



EMERGING TECH RESEARCH

Healthcare IT Report

VC trends and emerging opportunities

Q1
2023





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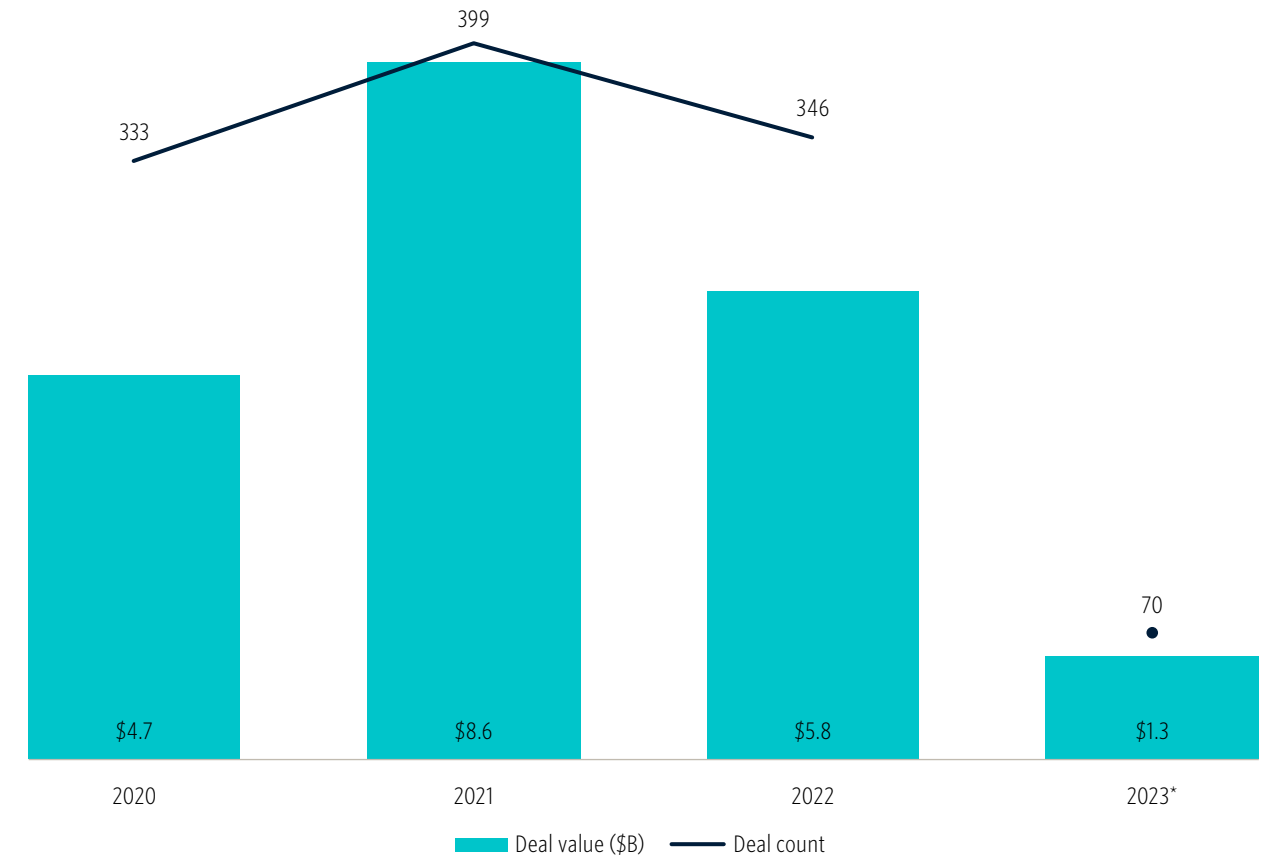


Vertical overview

The healthcare IT vertical comprises software used by healthcare providers and payers. Q1 2023 saw 70 VC rounds closed for a total of \$1.3 billion, a bump up from Q4's low point but still well off the pace set in 2020 to 2021. 27 PE deals also closed in the quarter, roughly flat from Q4. Despite lackluster deal flow, the opportunity and urgent need for improvements in healthcare delivery, reimbursement, and operations continue to drive interest in healthcare IT. The Healthcare Information and Management Systems Society (HIMSS) Conference, the industry's flagship conference, which was held on April 17 to 21, 2023, represents a useful bellwether. The event highlighted generative AI and interoperability solutions—both of which fall into the category of potentially transformative but currently limited in use case.

We believe that the new generation of large language models (LLMs) heralded by GPT-4 will be transformative for healthcare—but that that transformation will proceed slowly. We envision progress along a glide path, beginning with applications that are the furthest from medical decision-making, such as patient engagement applications, electronic health record (EHR) summaries and clinical documentation, and prior authorization request composition; then moving to medically adjacent applications that require discretion, such as symptom triage, care navigation, wellness coaching, and limited prior authorization review; then progressing to diagnosis, prescription, and payer medical review along predefined care pathways; then finally entering the realm of autonomous medical decision-making. This progress will be made over five to 10 years or more and will require significant focus on transparency and explainability.

Healthcare IT VC deal activity



Source: PitchBook • Geography: Global • *As of March 31, 2023

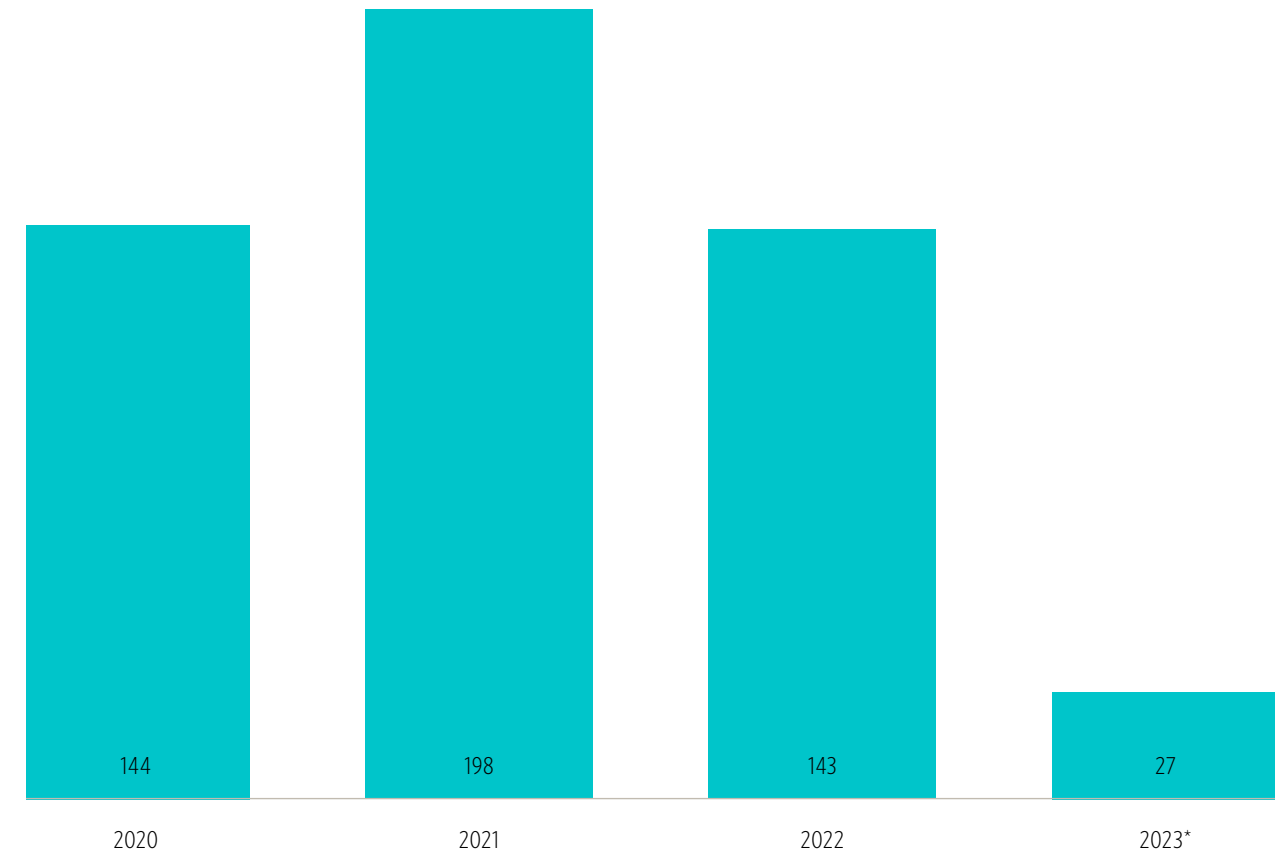


VERTICAL OVERVIEW

[Microsoft's](#) partnership with [Epic](#) and ([Microsoft-owned](#)) [Nuance's](#) partnership with [OpenAI](#) create a triumvirate of healthcare generative AI leaders, but many observers also believe that open-source models like GPT-4 will prove to be a democratizing force, allowing startup challengers to compete with incumbents on both capabilities and pricing. The May launch of [Hippocratic AI](#), a clinical LLM startup, with a \$50 million seed round from [General Catalyst](#) and [Andreessen Horowitz](#), portends significant future capital deployment on this theme. We heard from one investor that most VCs are spending most of their time working on generative AI.

