Impact of COVID-19 on Characteristics and Funding of U.S. Healthcare Startups: Retrospective Review

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Submitted to: JMIR Formative Research
on: January 12, 2024

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Abstract

Background: The rise of telehealth and telemedicine during the pandemic allowed patients and providers to develop a sense of comfort with telehealth, which may have increased the demand for virtual-first care solutions with spillover effects into venture capital funding.

Objective: Our objective was to understand the size and type of digital health investments pre- and post-pandemic.

Methods: We examined healthcare companies founded from 03/14/2019-03/14/2020 (pre-pandemic) versus those founded 03/14/2021-03/14/2022 (post-pandemic) according to Crunchbase, a publicly available database that catalogues information about investments. We used descriptive statistics to compare the characteristics of companies pre- and post-pandemic. We used a chi-square test to compare categorical variables and t-test for continuous variables. We conducted a Wilcoxon rank sum test to compare median funding amounts.

Results: There were 2,714 healthcare companies founded “pre-pandemic” and 581 companies founded “post-pandemic.” Companies were similarly distributed across geographies pre- versus post-pandemic (p=0.71). Companies founded pre-pandemic had a significantly greater mean (SD) number of founders than those founded post-pandemic (1.75 (0.96) vs. 1.62 (0.88), p=0.02). The distribution of funding rounds differed significantly for companies founded pre- and post-pandemic (p<0.001). Distributions of companies across healthcare subcategories were significantly different pre- versus post-pandemic (p < 0.001). Companies founded post-pandemic were more likely to be labeled Artificial Intelligence (7.3% post-pandemic vs. 4.7% pre-pandemic) and Software (17.3% post-pandemic vs. 12.7% pre-pandemic).

Conclusions: We demonstrate significant changes in the distribution of focus areas for companies founded before versus after the coronavirus pandemic, which suggests the ability of venture capital to respond to major health-related events. Clinical Trial: NA

(JMIR Preprints 12/01/2024:56327)
DOI: https://doi.org/10.2196/preprints.56327

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Funding: None

Number of pages: 13
References: 10
Figures: 1
Tables: 1

Word count: 1500/1500
References: 25
Tables: 2/2 tables or figures

Abstract: 446/450

Background: The rise of telehealth and telemedicine during the pandemic allowed patients and providers to develop a sense of comfort with telehealth, which may have increased the demand for virtual-first care solutions with spillover effects into venture capital funding.

Objective: Our objective was to understand the size and type of digital health investments pre- and post-pandemic.

Methods: We examined healthcare companies founded from 03/14/2019-03/14/2020 (pre-pandemic) versus those founded after the start of the COVID-19 pandemic 03/15/2020- 03/14/2022 according to Crunchbase, a publicly available database that catalogues information about venture capital investments for companies. We also compared companies founded pre-pandemic to those founded after the first year of the pandemic. We used descriptive statistics to compare the characteristics of companies pre- and post-pandemic. We used a chi-square test to compare categorical variables and t-test for continuous variables. We conducted a Wilcoxon rank sum test to compare median funding amounts. We compared these groups of companies on the type of funding round raised, geography, healthcare subcategory, total amount of funding per year since founding, and number of founders.

Results: There were 2,714 companies founded pre-pandemic and 2,218 companies founded during the pandemic. Companies were similarly distributed across geographies pre- versus pandemic ($p=0.46$) and there were no significant differences in the number of founders (1.75 (0.96) vs. 1.72 (0.93), $p=0.32$). There was a significant difference in total funding per year since founding among pre- and pandemic companies ($10.8M vs. $20.9M, $p<0.001$). The distribution of funding rounds differed significantly for companies founded pre- and post-pandemic ($p<0.001$).

When we excluded data from the first year of the pandemic there were 581 companies founded in the steady-state pandemic period from 03/14/2021-03/14/2022. Companies founded pre-pandemic had a significantly greater mean (SD) number of founders than those founded post-pandemic (1.75 (0.96) vs. 1.62 (0.88), $p=0.02$). There was no significant difference in total funding per year since founding among pre- and steady-state companies ($10.8M vs. $14.4M, $p=0.34$).

