

Lessons from drug revenue life cycles: distributions across modalities and therapeutic areas

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SUPPLEMENTARY INFORMATION

While much has been written about R&D costs and development risks, comparatively less empirical evidence explores the variability of revenue trajectories and lifecycles.^{1,2,3} Previous studies have found that pharmaceutical revenues are highly skewed with a small number of drugs generating a disproportionate share of total industry sales.^{4,5,6,7,8,9,10} These studies are now dated, however, with the most recent covering U.S. sales through 2014.¹¹ Other studies have examined sales in subsets of specific therapeutic categories or modalities,^{12,13,14,15,16} but no previous study has provided a granular, cohort-based analysis of global revenue patterns.

Data Sources and Methodology

To analyze lifecycle revenue trajectories, we compiled a comprehensive dataset of global net revenues for new prescription drugs, excluding vaccines and diagnostic products, approved in the U.S. between 1995 and 2015. We refer to new molecular entities and new biologic approvals collectively as NMEs using the compilation of approvals by the FDA's Center for Drug Evaluation and Research.¹⁷ NMEs are products in which at least one active moiety or ingredient had not previously been approved for use in the United States by the FDA and receive the highest exclusivity designation. We limited our sample to products approved between 1995 and 2015 to ensure sufficient post-launch sales data.

Commercial and financial data were sourced from EvaluatePharma, a leading third-party provider used by pharmaceutical industry analysts for drug development, sales and forecast data. The dataset details attributes such as FDA approval date, first U.S. and worldwide launch dates, drug modality (small molecule or biologic), therapeutic category, manufacturer(s), and quarterly net revenues. EvaluatePharma obtains historical revenue data from SEC filings, corporate press releases, and investor presentations by drug manufacturers and has been the source for previous academic and governmental analyses.^{18,19,20,21,22,23,24,25,26} For sales from 2025 to 2030, EvaluatePharma aggregates up to six projections from Wall Street equity research analysts for available products.

For products with revenues reported by multiple manufacturers under licensing or collaboration agreements, all disclosed sales were aggregated. When product sales changed hands due to acquisitions or name changes, discrepancies were reconciled through a manual process using supplementary sources including SSR Health data and company 10-K filings. This process identified several cases in which line extensions or reformulations of the same original NME were reported under new product names. Sales for these identified line extensions were consolidated into their parent product's revenue stream to accurately capture total lifecycle sales for that product. An additional 32 unique products were added to the dataset following a comprehensive comparison between the product list and FDA Orange Book. These products were initially omitted from the initial EvaluatePharma data extraction but met the criteria for inclusion as NMEs with reported commercial sales.

To ensure consistency in lifecycle analysis, all sales data were normalized to launch year (Y1, Y2, etc.) with Y1 sales pro-rated to represent a full calendar year based on a bi-weekly time scale. For drugs launched mid-year (e.g., July 2nd), partial-year sales were scaled up proportionally (e.g., doubled) to approximate full-year performance. Drugs launched on or after December 15th were rounded forward and treated as if they had launched on January 1st of the following year to preserve alignment with the bi-weekly pro-rating methodology. Additionally, we adjusted the launch dates for products approved in the U.S. after their worldwide launch, recalculating global lifecycle revenues to exclude sales prior to U.S. approval and launch.

To ensure robustness in lifecycle analysis, products missing one or more years of annual revenue values beyond Y2 were identified for reconciliation. For products with one or two missing years of revenue data surrounded by non-missing years, the midpoint(s) between adjacent known values was linearly interpolated. For products with more than two years of missing revenue data surrounded by non-missing years, these gaps were censored for analysis or manually corrected if sufficient external data were available in company 10-K filings. In cases where U.S. revenue data were not available for specific years, but global revenue figures were reported, missing U.S. values were estimated by applying historical U.S. versus ex-U.S. sales splits to the global revenue for the year in question. This ensured consistency in geographic revenue allocation across a product's full commercial lifecycle.