The healthcare IT industry has also welcomed a recent federal regulatory push toward healthcare data interoperability. Healthcare's data silos problem is difficult to overstate, yet the industry's transition toward value-based care is predicated on the ability to utilize holistic, longitudinal, and real-time patient data. Many potential generative AI applications would also need to sit atop an application programming interface (API)-based, interoperable data architecture. [Zus Health](#) and [Clearsense](#) scored sizable fundraises in Q1, while [Health Gorilla](#) announced its Qualified Health Information Network (QHIN) status in April. We are bullish on the need for improved data interoperability and quality and believe that innovation and investment in the space will allow important progress in diverse applications such as population health and, as discussed later in this report, prior authorization. However, many interoperability companies face serious risks, including end-market concentration in digital-first providers and the allure of building infrastructure ahead of concrete use cases.

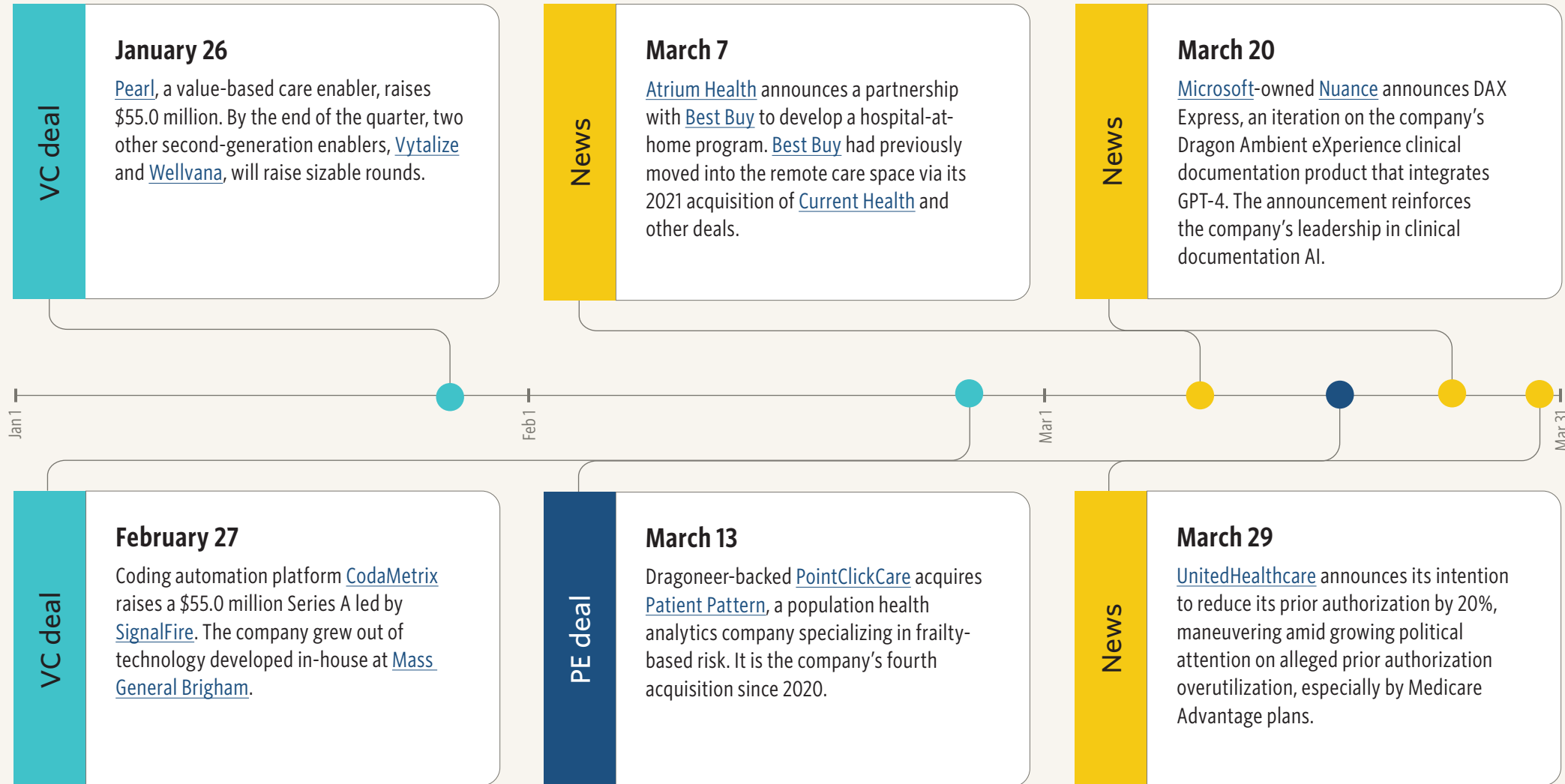
Healthcare IT PE deal count



Source: PitchBook • Geography: Global • *As of March 31, 2023



Q1 2023 timeline



Q1 2023 VC deal value summary

\$1.3B

total deal value

184.5%

QoQ change in deal value

-44.5%

YoY change in quarterly deal value

2023 PE deal count summary

27

Q1 2023 deal count

8.0%

QoQ change in deal count

-38.6%

YoY change in quarterly deal count



Healthcare IT landscape

- 1** EHRs & clinical information
- 2** Revenue cycle
- 3** Operations
- 4** Analytics
- 5** Infrastructure & compliance

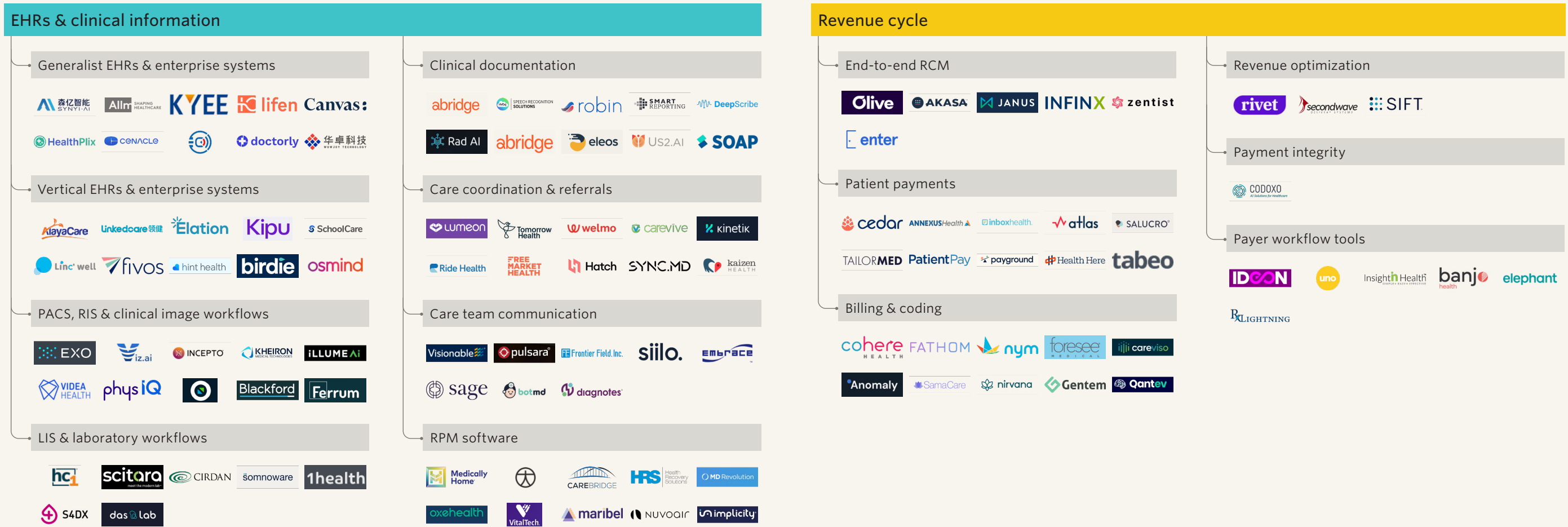




Healthcare IT VC ecosystem market map

Click to view the interactive market map on the PitchBook Platform.

Market map is a representative overview of venture-backed companies in each segment. Companies listed have received VC investment since 2020.

