	TRML NASDAQ	Phase 2	6/22/2023	10/19/2023	75	$26.18 (+117%)	$546
		Notable Labs	Vascular Biogenics	NTBL NASDAQ	Phase 2	12/23/2023	10/16/2023	10	$1.89 (-65%)	$15
	Announced	**Q32 Bio**	Homology Medicines	--	Phase 2	11/16/2023	--	42	--	Private
		LENZ therapeutics	Graphite Bio	--	Phase 3	11/15/2023	--	54	--	Private

Sources: Locust Walk Analysis; Pitchbook; Yahoo Finance.
Note(s): All values in USD M unless otherwise noted.

Q4 saw the lowest US biopharma venture financing aggregate deal value in the past 3 years and the lowest deal volume since Q3 2022

While Q4 aggregate deal value is similar to the depressed Q1 values, greater aggregate value for Phase 2 deals indicates a trend towards de-risked late-clinical stage financings in the current market.

Venture Financings Deals by Quarter with Dev't Stage Breakdown[1, 2]

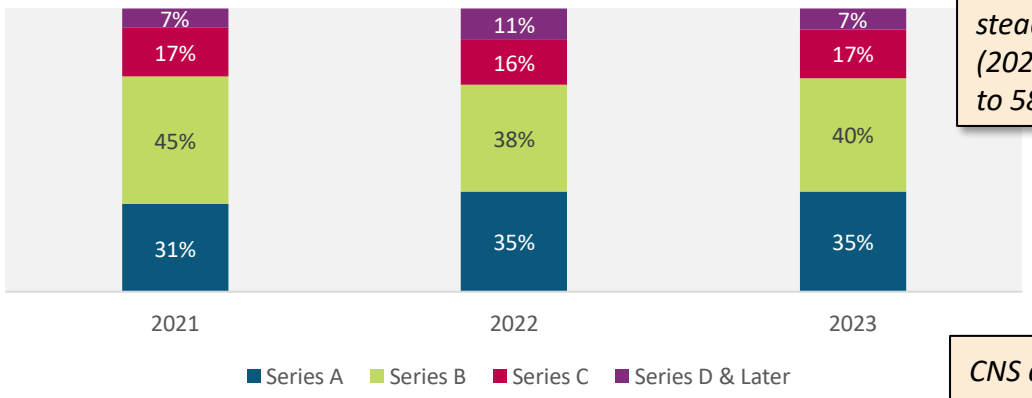


Sources: Locust Walk Analysis; Pitchbook.

Note(s): (1) Includes only Series A and later-stage financings; (2) Data labels only provided for values >$20M.

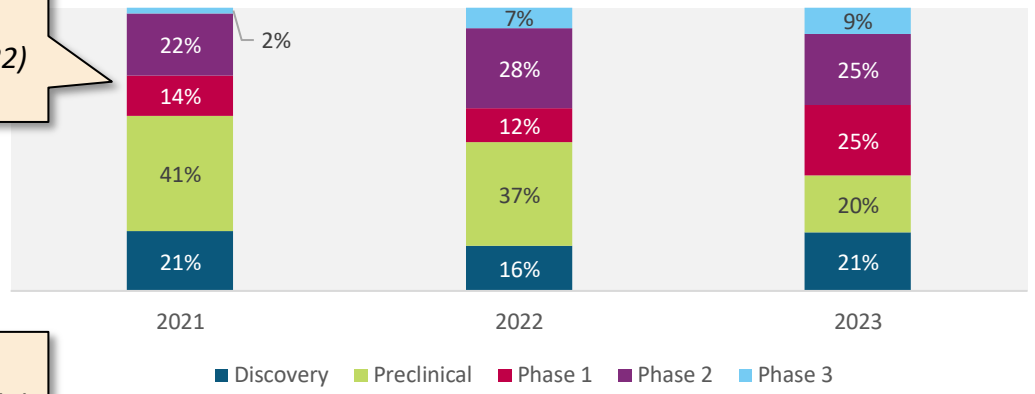
While deal value distribution by series round has remained consistent since 2021, mid-to-late clinical stage companies have increasingly driven private financing activity

Percent of Deal Value by Series Round



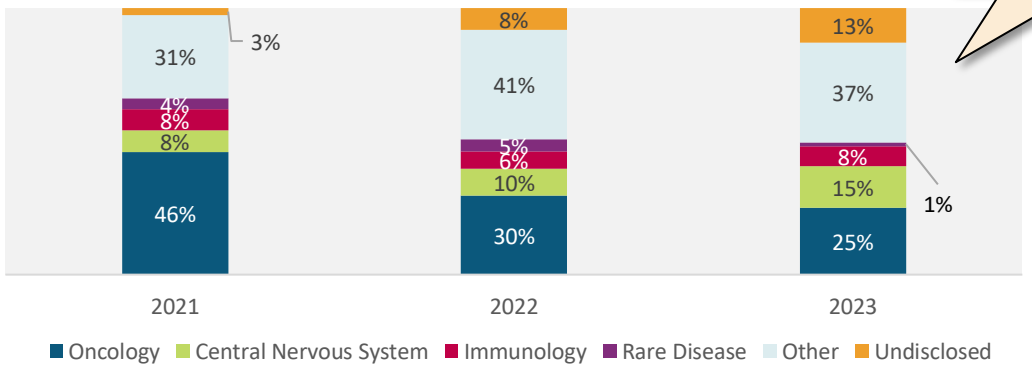
Clinical-stage deals have increased steadily from 38% (2021) to 47% (2022) to 58% (2023)

Percent of Deal Value by Development Stage

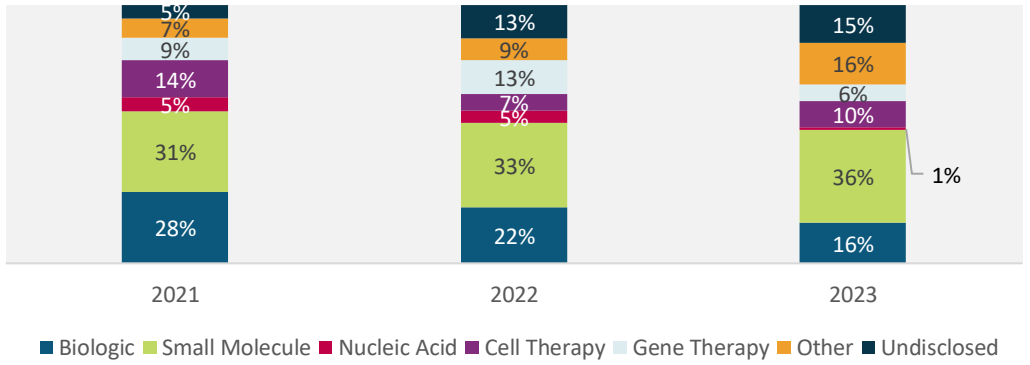


CNS deal value up ~90% since 2021 while Oncology deal value has decreased 21%

Percent of Deal Value by Therapeutic Area



Percent of Deal Value by Modality



Sources: GlobalData; Locust Walk Analysis; Pitchbook.
Note(s): CNS = Central Nervous System.

Q4 represented the highest new investor participation in 2023 across private financing rounds, with gradually growing interest in Series A and Series B raises suggesting expanded risk tolerance

Existing vs. New Investor Split Per Round (% of Total Investor Count)

Calculated based on total count of investors per round, not capital contributed

Key Takeaways:

- Through 2023, investors continued to show a willingness to participate in Series C deals to increase exposure to later-stage, lower-risk opportunities
- New investor participation continued to slowly expand to Series B deals, growing to 62% in Q4 '23 from 54% in Q1 '23, potentially reflecting expanded risk tolerance
- Growing new investor participation in Series A deals in Q4 may reflect gradually increasing interest in earlier-stage companies, though the extent of the trend remains to be seen
- Series D and later financings also saw an increase in new investors, potentially stemming from overall improvements in biotech public markets and anticipation of greater future accessibility

Five companies spanning a range of development stages, modalities and TAs secured fundraising rounds over $100M in Q4, representing a significant decrease from 11 companies in Q3

Despite a lower frequency of private financing rounds, activity in Q4 continued to see large financing rounds, with 60% of financings self-identified as oversubscribed.

Key: ★ *Oversubscribed Round*

High-Value Investment Rounds (i.e., >$100M)

	Company	Series	Raised ($M)	Deal Date	Lead Investor(s)	Therapeutic Area(s)	Company Description
★	AIOLOS BIO	A	245	10/24/2023	*Atlas Venture, Bain Capital Life Sciences, Sofinnova Partners, RA Capital Management*	Ear, Nose, and Throat	Clinical-stage biopharmaceutical company intended to focus on addressing the unmet treatment needs of patients with respiratory and inflammatory conditions
★	MapLight	C	225	10/30/2023	*5AM Ventures, Novo Holdings, Cowen Healthcare Investments*	Neurology	Biopharmaceutical company intended to discover novel treatments for brain disorders
	SUDO BIOSCIENCES	B	116	12/20/2023	*Enavate Sciences, TPG*	Immunology, Neurology	Develops medicines targeting TYK2 for immune-mediated dermatologic diseases, MS, and neurodegenerative diseases
	LYNDRA THERAPEUTICS	E	101	12/21/2023	*Sarissa Capital Management, Polaris Partners*	Neurology, Cardiovascular	Developing long-acting oral delivery platform for psychiatric and cardiometabolic diseases
★	Iambic	B	100	10/3/2023	*Abingworth, OrbiMed, Catalio Capital Management, Sequoia Capital*	Oncology	Developer of therapeutic discovery quantum molecular simulation engine designed to accelerate molecular discovery

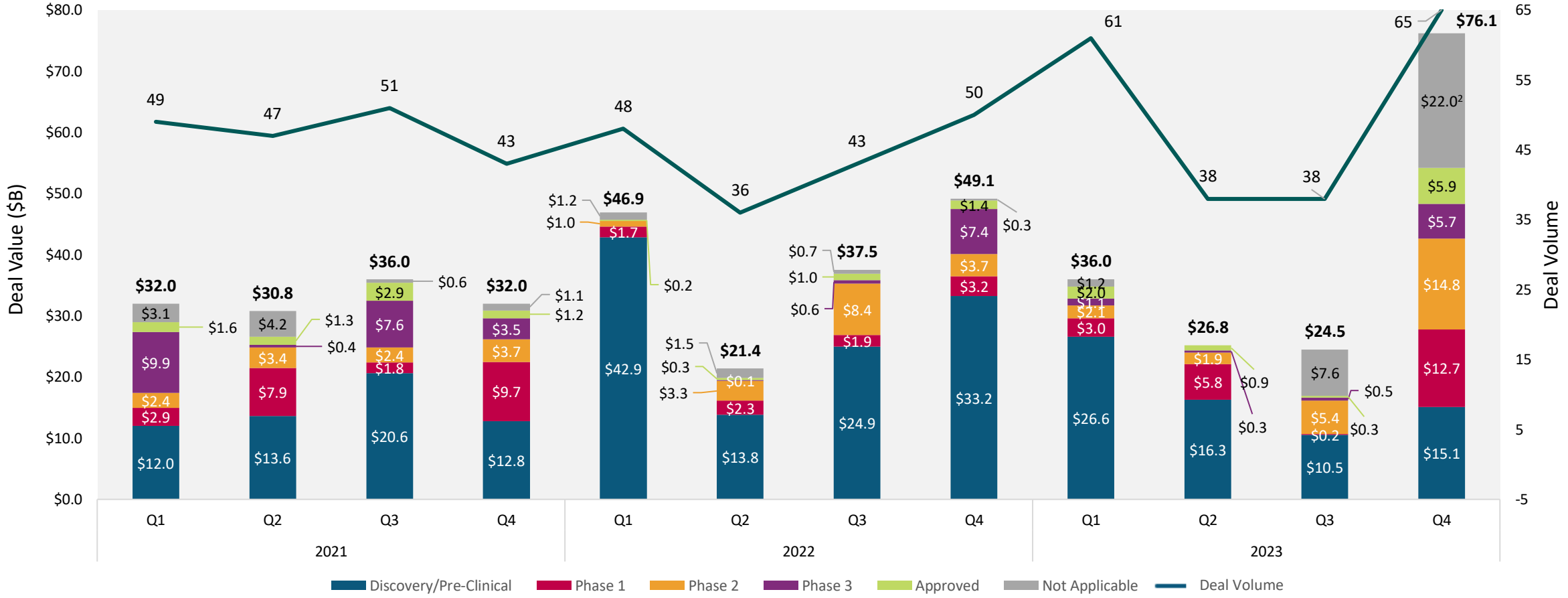
Sources: Locust Walk Analysis; PitchBook.

Note(s): All values in USD M unless otherwise noted; Only includes raises ≥100M.

Q4 2023 had the largest global total licensing deal volume and value over the past three years

Average deal size increased ~81% since Q3 and deal volume increased by ~71%, indicating increased deal activity across all development stages.

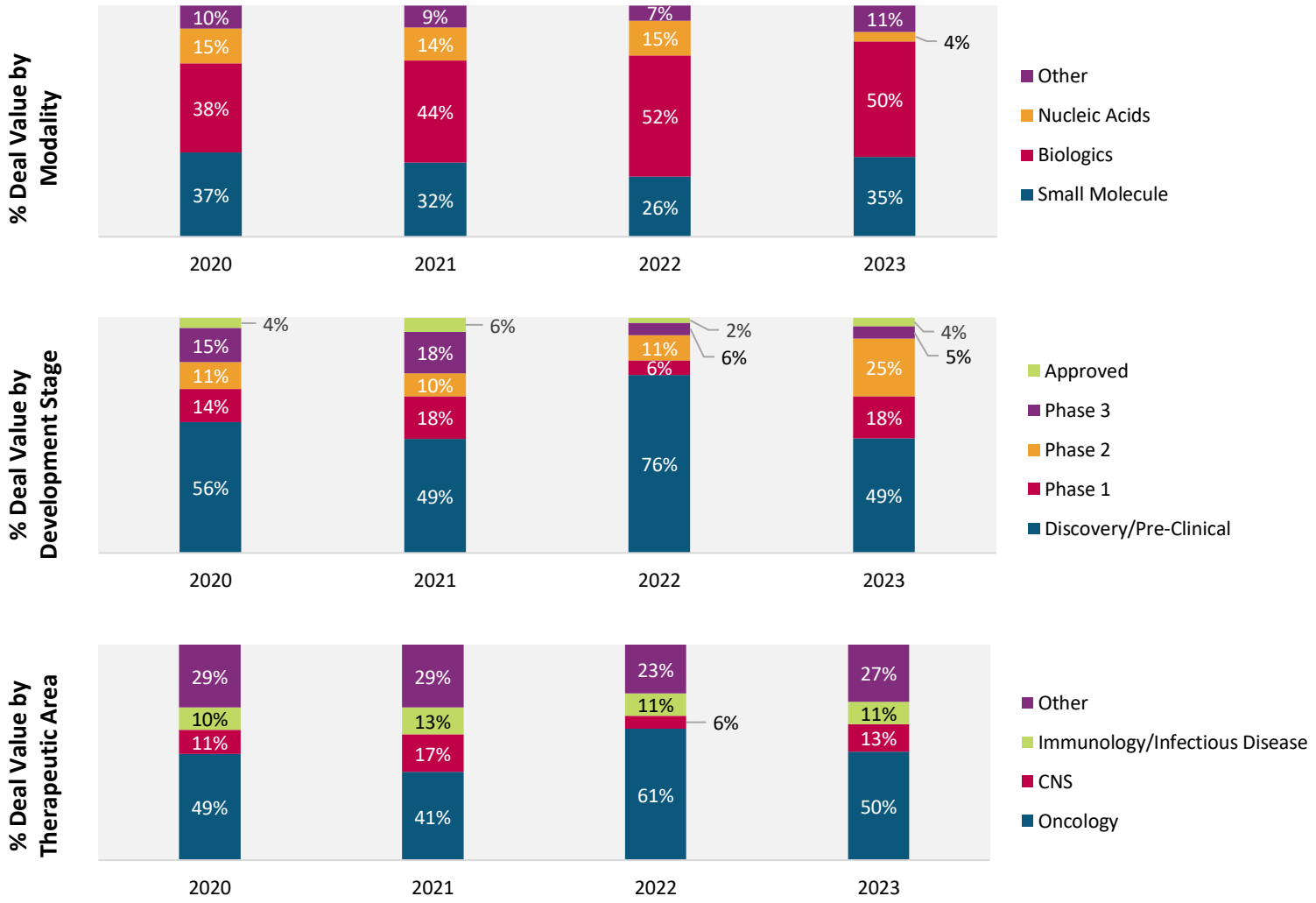
Licensing Deals by Quarter With Development Stage Breakdown[1]



Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): "Not Applicable" represents large deals with multiple drugs of significantly varying development stages. (1) Includes WW and US licensing deals; Excludes ex-US regional deals; Excludes Deals with undisclosed value; Excludes Medtech, Distribution-only and CMO/CDMO-only. (2) Daiichi Sankyo & Merck deal worth up to $22B.

While partners continue to show a willingness to invest in preclinical/discovery stage technologies, overall interest in Phase 1 and Phase 2 deals grew in 2023



Key Takeaways:

- Aggregate licensing deal value for Ph 1 assets jumped ~3x from 2022 levels, signifying a reversal in the bimodal preclinical / post-PoC deal distribution that characterized the 2022 landscape
- Across 2023, licensing deals continue to be heavily backloaded, with total upfront consideration accounting for only ~18% of total deal value in Q4
- Biologics and small molecules make up ~85% of deal values as preference for these modalities has remained consistent over the past 4 years
- While partner interest in oncology remains high, increasing interest in CNS may reflect further diversification in deal-making

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): Includes WW and US licensing deals; Excludes ex-US regional deals; Excludes deals with undisclosed value; Includes deals with total value >$50M; Excludes Medtech, Distribution-only and CMO/CDMO-only deals; Development stage values excludes deals with undisclosed development stage; Data label only provided for values >1%; CNS includes CNS, PNS, Pain and Psychiatric Disorders.

Large partnering deals (>$1B) were seen in mostly early-stage programs (1/3)

There were a limited number of large late-stage partnering deals compared to discovery/preclinical and Phase 1 deals. Most transactions were for oncology indications and involved a large pharma partner.

Q4 2023 Licensing Deals

Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
Daiichi-Sankyo	MERCK	Phase 2	5,500/22,000	10/19/2023	Oncology	Merck to develop and co-commercialize Daiichi Sankyo's ADCs HER3-DXd, ifinatamab, I-DXd, and R-DXd for cancer indications worldwide
SYSTIMMUNE	Bristol Myers Squibb	Phase 2	800/8,400	12/11/2023	Oncology	Systimmune and Bristol Myers Squibb announced an exclusive license and collaboration for Systimmune's BL-B01D1, a potentially first-in-class EGFRxHER3 bispecific ADC
C4 Therapeutics	MERCK	Discovery	10/3,110	12/12/2023	Oncology	License and collaboration agreement to develop degrader-antibody conjugates (DACs) for an undisclosed oncology target
AVIDITY BIOSCIENCES	Bristol Myers Squibb	Discovery	100/2,300	11/28/2023	Cardiovascular	Research collaboration and licensing agreement for Antibody Oligonucleotide Conjugates (AOCs) for multiple cardiovascular targets where Bristol Myers Squibb will fund all future clinical development and commercialization coming from this collaboration
Monte Rosa THERAPEUTICS	Roche	Discovery	50/2,050	10/18/2023	Neurology / Oncology	Roche to license Monte Rosa's QuEEN targeted protein degradation platform for cancer and neurological diseases previously considered impossible to drug with the option to expand to additional targets within the next two years
ECCOGENE 诚益生物	AstraZeneca	Phase 1	185/2,010	11/9/2023	Metabolic	License agreement for ECC5004, a GLP-1RA for treatment of obesity, type-2 diabetes, and other cardiometabolic conditions in all territories except China
LCB LegoChemBio	Johnson & Johnson	Phase 2	100/1,700	12/26/2023	Oncology	Janssen to develop and commercialize LegoChem's LCB-85, a Trop2 directed ADC, for oncology indications

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): Showing licensing deals >$1B in total deal value; (1) Stage indicates latest stage of development for all assets involved; (2) All values in USD M unless otherwise noted and includes upfront payment and preclinical research milestones; ADC = Antibody Drug Conjugate.