Lifecycle revenue curves for these NMEs were analyzed using both descriptive and statistical methods. Annual and cumulative lifecycle net sales were calculated in present value terms, adjusting for inflation to 2024 dollars using the Consumer Price Index for All Urban Consumers.²⁷ Following the approach in previous studies of drug revenues, we used a discount rate of 10.5 percent.^{28,29,30,31,32} Sales were discounted on a fractional basis to reflect cash inflows throughout the year rather than assuming end-of-year accumulation.

Our final dataset comprised 622 NMEs—464 small molecules and 158 biologics—approved by the FDA between 1995 and 2015. Of these, 449 products launched between 1995 and 2010 had complete 15-year sales histories based entirely on observed data. For the 173 products launched between 2011 and 2015, lifecycle revenues were supplemented by EvaluatePharma's forecasts through 2030. On average, 83% of the 15-year lifecycle revenues for these latter products are based on actual historical sales, with approximately 17% derived from analyst forecasts. Across the full cohort of small molecules launched between 1995-2015, forecasted revenue accounts for an average of 2.5% of 15-year cumulative net present value (NPV) revenues. For biologics launched between 1995-2015, the average share of forecasted revenue is higher, at 5.5%. The tables below provide further detail on the proportion of forecasted revenue by decile.

SUPPLEMENTARY TABLES AND FIGURES

Supplementary Table 1. Share of PV for 15Y Cumulative Revenues Based on Forecasted Revenues 2025-2030 for Products Launched Between 1995-2015

Discounted at 10.5%

Small Molecules (*n* = 464)

Decile	PV of 15Y Cumulative Net Revenue	PV of WW Forecasted '25-'30 Revenues	Share of Decile PV 15Y Cumulative Net Revenues Forecasted
1	\$ 1,284,478	\$ 56,723	4.4%
2	\$ 495,364	\$ 23,720	4.8%
3	\$ 310,232	\$ 6,295	2.0%
4	\$ 204,535	\$ 1,483	0.7%
5	\$ 130,730	\$ 2,618	2.0%
6	\$ 80,285	\$ 2,701	3.4%
7	\$ 46,095	\$ 1,205	2.6%
8	\$ 21,374	\$ 578	2.7%
9	\$ 8,558	\$ 33	0.4%
10	\$ 1,979	\$ 36	1.8%
Total	\$ 2,583,630	\$ 95,392	3.7%
Average			2.5%

Biologics (*n* = 158)

Decile	PV of 15Y Cumulative Net Revenue	PV of WW Forecasted '25-'30 Revenues	Share of Decile PV 15Y Cumulative Net Revenues Forecasted
1	\$ 621,677	\$ 87,843	14.1%
2	\$ 250,290	\$ 2,393	1.0%
3	\$ 145,263	\$ 10,167	7.0%
4	\$ 77,900	\$ 8,476	10.9%
5	\$ 51,908	\$ 3,124	6.0%
6	\$ 22,512	\$ 1,120	5.0%
7	\$ 9,522	\$ 238	2.5%
8	\$ 5,859	\$ 209	3.6%
9	\$ 3,177	\$ 90	2.8%
10	\$ 772	\$ 19	2.5%
Total	\$ 1,188,880	\$ 113,679	9.6%
Average			5.5%

Supplementary Table 2. Geographic (US vs. ex-US) and Temporal (Y1-Y9 vs. Y10-Y15) Breakdown of 15Y Cumulative Net Revenue PVs for Products Launched 1995-2015

Discounted at 10.5%

Small Molecules (n= 464)