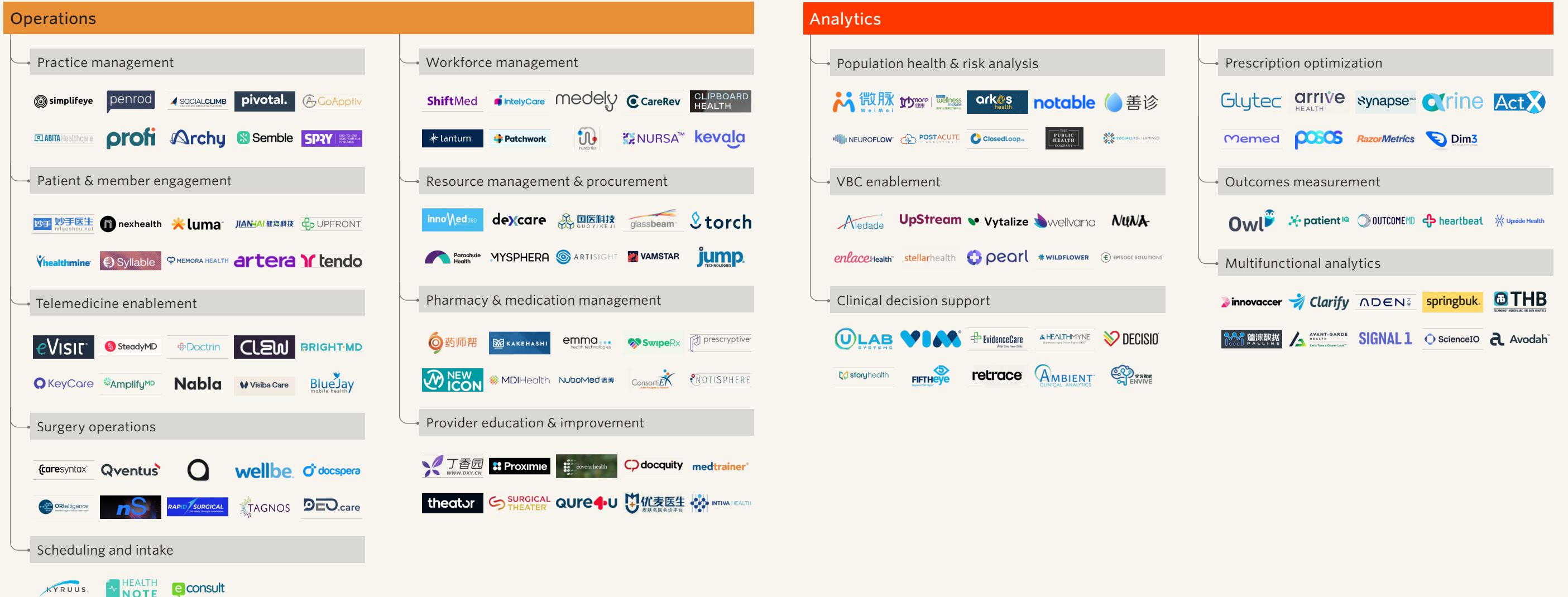




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Healthcare IT VC ecosystem market map

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Infrastructure & compliance

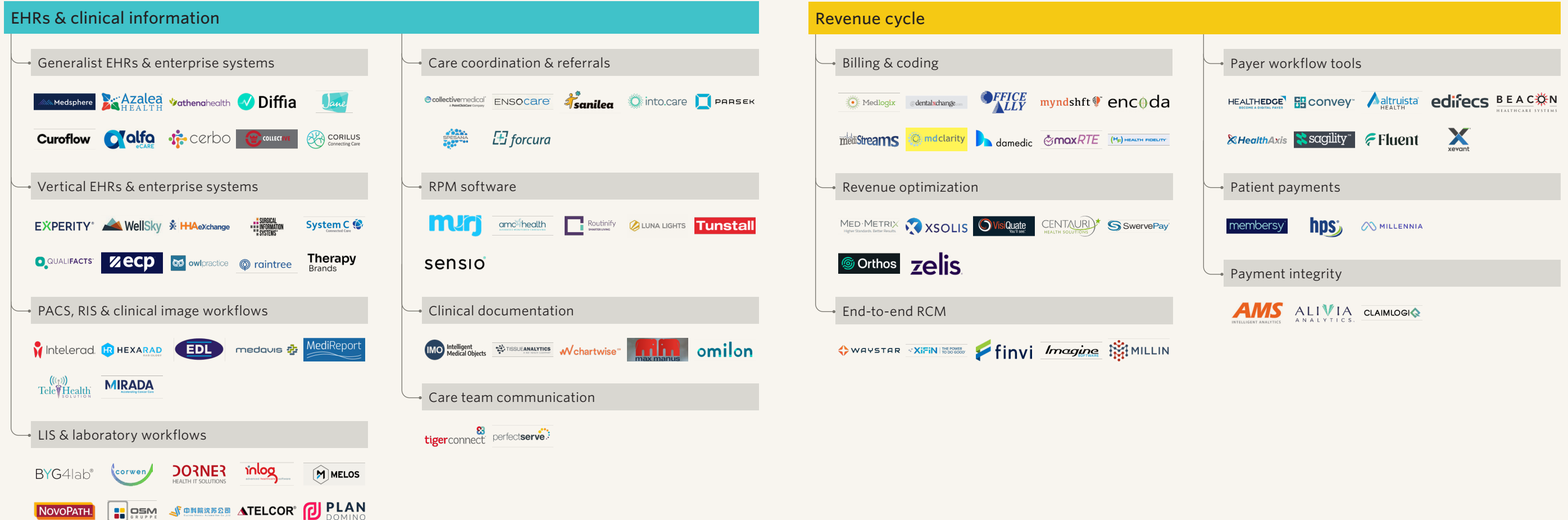




Healthcare IT PE ecosystem market map

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Market map is a representative overview of private equity-backed companies in each segment. Companies listed are currently active in PE portfolios.

