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UNICORNS IN ONCOLOGY: VALUE CREATION AND ALLOCATION

Abstract

Unicorns in oncology create enormous value (over $60 billion). However, little is known about their economics. All 117 unicorns in the field of medicine and healthcare were analyzed to determine the extent to which they are oncologically significant. For the selected companies–those active in the field of oncology–location, business model, and value distribution were modeled. Twenty-two of the 117 highest-valued medical unicorns also, or predominantly, focus on oncology. With three exceptions, all are based in the USA. Their valuations range from $1.0 to $8.1 billion. By analyzing their business models further, we found eight different product/service offerings. The value added and its distribution are as follows: 60% to investors, 27% to sunk costs, 13% to management, and 1% to data providers. Oncological health tech unicorns create enormous value, but whether this value creation flows into the care system or is extracted from it is an open question.

Key words:

oncology, unicorns, value allocation.

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Problem Statement and Literature Review

So-called unicorns–companies that have not yet been listed on the stock exchange but are already worth more than one billion US dollars–create enormous value in healthcare within a very short time period: These companies are usually only 5 to 15 years old (there are even «faster» unicorns: a few companies achieved unicorn status in less than one year (Zenbusiness, 2024)). According to a study by the market research company CBInsights (2024), as of March 2024, there are over 100 unicorns in the healthcare and life sciences sector, with a total value of almost 270 billion US dollars. Other researchers report similar results (e.g., HolonIQ, 2024). By way of comparison, this figure corresponds almost exactly to the expenditure of Germany's entire statutory health insurance system in 2022, which amounted to 266 billion euros (Federal Statistical Office, 2024). Around 1% of all seed-financed start-ups (i.e. start-ups financed by investors in their early stages) make it to unicorn status (Atomico, 2024).

The sheer amount of value generated by unicorns could have a massive impact on medicine. First, it may redirect financial flows, strengthening some participants while potentially weakening others. Innovations emerging in these new companies could change treatment patterns. Finally, the money that is currently flowing into unicorns will have to be paid back at some point, potentially extracting money from (some) healthcare providers.

Medicine as a whole is a complex system, even more so when taking its economic aspects into account. Focusing on one specialty often enables more meaningful analysis (Obermann & Thielscher, 2022). This article focuses on unicorns in oncology for two reasons: (i) oncology is important as cancers are still hard to treat, thus causing many deaths and a massive burden of disease (Institute for Health Metrics and Evaluation, 2024); and (ii) the field is rapidly developing, especially in new diagnostics, treatments, information technology, and digitalization (Rösler et al., 2023)–all areas in which health unicorns prevail.

The main aim of the paper is to better understand what kind of products and services oncological unicorns provide, how and how much value they create, and how this value is allocated among stakeholders.

Methodology

All 117 unicorns in the field of healthcare and life science in the list of CB Insights (2024) were analyzed to determine the extent to which they are oncologically significant. All companies that conduct research into cancer drugs, offer special products or services for cancer patients or for which oncology is otherwise an important–but not necessarily the only–area of work were included. Companies that are only marginally involved in oncology were excluded, e.g. providers of digital health insurance (which insure oncology treatments among many others, but only incidentally), or providers of radiology services without a focus on oncological radiology, or developers of anti-ageing products (although cancer is of course a disease of advanced age).

For the selected companies, i.e. those active in the field of oncology, we analyzed in more detail which products and/or services they offer to patients, doctors and others and categorized this as their «business model». The analysis was based on publications by the companies themselves, particularly on the Internet, and publications by third parties. The respective websites were searched, with a focus on the business purpose and business figures, and the company name was searched for in standard search engines. Pubmed and Google Scholar were also searched.

The categorization itself relied on several iterative rounds of assigning main activities to the companies so that the categories became complete and disjoint (i.e., mutually exclusive and collectively exhaustive). In one case, overlap was unavoidable: some companies focus on process optimization as such and offer this service for a variety of ends (e. g., drug research, patient recruitment for clinical studies, automation of administration, and others). This problem was solved as follows: if one or more specific content-related foci were discernible, we used the respective categories (e.g., drug research); if instead the focus of the analyzed company was on process optimization as such and this optimization was used for a variety of different purposes, then we called this «process optimization». In one company, it was hard to determine the business area it operates in from available data; we labeled this as «unclear».