Large partnering deals (>$1B) were seen in mostly early-stage programs (2/3)

There were a limited number of large late-stage partnering deals compared to discovery/preclinical and Phase 1 deals. Most transactions were for oncology indications and involved a large pharma partner.

Q4 2023 Licensing Deals

Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
HANSOH PHARMA	GSK	Phase 2	185/1,700	12/20/2023	Oncology	GSK signed a license agreement to develop and commercialize Hansoh Pharma's HS-20093 against lung cancer and other solid tumors worldwide
HENGRUI	MERCK	Phase 1	169/1,648	10/20/2023	Oncology	Merck to license Jiangsu Hengrui's PARP1 inhibitor, HRS-1167 for advanced solid tumors with the option to license the Claudin-18.2 ADC, SHR-A1904
HANSOH PHARMA	GSK	Phase 1	85/1,570	10/20/2023	Oncology	GSK to license Hansoh's HS-20089, a B7-H4 targeted ADC in Phase 1 for oncology indications
teva	sanofi	Phase 2	500/1,500	10/3/2023	Immunology	Sanofi to co-develop and commercialize Teva's TEV'574 in Phase 2b clinical trials for Ulcerative Colitis and Crohn's Disease
ENSEM THERAPEUTICS	BeiGene	IND-filing	Undisclosed/1,330	11/21/2023	Oncology	BeiGene to license ENSEM's CDK2 inhibitor with an undisclosed upfront payment alongside development, regulatory, and commercial milestones
KBP BIOSCIENCES	novo nordisk	Phase 3	Undisclosed/1,300 (Asset purchase)	10/16/2023	Cardiovascular	Novo Nordisk acquired ocedurenone for uncontrolled hypertension with potential application in cardiovascular and kidney disease
Chong Kun Dang Pharm. Seoul,Korea	NOVARTIS	Phase 1	80/1,280	11/6/2023	Genetic Disorders	Chong Kun Dang Corp out-licensed CKD-510, a small molecule HDA6 inhibitor for an upfront payment with milestones for future development, approval, and sales

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): Showing licensing deals >$1B in total deal value; (1) Stage indicates latest stage of development for all assets involved; (2) All values in USD M unless otherwise noted and includes upfront payment and preclinical research milestones.

Large partnering deals (>$1B) were seen in mostly early-stage programs (3/3)

There were a limited number of large late-stage partnering deals compared to discovery/preclinical and Phase 1 deals. Most transactions were for oncology indications and involved a large pharma partner.

Q4 2023 Licensing Deals

Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
NONA BIOSCIENCES	Pfizer	Phase 1	53/1,110	12/14/2023	Oncology	Pfizer licensed HBM9033, an MSLN-targeted ADC from Nona Biosciences, and will run all clinical development and commercialization
LEGEND BIOTECH	NOVARTIS	Phase 1	100/1,100	11/13/2023	Oncology	Novartis licensed Legend Biotech's CAR-T therapies targeting DLL3, including BL2102 for NSCLC and neuroendocrine carcinoma, where Legend Biotech will conduct the Phase 1 trial and Novartis will run all other development
MediLink Therapeutics	BIONTECH	Preclinical	70/1,070	10/13/2023	Oncology	MediLink and BioNTech entered a strategic research collaboration and worldwide license agreement where MediLink will grant BioNTech exclusive global rights for development and commercialization of an ADC asset for HER3 cancer targets
BIOTHEUS 普米斯生物技术	BIONTECH	Preclinical/Phase 3	55/1,055	11/6/2023	Oncology	Strategic research collaboration, option, and license agreement for a preclinical-stage bispecific antibody and a clinical-stage monoclonal antibody for cancer
HENGRUI	elevar therapeutics	BLA-filing	Undisclosed/1,000	10/27/2023	Oncology	Elevar licensed Hengrui's anti-PD1 antibody camrelizumab in combination with rivoceranib for uHCC worldwide
Johnson & Johnson	GSK	Phase 3	Undisclosed/1,000	10/31/2023	Infectious Disease	Janssen granted a license to GSK to further develop and commercialize JNJ-3989, a CHB-targeted siRNA that was previously in-licensed from Arrowhead Pharmaceuticals in 2016

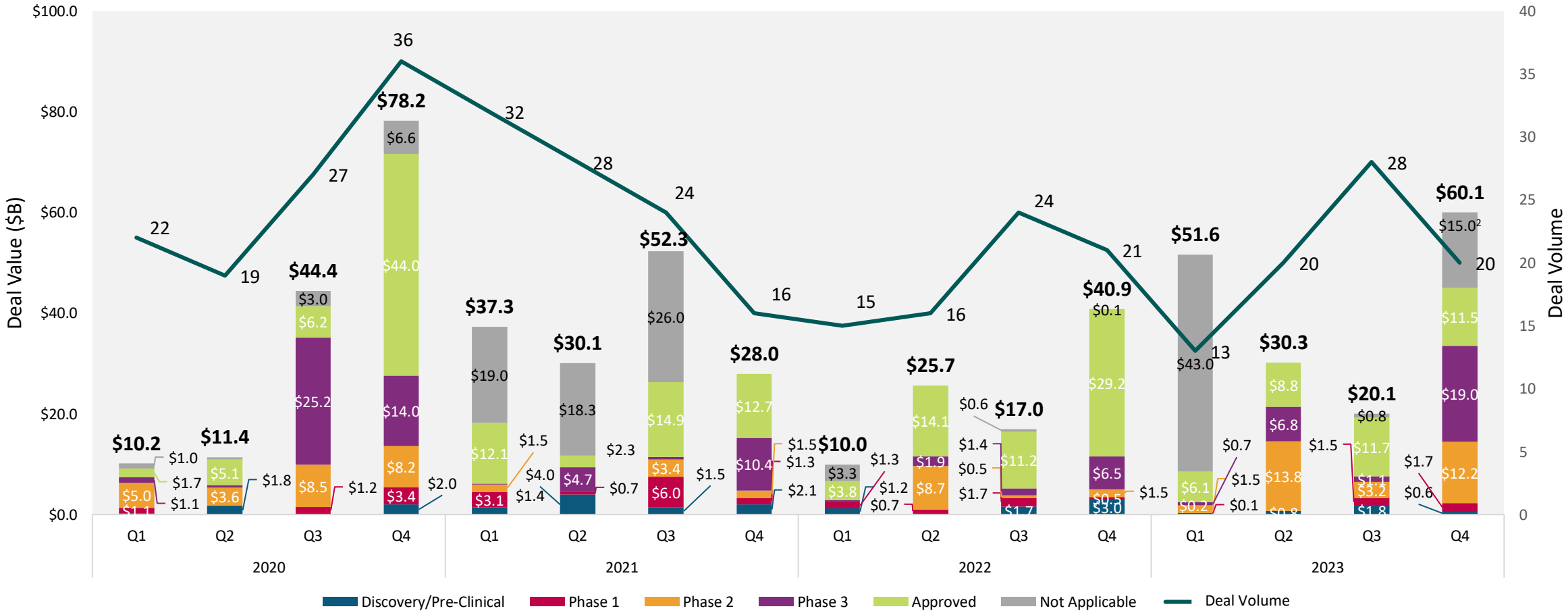
Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): Showing licensing deals >$1B in total deal value; (1) Stage indicates latest stage of development for all assets involved; (2) All values in USD M unless otherwise noted and includes upfront payment and preclinical research milestones; CHB = Chronic Hepatitis B; uHCC = Unresectable Hepatocellular Carcinoma.

M&A deal volume decreased by 29% since Q3, while total deal value nearly tripled in Q4 versus Q3

Q4 saw a significant increase in aggregate deal value and was the largest quarter since Q4 2020.

M&A Deals by Quarter With Development Stage Breakdown[1]



Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): "Not Applicable" represents large deals with multiple drugs of significantly varying development stages; (1) Includes WW and US M&A and Asset Purchase Agreement Deals; Excludes Deals with undisclosed value; Excludes Medtech, Distribution-only and CMO/CDMO-only deals; (2) Includes Karuna Therapeutics & BMS deal worth $14B.

The M&A aperture in Q4 2023 shifted significantly earlier from the approved product focus seen in 2022, though minimal value continues to be ascribed to pre-Ph 2 assets

Key Takeaways:

- Long-term effects of the IRA remain to be seen, as small molecule deal activity continued its upward trend in 2023 despite headwinds
- Buyers showed greater interest in Phase 2 on a relative basis than in any year from 2020-2022, indicating a willingness or need to take risks on earlier-stage programs to fill pipeline gaps
- Despite somewhat earlier aperture, M&A activity was still predicated on meaningful clinical validation, with minimal value ascribed to Phase 1 / preclinical deals
- At the close of 2023, the clear trend in value ascribed to CNS and immunology/infectious diseases continued, increasing from a combined 14% in 2020 to now 48% in 2023

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): Includes WW and US M&A and Asset Purchase Agreement Deals; Excludes ex-US regional deals; % deal value by dev. stage graph excludes non-applicable deals from percent calculations; Includes Deals with total value >$50M; Excludes Deals with undisclosed value; Excludes Medtech, Distribution-only and CMO/CDMO-only Deals.

M&A equity premiums in Q4 increased slightly from Q3 values, as would be expected given the larger average deal size despite companies being in earlier stages of development

Q4 2023 M&A Equity Premiums

Seller	Buyer	Deal Date	Total Deal Value ($M)	Buy Price per Share	Pre-Deal 52-Week High	52-Week High Premium	30-Day VWAP	Equity Premium
KARUNA THERAPEUTICS	Bristol Myers Squibb	12/22/2023	14,000	$330.00	$245.00	35%	$199.95	65%
immunogen	abbvie	11/30/2023	10,100	$31.26	$31.26	51%	$15.02	108%
cerevel	abbvie	12/6/2023	8,700	$45.00	$38.24	18%	$29.73	51%
RayzeBio	Bristol Myers Squibb	12/25/2023	4,100	$62.50	$35.98	74%	$25.85	142%
POINT BIOPHARMA	Lilly	10/3/2023	1,400	$12.50	$11.13	12%	$7.44	68%
GRACELL	AstraZeneca	12/23/2023	1,200	$10.00	$6.99	43%	$5.19	92%
ICOSAVAX	AstraZeneca	12/12/2023	1,100	$15.00	$11.99	25%	$9.45	59%
Orchard therapeutics	KYOWA KIRIN	10/5/2023	478	$16.00	$8.35	92%	$6.64	141%
							Mean Equity Premium	**91%**
							Median Equity Premium	**80%**

Q4 M&A equity premiums increased slightly from those observed in Q3 (87% mean, 73% median)

Sources: BioSciDB; Cortellis; GlobalData; Company Press Release; Yahoo Finance; Locust Walk Analysis.
Note(s): Excludes private and foreign listed "Seller" companies; Excludes M&A deals with stock considerations; Showing M&A deals >$100M in total deal value.

Large pharma companies continue to focus on later stage assets for large M&A deals

Biopharma M&A activity showed a focus on mostly clinical-stage deals in Oncology, Neurology, and Gastrointestinal indications.

Q4 2023 M&A Deals

Seller	Buyer	Acquisition Announcement Date	Stage[1]	Deal Size ($M)[2]	Therapeutic Area	Deal Subject
KARUNA THERAPEUTICS	Bristol Myers Squibb	12/22/2023	Phase 3	14,000	Neurology	Bristol Myers Squibb signed a definitive agreement to acquire Karuna Therapeutics to add their pipeline of psychiatric drugs including the lead asset, KarXT, for schizophrenia and psychosis
immunogen	abbvie	11/30/2023	Approved	10,100	Oncology	AbbVie acquired ImmunoGen and its flagship cancer therapy, ELAHARE, an ADC approved for platinum-resistant ovarian cancer, to advance AbbVie's commercial and clinical presence in the solid tumor space
cerevel	abbvie	12/6/2023	Phase 3	8,700	Neurology	AbbVie acquired Cerevel Therapeutics for a total equity value of $8.7B to add to their neuroscience pipeline, including emraclidine, a positive allosteric modulator of the M4 receptor for schizophrenia
Telavant	Roche	10/23/2023	Phase 2	7,250	Gastrointestinal	Roche entered a definitive agreement with Roivant to acquire Telavant Holdings, adding Telavant's RVT-3101, a TL1A directed antibody in development for IBD, UC, and Crohn's disease
MIRATI THERAPEUTICS	Bristol Myers Squibb	10/8/2023	Phase 3	4,800	Oncology	Bristol Myers Squibb entered into an agreement to acquire Mirati Therapeutics to access their oncology pipeline targeting the MTAP and MAPK pathways
RayzeBio	Bristol Myers Squibb	12/25/2023	Phase 3	4,100	Oncology	Bristol Myers Squib acquired all outstanding shares of RazyeBio, adding their differentiated actinium-based radiopharmaceutical platform and pipeline of drug development programs to Bristol Myers Squibb's oncology franchise
CARMOT THERAPEUTICS	Roche	12/3/2023	Phase 2	3,100	Gastrointestinal	Roche acquired Carmot Therapeutics with $2.7B upfront and potential for $400M in milestone payments to add Carmot's pipeline of metabolic therapeutics including CT-388 for obesity and type-2 diabetes
POINT BIOPHARMA	Lilly	10/3/2023	Phase 3	1,400	Oncology	Eli Lilly announced a definitive agreement to acquire POINT, a radiopharmaceutical company with a pipeline of clinical and preclinical-stage radioligand therapies in development for cancer
GRACELL	AstraZeneca	12/23/2023	Phase 1	1,200	Oncology	AstraZeneca entered into a definitive agreement to acquire Gracell Biotechnologies, a biopharmaceutical company developing cell therapies for cancer and autoimmune diseases
ICOSAVAX	AstraZeneca	12/12/2023	Phase 2	1,100	Infectious Disease	AstraZeneca entered into a definitive agreement to acquire Icosavax, a clinical-stage company focused on developing vaccines using a protein virus-like particle (VLP) platform

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): Showing M&A deals ≥ $1B in total deal value; (1) Stage indicates the most advanced stage of development out of all assets involved; (2) All values in USD M unless otherwise noted; Includes upfront payment and milestones.

Selected Clinical Trial Readouts For Q4 2023 (1/2)

The quarter was marked by a number of key events for Phase 2 and 3 clinical assets across a range of indications.

Q4 2023 Clinical Readouts

Legend: Positive | Neutral | Negative

Company	Sentiment	Asset	Clinical Stage	Therapeutic Area/Indication	Modality/MOA	Description
Akesobio	✓	cadonilimab	Phase 3	Cervical cancer	PD-1 / CTLA-4 antagonist	Cadonilimab in combination with chemotherapy showed statistically significant improvement in overall survival compared to placebo in a Phase 3 trial. Notably, it reduced the risk of death in all-comer patients, and Akesobio noted they will submit a new drug application shortly.
Roche	✓	inavolisib	Phase 3	Breast cancer	P13K inhibitor	Inavolisib aims to improve upon Novartis' Piqray (also targeting P13K) with better potency and selectivity. Phase 3 trial hit the primary endpoint with increased PFS and the potential to significantly impact the treatment paradigm of HR-positive breast cancer if approved.
AnaptysBio	✓	imsidolimab	Phase 3	Hidradenitis suppurativa	IL-26R	Imsidolimab hit its primary endpoint of 13.3% improvement over placebo with 53.3% of patients on the drug receiving a clearing score on the physician assessment scale. Anaptys plans to file for regulatory approval in Q3 2024 and out-license the drug next year.
Cytokinetics	✓	aficamten	Phase 3	Obstructive HCM	Cardiac myosin inhibitor	Aficamten significantly improved exercise capacity and increased peak oxygen uptake compared to placebo in patients with symptomatic obstructive HCM in a Phase 3 interim readout. Full Phase 3 results will be presented in 2024.
SpringWorks Therapeutics	✓	mirdametinib	Phase 2b	Neurofibromatosis Type 1	HER2 tyrosine kinase inhibitor	Mirdametinib achieved a 52% response rate in pediatric patients and 41% response rate in adults with NF1 who have plexiform neurofibromas in a Phase 2b trial. There is only one FDA-approved medication for this condition and major unmet needs remain, suggesting that mirdametinib can make a substantial impact on SoC.
ALTO Neuroscience	✓	ALTO-300	Phase 2a	Major Depressive Disorder	Melatonin and serotonin signaling modulator	Alto Neuroscience used its machine learning-derived biomarker-based platform to develop ALTO-300 for MDD and demonstrated a 50% or greater reduction in depression symptoms with no adverse events. A Phase 2b trial is now enrolling patients and is expected to read out data in 1H 2025.
transcend Therapeutics	✓	TSND-201	Phase 2	PTSD	MDMA analog	Transcend's TSND-201 is a psychoactive MDMA analog that showed consistent PTSD improvements in a Phase 2 trial as measured with the CAP-5 score of PTSD symptoms. There was a small sample size, so part B of the Phase 2 study is now enrolling with data expected in the first half of 2025.
imbria Pharmaceuticals	✓	ninerafaxstat	Phase 2	Chronic stable angina and cardiomyopathy	Fatty acid oxidation inhibitor	Ninerafaxstat produced positive Phase 2 data in both cardiomyopathy and chronic stable angina indications. The primary endpoint for angina was met with a reduction in the incidence of treatment-emergent adverse events which confirms the anti-schemic effect of ninerafaxstat to support further development in cardiac ischemic disorders.

Sources: Fierce Biotech; Locust Walk Analysis.

Note(s): Includes Phase 2 and Phase 3 clinical results only; Includes select results from Big Pharma companies and non-Big Pharma companies deemed pivotal or breakthrough by Locust Walk; CAP-5 = Clinician-Administered PTSD Scale for DSM-5; HCM = Hypertrophic cardiomyopathy; PTSD = Post-Traumatic Stress Disorder.

Selected Clinical Trial Readouts For Q4 2023 (2/2)

The quarter was marked by a number of key events for Phase 2 and 3 clinical assets across a range of indications.

Q4 2023 Clinical Readouts

Legend: ✓ Positive — Neutral ✗ Negative

Company	Sentiment	Asset	Clinical Stage	Therapeutic Area/Indication	Modality/MOA	Description
CONNECT BIOPHARMA	✓	rademikibart	Phase 2b	Moderate to Severe Asthma	IL-4 inhibitor	Rademikibart met its primary endpoint of change from baseline in forced expiratory volume (FEV) and up to 50% reduction in severe asthma lasting through 24 weeks of treatment. Connect will soon discuss rademikibart's Phase 3 regulatory path with the FDA to be a potentially transformational therapy for uncontrolled asthma patients.
MoonLake	✓	sonelokimab	Phase 2	Psoriatic Arthritis	IL-17 inhibitor	Sonelokimab, a trivalent camelid nanobody, induced a 50% or greater reduction in symptoms of psoriatic arthritis in a Phase 2 trial. It also achieved all secondary endpoints with a 90% or greater improvement from baseline on the Psoriasis Area and Severity Index score. Both doses of sonelokimab outperformed Humira on the primary endpoint which supports its potential as a future leading therapy.
lumos PHARMA	✓	LUM-201	Phase 2	PGHD	GH agonist	Lumos Pharma's stock soared from a successful Phase 2 trial for LUM-201 in moderate PGHD. Preliminary data showed that the drug maintained effectiveness for up to 24 months with no safety concerns. Lumos plants to initiate a Phase 3 pivotal trial in 1H 2024.
Pfizer	—	marstacimab	Phase 3	Hemophilia	Anti-tissue factor pathway inhibitor	Pfizer released data from the Phase 3 BASIS trial with 92% reduction in bleeds and a strong safety profile. However, it did not meet a secondary goal of improving hemophilia quality-of-life indicators and failed to demonstrate superior results over existing treatments.
ISA Pharmaceuticals	—	ISA101b	Phase 2	Oncology	HPV16	ISA101b failed to meet its primary endpoint of ORR across the entire population but saw doubling of ORR in a specific subgroup of patients. ISA Pharmaceuticals plans to continue with a Phase 3 study to expand the patient population.
PHARNEXT	✗	PXT3003	Phase 3	Charcot-Marie-Tooth disease type 1A	PMP22 downregulation	Phase 3 trial showed that PXT3003 could not improve functional motor disability. Pharnext's stock crashed 68% as a result and they are looking for out-licensing or acquisition opportunities for PXT3003. Pharnext will continue to analyze the data and hopes for positive Phase 3 data from its partner, Tasly.
MERCK	✗	vibostolimab	Phase 2	NSCLC	Anti-TIGIT	Vibostolimab failed PFS and OS endpoints in all combination groups in a Phase 2 trial with 29.4% of patients showing adverse events compared to 12% in the control arm. Merck aims to continue the study in broader populations outside of the notably difficult-to-treat NSCLC indication.
Jazz Pharmaceuticals	✗	JZP150	Phase 2	PTSD	FAAH inhibitor	JZP150 was unable to show a statistically significant decrease in the severity of PTSD symptoms over placebo, missing the Phase 2 trial's primary endpoint. As a result, Jazz plans to drop this therapy altogether.