The most common types of healthcare companies included Wellness, Biotech/Biopharma, and Software companies. Distributions of companies across healthcare subcategories were not significantly different pre- vs. during the pandemic. However, when data from the first year of the pandemic was excluded, there were significant differences identified ($p<0.001$). Companies founded during the steady state pandemic were significantly more likely to be classified as Artificial Intelligence (7.3% vs. 4.7%, $p=0.005$), Software (17.3% vs. 12.7%, $p=0.002$), and Insurance (3.3% vs. 1.7%, $p=0.003$), and significantly less likely to be classified as Healthcare Diagnostics (2.4% vs. 5.1%, $p=0.002$).

Conclusions: We demonstrate no significant changes in the types of healthcare companies founded pre- versus during the pandemic, but significant differences emerge when we compare pre-pandemic companies to those founded after the first-year of the pandemic.

Background: (231)

The COVID-19 pandemic rapidly shifted priorities for healthcare delivery. Patients and providers gained comfort with telehealth,[1] and increasingly relied on this modality of care delivery.[2] Pressures related to social distancing created an increased focus on home-based care and new diagnostic methods to test for COVID-19 were needed, which may have impacted the types of companies founded. [2–65]

Unlike stock markets, venture capital is less impacted by individual investors and can assess the reallocation of capital in response to major events.[7] Industry and published research has shown significant venture activity in health-related areas of healthtech, biopharma, devices, and diagnostic tools post-pandemic, but less exploration has been done on changes in investments pre- and post-pandemic.[8–11] One study on the impact of COVID-19 on venture investments found that venture capitalists invested up to 44% more capital in pandemic-related fields. Another study found that half of venture capitalists reported a positive impact of COVID-19 on investments. Another white paper found that early-stage VC activity declined by 38%, which supports other data demonstrating that the overall number of venture capital investments declined post-pandemic. [12,13]

While these studies inform our understanding, little data exists on the impact of the COVID-19 pandemic on the specific types of healthcare investments in the United States where overall venture spending has increased.[14] Our objective was to understand the types of healthcare companies founded before versus after the COVID-19 pandemic.

Methods (249)

Data Source

We obtained data on U.S. healthcare companies from Crunchbase, a web-based database cataloging startup information about company variables and healthcare subcategories from users, public data,

and other data partners. Companies and users self-classify into pre-existing subcategory tags and can use multiple similar or overlapping tags.

Study Sample

We investigated U.S. companies founded from 03/14/2019 to 03/14/2022.

Outcomes

We extracted geography, profit structure, funding round, amount of total funding, and number of founders. We grouped Crunchbase's healthcare subcategories into broader groupings (Appendix 1). Using companies' total funding to date and founding dates, we calculated total funding per year to compare across companies.

Analysis Approach

In our primary analysis, we compared characteristics of U.S. healthcare companies founded from 03/14/2019-03/14/2020 (pre-pandemic) versus those founded 03/15/2020-03/14/2022 ("during pandemic" period). In a secondary analysis, we compared characteristics of companies founded pre-pandemic to those founded from 03/14/2021-03/14/2022, when the initial pandemic peak subsided ("pandemic steady state" period).

We used descriptive statistics to describe the characteristics of companies founded in the pre-pandemic, during pandemic, and pandemic steady state periods. We used chi-squared tests to compare categorical variables and Wilcoxon-rank tests to compare continuous variables. A p-value of 0.05 was used to assess statistical significance. As this study used data not related to patients, it did not require Institutional Review Board review.

Ethical Considerations

Study data are anonymous and did not required informed consent. We have adhered to local, national, regional, and international law and regulations regarding protection of personal information, privacy, and human rights.

Results (362)

According to Crunchbase, there were 2,714 companies founded pre-pandemic and 2,218 companies founded after the start of the pandemic (Table 1). Companies were similarly distributed across geographies pre-pandemic versus after the start of the pandemic (p=0.46) and had a similar number of founders (p=0.32). Total funding per year since founding differed significantly pre-pandemic versus after the start of the pandemic ($10.8M ($45M) vs. $20.9M ($119M), p<0.001).