In addition, the distribution of the increase in value of an average unicorn was modeled. To this end, key business data such as number of employees and sales of a typical unicorn were estimated from the available data and unpublished hints from business insiders. These estimates were transferred into a consistent model.

Research Results

Twenty-two unicorns are involved in oncology (see Table 1 for a detailed list of all 22 unicorns, including descriptions of their business areas). Their valuations range from $1.0 billion to $8.1 billion; their total value is $61.74 billion. Nineteen of them are based in the US, and three are based in China.

There are eight main business areas in which these unicorns are engaged:

- services for other companies' pharmaceutical drug research with or without an IT/AI (information technology/artificial intelligence) focus;
- (own) pharmaceutical drug research with or without IT/AI focus;
- personalized medicine (in diagnostics and/or therapy);
- patient recruitment for clinical trials;
- blood, genetic, and other tests for patients;
- process optimization;
- decision support systems for oncologists;
- robotics.

During the research, it became evident, as an incidental finding, that unicorns also:

- grow very quickly, for example by utilizing considerable financial resources–such as those used for product development and/or marketing–which do not come from their own sales but are contributed by investors, and
- diversify as quickly as possible, i.e. they rapidly add other products in addition to those with which they started (e.g. a company begins with AI/gene-based molecule development and then buys gene sequencing laboratories).

Table 1

Health unicorns (overview)

	Valuation (bn)	Name of the company	Description	Main business area(s)
1	$8.10	Tempus	Tempus is a company focused on precision medicine, operating within the healthcare and artificial intelligence sectors. The company offers services that utilize artificial intelligence to provide physicians with real-time, data-driven decisions for personalized patient care and targeted therapies. It also facilitates the discovery, development, and delivery of optimized therapeutic options for patients. It was founded in 2015 and is based in Chicago, Illinois.	Services for pharma research (AI focused), personalized medicine
2	$7.83	Caris	Caris focuses on molecular science, specifically in the domain of cancer care. The company offers services such as molecular profiling, blood profiling, and tissue profiling, which provide comprehensive molecular information to help oncologists create personalized treatment plans for cancer patients. It primarily sells to the healthcare industry, particularly oncology. It was founded in 1996 and is based in Irving, Texas.	Services for pharma research (AI focused), personalized medicine
3	$6.10	Benchling	Benchling develops cloud-based informatics for life science research and development (R&D). It provides an R&D platform purpose-built for biologics, including solutions for lab notebooks, molecular biology, bioregistration, sample tracking, requests, and workflow management. It allows scientists to design, share, and record experiments. The company was founded in 2012 and is based in San Francisco, California.	Services for pharma research (AI focused)

	Valuation (bn)	Name of the company	Description	Main business area(s)
4	$4.80	Reify Health	Reify Health is a company focused on improving the clinical trial process within the healthcare industry. The company offers cloud-based software that accelerates patient enrollment in clinical trials, thereby facilitating the development of new therapies. Reify Health primarily serves the healthcare and biopharma industries. The company was formerly known as ZeroSum Health. It was founded in 2012 and is based in Boston, Massachusetts.	Patient recruitment for clinical trials
5	$4.60	Color	Color operates as a healthcare technology company democratizing access to genetic information. It offers color tests for patients to detect hereditary cancers such as breast, colorectal, melanoma, ovarian, pancreatic, prostate, stomach, and uterine cancers. It was formerly known as Color Global. It was founded in 2014 and is based in Burlingame, California.	Genetic tests for patients
6	$3.70	Abogen	Abogen operates as a plant-based pharmaceutical research company. It focuses on the research and development of messenger ribonucleic acid (mRNA) drugs to create antidotes against human disease. The company was founded in 2019 and is based in Suzhou, China.	(Own) pharma research
7	$3.20	Eikon Therapeutics	Eikon Therapeutics operates a biopharmaceutical company specializing in drug discovery. The company's platform identifies compound-protein interactions by measuring the effects of chemical compounds on the behavior of individual proteins in a live cellular environment. The company was founded in 2019 and is based in Hayward, California.	(Own) pharma research with IT/AI focus