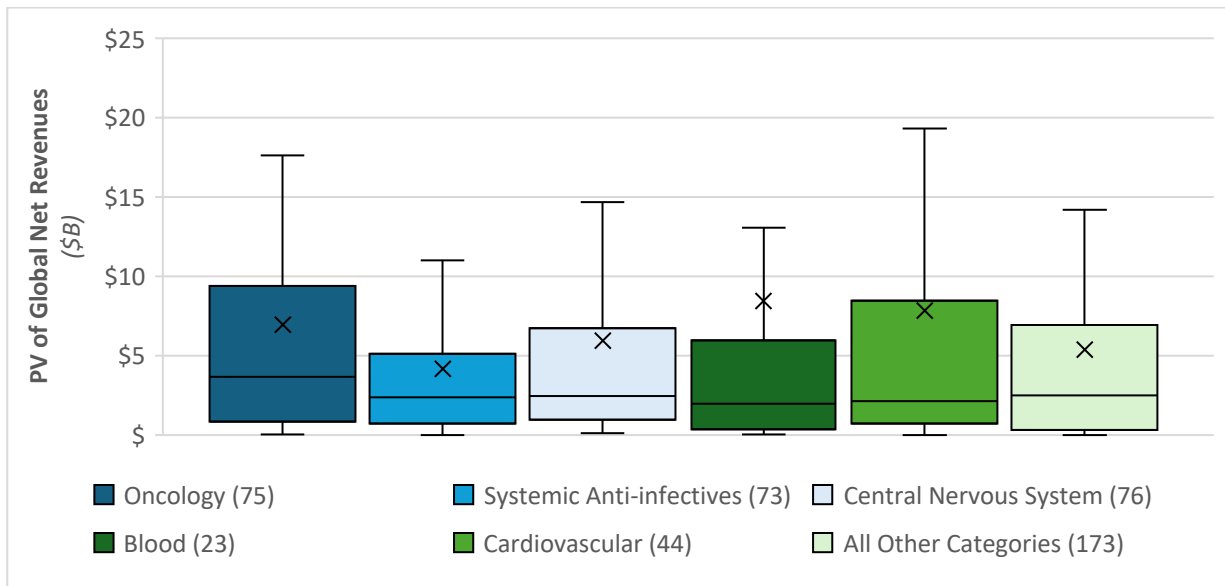
Type	Decile	Avg. PV of 15Y Cumulative Net Revenues	Avg. US Share of WW Net Revenues	Avg. Ex-US Share of WW Net Revenues	Number of Products	Share of 15Y Cumulative Net Revenues Earned Y1-Y9 (%)
Chemical (NDA)	1	\$27.33 B	62%	38%	47	66%
Chemical (NDA)	2	\$10.77 B	60%	40%	46	67%
Chemical (NDA)	3	\$6.74 B	55%	45%	46	68%
Chemical (NDA)	4	\$4.35 B	59%	41%	47	70%
Chemical (NDA)	5	\$2.84 B	59%	41%	46	70%
Chemical (NDA)	6	\$1.75 B	65%	35%	46	79%
Chemical (NDA)	7	\$.98 B	71%	29%	47	77%
Chemical (NDA)	8	\$.46 B	76%	24%	46	80%
Chemical (NDA)	9	\$.19 B	74%	26%	46	82%
Chemical (NDA)	10	\$.04 B	87%	13%	47	73%

Biologics (n = 158)

Type	Decile	Avg. PV of 15Y Cumulative Net Revenues	Avg. US Share of WW Net Revenues	Avg. Ex-US Share of WW Net Revenues	Number of Products	Share of 15Y Cumulative Net Revenues Earned Y1-Y9 (%)
Biological (BLA)	1	\$38.85 B	67%	33%	16	55%
Biological (BLA)	2	\$15.64 B	60%	40%	16	60%
Biological (BLA)	3	\$9.08 B	67%	33%	16	54%
Biological (BLA)	4	\$5.19 B	50%	50%	15	64%
Biological (BLA)	5	\$3.24 B	63%	37%	16	68%
Biological (BLA)	6	\$1.41 B	64%	36%	16	69%
Biological (BLA)	7	\$.63 B	82%	18%	15	75%
Biological (BLA)	8	\$.37 B	85%	15%	16	79%
Biological (BLA)	9	\$.2 B	72%	28%	16	73%
Biological (BLA)	10	\$.05 B	91%	9%	16	83%