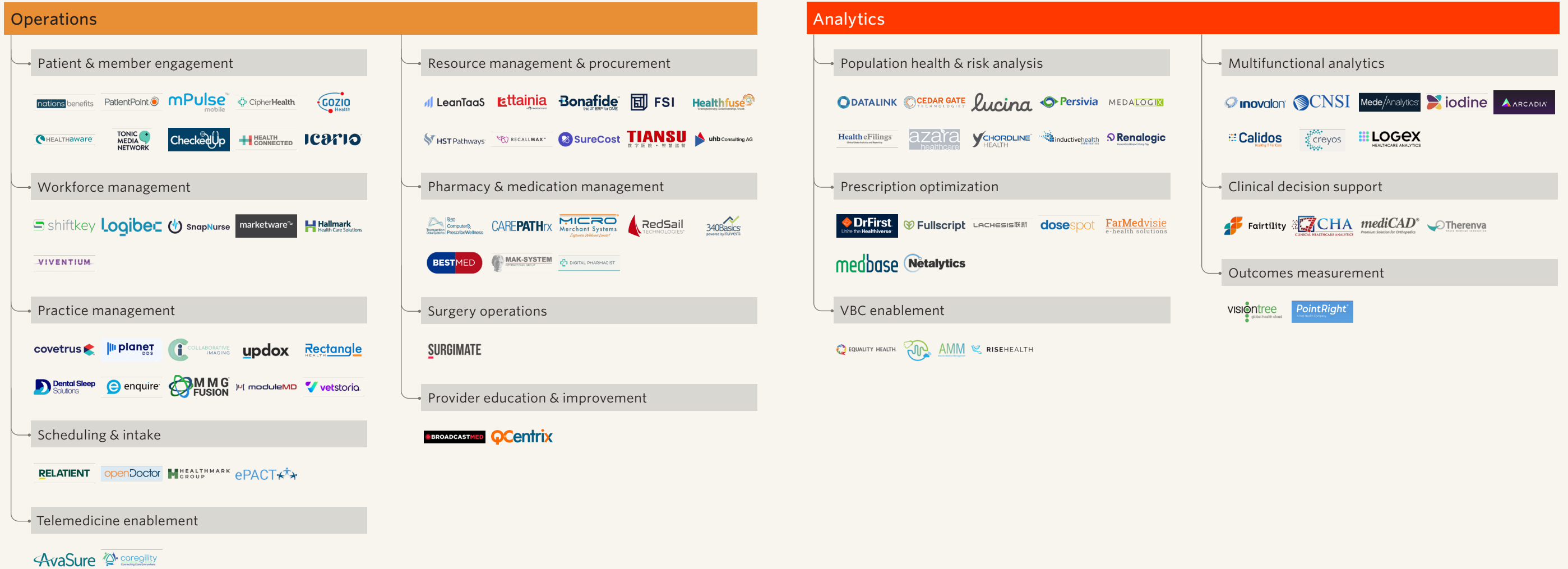




Healthcare IT PE ecosystem market map

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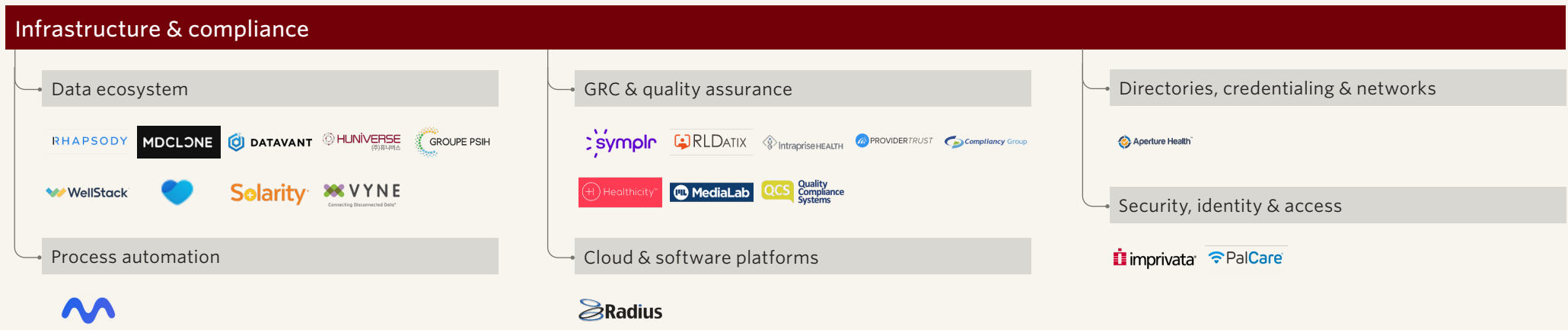




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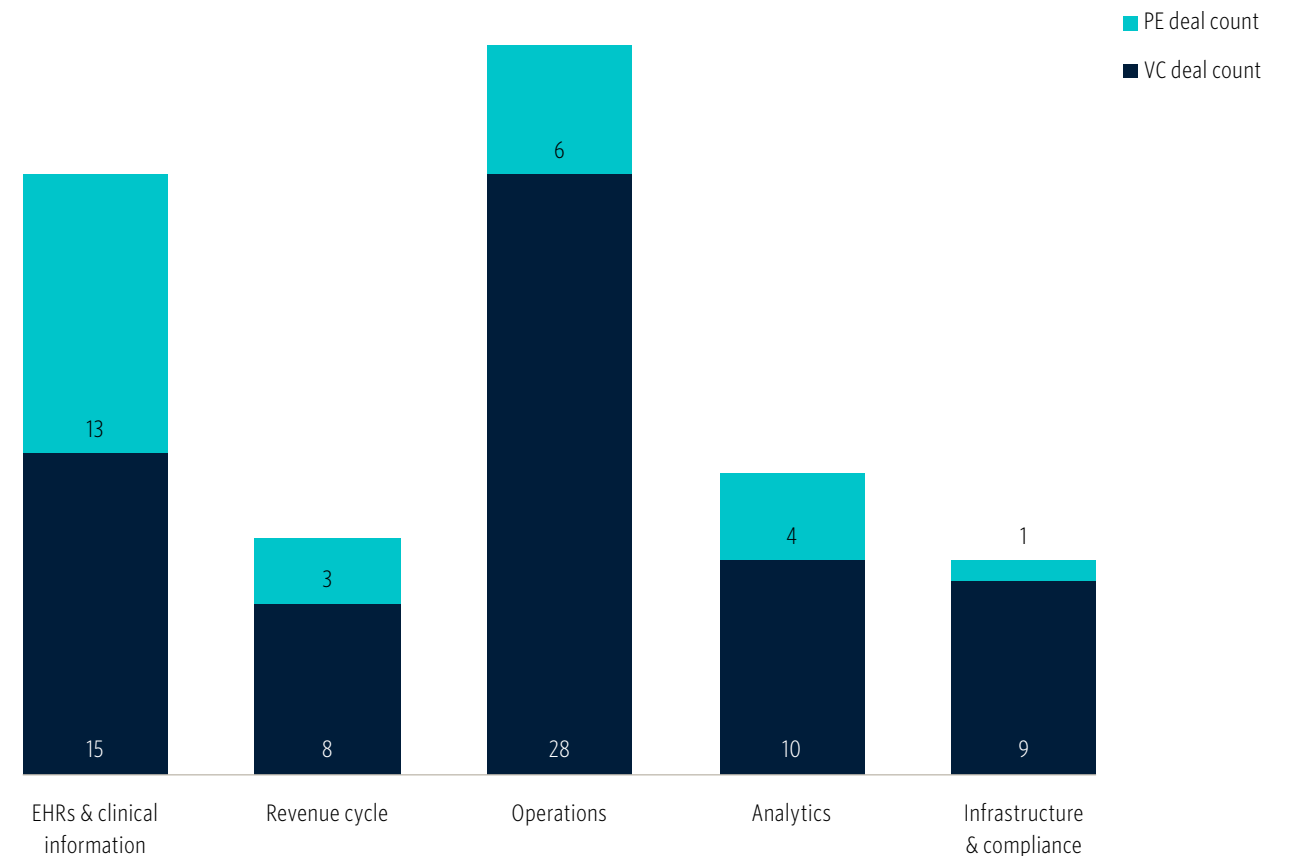


VC and PE activity

VC funding bounced back modestly in Q1 2023 after hitting rock bottom in Q4. Startups raised \$1.3 billion across 70 deals, roughly in line with Q3 2023's activity levels and representing a greater deal value than Q1 2020. We attribute this partially to the slightly sunnier macroeconomic outlook that characterized the quarter—until [Silicon Valley Bank's](#) collapse and the subsequent banking crisis rattled markets. Additionally, clusters of sizable workforce management ([ShiftMed](#) and [ShiftKey](#)) and value-based care enablement ([Pearl](#), [Vytalize](#), and [Wellvana](#)) deals boosted the quarter's figures. Overall, Q1 represented a flight to quality for VC investors, manifest in a willingness to write decently sized checks to startups with prestigious origin stories. [CodaMetrix](#), an AI coding company developed at [Mass General Brigham](#) and piloted at a handful of leading academic medical centers, took in \$55.0 million, while [Zus Health](#), an interoperability company started by [Athenahealth](#) founder Jonathan Bush, brought in \$40.0 million. With IPO markets still shuttered until at least 2024, we recorded only a handful of VC-backed exits at undisclosed valuations.

In contrast to the volatility in the VC market, PE healthcare IT deal activity continues to show resilience. PE firms closed 27 healthcare IT deals in the quarter, modestly below the activity levels that characterized 2021. We are seeing some PE firms continue a trend begun a few years ago by moving “upstream” to invest in late-stage startups. For example, [Enhanced Healthcare Partners](#), a middle-market firm that has lately been pivoting from healthcare services toward a greater proportion of healthcare IT deals, invested just over \$45 million in [Janus Health](#) in February. Compared with buying out a mature company, this strategy is less capital intensive and requires no leverage; lately, it has also begun to look more attractive from a valuation standpoint. Other noteworthy deals in the quarter included [Aquiline](#) and [Level Equity's](#) buyout of dental EHR vendor [Cloud 9 Software](#), [Thoma Bravo's](#) acquisition of healthcare analytics provider [Logex Group](#), and [Alpine Investors' acquisition of Medusind Solutions](#), a medical and dental billing company that offers both fully outsourced and software-only solutions.

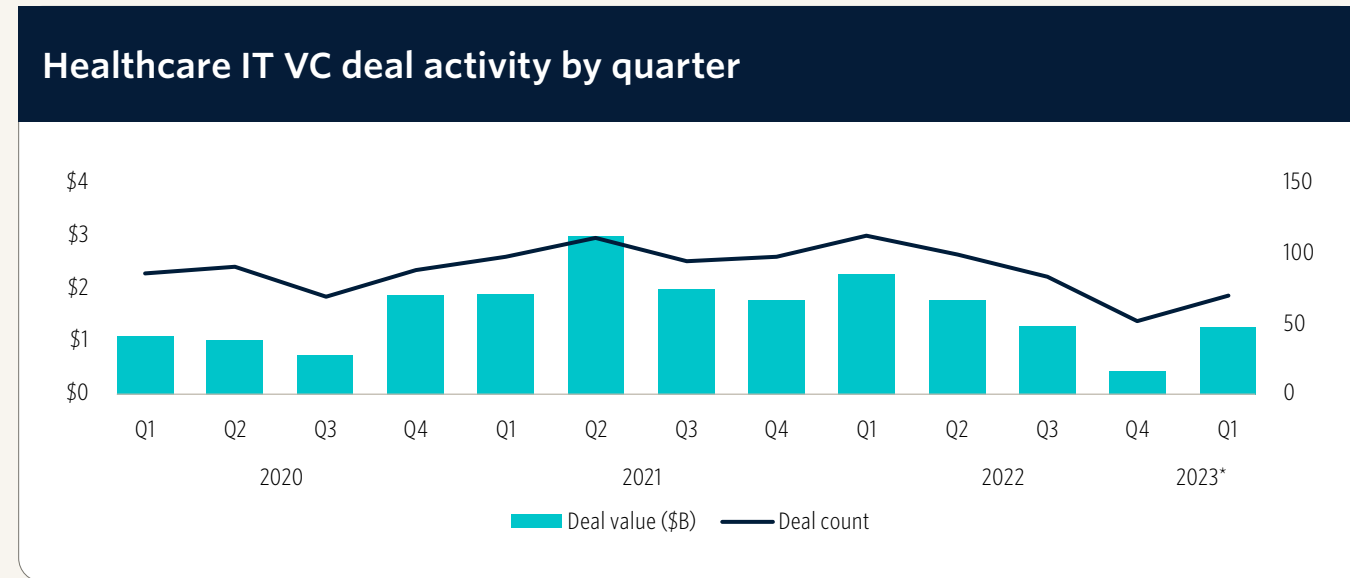
Q1 2023 healthcare IT VC and PE deal count by segment*