Sources: Fierce Biotech; Locust Walk Analysis.

Note(s): Includes Phase 2 and Phase 3 clinical results only; Includes select results from Big Pharma companies and non-Big Pharma companies deemed pivotal or breakthrough by Locust Walk; PGHD = Pediatric Growth Hormone Deficiency; NSCLC = Non-Small Cell Lung Cancer; FAAH = Fatty Acid Amide Hydrolase.

Quarterly FDA New Drug Approvals

Q4 2023 saw 18 new drug and biologics license applications, mainly from big pharma, with 6 of the 18 approvals for oncology indications.

Q4 2023 FDA Approvals

New Drug Application (NDAs) | *Biologics License Application (BLAs)* | *Orphan Designation*

Dec '23: Filsuvez (birch triterpenes)
To treat wounds associated with dystrophic and junctional epidermolysis bullosa
AMRYT PHARMA

Dec '23: Fabhalta (iptacopan)
To treat paroxysmal nocturnal hemoglobinuria
NOVARTIS

Dec '23: Wainua (eplontersen)
To treat polyneuropathy of hereditary transthyretin-mediated amyloidosis
NOVARTIS

Nov '23: Ogsiveo (nirogacestat)
To treat adults with progressing desmoid tumors who require systemic treatment
SpringWorks THERAPEUTICS

Nov'23: Truqap (capivasertib)
To treat HR-positive, HER2-negative, locally advanced or metastatic breast cancer
AstraZeneca

Nov '23: Ryzneuta (efbemalenograstim alfa-vuxw)
Indicated for chemotherapy-induced neutropenia
EVIVE

Nov '23: Augtyro (repotrectinib)
Indicated for ROS1-positive non-small cell lung cancer
Bristol Myers Squibb

Nov '23: DefenCath (taurolidine, heparin)
To reduce the incidence of catheter-related bloodstream infections with kidney failure
CorMedix

Nov '23: ADZYNMA (ADAMTS13, recombinant-krhn)
Intended for prophylactic or on demand enzyme replacement therapy for cTTP patients
Takeda

Nov '23: IXCHIQ (Chikungunkya vaccine)
Intended for active immunization for prevention of disease caused by chikungunya virus
valneva

Nov '23: Fruzaqla (fruquintinib)
Indicated for refractory, metastatic colorectal cancer
Takeda

Oct '23: Loqtorzi (toripalimab-tpzi)
To treat recurrent or metastatic nasopharyngeal carcinoma
Coherus BIOSCIENCES

Oct '23: Omvoh (mirikizumab-mrkz)
Indicated for ulcerative colitis
Lilly

Oct '23: PENBRAYA (Meningococcal vaccine)
Indicated to prevent invasive disease by Neisseria meningitidis serogroups
Pfizer

Oct '23: Agamree (vamorolone)
To treat Duchenne Muscular Dystrophy
santhera Pharmaceuticals

Oct '23: Bimzelx (bimekizumab-bkzx)
To treat moderate to severe plaque psoriasis for systemic or phototherapy candidates
ucb

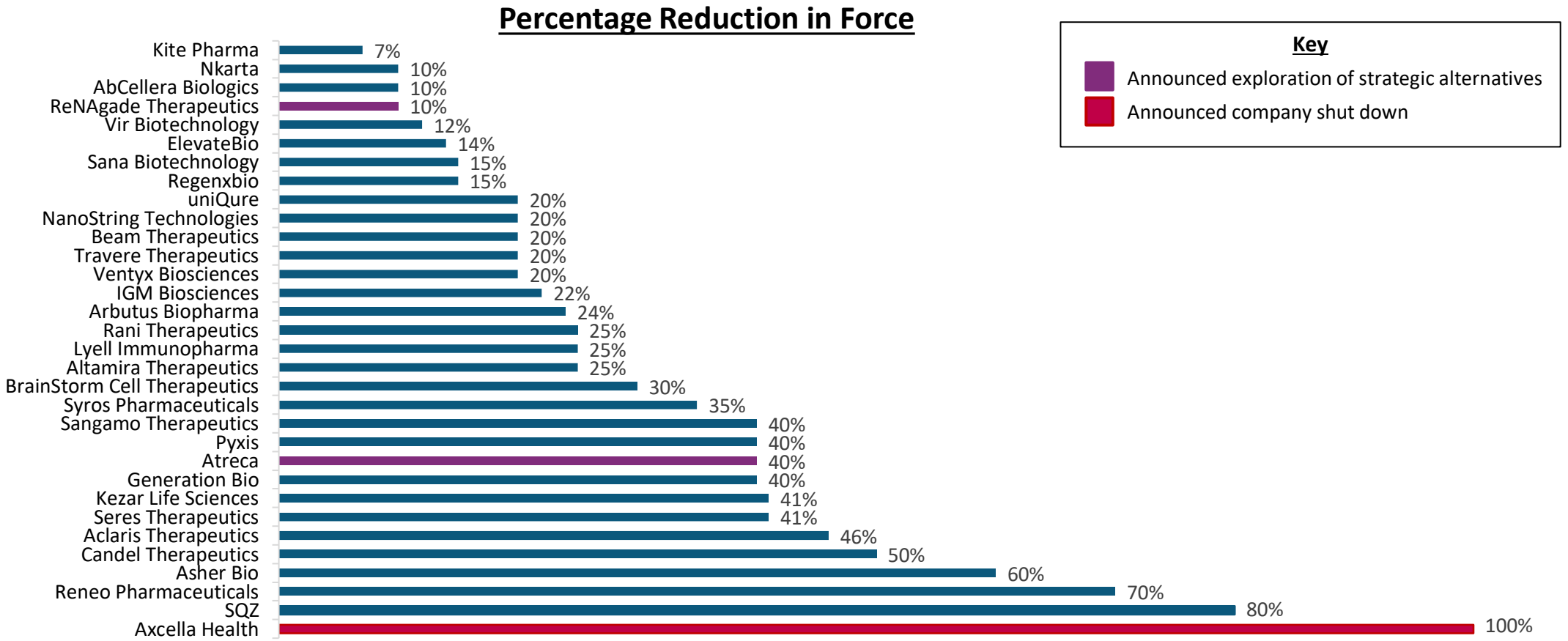
Oct '23: Zilbrysq (zilucoplan)
Indicated for generalized myasthenia gravis in anti-AChR antibody positive patients
ucb

Oct '23: Velsipity (etrasimod)
To treat moderate to severe ulcerative colitis in adults
Pfizer

Sources: FDA; Locust Walk Analysis.
Note(s): AChR = Acetylcholine receptor; cTTP = Congenital thrombotic thrombocytopenic purpura; HER2 = Human epidermal growth factor receptor 2.

Despite the uptick in XBI and deal activity, significant layoffs continued for the industry in Q4

As a continuation of the trend from last quarter, 24 small to mid-sized biopharma companies laid off 20%+ of their workforce in Q4, with Atreca announcing exploration of strategic alternatives and Axcella Health shutting down.



Other notable RIFs that did not fit the data parameters: Pfizer (1,291 employees and a facility with 940 employees), Galapagos (400 employees), Amgen (350 employees), Indorsia (300 employees), Ferring Pharmaceuticals (134 employees), Biogen (113 employees), Gilead (45 employees), Kintara Therapeutics (CSO and consultants), Oxurion (reducing team to 10 employees), Orna Therapeutics (undisclosed), Novavax (undisclosed), CRISPR Therapeutics (undisclosed), Eikon Therapeutics (undisclosed), Atsena Therapeutics (undisclosed)

Sources: Fierce Biotech; Locust Walk Analysis.
Note(s): RIF = Reduction in force.

TABLE OF CONTENTS

Comments

Global/US

Europe

Asia

About Locust Walk

Europe Biopharma Transaction Activity Overview for Q4 2023

Private financing market activity in Europe rose to levels not seen since 2021; however, European strategic transaction activity remained depressed relative to the highs observed during the COVID-19-fueled rush in 2020 – 2021.

Private Financing Deals

- European private financing deal value in Q4 2023 (i.e., $735M) rose to the highest value observed since Q4 2021, accompanied by deal volume increasing 150% from Q2, representing the highest quarterly deal volume since Q2 2021
- 2023 saw a trend towards early-stage rounds, most notably with a 41% increase in Series A deals compared to 2022, a trend not seen in other geographies
- European private company financing activity has historically been driven by earlier-stage companies (i.e., pre-clinical, Phase 1); however, 2023 saw an uptick in Phase 2 deals, signaling a potential shift in investor focus to more de-risked approaches
- Biologics and small molecules remained the preferred modalities, in line with historical trends (i.e., 60 – 65% of aggregate deal value from 2021 – 2023)

Strategic Transactions

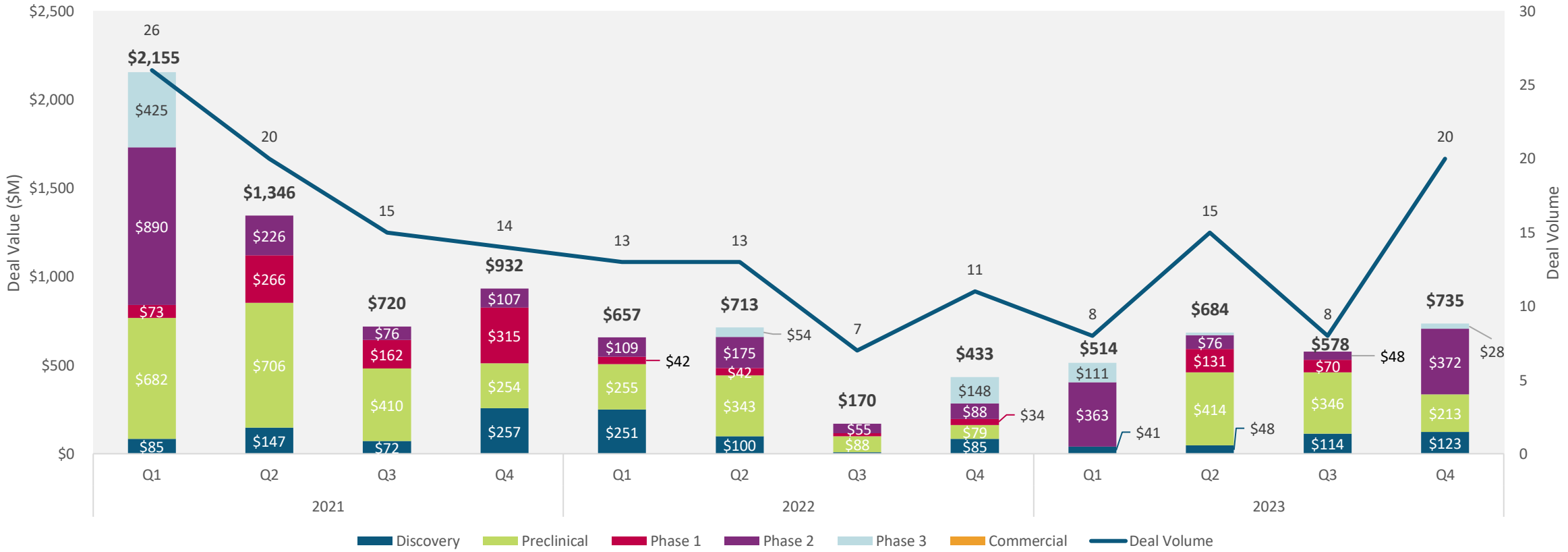
- M&A Activity
  - European biopharma M&A activity declined this quarter, with only two acquisitions and an aggregate value of $1B; however, aggregate deal value remained in line with values observed since Q1 2022 (i.e., $0.6 – $1.7B for all quarters Q1 2022 – Q4 2023[1])
  - From an annual perspective, aggregate M&A deal value in 2023 increased 62% from 2022, though European M&A remained limited compared to 2021
- Licensing Activity
  - European biopharma companies executed 11 licensing deals in Q4 2023, consistent with the 11 deals in Q3; however, the aggregate and average deal value dropped meaningfully (i.e., 47% and 51%, respectively) compared to Q3
  - 2023 saw an 18% decline in aggregate deal value relative to 2022, with total deal volume similarly decreasing 27% in 2023
  - From a qualitative perspective, later-stage licensing deals accounted for a higher proportion of overall deal value relative to 2022 (but in line with 2020 and 2021), in line with a consistent preference for de-risked opportunities seen across deal types and geographies

Source: Locust Walk Analysis.
Note: (1) Notable exception of Q2 2023, where M&A aggregate deal value reached $3.6B.

Private European biopharma companies raised a total of $2.5B across 51 deals in 2023, representing a 29% increase in aggregate deal value and 16% increase in deal volume from 2022

Relative to Q3, average deal value for European private company venture financings increased 32% and deal volume increasing 150%, representing the highest quarterly deal volume since Q2 2021.

Venture Financings Deals by Quarter with Development Stage Breakdown[1,2]



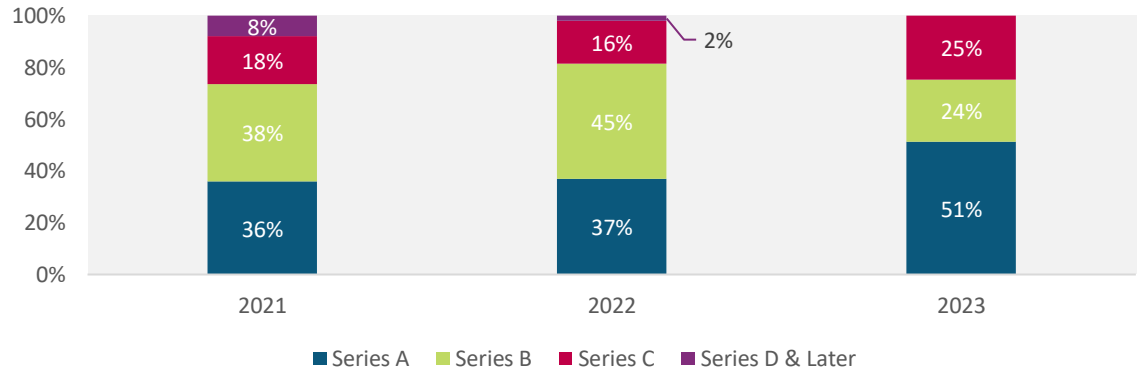
Sources: PitchBook; Locust Walk Analysis.

Note(s): (1) Includes only Series A and later-stage financings; (2) Data labels only provided for values >$20M.

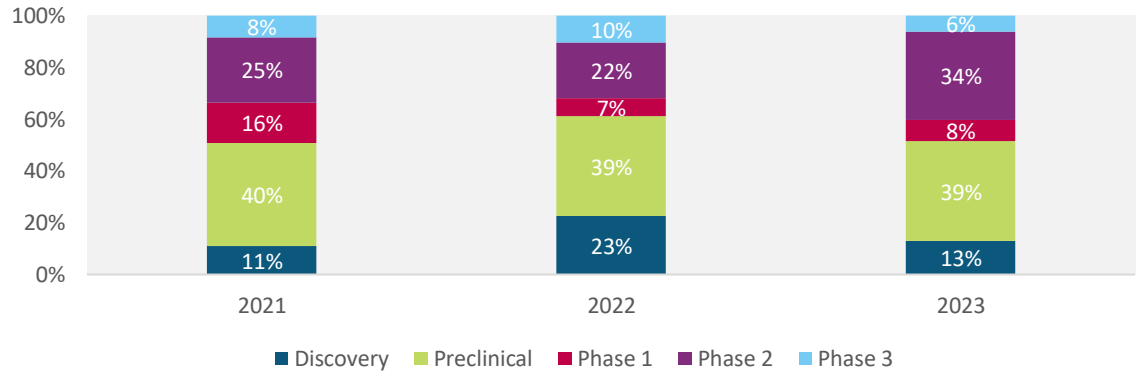
In 2023, European investments showed an uptick in Series A raises in contrast to the US / global environment

Percent of deal value by development stage remained consistent year-to-year in Europe, a trend that is not seen in the US or Asian markets.

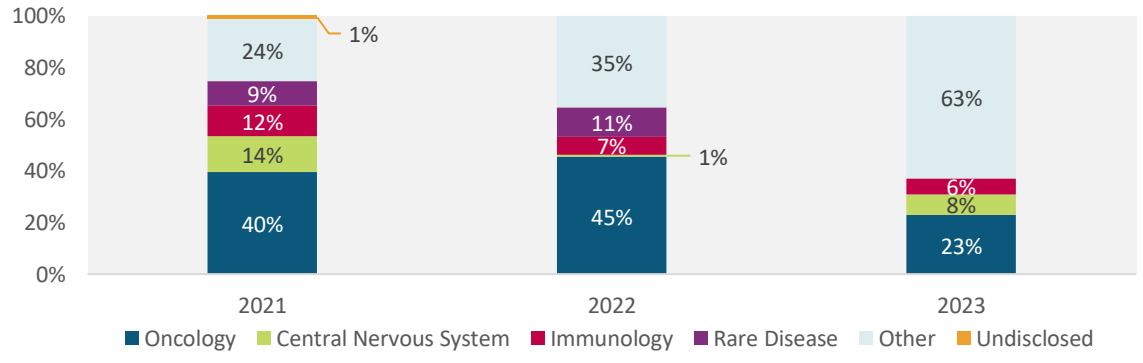
Percent of Deal Value by Series Round[1,2]



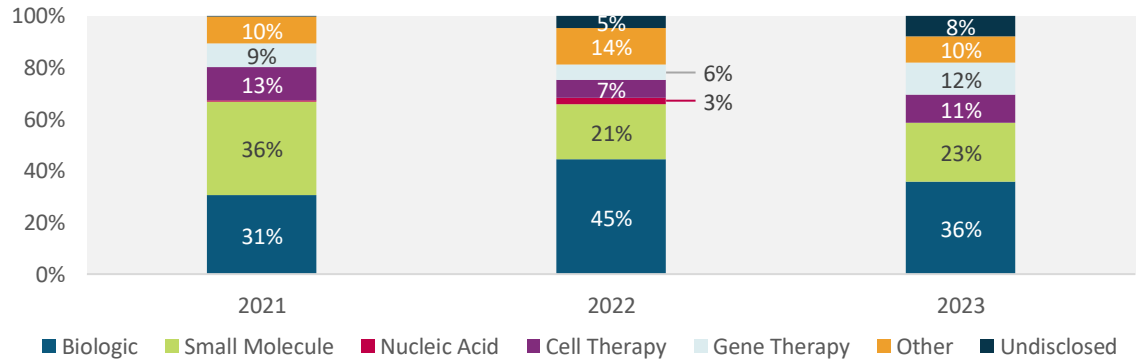
Percent of Deal Value by Development Stage[1,2]



Percent of Deal Value by Therapeutic Area[1,2]



Percent of Deal Value by Modality[1,2]



Sources: PitchBook; Locust Walk Analysis.

Note(s): (1) Includes only Series A and later-stage financings; (2) Data labels only provided for values >1%.