Table 1. Characteristics of Companies Founded Pre-Pandemic vs. During Pandemic

	Pre-Pandemic *March 15, 2019 to March 14, 2020* **N = 2,714**	**During Pandemic** *March 15, 2020 to March 14, 2022* **N = 2,218**	**p-value for difference**
Geography N (%) in each category (no missing data)	Information available for = 2,714 Northeast 697 (25.68%) Midwest 300 (11.05%) South 770 (28.37%) West 947 (34.89%)	Information available for = 2,218 Northeast 526 (23.72%) Midwest 248 (11.18%) South 650 (29.30%) West 794 (35.80%)	p = 0.46
Funding Round N (%) in each category	Information available for N = 851 Seed 586 (69%) Early Stage 173 (20%) Private Equity 11 (1.3%) IPO 16 (1.9%) M&A 57 (6.7%) Late Stage 8 (0.9%)	Information available for N = 771 Seed 618 (80%) Early Stage 113 (15%) Private Equity 8 (1.0%) IPO 14 (1.8%) M&A 17 (2.2%) Late Stage 1 (0.1%)	p < 0.001
Total Funding Per Year Since Founding **Mean (SD)**	Information available for N = 901 $10,832,252 ($45,669,417)	Information available for N = 759 $20,970,037 ($119,295,457)	p <.001
# of Founders **Mean (SD)**	Information Available for N = 1,1417 1.75 (0.96)	Information Available for N = 1,093 1.72 (0.93)	p = 0.32

Mean funding per year by healthcare category did not significantly differ pre- and versus during the pandemic (Table 2).

Table 2. Median Total Funding Amount Per Year by Healthcare Category

Name	Median Total Funding Amount Per Year						
	Pre-Pandemic (3/14/2019-3/14/2020)	**Count of Companies**	**% of Available Data**	**During Pandemic (3/15/2020-3/14/2022)**	**Count of Companies**	**% of Available Data**	**p-value**
Wellness	$2,000,000.00	219	29.2%	$1,311,250.00	184	31.3%	0.27
Integrative Medicine	$1,750,000.00	51	30.9%	$1,556,000.00	36	29.0%	0.907
Care for older adults and rehabilitation	$1,400,000.00	19	14.4%	$1,000,000.00	21	19.1%	0.655
Mobile Health (mHealth)	$1,000,000.00	17	41.5%	$1,500,000.00	21	42.9%	1
Artificial Intelligence	$1,425,000.00	73	49.7%	$1,000,000.00	62	48.1%	0.598
Software	$2,000,000.00	172	43.4%	$1,000,000.00	147	39.5%	0.116
Payments	$10,050,000.00	26	33.8%	$3,500,000.00	25	41.0%	0.19
Insurance	$2,436,500.00	18	34.6%	$1,500,000.00	19	48.7%	0.727
Data	$11,000,000.00	9	37.5%	$800,000.00	12	60.0%	0.286
Pharmaceutical	$6,684,975.50	80	44.4%	$4,812,500.00	48	38.1%	0.883
Fertility	$1,485,000.00	6	60.0%	$2,803,500.00	5	55.6%	0.715
Healthcare Diagnostics	$3,000,000.00	53	33.5%	$2,116,750.00	50	40.0%	0.984
Biotech and Biopharma	$6,000,000.00	265	50.0%	$10,000,000.00	195	49.1%	0.144
Health systems	$3,271,673.00	26	19.0%	$2,200,000.00	31	23.8%	0.86
Medical Device	$1,370,000.00	105	42.2%	$1,440,000.00	87	48.9%	0.634

Home Health Care	$2,900,000.00	18	28.6%	$630,000.00	15	29.4%	0.294

The distribution of funding rounds differed significantly for companies founded pre- and during the pandemic ($p<0.001$), with more pandemic companies in the seed stage (80.0% post-pandemic vs. 68.9%) and fewer in the early-stage (15.0% vs. 20.3%), mergers and acquisitions stage (2.2% vs. 6.7%), or late-stage (0.1% vs. 0.9%) (Table 1).

When data from the first year of the pandemic were excluded, there were 581 companies founded in the pandemic steady-state period 03/14/2021-03/14/2022 (Table 3). Data on geographic distribution, funding rounds, and number of founders were similar. However, in contrast to analyses including the period from 03/15/2020 to 03/14/2021, in analyses comparing the pre-pandemic period to the pandemic steady state period, there was no significant difference in the total funding per year since founding ($10.8M pre-pandemic ($45,669,417) vs. $14.3M ($52,119,919) pandemic steady-state, $p=0.34$).