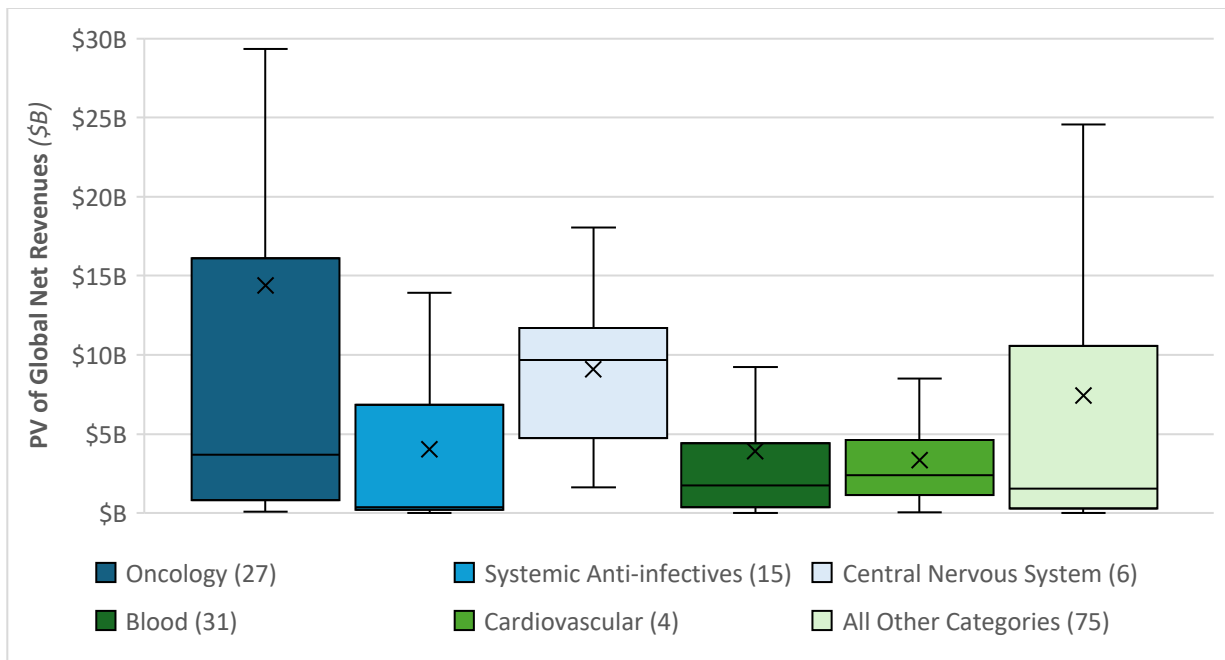
Supplementary Figure 1. Distribution of 15Y (Lifecycle) Cumulative Global Net Revenues by Therapeutic Category for all Products Launched Between 1995-2015
Discounted at 10.5%

Small Molecules (*n*= 464)



Note: Value in parentheses indicates number of products per therapeutic category

Biologics (*n* = 158)