Q4 2023 Highlighted Private Financing Rounds (1/2)

20 European biopharma companies completed private venture rounds in Q4 2023, spanning broad therapeutic areas.

Investment Rounds						
Company	**Series**	**Raised ($M)[1]**	**Deal Date**	**Lead Investor(s)**	**Therapeutic Area**	**Company Description**
VectorY Therapeutics	Series A	137	11/13/2023	*EQT Life Sciences, Forbion Investment*	Musculoskeletal	Developer of a medical platform combining the therapeutic potential of antibodies and gene therapy
EyeBio	Series A	130	11/14/2023	*Bain Capital, Omega Funds, Vertex Ventures*[2]	Ophthalmology	Developer of a vision therapy intended to protect, restore, and improve vision by protecting against sight-threatening eye diseases
AGOMAB Therapeutics	Series C	100	10/11/2023	*Fidelity Management & Research*	Gastrointestinal	Developer of agonistic antibodies designed to help in the regeneration of damaged tissues
NMD Neuromuscular Disorders	Series B	80	11/15/2023	*Jeito Capital*	Neuromuscular	Operator of a clinical-stage biotech company intended to design drugs and therapeutics for the treatment of neuromuscular disorders
nousCom	Series C	72	11/14/2023	*Andera Partners, Bpifrance, M Ventures*	Oncology	Developer of an immunotherapy platform designed to develop engineered viral vector vaccines for the treatment of cancer
Kynexis	Series A	60	11/7/2023	*Forbion Investment*	Neurology	Developer of a precision medicine intended for the treatment of cognitive impairment associated with schizophrenia
AstronauT Stellar Medicines	Series A	59	10/8/2023	*Novartis Venture Fund*	Neurology	Operator of a biotechnology platform intended for the treatment of Alzheimer's disease and other neurodegenerative diseases
T-Therapeutics	Series A	59	11/15/2023	*Sofinnova Partners, F-Prime Capital, Digitalis Ventures, Cambridge Innovation Capital*	Oncology	Operator of a biopharmaceutical company developing engineered T-cell therapies intended to treat chronic and infectious diseases
FREYA™	Series A	38	12/12/2023	*OMX Ventures, Sofinnova Ventures*	Women's Health	Developer of microbial immunotherapies intended to address needs across a range of women's health indications, using a proprietary approach to engineer live microbes
LimmaTech Biologics	Series A	37	10/9/2023	*Adjuvant Capital, AXA Investment, Novo Holdings*	Infectious Diseases	Clinical-stage biopharmaceutical company that specializes in the research, development, and manufacture of bioconjugate vaccines

Sources: PitchBook; Locust Walk Analysis.

Note(s): (1) All values in USD M unless otherwise noted and rounded to the nearest million; (2) New investors listed; no investor indicated as lead.

Q4 2023 Highlighted Private Financing Rounds (2/2)

20 European biopharma companies completed private venture rounds in Q4 2023, spanning broad therapeutic areas.

Investment Rounds						
Company	**Series**	**Raised ($M)[1]**	**Deal Date**	**Lead Investor(s)**	**Therapeutic Area**	**Company Description**
SHORLA ONCOLOGY	Series B	35	10/4/2023	*Kurma Partners*	Oncology	Developer of oncology medicines designed for rare forms of ovarian and pediatric cancer
ELIGO BIOSCIENCE	Series B	30	12/5/2023	*Sanofi Ventures*	Infectious Diseases	Developer of antibiotics intended to treat microbiome precision and bacteria-associated diseases
MEMO THERAPEUTICS	Series C	28	11/2/2023	*Pureos Bioventures*	Infectious Disease / Oncology	Developer of antibody discovery and immune repertoire analysis platform designed to transform the lives of patients with virus infections and cancer
NETRIS Pharma	Series A	27	12/19/2023	*European Innovation Council Fund, Wille Finance Family Office*[2]	Oncology	Operator of a biopharmaceutical company intended to drive superior clinical benefits for patients in the treatment of cancer
ViaNautis	Series A	25	11/13/2023	*4BIO Capital, BGF, UCB Ventures*	Undisclosed	Developer of nanoparticle technology designed to offer self-assembly polymers for intracellular delivery
hoba	Series A	25	12/11/2023	*Indaco Venture Partners, Medical Incubator Japan*	Neurology	Developer of medical therapeutics designed to assist neuropathic pain and CNS disorders treatments
(Cradle Bio)	Series A	24	11/23/2023	*Index Ventures*	Undisclosed	Developer of an algorithm and artificial intelligence tool designed to help biologists design improved proteins
Vandria	Series A	20	12/14/2023	*ND Capital*	Musculoskeletal	Developer of mitophagy inducers designed to rejuvenate cells to treat age-related and chronic diseases
SOM BIOTECH	Series B	18	12/4/2023	*Prevail Partners*[2]	Neurology	Developer of drugs designed for the treatment of rare and critical diseases, whose artificial intelligence-based drug discovery technology allows for reducing costs and time for drug development
amyl THERAPEUTICS	Series A	5	11/8/2023	*Noshaq Venture Capital*	Metabolic	Operator of a biotechnology company intended to develop therapeutics for the treatment of all forms of amyloidosis

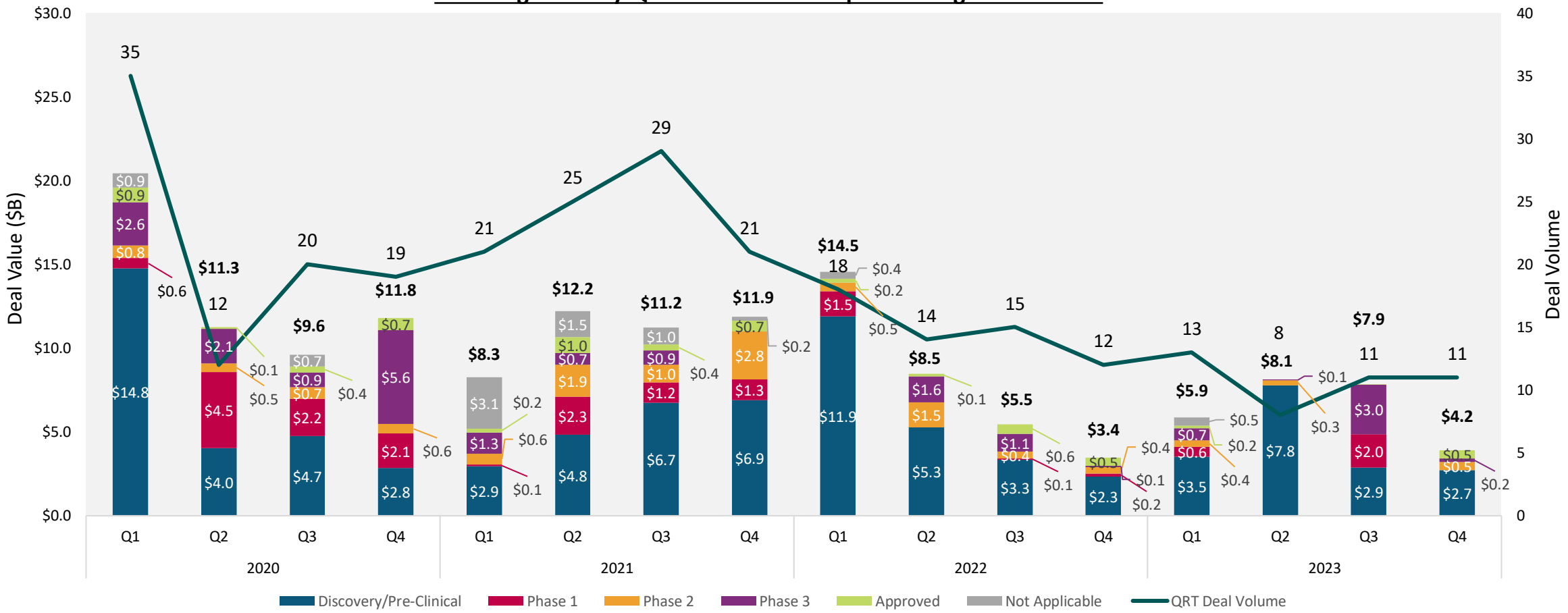
Sources: PitchBook; Locust Walk Analysis.

Note(s): (1) All values in USD M unless otherwise noted and rounded to the nearest million; (2) No investor indicated as lead; new investors listed.

While European biopharma licensing deal volume held relatively steady in Q4, the aggregate and average deal value dropped 47% and 51%, respectively

European biopharma companies executed 43 out-licensing deals worth a total of $26B in 2023, representing a 27% decline in volume and an 18% decline in aggregate deal value from 2022.

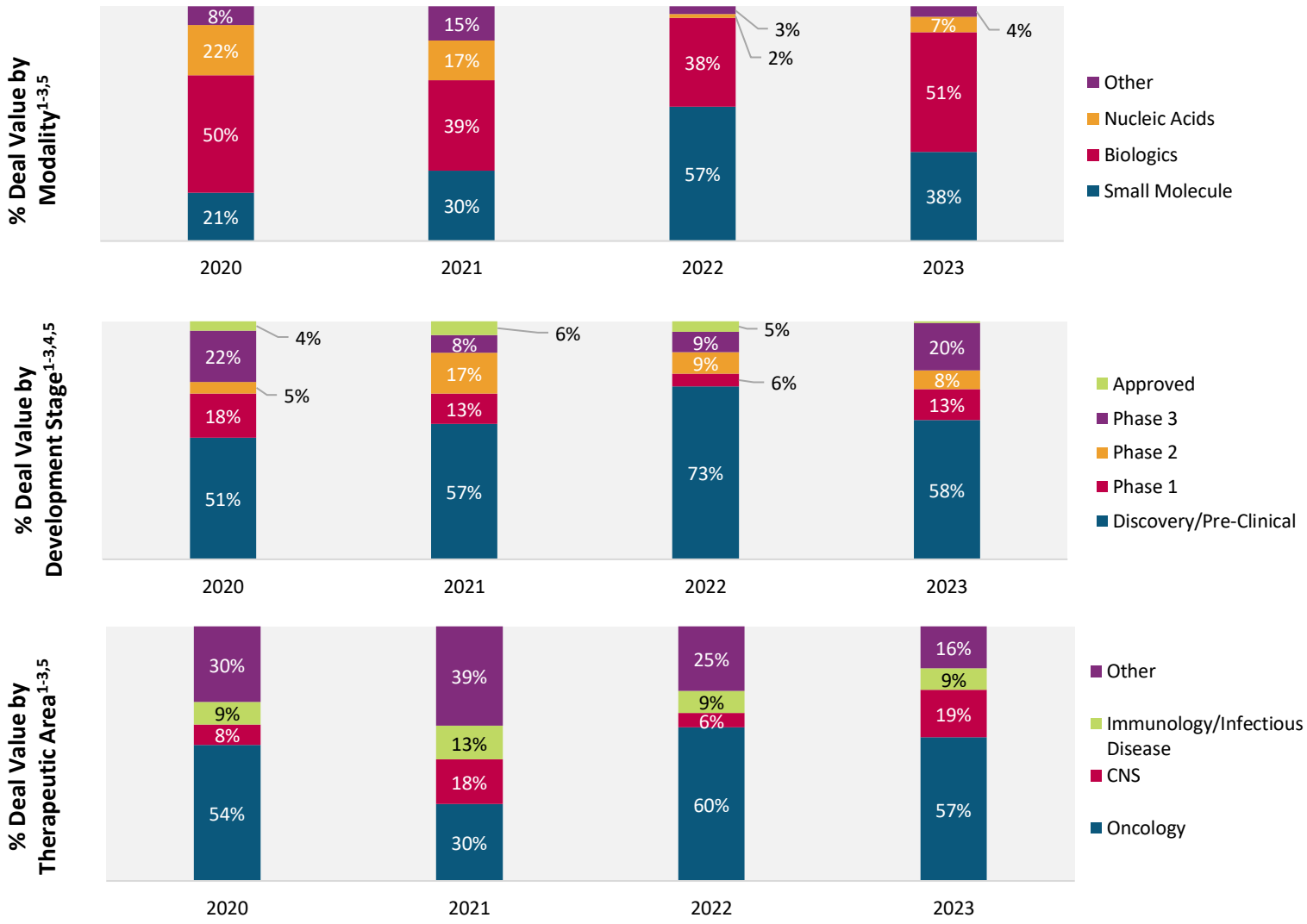
Licensing Deals by Quarter With Development Stage Breakdown[1-3]



Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Includes licensing deals with European Seller or regional European deal; (2) Includes Deals with total value >$50M; Excludes Deals with undisclosed value; (3) Excludes Medtech, Distribution-only and CMO/CDMO-only Deals.

Oncology continued to drive the majority of European licensing deal value in 2023, while shifts in partner interest materialized in greater deal activity across Phase 3, biologic, and CNS programs



Key Takeaways:

- 2023 saw an increased interest in later-stage assets in Europe compared to 2022, in line with trends observed in other geographies
- Total licensing deal value for biologics began to outpace other modalities despite continued interest in small molecules
- Europe showed a similar preference to the US in therapeutic areas, with the value attributed to CNS licensing deals notably increasing from 2022

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Includes licensing deals with European Seller or regional European deal; (2) Includes Deals with total value >$50M; Excludes Deals with undisclosed value; (3) Excludes Medtech, Distribution-only and CMO/CDMO-only Deals; (4) Development stage values excludes deals with undisclosed development stage; (5) Data labels only provided for values >1%.

Q4 2023 Europe Licensing Deal Activity (1/2)

Global licensing deals accounted for most of the total European licensing deal activity, with a significant focus on Oncology in Q4.

Global EU Licensing Deals (i.e., Global deals executed by EU-based companies)

Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
autifony THERAPEUTICS	Jazz Pharmaceuticals	Preclinical	Undisclosed/771	11/14/2023	Neurology	The companies formed a collaboration to develop drug candidates targeting two ion channel targets associated with CNS disorders
Synaffix connect to cure	sotio MEMBER OF PPF GROUP	Preclinical	Undisclosed/740	10/16/2023	Oncology	The companies entered a licensing agreement focused on commercializing Synaffix's clinical-stage platform technology for the development of antibody-drug conjugates (ADCs)
amplyx	basilea PHARMACEUTICA	Phase 2	37/543	11/13/2023	Infectious Disease	Basilea Pharmaceutica signed an asset purchase agreement to acquire fosmanogepix (iv and oral) and acquired the rights to a preclinical antifungal compound
PHENOMIC.AI	Boehringer Ingelheim	Discovery	9/509	11/29/2023	Oncology	The partners will leverage Phenomic's scTx single-cell transcriptomics platform which will greatly enhance Boehringer's efforts to develop first-in-class medicines to transform the lives of people with cancer
ATARA BIO	Pierre Fabre	Marketed	45/365	11/1/2023	Oncology	The companies' alliance leverages Atara's innovative allogeneic anti-Epstein-Barr virus (EBV) T-cell platform for EBVALLO® for the treatment of patients with positive post-transplant lymphoproliferative disease
cellectis EDITING LIFE	AstraZeneca	Preclinical	25/325	11/1/2023	Oncology / Immunology / Rare Diseases	The companies entered into a collaboration to accelerate the development of next generation therapeutics in areas of high unmet need, including oncology, immunology and rare diseases
eTheRNA immunotherapies	almirall	Discovery	Undisclosed/323	12/12/2023	Dermatology / Oncology	The companies announced a multi-target alliance to discover and develop new mRNA-based therapies for severe skin diseases, including non-melanoma skin cancer

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Stage indicates latest stage of development for all assets involved; (2) All values in USD M unless otherwise noted; Includes upfront payment and preclinical research milestones.

Q4 2023 Europe Licensing Deal Activity (2/2)

European biopharma companies closed four regional licensing deals across both in- and out-licensing transaction structures in Q4.

Europe Regional Licensing Deals (i.e., Regional licensing deals for EU rights)

Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
Dimerix	ADVANZ PHARMA	Phase 3	7/139	11/6/2023	Opthalmology	Advanz has been granted exclusive rights to commercialize DMX-200 for FSGS in the European Economic Area, the UK, Switzerland, Canada, Australia, and New Zealand
IONIS	Otsuka	Phase 3	65/Undisclosed[3]	12/7/2023	Immunology	Otsuka Pharmaceutical entered into an exclusive agreement to develop and commercialize Ionis Pharmaceuticals' donidalorsen against hereditary angioedema (HAE) in Europe
Lilly	ORGANON	Marketed	50/50[4]	12/18/2023	Neurology	Organon entered into an agreement to commercialize Eli Lilly's Emgality (galcanezumab) and Rayvow (lasmiditan) against migraine in Europe

Regional Licensing Deals by EU Companies (i.e., Deals executed by EU companies for ex-Europe regional rights)

Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
ACTELION	VANDA PHARMACEUTICALS INC.	Marketed	100/100	12/27/2023	Neurology	Vanda Pharmaceuticals acquired Ponvory (ponesimod) rights from Actelion Pharmaceuticals for relapsing multiple sclerosis in US and Canada

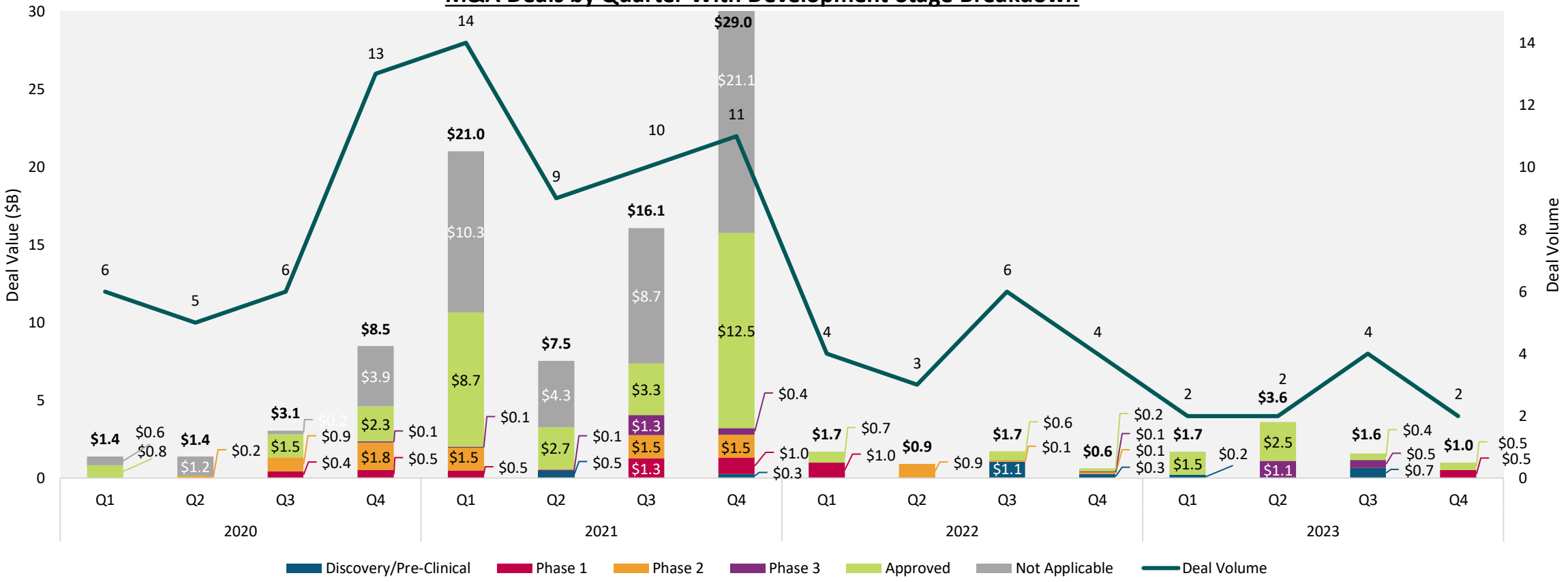
Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Stage indicates latest stage of development for all assets involved; (2) All values in USD M unless otherwise noted; Includes upfront payment and preclinical research milestones; (3) Undisclosed milestone payments, tiered royalties ranging from 20 – 30%; (4) Not inclusive of sales-based milestone payments; (5) Not inclusive of undisclosed commercial milestones.