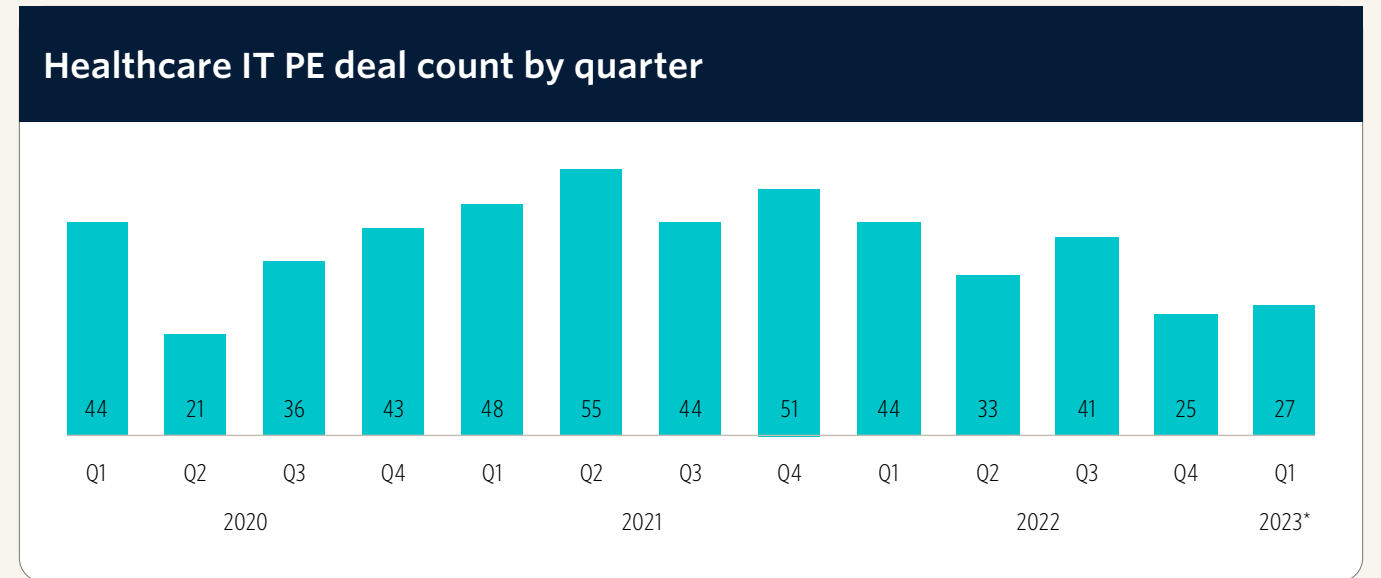
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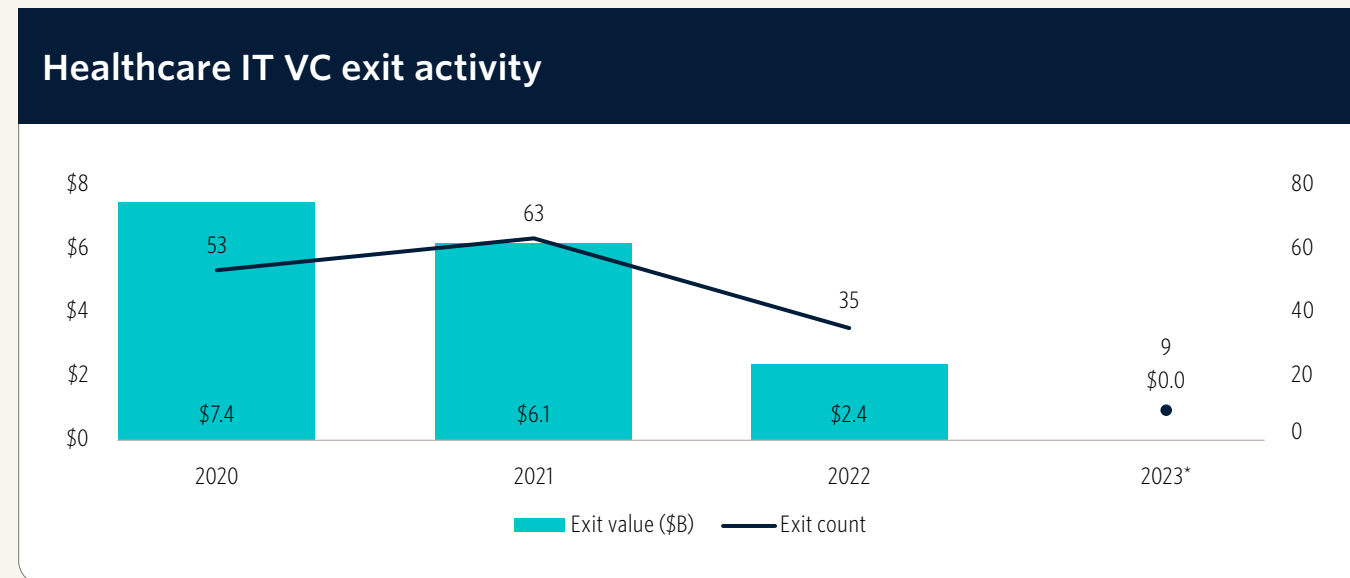
VC AND PE ACTIVITY