	Valuation (bn)	Name of the company	Description	Main business area(s)
8	$2.44	insitro	Insitro focuses on drug discovery and development. The company's main services involve the use of machine learning and high-throughput biology to predict successful paths for medicine creation. It aims to avoid costly failures in pharmaceutical research and development (R&D). Insitro primarily sells to the healthcare industry. It was founded in 2018 and is based in South San Francisco, California.	Services for pharma research (AI focused)
9	$2.62	Freenome	Freenome serves as a biotechnology company focused on early cancer detection through advanced diagnostic tools. The company develops blood tests that identify early signs of cancer by analyzing biomarkers from tumor and non-tumor sources using a multiomics platform. These tests are designed to be non-invasive and accessible, aiming to detect various types of cancer at its most treatable stages. It was founded in 2014 and is based in South San Francisco, California.	Blood tests for patients
10	$2.10	Medable	Medable operates as a global platform for decentralized clinical trials. It solves the systemic challenges inherent in modern clinical trials including access, interoperability between systems, and inefficient technology experiences. Medable was formerly known as Dermatrap. It was founded in 2012 and is based in Palo Alto, California.	Services for pharma research, especially for clinical trials
11	$1.90	ConcertAI	ConcertAI is a healthcare technology company. It uses artificial intelligence (AI) to help oncologists make more informed treatment decisions for their patients. The platform analyzes large datasets of clinical and genomic data to identify patterns and insights which is used for personalized cancer treatment. It was formerly known as Precision HealthAI. It was founded in 2017 and is based in Cambridge, Massachusetts.	Decision support systems, personalized medicine

	Valuation (bn)	Name of the company	Description	Main business area(s)
12	$1.80	Opentrons	Opentrons develops robots for biologists. It creates robotics to help life science laboratories in academia and industry automate their operations. The company seeks to provide the scientific community with a common platform to easily share protocols and reproduce each other's results. It was founded in 2014 and is based in Brooklyn, New York.	Robotics
13	$1.70	Redesign Health	Redesign Health focuses on healthcare innovation. The company involves developing technologies and tools, as well as providing insights to facilitate change in the healthcare industry. It primarily serves the healthcare sector. It was founded in 2018 and is based in New York, New York.	Several fields of optimization / unclear
14	$1.69	Tessera Therapeutics	Tessera Therapeutics is a life sciences company with a focus on genetic medicine and biotechnology. The company's main service is Gene Writing, a new genome engineering technology that writes therapeutic messages into the genome to treat diseases at their source. Tessera Therapeutics primarily serves the healthcare and medical research sectors. It was founded in 2018 and is based in Cambridge, Massachusetts.	Services for pharma research (AI focused), personalized medicine
15	$1.50	Orna Therapeutics	Orna Therapeutics is a biotechnology company that focuses on the development of fully engineered circular RNA (oRNA) therapeutics, a new class of RNA medicines. The company's main offerings include the creation of oRNAs that can realize the full potential of RNA and change the way diseases are treated. These oRNAs have applications across multiple disease areas including cancer, regenerative medicine, protein replacement, infectious diseases, and autoimmunity. It was founded in 2019 and is based in Cambridge, Massachusetts.	Pharma research

	Valuation (bn)	Name of the company	Description	Main business area(s)
16	$1.36	Generate Biomedicines	Generate Biomedicines runs a therapeutics company. It focuses on a machine learning-powered generative biology platform to create new drugs on demand across a wide range of biological modalities. The company was founded in 2018 and is based in Somerville, Massachusetts.	Pharma research
17	$1.30	Biofourmis	Biofourmis discovers, develops, and delivers clinically-validated, software-based therapeutics. The company produces Biovital, a personalized, artificial intelligence (AI) powered health analytics platform to predict clinical exacerbation. It was founded in 2015 and is based in Boston, Massachusetts.	Process optimization (IT based) for treatment and clinical studies
18	$1	LinkDoc Technology	LinkDoc Technology is a data-driven, AI-enabled medical technology company operating in the healthcare and technology sectors. The company offers a range of services including big data processing, AI diagnosis and treatment, clinical trial matching, and digital therapeutics, all aimed at improving patient care and facilitating medical research. Its primary customers are in the healthcare industry, including pharmaceutical companies, medical institutions, insurance organizations, and administrative regulatory departments. It was founded in 2014 and is based in Beijing, Beijing.	Process optimization (AI based) for treatment, clinical studies, and other purposes
19	$1	Orca Bio	Orca Bio operates as a clinical-stage biotechnology company. It develops a pipeline of allogeneic cell therapy products that replace patients' diseased blood and unhealthy immune systems. The company was founded in 2016 and is based in Menlo Park, California.	(Own) pharma research