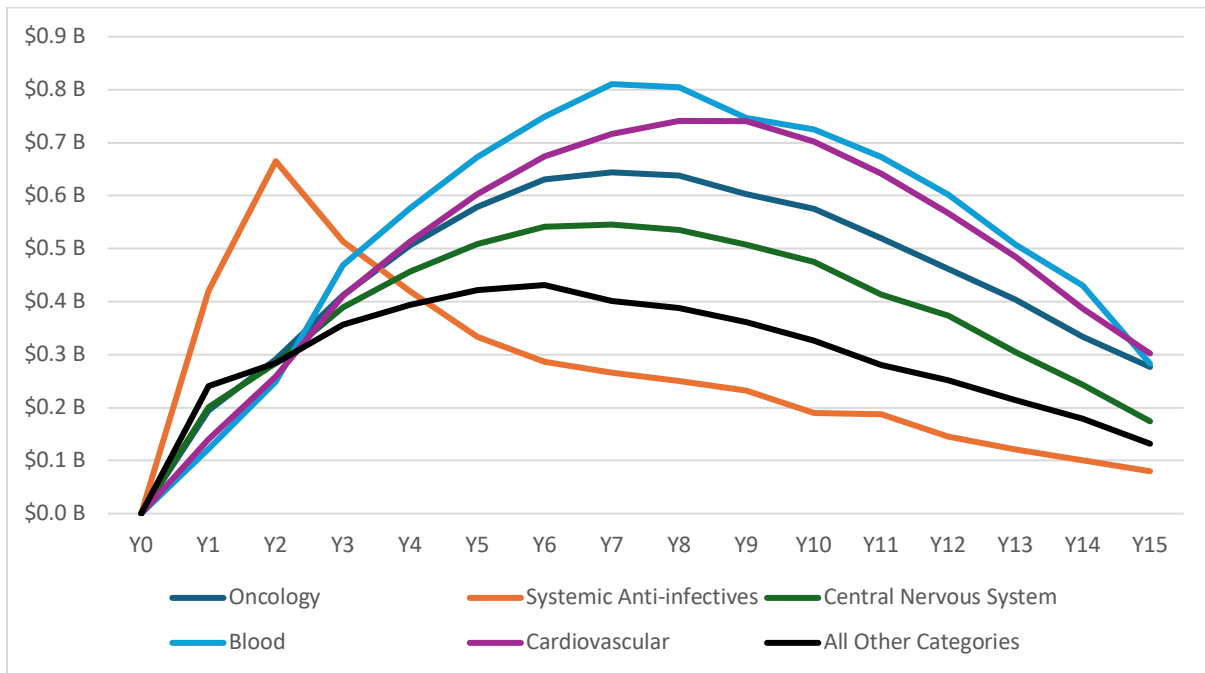


Note: Value in parentheses indicates number of products per therapeutic category

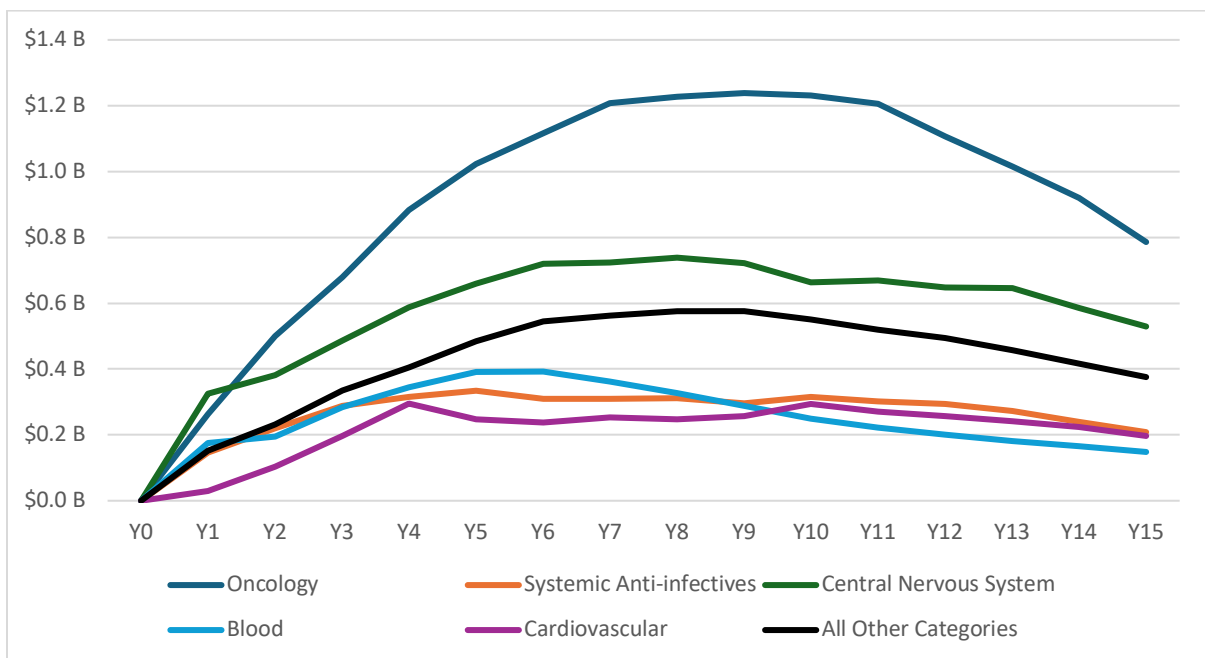
Supplementary Figure 2. Average Yearly Global Net Revenue by Therapeutic Category for all Products Launched Between 1995-2015