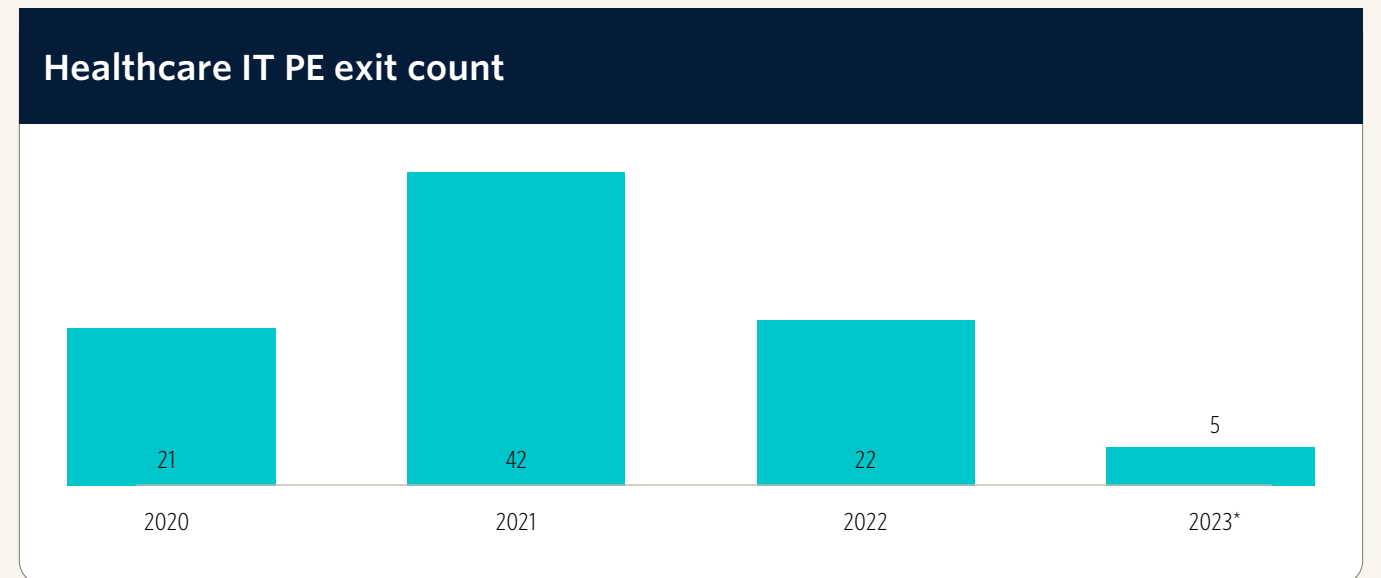
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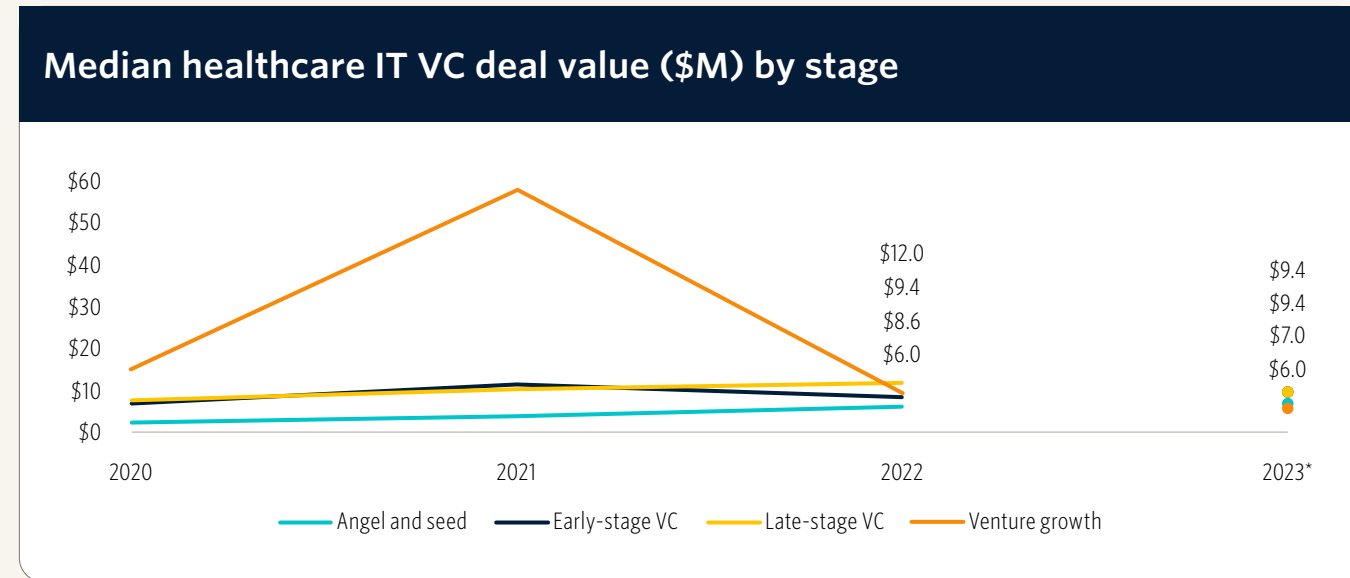
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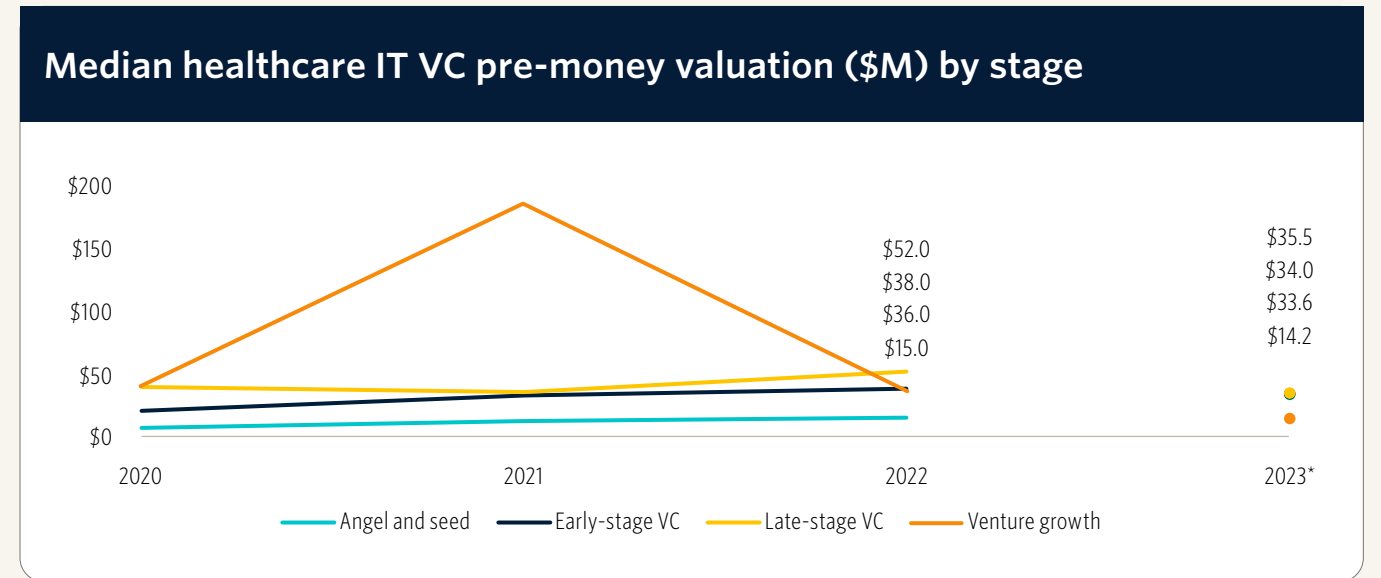
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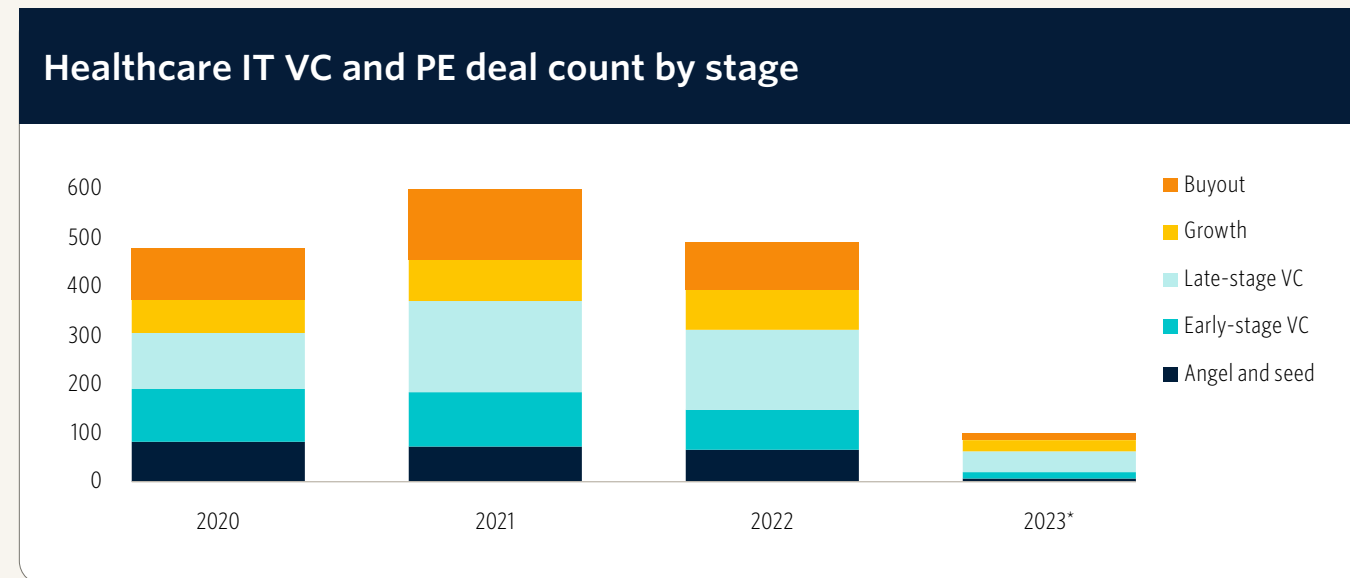
VC AND PE ACTIVITY