European M&A activity remained depressed in Q4, mirroring limited activity seen since 2022

European biopharma companies executed 10 M&A deals worth a total of $8B in 2023, representing a 62% increase in aggregate deal value and, contrastingly, a 59% decrease in deal volume from 2022.

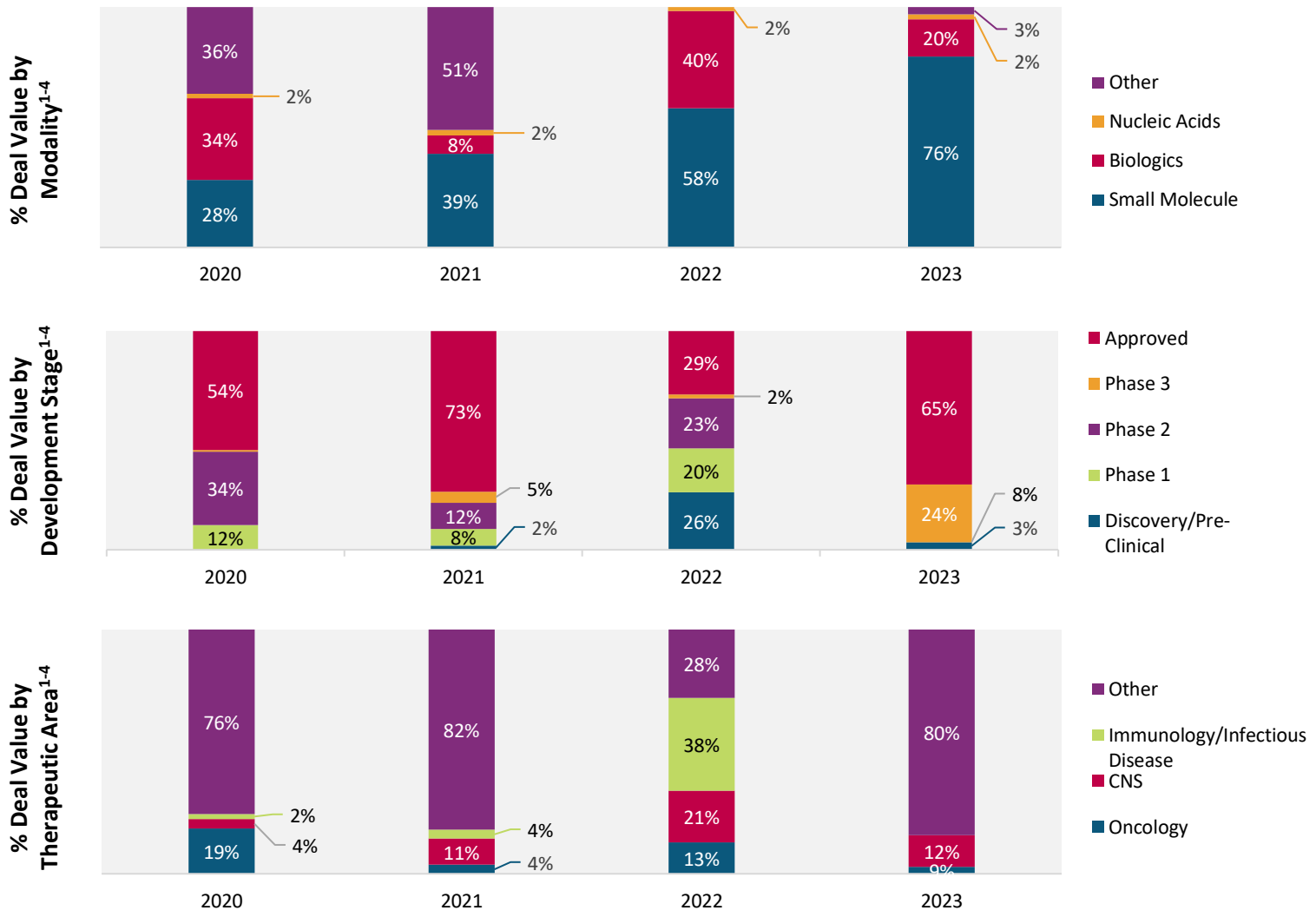
M&A Deals by Quarter With Development Stage Breakdown[1-3]



Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Includes M&A and Asset Purchase Agreements deals with European Seller or regional European deal; (2) Includes Deals with total value >$50M; Excludes Deals with undisclosed value; (3) Excludes Medtech, Distribution-only, and CMO/CDMO-only Deals.

2023 M&A activity featured a strong focus on established modalities and late-stage, de-risked opportunities



Key Takeaways:

- In contrast to European licensing deal activity, M&A interest shifted to small molecules in 2023, consistent with observations in the US
- 2023 M&A activity in Europe saw a centralization of value towards de-risked opportunities in Phase 3 and beyond
- Therapeutic area focus has largely reverted to pluralistic trends seen in 2020 and 2021, but still features a moderate level of attention from buyers toward CNS despite a sharp drop in interest in immunology / infectious disease

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Includes M&A and Asset Purchase Agreements deals with European Seller or regional European deal (2) Includes Deals with total value >$50M; Excludes Deals with undisclosed value (3) Excludes Medtech, Distribution-only and CMO/CDMO-only Deals (4) Data labels only provided for values >1%.

There were two European M&A deals in Q4 2023

Q4 M&A activity featured both an early-stage and late-stage acquisition in different therapeutic areas.

EU M&A Deals

Seller	Buyer	Stage[1]	Deal Size ($M)[2]	Therapeutic Area	Deal Subject
T3 Pharma	Boehringer Ingelheim	Phase 1	509	Oncology	Boehringer Ingelheim entered into an acquisition to acquire T3 Pharmaceuticals to expand immuno-oncology pipeline, which includes T3's lead product (T3P-Y058-379) for advanced solid tumors
Orchard therapeutics	Kyowa Kirin	Marketed	478	Metabolic / Endocrine	The companies entered into a definitive agreement under which Kyowa Kirin will acquire Orchard Therapeutics which would provide Kyowa Kirin a global leadership position in the burgeoning field of genetic medicine, with Orchard's Libmeldy PDUFA date in March 2024

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Stage indicates latest stage of development for all assets involved; (2) All values in USD M unless otherwise noted; Includes upfront payment and research/development milestones; PDUFA = Prescription Drug User Fee Act.

EMA New Drug Approvals

The EMA approved 13 new drugs including four orphan drugs and two biosimilars in Q4 2023, showcasing a slight decrease in total drug approvals compared to the previous quarter.

Q4 2023 EMA Approvals

Novel Drug / Biologic Approvals | *Generic / Biosimilar Approvals* | *Orphan Designation*

Oct '23: Zoonotic influenza vaccine Seqirus

For adults to protect against flu caused by H5N1 strain of influenza A virus

CSL Seqirus

Oct '23: Jaypirca (pirtobrutinib)

To treat adults with mantle cell lymphoma whose cancer has come back or is refractory

Lilly

Nov '23: Pylclari (piflufolastat)

To treat adults with prostate cancer to detect prostate cancer cells

CURIUM™ LIFE FORWARD

Nov '23: Herwenda (trastuzumab)

To treat early or metastatic breast cancer, and metastatic gastric cancer

SANDOZ

Nov '23: Aqumeldi (enalapril maleate)

To treat children and adolescents for heart failure

Proveca Medicines for Children

Nov '23: Vanflyta (quizartinib)

To treat adults who have been newly diagnosed with acute myeloid leukemia

Daiichi-Sankyo

Nov '23: Ebglyss (lebrikizumab)

To treat moderate to severe atopic dermatitis in adults and children over 12

almirall

Nov '23: Finlee (dabrafenib)

To treat children with glioma whose cancer cells have a specific mutation in BVAF gene

NOVARTIS

Nov '23: Yorvipath (palopegteriparatide)

To treat adults with chronic hypoparathyroidism

ascendis pharma

Nov '23: Catiolanze (latanoprost)

An eye drop medicine used for intraocular pressure in adults with open-angle glaucoma ocular hypertension

Santen

Dec '23: Veoza (fezolinetant)

To treat moderate to severe vasomotor symptoms associated with menopause

astellas

Dec '23: Zilbrysq (zilucoplan)

To treat myasthenia gravis in adults whose immune system produces antibodies against the acetylcholine receptor

ucb Pharma

Dec '23: Loargys (pegzilarginase)

To treat people from 2 years of age and up with hyperargininemia

Immedica pharma

TABLE OF CONTENTS

Comments

Global/US

Europe

Asia

About Locust Walk

Japan Biopharma Transaction Activity Overview for Q4 2023

Despite the Nikkei Biotech Company index falling by 13.9% this year, Japanese stocks performed well overall in 2023, with the Nikkei 225 hitting all-time highs and capturing a 30.1% increase since 2022, with pharma stocks remaining relatively flat

- The TSE1 index (comprises major pharmaceutical companies listed on the prime market of the Tokyo Stock Exchange) increased 4% in 2023, while the Nikkei Biotech Company index declined substantially, indicating that market recovery for biopharma remains suppressed by shifting interest rates, inversion of deflationary trends with the Japanese Yen, and a global tempering of biotech interest from generalist investors in recent quarters
- The Nikkei 225's rally can be attributed to the increasing favorability of Japanese stocks with ex-Japan investors in light of strained global relationships with China, transferring some economic reliance to Japan, and thus prospectively boosting the economy along with the Bank of Japan indicating near-term continuation of low interest rates

Japan biopharma financing lagged 2021 and 2022 levels, with a 31% decrease in financing volume, driving a 33% decline in total capital invested as compared to last year and only three financings closing in Q4 2023

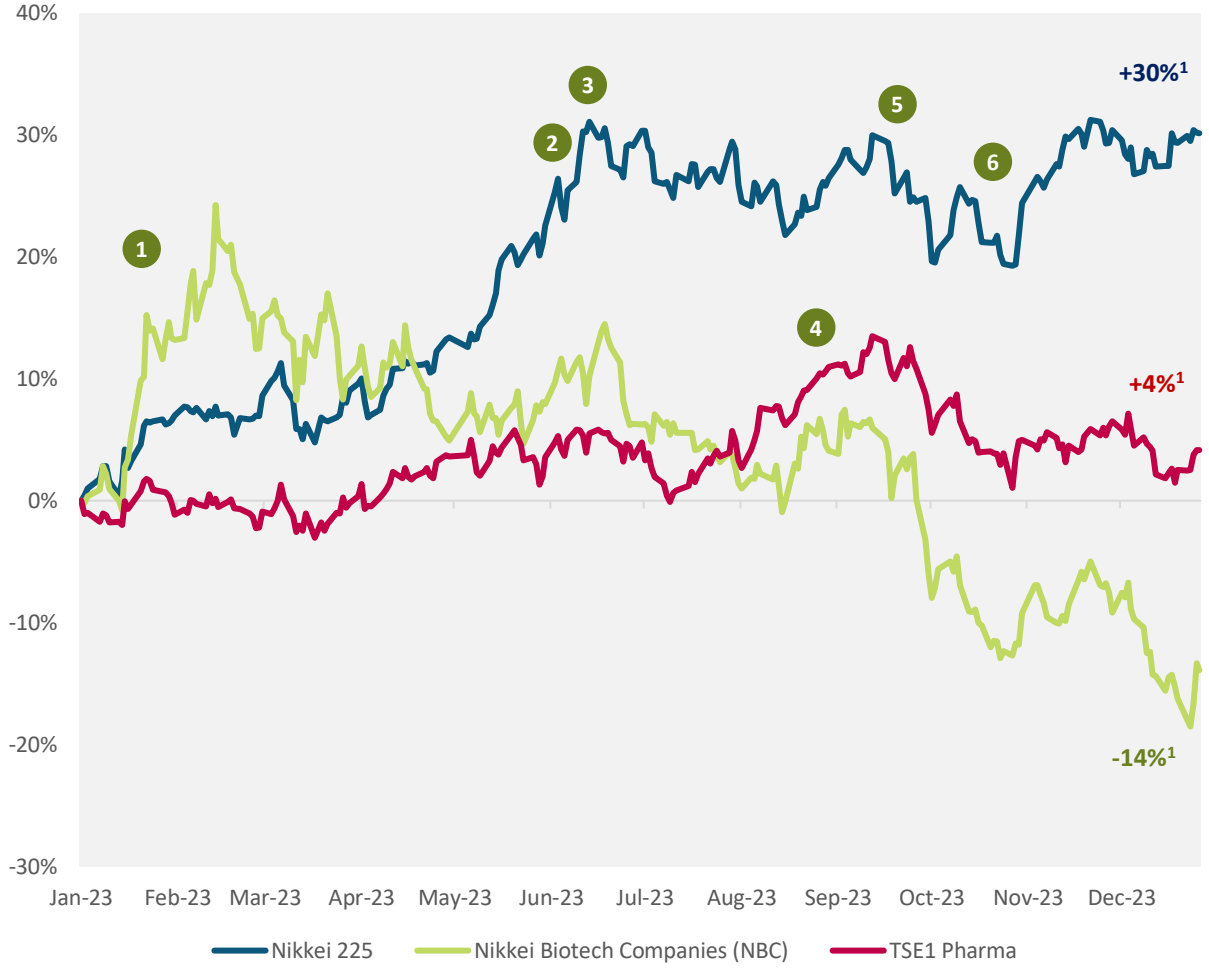
- The three venture financing deals completed in Japan in Q4 were headlined by Shinobi Therapeutics' oversubscribed $51M Series A
- Unlike other geographies, discovery, and preclinical companies have continued to comprise a substantial portion of the total capital invested in private financings for Japanese biopharma companies in 2023, with the majority of invested capital being deployed in Seed and Series A deals in 2023
- In contrast to recent years, Japanese investors were far less interested in funding small molecule programs in 2023, with small molecule financings only comprising 12% of the total capital deployed amongst Japanese biopharma companies in 2023

Japanese strategics expressed continued interest in early-stage discovery and preclinical programs and platforms in 2023, with the $22B Merck/Daiichi ADC deal reflecting global alignment in excitement around the promise of ADCs

- Japanese companies continued expanding into global markets, completing four global in-licensing deals >$100M in total deal size in Q4 2023
- Licensing deals amongst Japanese companies continued to focus on discovery and preclinical research deals, in line with what has been observed in US and EU licensing markets (when adjusting for the $22B Merck/Daiichi as an outlier)

Japanese Biotech stocks (NBC) fell by 16% in Q4 despite stability found by major pharma companies in the TSE1, though both were outperformed by the Nikkei 225 which surged 30% in 2023

NBC vs TSE1 Pharma vs Nikkei 225 Performance (LTM)



Event	Date	Summary
Macro Events		
1	1/31/2023	Monthly inflation rate reaches decades-high peak of 4.3% in January 2023, promoting investor expectations of an inflection point in the traditionally deflationary Japanese Yen
2	6/13/2023	Nikkei 225 experiences run-up amidst strained US-China relations, boosting investor confidence in the broader Japanese market; Nikkei 225 breaks 33,000 for the first time since the 1990's bubble
3	6/15/2023	On June 15 Tokyo stocks reached at 33-year high as investor sentiment was boosted by a surge in US stocks, and favorable factors such as a cheap yen, low leverage among listed companies, an attractive price-to-book ratio, and growing optimism about the country's economic potential
4	9/2023	Biotech and Pharma stocks decouple from the Nikkei 225 and fall further than the temporary drop in the Nikkei 225 as investor interest focuses on other sectors, such as heavy industry, energy, financial, and trading companies
5	9/29/2023	Japanese government notes potential for near-term action to ameliorate currency volatility as the Yen approaches the 150 Yen-per-dollar mark often viewed as the bar for intervention
6	10/31/2023	Nikkei 225 surges following the Bank of Japan's decision to leave its short-term lending rate unchanged while indicating intent for increased flexibility in yield curve control

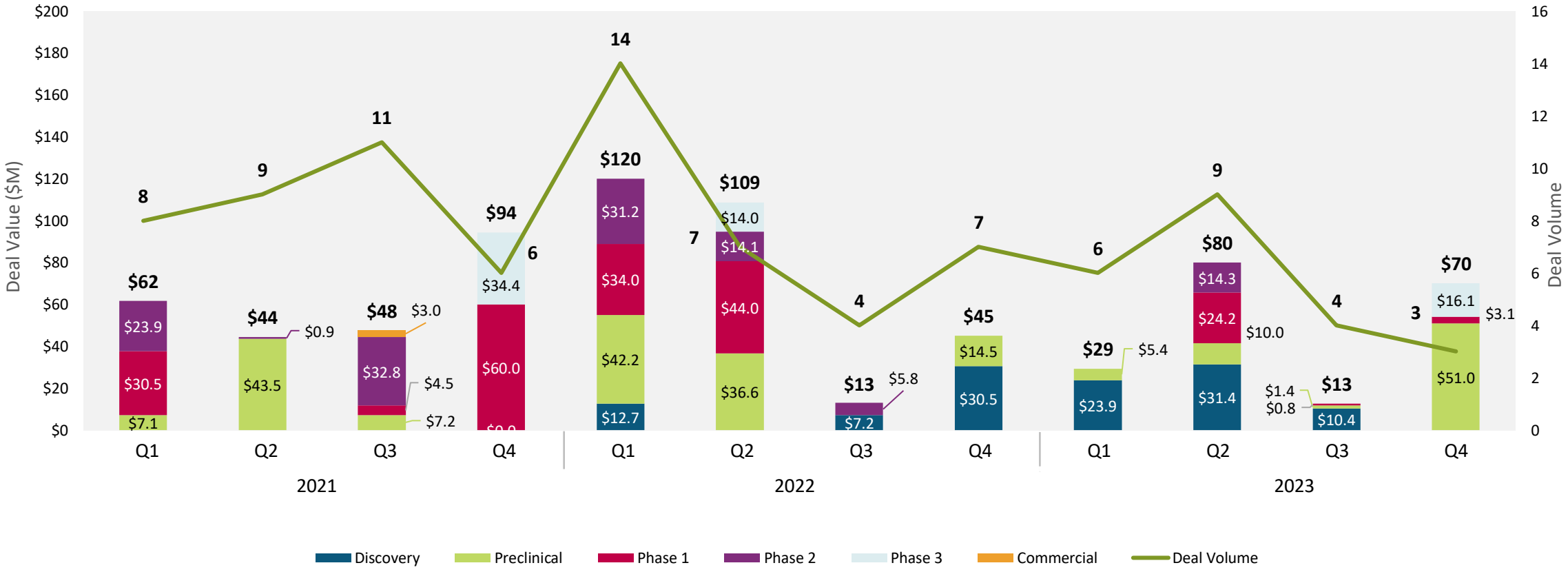
Sources: Yahoo Finance Japan; Locust Walk Analysis.

Note(s): (1) Percent change in the last 12 months; TSE1 = Major Japanese pharmaceutical companies listed in on the 1st Section of the Tokyo Stock Exchange.

Q4 saw the lowest Japan biopharma financing deal volume since 2021, with the three deals that occurred contributing to an aggregate deal value of $192M in 2023, a ~33% decrease from 2022 levels

Aggregate deal value in Q4 increased 438% from Q3, while maintaining the trend across 2023 that private financings in Japan shifted towards funding earlier-stage companies with discovery and preclinical assets.

Venture Financings Deals by Quarter with Development Stage Breakdown[1,2]



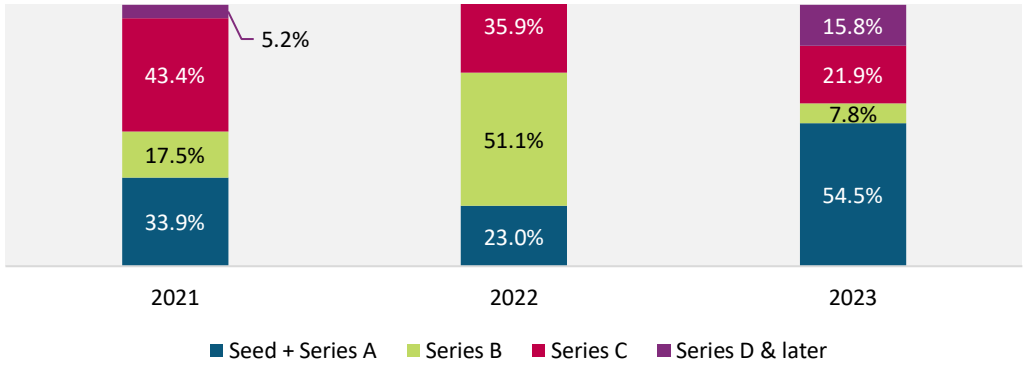
Sources: Pitchbook; GlobalData; Locust Walk Analysis.