Discounted at 10.5%

Small Molecules ($n = 464$)



Biologics ($n = 158$)



REFERENCES – SUPPLEMENTARY MATERIALS

- ¹ DiMasi JA, Grabowski HG, Hansen RW. Innovation in the pharmaceutical industry: New estimates of R&D costs. *J Health Econ*. 2016 May;47:20-33.
- ² Chandra A & Mazumdar S. Biotech asset valuation methods: A practitioner's guide. *J. Invest Mgmt*. 2024;22(1):36-57.
- ³ Wouters OJ, McKee M, Luyten J. Estimated Research and Development Investment Needed to Bring a New Medicine to Market, 2009-2018. *JAMA*. 2020 Mar 3;323(9):844-853. doi: 10.1001/jama.2020.1166. Erratum in: *JAMA*. 2022 Sep 20;328(11):1110.
- ⁴ Schwartzman, D. Pharmaceutical R&D expenditures and rates of return. In: *Drug Development and Marketing*. pp. 63-80, Helms, R. B. (ed.). American Enterprise Institute, 1985.
- ⁵ Grabowski H, Vernon J. A new look at the returns and risks to pharmaceutical R&D. *Manag Sci*. 1990;36(7):804–821.
- ⁶ Grabowski HG, Vernon JM. Returns to R&D on new drug introductions in the 1980s. *J Health Econ*. 1994 Dec;13(4):383-406.
- ⁷ Grabowski HG, Vernon J. The distribution of sales revenues from pharmaceutical innovation. *Pharmacoeconomics*. 2000;18 Suppl 1:21-32.
- ⁸ Grabowski H, Vernon J, DiMasi JA. Returns on research and development for 1990s new drug introductions. *Pharmacoeconomics*. 2002;20 Suppl 3:11-29.
- ⁹ Berndt ER, Nass D, Kleinrock M, Aitken M. Decline in economic returns from new drugs raises questions about sustaining innovations. *Health Aff (Millwood)*. 2015 Feb;34(2):245-52.
- ¹⁰ Schuhmacher A, Hinder M, Boger N, Hartl D, Gassmann O. The significance of blockbusters in the pharmaceutical industry. *Nat Rev Drug Discov*. 2023 Mar;22(3):177-178.
- ¹¹ Wouters OJ, Kesselheim AS, Kuha J, Luyten J. Sales Revenues for New Therapeutic Agents Approved by the United States Food and Drug Administration From 1995 to 2014. *Value Health*. 2024 Oct;27(10):1373-1381.
- ¹² Rahman S, Lindahl O, Morel CM, Hollis A. Market concentration of new antibiotic sales. *J Antibiot (Tokyo)*. 2021 Jun;74(6):421-423.
- ¹³ Tay-Teo K, Ilbawi A, Hill SR. Comparison of Sales Income and Research and Development Costs for FDA-Approved Cancer Drugs Sold by Originator Drug Companies. *JAMA Netw Open*. 2019 Jan 4;2(1):e186875.
- ¹⁴ Prasad V, Mailankody S. Research and Development Spending to Bring a Single Cancer Drug to Market and Revenues After Approval. *JAMA Intern Med*. 2017 Nov 1;177(11):1569-1575.
- ¹⁵ Brinkhuis F, Goettsch WG, Mantel-Teeuwisse AK, Bloem LT. Added benefit and revenues of oncology drugs approved by the European Medicines Agency between 1995 and 2020: retrospective cohort study. *BMJ*. 2024 Feb 28;384:e077391.
- ¹⁶ Walsh G. Biopharmaceutical benchmarks 2018. *Nat Biotechnol*. 2018 Dec 6;36(12):1136-1145.
- ¹⁷ FDA. Compilation of CDER New Molecular Entity (NME) and New Biologic Approvals. <https://www.fda.gov/drugs/drug-approvals-and-databases/compilation-cder-new-molecular-entity-nme-drug-and-new-biologic-approvals>
- ¹⁸ Jentzsch V, Osipenko L, Scannell JW, Hickman JA. Costs and Causes of Oncology Drug Attrition With the Example of Insulin-Like Growth Factor-1 Receptor Inhibitors. *JAMA Netw Open*. 2023 Jul 3;6(7):e2324977.
- ¹⁹ Berghauser Pont L, Keirsse J, Moss R, Poda P, Robke L, Wurzer S. Developing blockbuster drugs: both nature and nurture. *Nat Rev Drug Discov*. 2021 Jun;20(6):421-422.
- ²⁰ Smietana K, Quigley D, Van de Vyver B, Møller M. The fragmentation of biopharmaceutical innovation. *Nat Rev Drug Discov*. 2020 Jan;19(1):17-18.
- ²¹ Cha M, Rifai B, Sarraf P. Pharmaceutical forecasting: throwing darts? *Nat Rev Drug Discov*. 2013 Oct;12(10):737-8.
- ²² What Medicare Negotiation Tells Us About Drug Pricing In The U.S., *Health Affairs Forefront*, September 13, 2024. Accessed November 30, 2024. <https://www.healthaffairs.org/content/forefront/medicare-negotiation-tells-us-drug-pricing-u-s>
- ²³ L.E.K. Consulting, RAND Europe, SiRM. The Financial Ecosystem of Pharmaceutical R&D: An evidence base to inform further dialogue. February 2022. Accessed November 30, 2024. https://www.rand.org/content/dam/rand/pubs/external_publications/EP60000/EP68954/RAND_EP68954.pdf