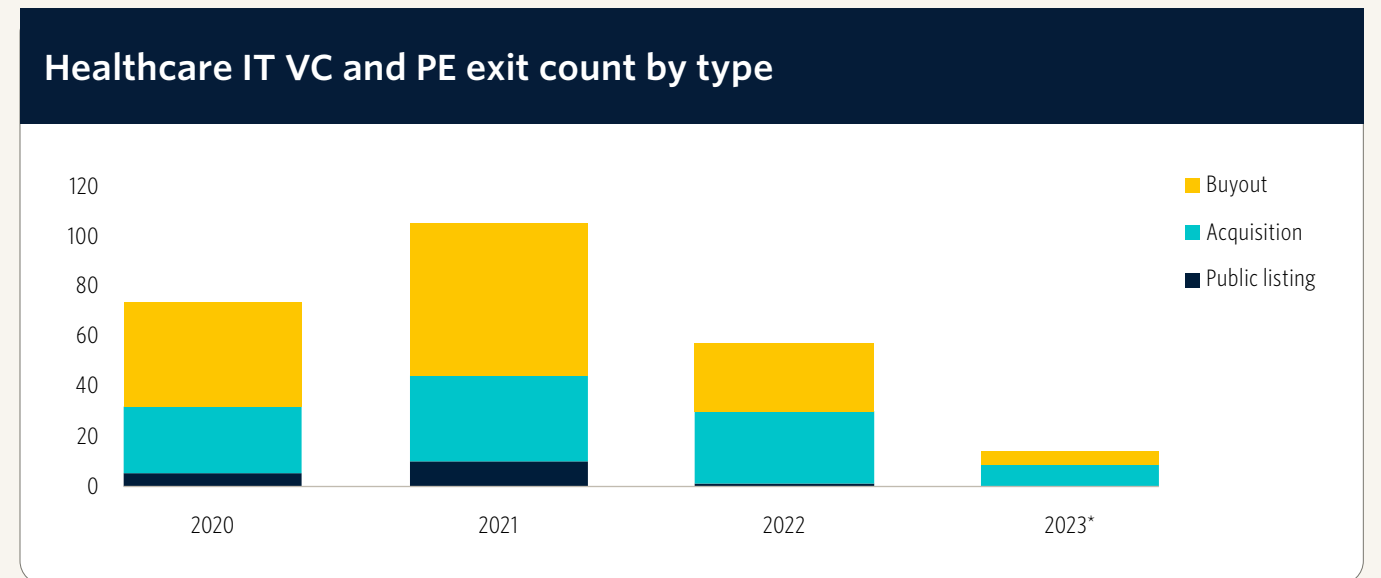
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VC AND PE ACTIVITY

Key healthcare IT early-stage VC deals*

Company	Close date (2023)	Deal value (\$M)	Category	Deal type	Lead investor(s)	Valuation step-up (post to pre)
Pearl	January 26	\$55.0	VBC enablement	Series B	Andreessen Horowitz, Viking Global Investors	N/A
Janus Health	February 28	\$45.1	Process automation	Series B	Enhanced Healthcare Partners	3.3x
Zus Health	February 22	\$40.0	Data ecosystem	Series A1	Andreessen Horowitz et al.	0.8x
KeyCare	January 5	\$27.0	Telemedicine enablement	Series A	8VC	3.2x
SpectrumAi	March 16	\$20.0	Vertical EHRs and enterprise systems	Series A	CVS Health Ventures	N/A
deepc	March 28	\$12.8	PACS, RIS, and clinical image workflows	Series A	Sofinnova Partners	N/A
Carium	January 20	\$6.0	Telemedicine enablement	Series A	American Family Ventures	1.5x
RhythmScience	March 23	\$6.0	Clinical decision support	Series A	Cedars Sinai Health Ventures	4.8x
HealthMed	January 17	\$5.7	Telemedicine enablement	Series A1	Panoramic Ventures	2.4x
Altrix	January 31	\$3.1	Workforce management	N/A	N/A	N/A

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VC AND PE ACTIVITY

Key healthcare IT late-stage VC and growth deals*

Company	Close date (2023)	Deal value (\$M)	Category	Deal type	Lead investor(s)
ShiftKey	January 11	\$300.0	Workforce management	N/A	Lorient Capital Management
ShiftMed	February 6	\$200.0	Workforce management	N/A	Panoramic Ventures
Vytalize	February 7	\$100.0	VBC enablement	Series C	Enhanced Healthcare Partners, Monroe Capital
Wellvana	March 27	\$84.0	VBC enablement	N/A	Heritage Group, Valtruis (Welsh, Carson, Anderson & Stowe)
Kakehashi	March 29	\$70.2	Pharmacy and medication management	Series C	Salesforce Ventures
CodaMetrix	February 27	\$57.4	Billing and coding	Series A	SignalFire
Clearsense	January 30	\$49.9	Data ecosystem	Series D	HealthQuest Capital
Viz.ai	March 22	\$40.0	PACS, RIS, and clinical image workflows	N/A	Canadian Imperial Bank of Commerce
Solve.Care	January 16	\$30.2	Cloud and software platforms	N/A	N/A
Smile Digital Health	January 23	\$30.0	Data ecosystem	Series B	30 North Group, UPMC Enterprises

Source: PitchBook • Geography: Global • *As of March 31, 2023



VC AND PE ACTIVITY

Key healthcare IT PE buyouts*

Company	Close date (2023)	Category	Deal type	Acquirer (Sponsor)
Clevermed	February 13	Vertical EHRs and enterprise systems	Add-on	System C Healthcare (CVC Capital Partners)
Cloud 9 Software	January 4	Vertical EHRs and enterprise systems	Buyout	Planet DDS (Aquiline Capital Partners, Level Equity)
Fingerprint Global	February 28	Surgery operations	Add-on	Aliter Capital, Net Solving
Hospital IQ	January 9	Billing and coding	Add-on	LeanTaaS (Bain Capital)
Logex Group	March 1	Multifunctional analytics	Buyout	Thoma Bravo
Medusind Solutions	January 5	Billing and coding	Buyout	Alpine Investors
Patient Pattern	March 13	Population health and risk management	Add-on	PointClickCare (Dragoneer Investment Group, et al.)
Pinnacle Quality Insight	January 19	Patient and member engagement	Add-on	Home Care Pulse (Cressey & Company, Upside Growth Partners)

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VC AND PE ACTIVITY

Key healthcare IT VC and PE exits*

Company	Close date (2023)	Category	Exit type	Acquirer (Sponsor)
Cloud 9 Software	January 4	Vertical EHRs and enterprise systems	Add-on	Planet DDS (Aquiline Capital Partners, Level Equity)
Hospital IQ	January 9	Billing and coding	Add-on	LeanTaaS (Bain Capital)
Human API	March 7	Data ecosystem	Acquisition	N/A
Logex Group	March 1	Multifunctional analytics	Buyout	Thoma Bravo
Medusind Solutions	January 5	Billing and coding	Buyout	Alpine Investors
Mpirik	March 9	Care coordination and referrals	Acquisition	Tempus Labs
Pando	March 3	Provider education and improvement	Acquisition	Beacon Health System
Patient Pattern	March 13	Population health and risk analysis	Add-on	PointClickCare (Dragoneer Investment Group)
Siilo	March 2	Care team communication	Acquisition	Doctolib

Source: PitchBook • Geography: Global • *As of March 31, 2023



VC AND PE ACTIVITY

Top strategic acquirers of healthcare IT companies since 2020*

Acquirer	Deal count	Investor type
Dedalus	8	PE-backed company
Symplr	7	PE-backed company
Netsmart Technologies	6	PE-backed company
Intelerad Medical Systems	5	PE-backed company
Modernizing Medicine	4	PE-backed company
EverCommerce	4	PE-backed company
HST Pathways	4	PE-backed company
RLDatix	4	PE-backed company
Cloudmed	4	Corporation

Source: PitchBook • Geography: Global • *As of March 31, 2023

Top PE investors in healthcare IT companies since 2020*

Investor	Deal count	Investor type
TA Associates Management	21	PE/buyout
Hg	15	PE/buyout
Clearlake Capital Group	14	PE/buyout
Francisco Partners	12	PE/buyout
Ardan Equity	12	PE/buyout
Warburg Pincus	11	PE/buyout
Sixth Street Partners	11	Growth/expansion
Main Capital Partners	10	PE/buyout

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VC AND PE ACTIVITY

Top VC investors in healthcare IT companies since 2020*

Investor	Deal count	Angel and seed	Early-stage VC	Late-stage VC	Venture growth	Investor type
General Catalyst	19	3	10	3	3	VC
F-Prime Capital	15	2	9	3	1	VC
Tiger Global Management	15	1	4	4	6	VC
Andreessen Horowitz	15	3	8	4	0	VC
Optum Ventures	14	0	4	9	1	CVC
Frist Cressey Ventures	12	2	1	8	1	VC
HealthX Ventures	12	2	2	6	2	VC
First Trust Capital Partners	12	1	3	8	0	VC
Providence Ventures	12	0	2	8	2	VC
LRVHealth	12	0	4	7	1	VC
Alumni Ventures	12	5	3	4	0	VC

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VC AND PE ACTIVITY

Top VC-backed healthcare IT companies by total VC raised to date*

Company	VC (\$M) raised to date	Segment	Category	HQ location
Olive AI	\$851.8	Revenue cycle	End-to-end RCM	Columbus, US
Miaoshou Doctor	\$815.1	Operations	Patient and member engagement	Beijing
DXY	\$685.0	Operations	Provider education and improvement	Hangzhou, China
Cedar	\$619.4	Revenue cycle	Patient payments	New York, US
Commure	\$576.8	Infrastructure and compliance	Cloud and software platforms	San Francisco, US
Yaoshibang	\$495.7	Operations	Pharmacy and medication management	Guangzhou, China
Innovaccer	\$438.1	Analytics	Multifunctional analytics	San Francisco, US
Aledade	\$417.9	Analytics	VBC enablement	Bethesda, US
Digital China Health	\$412.3	Infrastructure and compliance	Data ecosystem	Beijing
Neusoft Xikang Healthcare Technology	\$370.0	EHRs and clinical information	Vertical EHRs and enterprise systems	Shanghai

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Emerging opportunities

Prior authorization

Automation promises to shrink administrative burdens and improve access to care.