Note(s): (1) Includes from Seed to later-stage financings; (2) Only including financings with development stage and deal size disclosed.

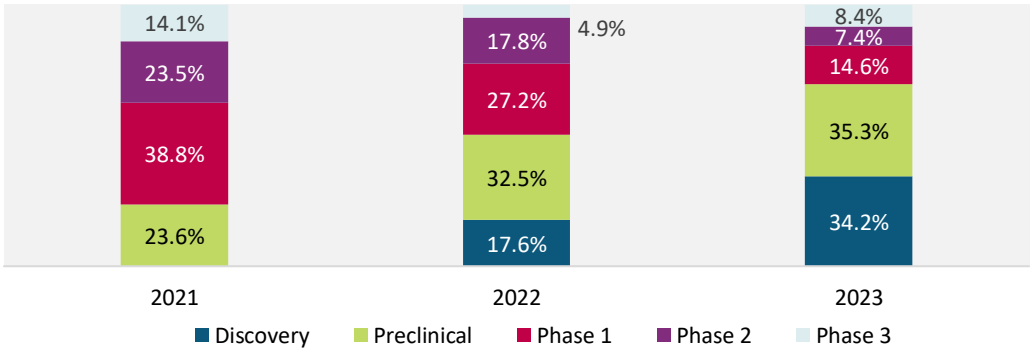
Japanese venture environment was dominated by early-stage stage deals in 2023, both in terms of financing lifecycle as well as development stage of the company's lead asset

Trend towards earlier stage financings in the comparatively limited Japanese private financing landscape represents a departure from the preference for later-stage, de-risked opportunities observed in other geographies.

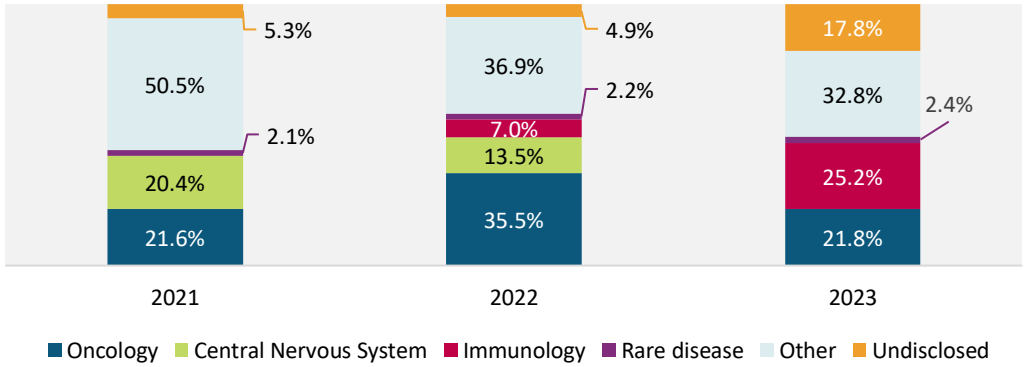
Percent of Deal Value by Series Round



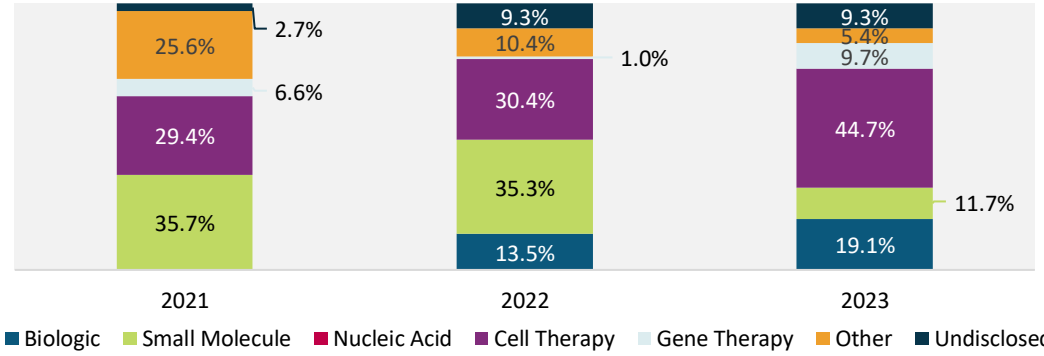
Percent of Deal Value by Development Stage



Percent of Deal Value by Therapeutic Area



Percent of Deal Value by Modality



Sources: Pitchbook; GlobalData; Locust Walk Analysis.

Note(s): Only includes deals where deal size and series round are disclosed.

Q4 2023 Japan private financing environment characterized by low deal volume and aggregate size

Following the rebound in Japan private financing activity in Q2 2023, deal volume remained low in Q4, with most of the overal**l** value driven by the $51M Shinobi Series A financing.

Key: ★ *Oversubscribed Round*

All Q4 Japan Private Investment Rounds

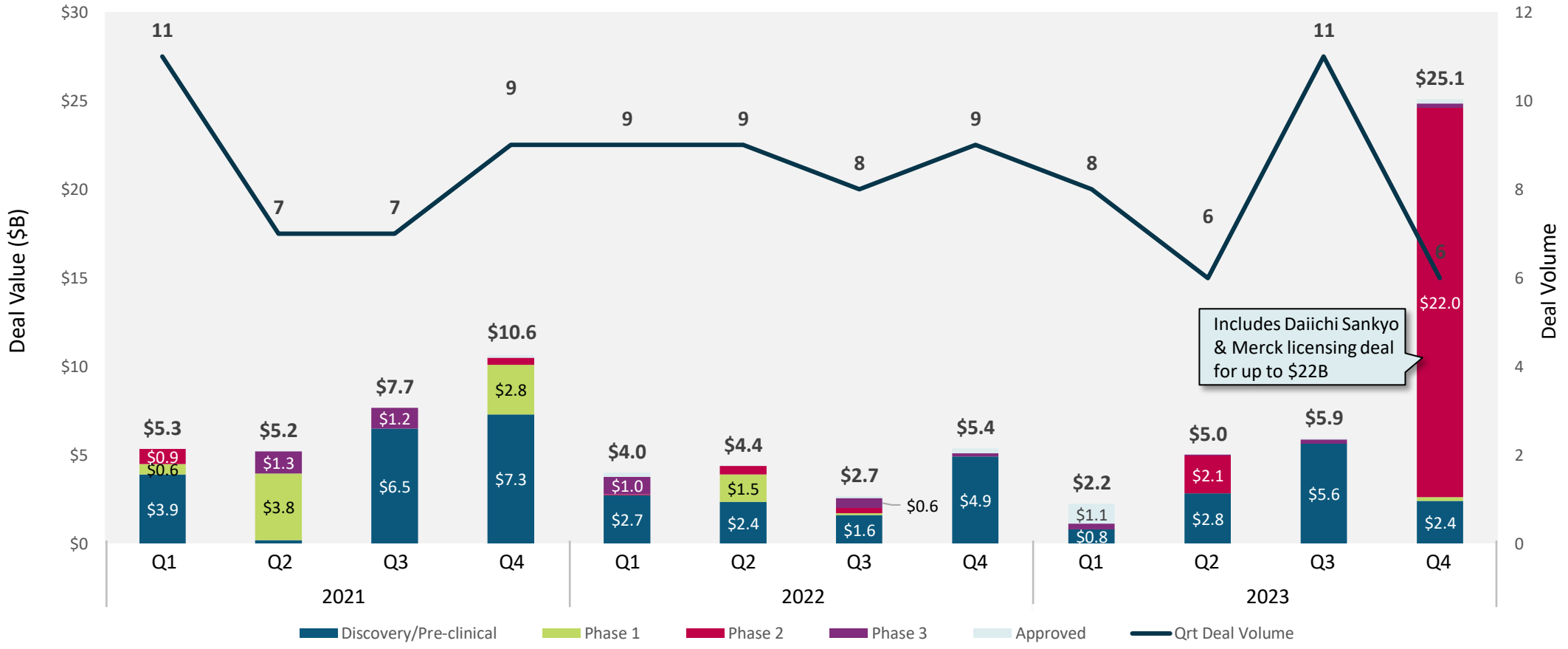
Company	Series	Raised ($M)	Deal Date	Lead Investor(s)	Therapeutic Area(s)	Company Description
★ SHINOBI THERAPEUTICS	A	51	12/12/2023	*Eight Roads Ventures Japan, EQT Life Sciences, F Prime Capital*	Oncology / Immunology	Shinobi has created a new allogeneic CD8αβ iPS-T cell platform that demonstrates comprehensive immune evasion from all arms of the immune system and will use the proceeds to advance its first off-the-shelf iPS-T cell therapy against GPC3+ cancers toward the clinic
J-Pharma	E	16	10/5/2023	*Eight Roads Ventures Japan, F Prime Capital*	Oncology	The Company, which is focused on building an SLC transporter drug discovery platform, will utilize the funds raised for continuing with the research and development of *nanvuranlat* and *JPH034*, LAT1 drug discovery, diagnostic technology development, investigational drug manufacturing, R&D of new drugs targeting various transporters, and management structure development
GEXVal	C	3	12/4/2023	*N/A (new investors included: Axil Capital, UTC Investment, Oita Venture Capital)*	Neurology	GexVal is a clinical-stage biotech company focused on the research and development of drugs for rare and intractable diseases and will use the proceeds from this funding round to accelerate the lead clinical program while bolstering their development pipeline

Sources: GlobalData; Company Websites; Locust Walk Analysis.
Note(s): Only includes deals where deal size is disclosed.

Total 2023 (in- and out-) licensing deal volume by Japanese companies was the lowest observed in the past 3 years, with aggregate deal value buoyed by the Merck/Daiichi deal

Japanese strategics expressed continued interest in early-stage discovery / preclinical programs and platforms in 2023, with the $22B Merck/Daiichi ADC deal reflecting global alignment in excitement around the promise of ADCs.

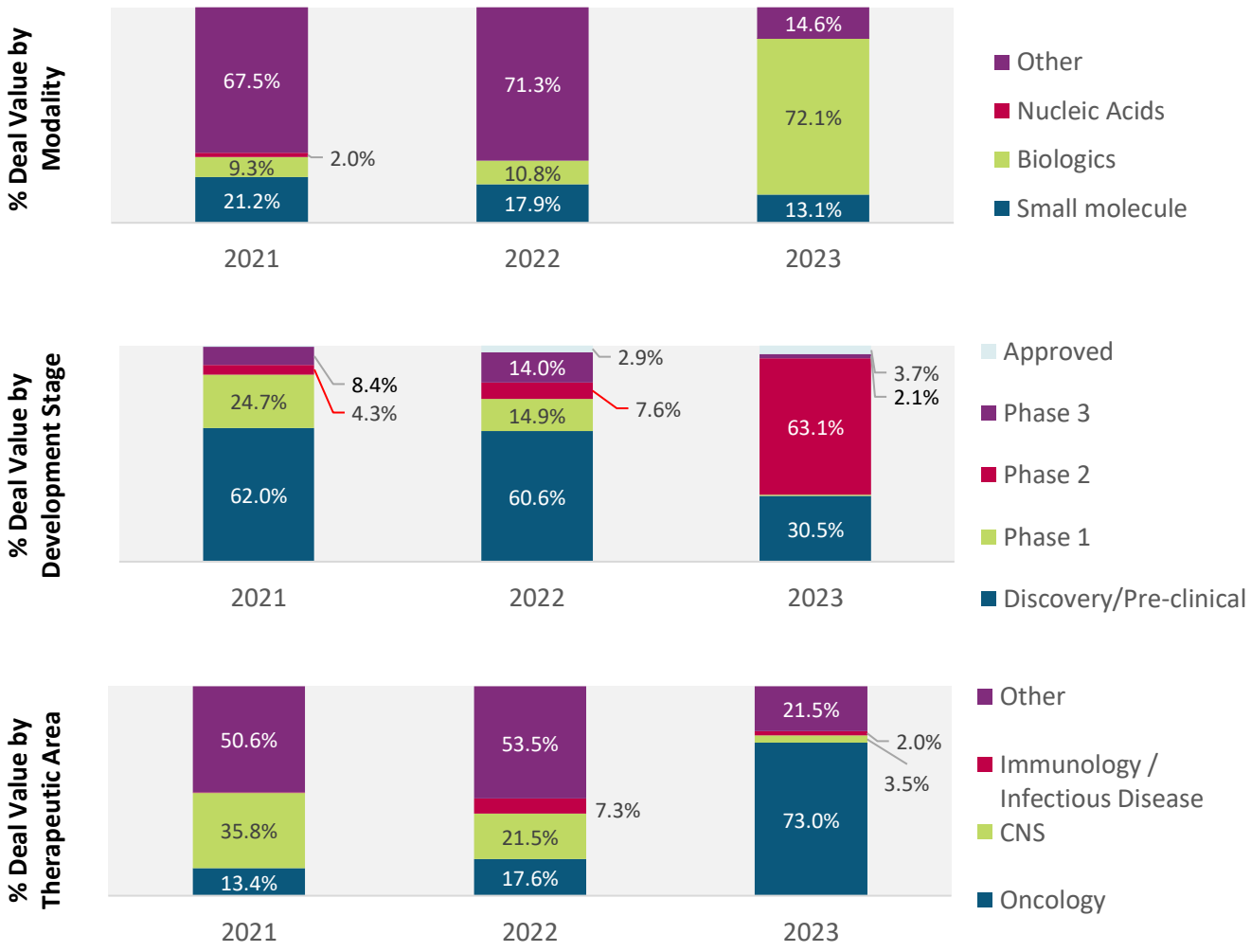
Licensing Deals by Quarter With Dev't Stage Breakdown[1]



Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.

Note(s): (1) Only includes deals where deal size and development stage are disclosed.

Total (in- and out-) licensing deal value by Japanese pharma was driven by biologics and oncology in 2023, representing a narrower interest set than recent years alongside a shift toward later-stage assets



Key Takeaways:

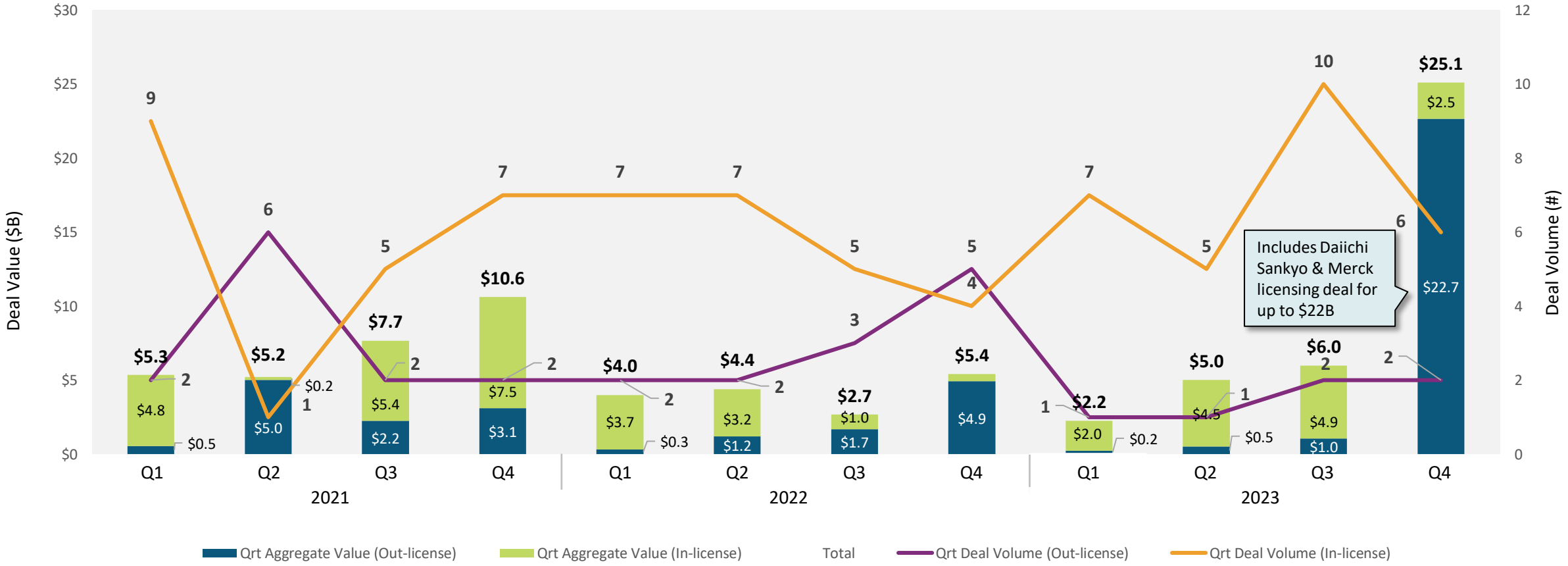
- Japanese companies completed 32 licensing (in- and out-) deals in 2023, down from 34 and 35 in 2021 and 2022, respectively
- Total Phase 2 deal value is skewed significantly by the $22B Merck/Daiichi ADC deal, which closed in Q4 2023
- While small molecules continue to see meaningful deal volume, biologics saw significant expansion from deals providing partners access to desirable ADCs, peptide platforms, and bispecific antibody targets
- Oncology deals emerged as the primary driver of total Japanese licensing deal values in 2023

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.
Note(s): Only includes deals where deal size and development stage are disclosed.

Q4 saw a significant increase in licensing deal value, driven by the Daiichi-Merck collaboration

While out-licensing deal value reached a 3-year high, this was largely driven by the DS-Merck collaboration, as out-licensing deal volume was at a 3-year low, and Japanese pharma companies continue to focus on in-licensing innovative technologies and assets.

Biopharma Deals (Based on Announced Deal Size)[1]



Sources: BioSciDB; GlobalData; Locust Walk Analysis.

Note(s): (1) Only includes deals where deal size and development stage is disclosed.

There were six in-licensing and two out-licensing deals for Japanese companies in Q4

High-value licensing deals by Japanese companies in Q4 were largely driven by a more aggressive investment in clinical-stage assets.

Global Japan Licensing Deals >$100M in Total Deal Value

	Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
In-Licensing	Athersys	Healios	Phase 3	$1.5/$155	10/10/2023	Neurology	Global rights to develop and commercialize MultiStem for the treatment of acute respiratory distress syndrome (ARDS). MultiStem cell therapy is a patented regenerative medicine product in clinical development that has shown the ability to promote tissue repair and healing in a variety of ways
	Elpiscience	astellas	Pre-clinical	$37/$1,737	12/27/2023	Oncology	Research collaboration and license agreement for novel bispecific macrophage engagers, ES019, and another program. The companies will collaboratively conduct early-stage research for these two programs
Out-Licensing	Daiichi-Sankyo	MSD	Phase 2	$4,000/$22,000	10/19/2023	Oncology	Co-develop/commercialize patritumab deruxtecan, ifinatamab deruxtecan, and raludotatug deruxtecan WW (Ex-Japan, where Daiichi Sankyo retains exclusive rights) as three potentially first-in-class DXd ADCs in various stages of clinical development for the treatment of multiple solid tumors
	PRISM BioLab	Lilly	Discovery	Undisclosed/$660	11/28/2023	Undisclosed	Collaboration to discover small molecule PPI inhibitors utilizing PRISM's PepMetics technology with the option to add up to two more targets and is responsible for clinical development & commercialization

Global Japan Licensing Deals >$100M in Total Deal Value

	Licensor	Licensee	Stage[1]	Upfront/Deal Size ($M)[2]	Deal Date	Therapeutic Area	Deal Subject
In-Licensing	ascendis pharma	TEIJIN	Pre-registration	$70/$245	11/28/2023	Metabolic	Development and commercialization of TransCon hGH, TransCon PTH, and TransCon CNP for endocrinology rare disease in Japan
	GI Innovation	maruho	Phase 1	Undisclosed/$221	10/16/2023	Immunology	Maruho will lead both the clinical development and commercialization efforts for GI-301 within the Japanese market. GI-301 is a bispecific fusion protein comprising the FceRIa extracellular domain of the Immunoglobulin E (IgE) binding site, with long-acting technology

Sources: BioSciDB; GlobalData; Locust Walk Analysis.