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- ²⁴ Cutler D, Kirson N, Long G. Financing Drug Innovation in the US: Current Framework and Emerging Challenges. *Pharmacoeconomics*. 2020 Sep;38(9):905-911.
- ²⁵ Government Accountability Office, “Drug Industry: Profits, Research and Development Spending, and Merger and Acquisition Deals.” November 2017. Accessed: November 30, 2024. <https://www.gao.gov/assets/gao-18-40.pdf>
- ²⁶ U.S. Food and Drug Administration. “Pathway to Global Product Safety.” 2011. Accessed November 30, 2024. <https://www.hsdl.org/?view&did=4123>
- ²⁷ U.S. Department of Labor CPI Inflation Calculator. Accessed March 22, 2025. https://www.bls.gov/data/inflation_calculator.htm.
- ²⁸ DiMasi JA, Grabowski HG, Hansen RW. Innovation in the pharmaceutical industry: New estimates of R&D costs. *J Health Econ*. 2016 May;47:20-33.
- ²⁹ Wouters OJ, McKee M, Luyten J. Estimated Research and Development Investment Needed to Bring a New Medicine to Market, 2009-2018. *JAMA*. 2020 Mar 3;323(9):844-853.
- ³⁰ Vogel M, Kesselheim AS, Feldman WB, Rome BN. Will Medicare Price Negotiation Delay Cancer-Drug Launches? *N Engl J Med*. 2023 Oct 26;389(17):1546-1548.
- ³¹ Vogel M, Kakani P, Chandra A, Conti RM. Medicare price negotiation and pharmaceutical innovation following the Inflation Reduction Act. *Nat Biotechnol*. 2024 Mar;42(3):406-412.
- ³² Wouters OJ, Vogel M, Feldman WB, Beall RF, Kesselheim AS, Tu SS. Differential Legal Protections for Biologics vs Small-Molecule Drugs in the US. *JAMA*. 2024 Nov 25.