Table 3. Characteristics of Companies Founded Pre vs. During Pandemic Steady State

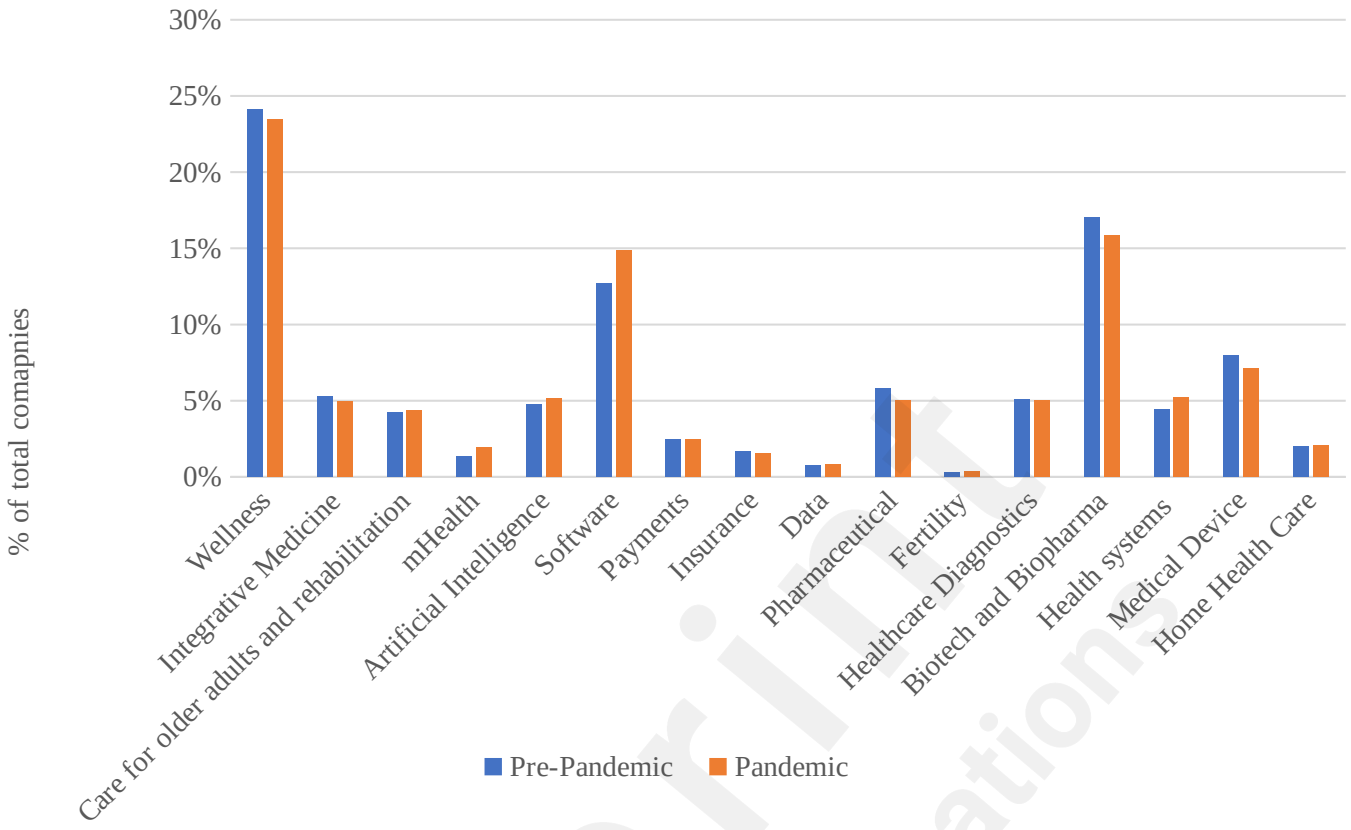
	Pre-Pandemic *March 14, 2019 to March 14, 2020* **N = 2,714**	**Pandemic Steady State** *March 14, 2021 to March 14, 2022* **N = 581**	**p-value for difference**
Geography N (%) in each category (no missing data)	Information available for = 2,714 Northeast 697 (25.68%) Midwest 300 (11.05%) South 770 (28.37%) West 947 (34.89%)	Information available for = 581 Northeast 136 (23.41%) Midwest 64 (11.02%) South 171 (29.43%) West 210 (36.14%)	p = 0.71
Funding Round N (%) in each category	Information available for N = 851 Seed 586 (69%) Early Stage 173 (20%) Private Equity 11 (1.3%) IPO 16 (1.9%) M&A 57 (6.7%) Late Stage 8 (0.9%)	Information available for N = 231 Seed 200 (86.6%) Early Stage 26 (11.3%) Private Equity 0 (0.0%) IPO 2 (0.9%) M&A 3 (1.3%) Late Stage 0 (0.0%)	p < 0.001
Total Funding Per Year Since Founding **Mean (SD)**	Information available for N = 901 $10,832,252 ($45,669,417)	Information available for N = 201 $14,348,739 ($52,119,919)	p = 0.34
# of Founders **Mean (SD)**	Information Available for N = 1,1417 1.75 (0.96)	Information Available for N = 312 1.62 (0.88)	p = 0.02