	Valuation (bn)	Name of the company	Description	Main business area(s)
20	$1	Caidya	Caidya operates as a clinical development company. It provides customers with solutions and services to improve clinical development capabilities. Caidya was formerly known as dMed Biopharmaceuticals. The company was founded in 2016 and is based in Shanghai, China.	Services for pharma research
21	$1	Owkin	Owkin operates as an artificial intelligence (AI)-based biotechnology company. It utilizes AI to enhance the process of finding suitable treatments for patients. The company's main services include the use of AI to identify new treatments, accelerate clinical trials, and build diagnostic tools. It enables researchers in hospitals, universities, and the biopharmaceutical industry to understand how drug efficacy varies for the improvement of drug development. Its services primarily cater to the biopharmaceutical and academic research sectors. It was founded in 2016 and is based in New York, New York.	Services for pharma research, AI based
22	$1	BostonGene	BostonGene is a biomedical software company focused on advanced patient analysis and personalized therapy decision making in the fight against cancer. The company's main services include performing sophisticated analytics to aid clinicians in evaluating viable treatment options based on each patient's individual genetics, tumor and tumor microenvironment, clinical characteristics, and disease profile. BostonGene primarily sells to the healthcare industry, specifically in the field of oncology. It was founded in 2015 and is based in Waltham, Massachusetts.	Personalized medicine, blood, genetic, and other tests, decision support systems

Source: CB Insights (2024), own research.

The value added and its distribution for a typical oncological AI/IT-focused unicorn were estimated based on data from these companies and non-public information from industry insiders. We assumed (see Table 2 for details) that the turnover of the model company would increase from $0 to $100 million in 5 years, the number of employees from 2 to 500, and the valuation from $0 to $1 billion. The costs per employee (including technical equipment) were estimated at $0.25 million, plus an additional mark-up for other costs of 60%; $0.2 million per project flows to the data providers (e.g. clinicians).

Table 2

Basic business data estimates for a typical oncology unicorn

	Year				
	1	2	3	4	5
Number of projects	0	2	5	15	50
Turnover per project	-	1	1	2	2
Total turnover	0	2	5	30	100
Number of employees	2	20	50	150	500
Costs for employees	0.5	5	12.5	37.5	125
Other costs	0.3	3	7.5	22.5	75
Data provision	0	0.4	1	3	10
Total costs	0.8	8.4	21	63	210
Cash flow	-0.8	-6.4	-16	-33	-110
CF, cumulated	-0.8	-7.2	-23.2	-56.2	-166.2
Valuation	0	10	20	100	1000

Source: own research

When further assuming that the investors hold 85% of the company shares (the model does not distinguish between investors who join at different times), with management and employees holding the remaining 15%, and that $0.2 million per project flows to the data providers (e.g. clinicians), then at the end of the fifth year, taking into account (negative) cash flow and valuation, the distribution of the increase in value is as follows:

- Investors: 60%
- Sunk costs: 27%
- Management: 13%
- Data providers (e. g., clinicians): 1%.

Discussion and Conclusions

Unicorns in oncology create enormous value both medically (Rösler et al., 2023) and financially, with unicorn valuations reaching more than $60 billion. While providing chances through value creation, unicorns may also produce some risks; for example, they may change the organization of medicine – its «management» – which does not automatically lead to improvements in the lives of everyone involved (e.g., if roles change (Thielscher & Kappler, 2023)). Some side effects aren't easy to predict: the introduction of new telemedicine services, for example, can lead to traditional doctors treating more difficult cases with reduced budgets (Wharton et al., 2019); and the privatization of research associated with unicorns can lead to a decline in publicly available research results (Cristea et al., 2019). These risks have rarely been studied.