Note(s): (1) Only includes deals where deal size is disclosed; (2) Stage indicates latest stage of development for all assets involved.

China Biopharma Transaction Activity Overview for Q4 2023

Chinese pharma stocks declined beneath Q4 2022 levels following three quarters of outperformance relative to the SSE Composite index[1], with declines driven by industry-specific regulatory tightening coupled with a reduced economic outlook more broadly across China over the next five years

- Q4 saw regulatory tightening by the NMPA in China around manufacturing and registration of approved active pharmaceutical ingredients (APIs)
- All COVID policies have been eased in Mainland China which has led to a gradual recovery of the domestic economy since the beginning of 2023
- Chinese pharma stocks saw significant volatility from beginning to end in Q4, with top Chinese pharma stocks recovering 8% from a -10% YTD low between October and December 2023

Private financings in China made a comeback in 2023, reaching 3-year highs in both deal volume and total capital invested, predominantly driven by a shift in investor interest away from preclinical programs and toward funding companies through late-stage pivotal Phase 3 trials

- Relative to the rest of the world, Chinese venture financings have declined less since the biotech heyday of 2020 and 2021, with the resurgence of medium-large deals funding programs through near-term pivotal trials spelling a promising future for the Chinese biopharma sector
- The four largest financing deals comprised 57% of the total capital invested in Q4, with the other fourteen deals all falling under $50M
- While an increase in aggregate YTD financing value has been driven by investment into clinical-stage companies, Q3 saw a significant drop-off in financing activity and a higher percentage of capital deployed going towards discovery and preclinical companies
- Phase 2 companies accounted for 34% of the aggregate deal value in 2023

China licensing increased in 2023 due to an uptick in out-licensing activity and a decrease in in-licensing deal volume, with total deal value being spread evenly across all phases of development and mostly used to fund biologic programs in oncology

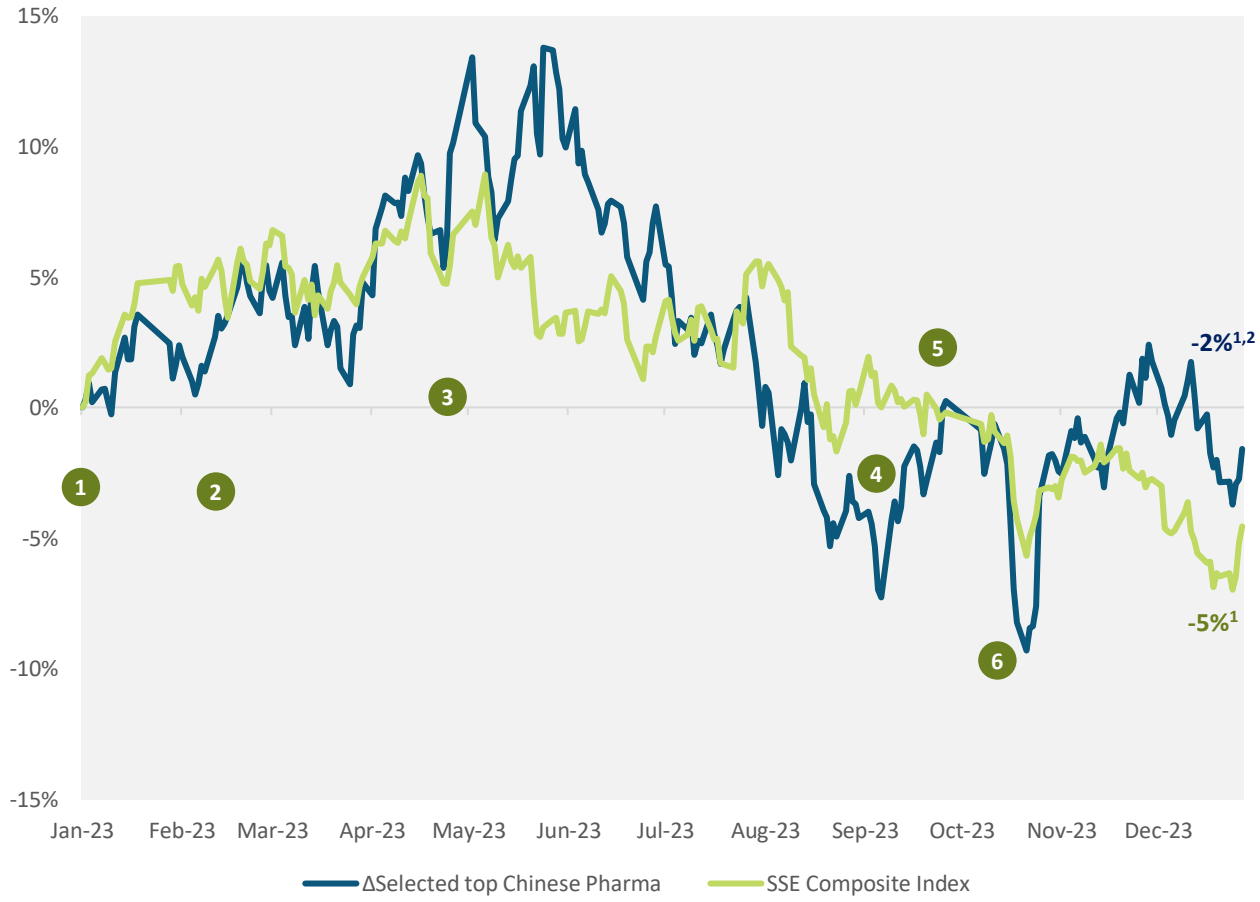
- Out-licensing deals saw an even spread across stages of development with a focus on global oncology deals
- Modality-wise, Chinese licensing targets reflected similar trends to other geographies, with ADCs, bispecifics, GLP-1s, and targeted small molecules being represented with >$1B deals
- 2023 largely mirrored 2022 in terms of licensing deal volume and aggregate deal value, with nearly half of all licensing deal value observed in Q4 for the second year in a row

Source: Yahoo finance; Locust Walk Analysis.

Note(s): (1) SSE Composite Index (Shanghai Stock Exchange Composite Exchange); (2) Top 16 Chinese Pharma companies: Guangzhou Baiyunshan, China Meheco, Shanghai Pharma, Fosun Pharma, Hengrui, Kelun, Buchang, Huadong Medicine, North China Pharma, Jumpcan Pharma, Zhejiang NHU, Tasly, Yunnan Baiyao, CONBA Pharma, Taiji Group, Apeloa Pharma.

China's top pharma stocks experienced a slight decline and generally moved in parallel to the broader SSE index in 2023

Selected top Chinese Pharma vs SSE Performance (LTM)

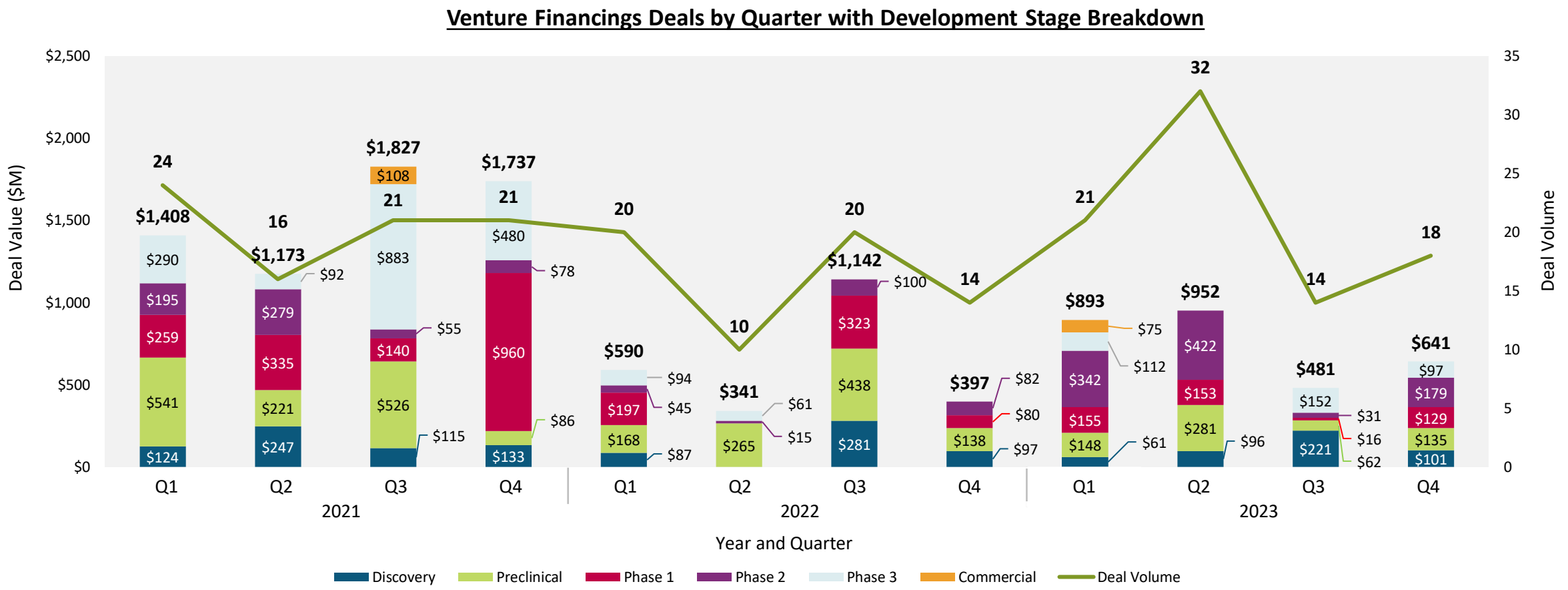


Event	Date	Summary
Macro Events		
1	1/31/2023	No new outbreak of variances of COVID in Q1 2023 stopped the slide of overall economies
2	2/2/2023	The US Federal Reserve slowed down the magnitude and cycle of interest hike to 25 bps[3]
3	4/26/2023	Chinese equities suffer a brutal sell off amid investors doubts over whether the country can sustain its rebound, losing $519B in market cap since April 18th
4	9/9/2023	Pharmaceutical stocks gain momentum after government stimulus measures that added liquidity to the financial markets
5	9/26/2023	Bloomberg publishes an article surveying 78 economists suggesting that China will just about meet its 5% GDP growth target for 2023
6	10/18/2023	NMPA announced implementation of tighter API registration renewals and outsourced pharmaceutical manufacturing

Sources: Yahoo Finance; Bloomberg; Locust Walk Analysis.
Note(s): (1) Percent change from the last 12 months; (2) Top 16 Chinese Pharma companies: Guangzhou Baiyunshan, China Meheco, Shanghai Pharma, Fosun Pharma, Hengrui, Kelun, Buchang, Huadong Medicine, North China Pharma, Jumpcan Pharma, Zhejiang NHU, Tasly, Yunnan Baiyao, CONBA Pharma, Taiji Group, Apeloa Pharma. API = Active Pharmaceutical Ingredients; (3) basis points.

Chinese biopharma saw greater private finance volume and aggregate deal value in 2023

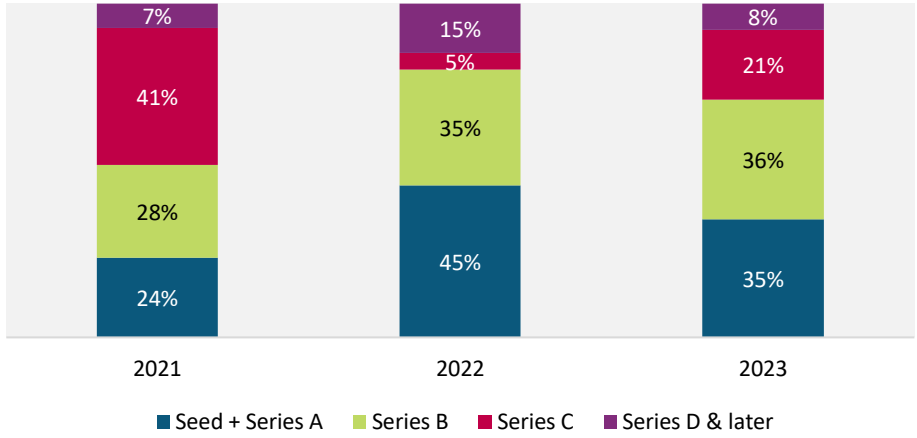
Despite a brief drop in Q3, China venture financing volume and aggregate value rose 34% and 20% respectively from 2022, largely driven by a shift in investor interest towards funding later-stage opportunities.



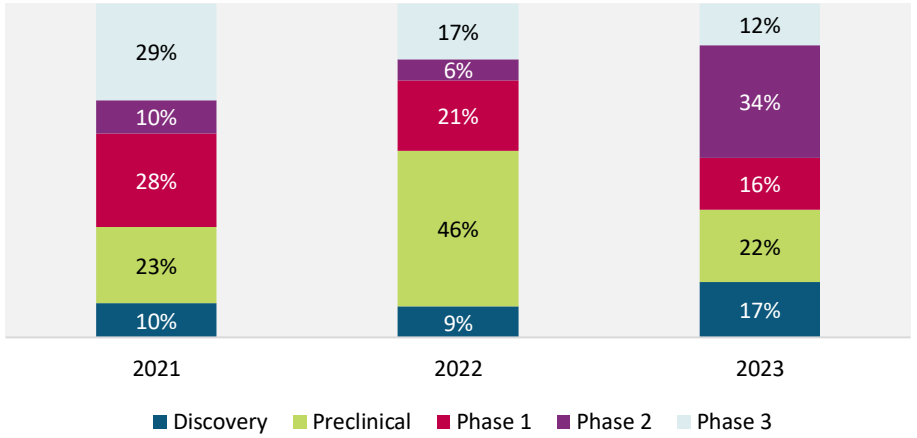
Sources: Pitchbook; Locust Walk Analysis.
Note(s): Only includes deals where deal size and development stage are disclosed.

In 2023, private financings in China showed a shift toward funding clinical-stage companies, compared to 2022's emphasis on Seed/Series A deals for discovery/preclinical companies

Percent of Deal Value by Series Round



Percent of Deal Value by Development Stage



Key Takeaways:

- Later-stage Series B, C, and D+ financing rounds funding clinical-stage companies took precedence over riskier discovery and preclinical companies raising Seed and Series A rounds in 2023, suggesting lower risk appetite for investors in China biopharma relative to 2022
- The recent uptick in financings funding Phase 2 companies suggests a wave of binary PoC trial outcomes to read out over the coming years and may reflect a maturing new wave of Chinese biotech companies looking for M&A exits or seeking a transition into a fully integrated pharma company

Sources: Pitchbook; GlobalData; Locust Walk Analysis.
Note(s): Only includes deals where deal size is disclosed.

Total VC funding in Q4 eclipsed $641M, though only four of 18 raises exceeded the $50M benchmark

In contrast with recent quarters, the majority of >$50M financing deals in Q4 2023 were for cardio/metabolic-focused drug developers, rather than oncology and immunology-focused companies.

Key: ★ *Oversubscribed Round*[1]

Q4 Japan Private Investment Rounds >$50M

Company	Series	Raised ($M)	Deal Date	Lead Investor(s)	Therapeutic Area(s)	Background
Avistone 鞍石生物科技	B	141	12/28/2023	*SDIC Investment, IDG Capital*	Oncology	This round of financing will support the accelerated clinical study of the company's existing drug candidates and explore the commercial potential of its clinical-stage assets
ATOM BIOSCIENCE®	D	83	10/16/2023	*Kaitai Capital*	Inflammatory/ Metabolic	Atom Bioscience, a clinical-stage biotechnology company developing best-in-class treatments for inflammatory and metabolic diseases, is currently conducting global pivotal clinical trials of ABP-671, its unique orally administered URAT1 inhibitor for chronic gout
Suzhou Shengyin Biopharmaceutical Co	A+	80	12/1/2023	*Tencent Investment, Yuansheng Venture Capital*	Cardiovascular	Suzhou Shengyin biopharmaceutical company is dedicated to developing new small nucleic acid drugs based on RNA interference (RNAi) technology
Sirius THERAPEUTICS	B	60	10/9/2023	*Hankang Capital*	Cardiovascular	Sirius Therapeutics is an international innovative biotechnology company with human health and well-being as its mission, focusing on the development of a new generation of nucleic acid innovative therapies in the field of cardiovascular diseases, and striving to become a leader in subverting the prevention and treatment of chronic diseases

Among the 14 deals under the $50M raise threshold completed in Q4, the average deal size was $20M

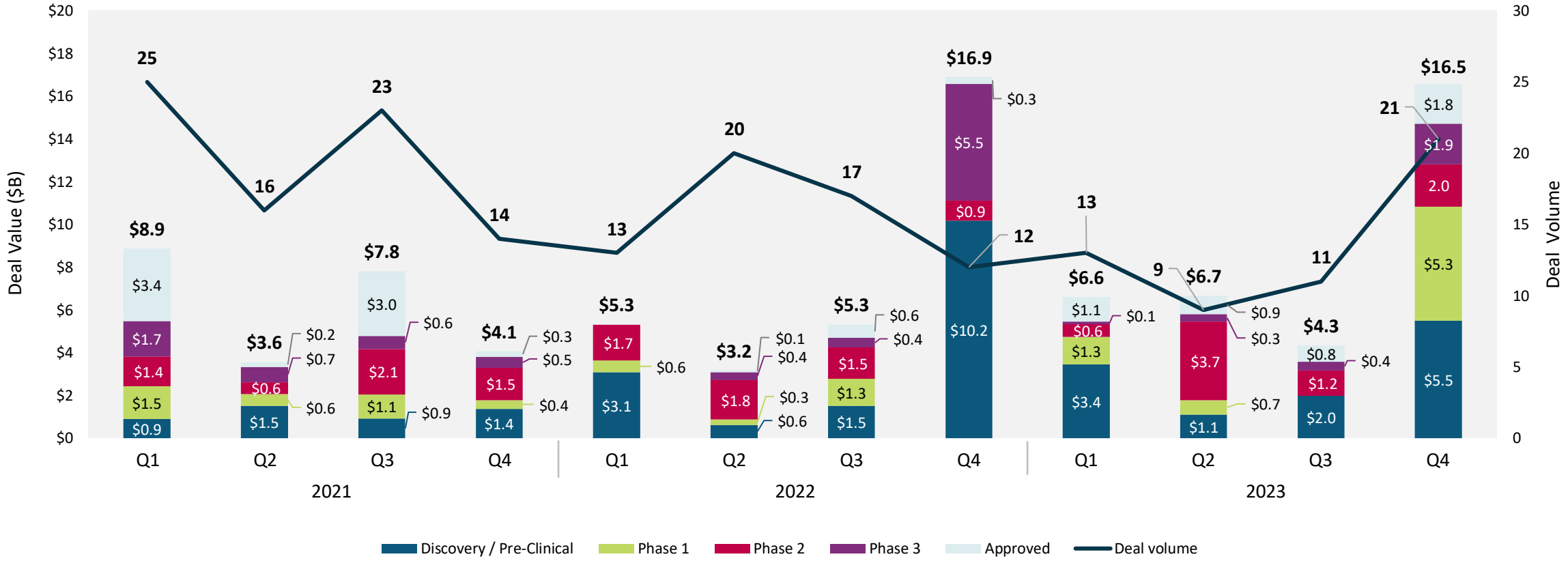
Sources: GlobalData; Locust Walk Analysis.

Note(s): (1) No oversubscribed rounds in China Q4 2023 financings; Only includes deals where deal size is disclosed.