The most common types of healthcare companies both pre-pandemic and during the pandemic included Wellness (24.1% pre-pandemic and 23.4% during pandemic), Biotech/Biopharma (17.0% pre-pandemic and 15.8% during pandemic), and Software (12.7% pre-pandemic and 14.8% during pandemic). Data companies (0.7% pre-pandemic and 0.8% during pandemic) and Fertility companies (0.3% pre-pandemic and 0.3% during pandemic) had a lower proportion of investments. Distributions of companies across healthcare subcategories were not significantly different pre- versus during the pandemic.

However, when data from the first year of the pandemic was excluded, there were significant differences. Companies founded post-pandemic were significantly more likely to be classified as Artificial Intelligence (7.3% pandemic steady-state vs. 4.7% pre-pandemic, p=0.005) and Software (17.3% pandemic steady-state vs. 12.7% pre-pandemic, p=0.002), and Insurance (3.3% pandemic steady-state vs. 1.7% pre-pandemic, p=0.003), and significantly less likely to be classified as Healthcare Diagnostics (2.4% pandemic steady-state vs. 5.1% pre-pandemic, p=0.002).

Figure 1. Categorizations of venture-backed healthcare companies pre-pandemic and during the pandemic

*Categorizations available for all pre- and pandemic companies



Discussion (658)

In this national, cross-sectional study of startup companies, we demonstrate significant differences in total funding per year since founding: $10.8M per year pre-pandemic compared to $20.9M per year during the pandemic. We also demonstrate a significant increase in the proportion of companies in the seed stage. Our results did not reveal significant differences in the types of companies founded pre-pandemic and during the first two-years of the pandemic. However, we found a significant difference in the types of companies founded pre-pandemic versus during the pandemic steady state, with a 55.3% relative increase in the proportion of companies classified as dealing with Artificial Intelligence, a 36.2% relative increase in the proportion of companies classified as Software, and a 52.9% relative decrease in the proportion of companies labeled Healthcare Diagnostics. Overall, Wellness, Biotech/Biopharma, and Software companies accounted for the highest proportions of founded companies overall with less activity in Fertility.

The significant increase in total funding per year pre-pandemic compared to during the pandemic is supported by data published elsewhere that demonstrates an increase in global venture funding from 2020-2022 compared to 2019.[15] This may suggest that the pandemic spurred increased activity in innovation, but no research to our knowledge compares differences in venture capital investments specifically before and after the start of the pandemic.[16,17]

Our results did not reveal significant differences in the types of companies founded pre-pandemic and during the first two-years of the pandemic. Given the significant lead time needed for founders to move from idea generation to founding a company and raising money, we hypothesized that the first year of the pandemic may have been more reflective of pre-pandemic trends and may not have captured shifts in the market from the pandemic itself. When we compared pre-pandemic companies to those founded during the pandemic steady-state, we did find significant increases in Artificial

Intelligence, Software, and Biotech investments, though this may also be influenced by longer-standing market trends.[17,18] While we did not find a significant increase in the proportion of mHealth companies despite the rise of virtual care during the pandemic, this expected trend may have been captured by the increase in the proportion of Software companies, which includes many mHealth companies. Industry research supports our research finding of high levels of venture investment in the areas of Artificial Intelligence, Biotech, and Software/Digital health/Health Tech.[19–21]

The significant relative decrease in Healthcare Diagnostics companies despite the increase of at-home COVID testing is surprising. It is possible that diagnostics were largely being developed by larger, traditional companies rather than newer startups. It is also possible that the post-pandemic period coincided with a higher inflationary environment that made investors and founders more conservative in more capital intensive areas like diagnostics.[22–24] A study in 2020 from the National Bureau of Economic Research found that from 1974-2019 during economic downturns, venture capital firms changed their investment focus toward less innovative startups.[13]

Some Crunchbase data comes directly from site users, which may contribute to selective reporting bias. Further, there are no standard definitions of healthcare subcategories for users to base their categorizations on. Companies can be tagged to multiple relevant healthcare categories which may overcome some ambiguity in definition. Nevertheless, Crunchbase represents one of the only publicly available repositories of startup company data and ours is the first to leverage this data to understand trends in founding of healthcare companies.