The majority of unicorns are based in the United States, although some authors have found profitability to be higher in Europe (Kartanaite & Krusinkas, 2022). In medicine (not limited to oncology), there are a few European companies with unicorn status, such as Doctolib from France, an appointment scheduling and telemedicine platform currently worth $6.4 billion, and Ostto Bock HealthCare from Germany, a medical technology company valued at $3.5 billion. It seems that European companies struggle to achieve unicorn status in oncology. At this point, it can only be speculated why this is the case: for example, oncological research may be more intensive in the United States; the U.S. market for oncological products may be larger and or more profitable; U.S. investors may be more eager to invest heavy sums, whereas EU investors prefer slower, «organic» growth; and so forth. Future research will provide better insights.

To my knowledge, this article is the first to categorize business models of oncological unicorns and model value distribution (among investors, managers, employees, and others) in oncological unicorns. It would be helpful if these findings could be verified (or falsified) by other researchers. Readers may wonder why we assumed that the cash flow of a typical unicorn remains negative after 5 years; this is quite usual for unicorns (see, e.g., Yahoo Finance, 2024). This was also suggested by business insiders. Modifying this assumption does not significantly change the distribution of value increase. In any case, I do encourage other researchers to provide more sophisticated models.

It remains unclear whether the current valuations of oncological unicorns will translate into stable, positive cash-flows in the future. This can only be analyzed in a few years by following up on the development of unicorns.

Health policymakers should continue to monitor what happens to the enormous value generated by unicorns: does this money ultimately flow into medical care, or does it flow away, e.g., by withdrawing money from healthcare to pay off investors? Depending on how value allocation develops, regulatory measures may be appropriate.

References

Atomico. (2024). *The state of European Tech 2020*. https://soet-pdf.s3.eu-west-2.amazonaws.com/State_of_European_Tech_2020.pdf

CBInsights. (2024). *The complete list of unicorn companies*. https://www.cbinsights.com/research-unicorn-companies

Cristea, I. A., Cahan, E. M., & Ioannidis, J. P. A. (2019). Stealth research: Lack of peer-reviewed evidence from healthcare unicorns. *European Journal of Clinical Investigation*, *49*(4), e13072. https://doi.org/10.1111/eci.13072

Federal Statistical Office. (2024, April 24). *Healthcare expenditure by providers*. Statistisches Bundesamt (Destatis). https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Gesundheit/Gesundheitsausgaben/Tabellen/ ausgabentraeger.html

HolonIQ. (2024). *Global Health Tech unicorns*. https://www.holoniq.com/healthtech-unicorns

Institute for Health Metrics and Evaluation. (2024, August 2). *Global burden of disease 2021: Findings from the GBD 2021 study*. https://www.healthdata.org/research-analysis/gbd

Kartanaite, I., & Krušinskas, R. (2023). Financial efficiency of unicorns: Regional and sector-related aspects. *Engineering Economics, 33*(2), 200-214. https://doi.org/10.5755/j01.ee.33.2.30798

Obermann, K., & Thielscher, C. (2022). *Medical economics*. Agenda Publishing.

Rösler, W., Altenbuchinger, M., Baeßler, B., Beissbarth, T., Beutel, G., Bock, R., von Bubnoff, N., Eckardt, J. N., Foersch, S., Loeffler, C. M. L., Middeke, J. M., Mueller, M. L., Oellerich, T., Risse, B., Scherag, A., Schliemann, C., Scholz, M., Spang, R., Thielscher, C., Tsoukakis, I., & Kather, J. N. (2023). An overview and a roadmap for artificial intelligence in hematology and oncology. *Journal of Cancer Research and Clinical Oncology, 149*(10), 7997-8006. https://doi.org/10.1007/s00432-023-04667-5

Thielscher, C., & Kappler, K. (2023). Digitalization and organization of care: The case of oncology. *Journal of European Economy, 22*(1), 127-139. https://doi.org/10.35774/jee2023.01.127

Wharton, G. A., Sood, H. S., Sissons, A., & Mossialos, E. (2019). Virtual primary care: Fragmentation or integration? *The Lancet Digital Health*, *1*(7), e330-e331. https://doi.org/10.1016/S2589-7500(19)30152-9

Yahoo Finance. (2024). *TEM Holdings Limited profile*. Retrieved August 3, 2024, from https://finance.yahoo.com/quote/TEM/profile/

Zenbusiness. (2024, May 2). *Fastest unicorn companies*. https://www.zenbusiness.com/fastest-unicorns/

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