Aggregate licensing activity by China-based companies jumped in Q4 2023

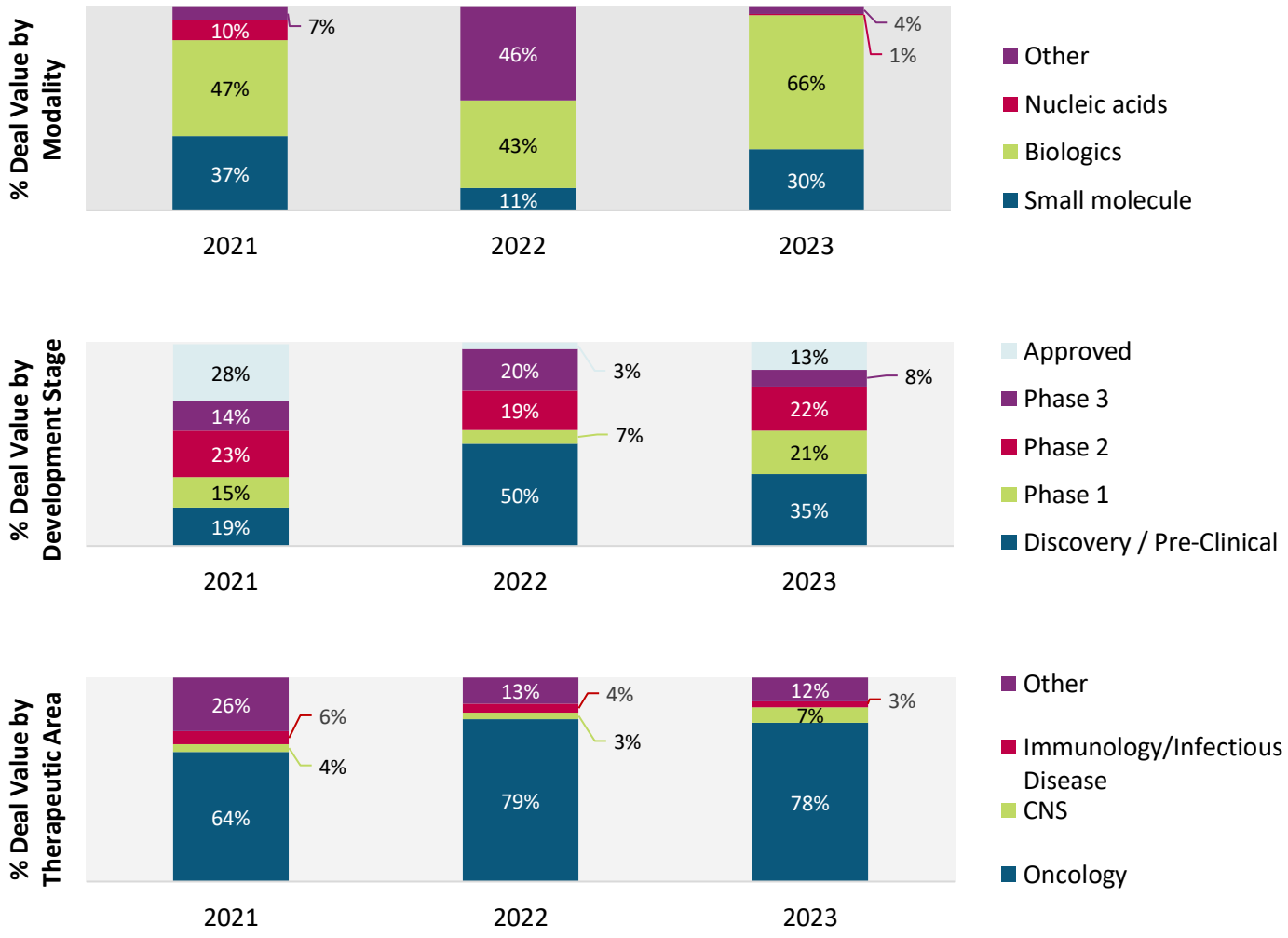
China biopharma (in- and out-) licensing activity closely mirrored 2022 in terms of total deal volume, aggregate deal value, and quarterly cyclicality with a jump in total deal value observed in Q4.

Total Licensing Deals by Quarter With Development Stage Breakdown



Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.
Note(s): Only includes deals where deal size is disclosed.

2023 saw continued growth in deal total value driven by biologics and oncology deals, accompanied by a shift away from higher-risk preclinical programs consistent with other geographies



Key Takeaways:

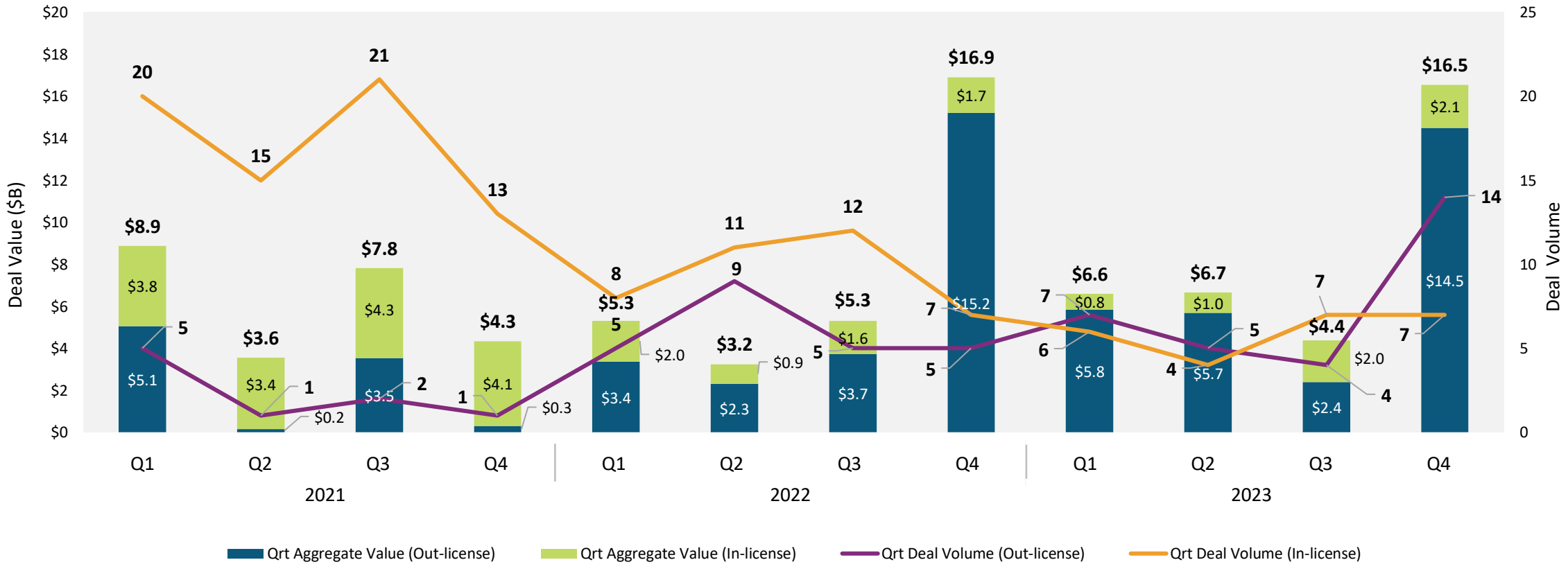
- Chinese licensing deal value continues to suggest interest in biologic modalities over small molecule therapies
- 2023 licensing deal value was driven by clinical stage and approved assets, increasing 15% from 2022 on an absolute basis
- Notably, the Chinese licensing environment is much more heavily oncology-driven than other geographies, consistent with the NRDL reimbursement focus on oncology and rare disease

Sources: BioSciDB; Cortellis; GlobalData; Locust Walk Analysis.
Note(s): Only includes deals where deal size is disclosed.

Aggregate deal volume in 2023 fell compared to 2022 despite an increase in out-licensing activity

For the first time in recent years, more Chinese biopharma innovation was exported via regional and global out-licensing deals than was brought in from outside China, with in-licensing volume falling 37% in 2023 and out-licensing volume rising 25% versus last year.

Biopharma Deals (Based on Announced Deal Size)[1]



Sources: BioSciDB; GlobalData; Locust Walk Analysis.
Note(s): Only includes deals where deal size and development stage are disclosed.

Q4 saw 7 in-licensing deals and 14 out-licensing deals by Chinese companies

There were 9 deals in Q4 surpassing $1B total deal value, with a greater focus on clinical stage programs compared to recent quarters.

Global China Licensing Deals >$1,000M in Total Deal Value

	Licensor	Licensee	Stage[2]	Upfront/Deal Size ($M)[1]	Deal Date	Therapeutic Area	Deal Subject
In-Licensing	ENSEM THERAPEUTICS	BeiGene	Preclinical	Undisclosed/$1,330	11/21/2023	Oncology	BeiGene acquired an exclusive global license to Ensem Therapeutics' Investigational and potentially best-in-class oral CDK2 inhibitor EXT-197, which is being developed for cancer
Out-Licensing	ECCOGENE 诚益生物	AstraZeneca	Phase 1	$185/$2,010	11/9/2023	Metabolic Disorders	Exclusive license agreement for ECC5004, an investigational oral once-daily GLP-1 agonist for the treatment of obesity and type-2 diabetes
	Elpiscience	astellas	Preclinical	$37/$1,737	12/27/2023	Oncology	Research collaboration and license agreement for novel bispecific macrophage engagers, ES019 and another program. The companies will collaboratively conduct early-stage research for these two programs
	HANSOH PHARMA	GSK	Phase 2	$185/$1,710	12/20/2023	Oncology	GSK enters exclusive license agreement with Hansoh for HS-20093 a novel B7-H3 ADC in development for lung cancer, sarcoma, head and neck cancers and other solid tumors in phase 1 and 2 clinical trials in China
	HENGRUI	MSD	Phase 1	$169/$1,650	10/30/2023	Oncology	PARP1 inhibitor deal. Hengrui's first strategic collaboration with a global pharma company. Deal includes license option for its Claudin-18.2 ADC
	HENGRUI	elevar therapeutics	BLA-filing	Undisclosed/$1,600	10/17/2023	Oncology	Global commercialization licensing agreement for PD-1 Inhibitor Camrelizumab in combination with rivoceranib for uHCC
	HANSOH PHARMA	GSK	Phase 1	$85/$1,570	10/17/2023	Oncology	GSK purchased global rights, excluding greater China for HS-20089 is a B7-H4 targeted ADC
	MediLink Therapeutics	BIONTECH	Preclinical	$70/1,070	10/12/2023	Oncology	BioNTech entered into a research collaboration and global licensing deal with MediLink Therapeutics for exclusive rights to a HER3-directed ADC

Sources: GlobalData; Company website; Locust Walk Analysis.
Note(s): (1) Only includes deals with disclosed size; (2) Stage indicates latest stage of development for all assets involved.

Contact

The Global and Europe sections were prepared by the following Locust Walk deal team members:

Geoff Meyerson*
CEO & Co-Founder
Boston
gmeyerson@locustwalk.com

Alex Hogenhuis*
Senior Associate
Boston
ahogenhuis@locustwalk.com

Kaitlin Demarco*
Associate
Boston
kdemarco@locustwalk.com

Anu Dwarumpudi*
Senior Analyst
Boston

Thomas Leichner*
Senior Analyst
Boston

McKenna Rybaltowski*
Analyst
Boston

Paige Fleming*
Analyst
Boston

Isabelle Wilson*
Analyst
Boston

The Asia section was prepared by the following Locust Walk deal team members:

Hiroshi Yamamoto
Managing Director
Tokyo; hyamamoto@locustwalk.com

Osvaldo Fernandez
Analyst
Tokyo

Zachary Allen*
Analyst
Boston

TABLE OF CONTENTS

Comments

Global/US

Europe

Asia

About Locust Walk

LOCUST WALK®

Locust Walk is a global investment bank that integrates corporate development strategy and execution with capital raising for innovative life science companies of all stages.

We partner with founders, executives, and board members through all aspects of corporate development across company, asset, and deal lifecycles.

Through our extensive market intelligence interfacing with investors, large pharma, biotechs, and academic leaders, we have a deep understanding of how science and data translates into actionable transactions and business strategy.

Locust Walk is a global life science investment bank with three main points of difference

Fully Integrated Corporate Development Offering

Comprehensive Capabilities Across the Company Lifecycle

- Support companies of all stages from **pre-seed NewCos to large public biopharma**
- Expertise **across the life sciences,** including Biotech, Pharma, and tech-enabled Pharma Services
- Deep **connections to investors, strategic buyers, and small companies**

Expertise Integrating Science, Strategy, and the Market

- Build significant expertise with our own **due diligence** and **pharma and investor intelligence**
- Leverage **scientific expertise** to inform actionable strategies, company positioning, and transactions
- Scientific and market knowledge enables deeper conversations with partners and investors to drive **high impact transactions**

We partner with companies of all stages to drive innovation through corporate development

Working across the company lifecycle enables us to understand our clients' and their counterparties' needs and provides flexibility on where, when, and how we provide support to achieve a successful outcome

NewCos and SpinCos

- Partner with founders and investors to launch companies based on innovative platforms or in-licensed assets
- Support from company ideation and formation through launch, including strategy, capital raises, and business development

Private Companies

- Private companies can leverage all of Locust Walk's core strategy, strategic transactions, and capital raising capabilities
- Flexible to work with clients on their greatest priority, from any single strategic question or deal through managing all corporate development needs

Public Companies

- Optimize corporate, portfolio, and transaction strategy
- Bring in non-dilutive funding or access value from sell-side transactions and spin-outs
- Grow and scale through buy-side strategy, search and evaluation, and deal execution

Large Cap

- Broadly support external innovation strategy
- Externalize innovation from spinning out NewCos to partnering assets
- Internalize innovation across stages of development including early and late-stage partnership models, incubator, corporate venture capital, strategy, and deal processes

Company Lifecycle →

Locust Walk's more than 300 clients to date span all company categories

NewCos and SpinCos

GARUDA THERAPEUTICS
LIGHTNING BIOTHERAPEUTICS
CoreBio
lenternal THERAPEUTICS
LOCUST WALK ACQUISITION CORP
NeoTX

Private Companies

Chiesi
KAHR
AskBio
C4 Therapeutics
Angiochem BEYOND BARRIERS
XYPHOS
ANOKION
almirall feel the science

Public Companies

KARUNA THERAPEUTICS
INTERMUNE®
gritstone bio
IONIS
Alkermes
EAGLE PHARMACEUTICALS
insmed
C4 Therapeutics
ZOGENIX
TherapeuticsMD

Large Cap

IPSEN Innovation for patient care
Biogen
REGENERON
ALEXION
Alnylam PHARMACEUTICALS
Otsuka
Shire
SK biopharmaceuticals
Lonza

Locust Walk's senior team has significant experience and tenure complemented by an all-star SAB

Senior Leadership Team

Geoff Meyerson
- CEO & Co-founder
- 15 years at LW
- Banking, VC, corp dev

Amy Brodsky
- COO & CPO
- 4 years at LW
- Exec coaching, HR & Ops

Andy Meyerson
- Managing Director
- 9 years at LW
- Banking and legal

Hiro Yamamoto
- Managing Director
- 2 years at LW
- Pharma corp officer, BD

Daniel Brog
- Sr. Vice President
- 5 years at LW
- Strategy consulting

Rene Veloso
- Sr. Vice President
- 2 years at LW
- Banking, VC

Troy Norris
- Senior Advisor
- 5 years with LW
- Strategy consulting, corp dev

Susan Graf
- Senior Advisor/EIR
- 3 years with LW
- C-level exec, corp dev

Jeremy Goldberg
- Senior Advisor
- 5 years with LW
- Banking, VC, corp dev

Scientific Advisory Board

Merit Cudkowicz
- Chief of Neurology at MGH and professor of neurology at Harvard Medical School
- MD from HMS, MS in clinical epidemiology from Harvard Public Health, and BSE in chemical engineering from MIT

Ross Levine
- Chief of molecular cancer medicine & Chair in leukemia research at Memorial Sloan Kettering
- MD from Johns Hopkins, fellowship at Dana Farber, and BA from Harvard College

Rachel Humphrey
- CEO of Normunity, previously senior roles at BMS, Bayer, CytomX, AstraZeneca, and Lilly; former CMO of Mirati
- MD from Case Western and BA in biochemistry from Harvard

Stan Wang
- CEO and founder of Thymmune Therapeutics, previously founding CSO of Cellino Biotech
- PhD in stem cell biology & regen medicine from University of Cambridge; MD from Columbia; George Church postdoc

Keith Usiskin
- Formerly TA clinical lead at Janssen, Sanofi & Celgene; VP at Bristol-Myers Squibb
- MD from Rutgers Robert Wood Johnson Medical School, BS in chemical engineering from Cornell University

Locust Walk has closed over 70 transactions of all stages and sizes since its inception

calliditas THERAPEUTICS Japanese regional transaction for specialty therapy for IgA nephropathy VIATRIS $20M Upfront, $80M Milestones plus Royalties	**Tolerance Therapeutics** Rapid M&A of company with royalties to Sanofi's Teplizumab $20M M&A	**Undisclosed** Financing process for Phase 2 Immuno-Oncology Company $45M Private Financing	**Undisclosed** NewCo Formation for Transcription Factor Network Pharmacology Platform Undisclosed Seed	**Undisclosed** NewCo Formation for Thymic Regeneration and Immune Senescence Platforms Undisclosed Seed
ELYPTA Financing process for the first metabolism-based liquid biopsy for early detection of cancer $21M Series A	TherapeuticsMD Exclusive sell-side advisor for divestiture of vitaCare Prescription Services GoodRx $150M Cash, $7M Financial Milestones	NANOLIVE Looking inside life Financing process for novel Live Cell Imaging Technology $20M Series C1	EAGLE PHARMACEUTICALS Commercial Diligence & Advisor for Acquisition acacia pharma $104M acquisition	GARUDA THERAPEUTICS Integrated business plan and strategy development with Series A financing for iPSC platform $1M Seed, $72M Series A
eFFECTOR THERAPEUTICS PIPE Placement Agent for clinical stage oncology company $60M PIPE	eFFECTOR THERAPEUTICS Served as SPAC Manager and deal execution support LOCUST WALK ACQUISITION CORP $340M acquisition	gritstone ONCOLOGY Development of HIV Therapeutic Vaccine GILEAD Creating Possible $60M upfront, $725M milestones w/ tiered royalties	C4 Therapeutics IPO Advisor $210M NASDAQ: CCCC	C4 Therapeutics Rapid financing process led to oversubscribed crossover financing $150M Series B, $20M Venture Debt
XYPHOS Exclusive sell-side financial advisor for sale of next generation CAR-T therapy astellas $120M Upfront, $545M in Pre-Commercial Milestones	Regenacy Pharmaceuticals Advised on Chinese joint venture and license with 3E Bioventures Undisclosed	Otsuka Sell-side Deal Strategy and Valuation Support Lundbeck $200M Upfront, $1.8B Total	STRONGBRIDGE BIOPHARMA Buy-side US rights acquisition for Keveyis TaroPharma $8.5M Upfront, Undiscl. Milestones	SAVARA Identified and initiated buy-side acquisition SERENDEX Pharmaceuticals Undisclosed

Locust Walk Thought Leadership

Our team is committed to bringing you insight into the life science industry with a lens on market trends, strategic deal making, and capital markets

Every quarter, our team produces a mix of quarterly market conditions reports, white papers, and live panels

Please subscribe to our channels for more updates


Locust Walk


Locust Walk


@Locust_Walk


Biotalk


Biotalk

If you have any questions about this report and/or want to participate in any of our podcast, please email Geoff Meyerson at ceo@locustwalk.com

Disclaimer

Locust Walk Securities, LLC is the US securities transaction affiliate of Locust Walk Partners, LLC offering mergers and acquisitions and financing transaction advisory services. Locust Walk Securities, LLC is a member of FINRA and SIPC.

 This presentation does not constitute a commitment by Locust Walk Securities to underwrite, subscribe for or place any securities or to provide any other services.