In conclusion, we demonstrate no changes in the distribution of focus areas for companies founded before after the start of the COVID pandemic, but when we isolate pandemic steady state data we see significantly increased activity related to Artificial Intelligence and Software and significantly less

activity in Healthcare Diagnostics. This may reflect impacts of the COVID pandemic on investing patterns. As healthcare venture capital investments more actively shape the healthcare delivery landscape, real-time efforts to aggregate information on company establishment and venture capital investments would allow health system researchers to better understand innovation trends and the flow of capital in healthcare.

Acknowledgements

Generative AI was not used in any portion of the data analysis or in manuscript writing.

Data Availability

The data sets analyzed during this study are not publicly available due to being proprietary data from Crunchbase, but are available from the corresponding author on reasonable request.

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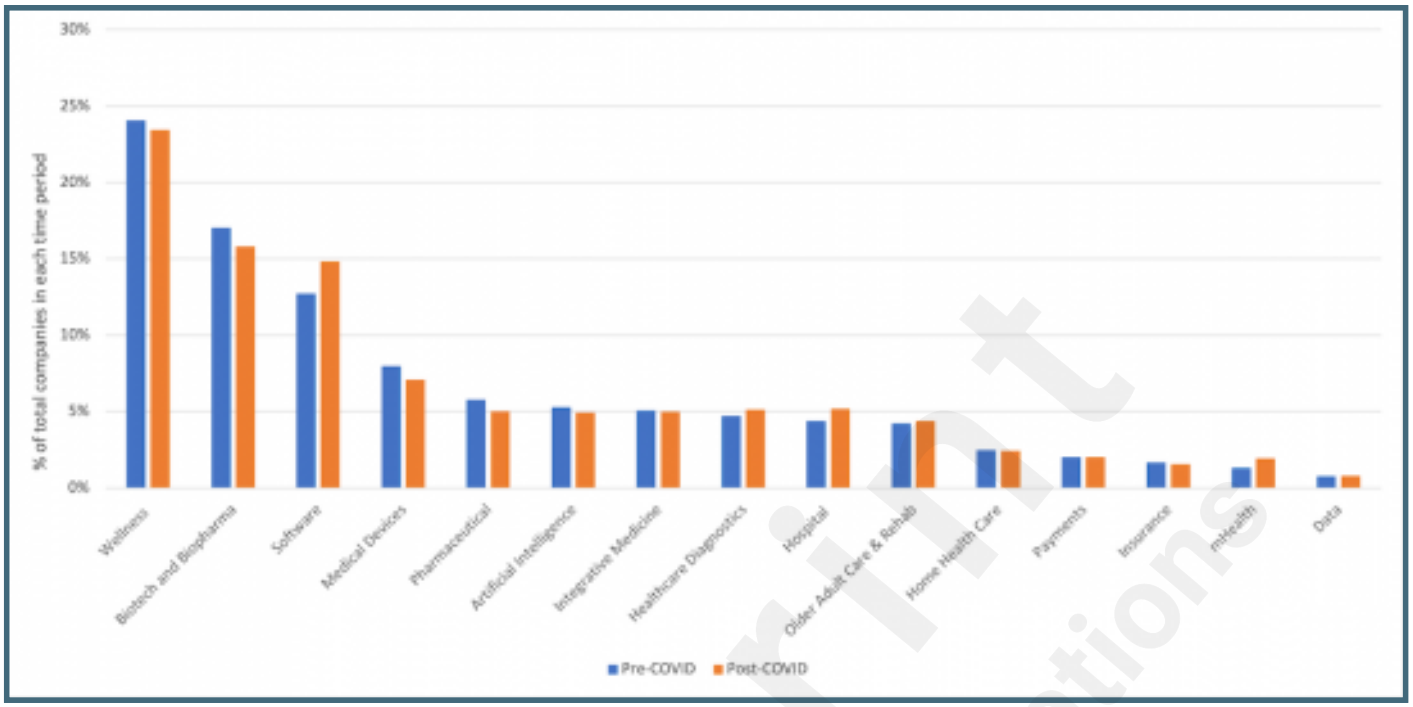
Supplementary Files

Figures

Categorizations of venture-backed healthcare companies pre- and post-pandemic.



Multimedia Appendixes

Grouping of Crunchbase healthcare categories into broader categories.
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