Synthetic data

Artificial datasets may help the industry keep pace with the demand for privacy-preserving AI training data.



Prior authorization

Prior authorization is a process used by payers to determine if a prescribed product or service will be covered. In a fee-for-service reimbursement architecture, providers are financially incentivized to deliver and bill for as much medical care as possible, whether or not that care improves patient health. Prior authorizations allow payers to control this impulse, reducing wasteful spending. However, many believe that payers overuse prior authorizations. Additionally, this process is often extremely time consuming for both providers and payers and frustrating for patients.

In a survey by the American Medical Association (AMA), 94% of providers reported that prior authorizations have delayed patients' access to necessary care at least "sometimes"; 80% said it has led to treatment abandonment, and 46% said it has led patients to go to the emergency department (ED) or an immediate care clinic,¹ resulting in more expensive care. The prior authorization process can take weeks, and denials are not always explainable by providers.

Additionally, seeking prior authorizations carries a significant administrative burden. Only 28% of prior authorizations are submitted fully electronically; 39% are submitted via proprietary payer web portals or interactive voice systems, while 33% are submitted manually via phone, mail, fax, or email.² Payers also have unique requirements for prior authorization formatting and supporting documentation. 77% of group practices report having hired or redistributed staff to cope with increasing prior authorization requirements.³

1: "2022 AMA Prior Authorization (PA) Physician Survey," American Medical Association, 2023, n.d., accessed May 10, 2023.

2: "2022 CAQH Index: A Decade of Progress," CAQH Explorations, 2023, n.d., accessed May 10, 2023.

3: "Spotlight: Prior Authorization in Medicare Advantage," MGMA, May 2023.

Policy tailwinds

Prior authorizations have recently become a more prominent policy issue in Congress and within the Centers for Medicare & Medicaid Services (CMS).^{4,5,6} Many payers waived certain prior authorization requirements to decrease provider burden and speed access to care during the COVID-19 pandemic. After those policies expired and patients sought elective procedures they had delayed during the pandemic, the volume of prior authorization requests increased by 61% from 2021 to 2022.⁷ Additionally, the increase in Medicare Advantage (MA) enrollment has resulted in higher prior authorization burdens for providers, as many MA plans lean heavily on prior authorization to control spending, while traditional Medicare requires very few prior authorizations.⁸ 84% of group physician practices reported to the Medical Group Management Association (MGMA) that prior authorization requirements for MA have increased in the past 12 months.⁹ This growing administrative burden has coincided with a climate of widespread staffing shortages and provider burnout. On the technology front, a growing industry and policy consensus around the use of Fast Healthcare Interoperability Resources (FHIR) APIs to exchange healthcare information finally appears to put prior authorization automation within reach. The table below summarizes recent regulatory and legislative developments.

4: "Mental Health Providers Decry 'Mind-Numbing' Prior Authorization Burdens as Senate Debates Reforms," Fierce Healthcare, Robert King, November 30, 2022.

5: "Jayapal, DeLauro, Schakowsky Lead Effort to Reform Medicare Advantage," Pramila Jayapal, February 16, 2023.

6: "Providers Press CMS to Finalize Prior Authorization Reforms to Alleviate Major Administrative Burdens," Fierce Healthcare, Robert King, January 18, 2023.

7: "2022 CAQH Index: A Decade of Progress," CAQH Explorations, 2023, n.d., accessed May 10, 2023.

8: "Medicare Advantage Appeal Outcomes and Audit Findings Raise Concerns About Service and Payment Denials," US Department of Health and Human Services Office of Inspector General, September 2018.

9: "Spotlight: Prior Authorization in Medicare Advantage," MGMA, May 2023.



PRIOR AUTHORIZATION

Recent regulatory developments pertaining to prior authorization*

Title	Date	Description
Advancing Interoperability and Improving Prior Authorization Processes Proposed Rule¹⁰	December 6, 2022	CMS would require MA plans, state Medicaid/Children’s Health Insurance Program (CHIP) plans, Medicaid/CHIP managed care organizations, and Affordable Care Act exchange plans to adopt electronic prior authorization processes by 2026. Specifically, the rule proposes that payers be required to offer Prior Authorization Requirements, Documentation and Decision (PARDD) APIs to automate the process of determining whether a prior authorization is required and what information is required for that authorization, and to exchange prior authorization requests and decisions. It would also require payers to include a specific reason when they deny a prior authorization request, and to return prior authorization decisions within 72 hours for urgent requests and seven calendar days for standard requests. Finally, the rule would update aspects of the 2020 Interoperability and Patient Access Final Rule to give patients and providers greater visibility into prior authorization decisions, among other measures. ¹¹
2024 Medicare Advantage and Part D Final Rule¹²	April 5, 2023	The 2024 Medicare Advantage fee schedule includes provisions to curb inappropriate use of prior authorizations by MA plans. Beginning in 2024, when a member switches to a new MA plan, the plan cannot require prior authorization for an active course of treatment during a 90-day transition period. Additionally, all MA plans must establish a Utilization Management Committee to ensure coverage consistent with traditional Medicare.
Improving Seniors’ Timely Access to Care Act of 2022¹³	September 14, 2022	This bipartisan legislation unanimously passed in the House of Representatives in September 2022 and is now before the Senate. The legislation directs the US Department of Health and Human Services (HHS) secretary to establish processes for electronic prior authorization and real-time decision-making for routinely approved requests.

Source: PitchBook Emerging Tech Research • *As of March 31, 2023

10: “Advancing Interoperability and Improving Prior Authorization Processes Proposed Rule CMS-0057-P: Fact Sheet,” [CMS.gov, December 6, 2022](#). This rule supersedes the 2020 Interoperability and Prior Authorization Proposed Rule, which was similar but excluded MA plans.

11: “Interoperability and Patient Access Fact Sheet,” [CMS.gov, March 9, 2020](#).

12: “2024 Medicare Advantage and Part D Final Rule (CMS-4201-F),” [CMS.gov, April 5, 2023](#).

13: “H.R.3173 - Improving Seniors’ Timely Access to Care Act of 2021,” [Congress.gov, 117th Congress, Rep. Suzan Delbene, September 15, 2022](#).



PRIOR AUTHORIZATION

The prior authorization process



Source: PitchBook Emerging Tech Research



PRIOR AUTHORIZATION

Relevant players

Technology players are working to improve the prior authorization process via a range of system entry points. Most solutions, including [AKASA's](#) Automation Management suite, focus on easing and/or automating administrative tasks on the provider side. For instance, [AKASA](#) flags missing member benefits or clinical information and helps to retrieve this information from EHR/practice management systems. [Glidian](#) offers a tech-plus-services product that lets providers submit requests and track their status via a single dashboard.

Another area of innovation focused on provider workflows is the development of FHIR standards specifically for prior authorization processes. The HL7 Da Vinci Project, a multi-stakeholder effort among payers, providers, and technology companies to improve data exchange in support of value-based care, has been developing and piloting prior authorization capabilities on both the payer and provider sides since 2019.

Alternatively, technology providers can deploy technology on the payer side that reaches into provider workflows. [Cohere](#) offers utilization management technology as well as a fully outsourced utilization management solution to payers. [Cohere's](#) platform ingests electronic transfers, portal submissions, and even faxes via optical character recognition (OCR), then uses machine learning and clinical guidelines to automatically approve 85% of requests. Additionally, where possible, the platform “nudges” providers before requests are submitted to follow appropriate care pathways that can be automatically approved by the payer. We see advantages in this payer-first approach in that it aligns care decisions between payer and provider to fundamentally reduce friction rather than simply accelerating manual steps in the prior authorization process.

As of 2022, [Olive](#) offered a comparable solution that automated prior authorization review for payers and adjudicated some immediate request approvals at the point of care. However, the future of this product is uncertain: The beleaguered ex-unicorn sold its utilization management business to electronic data interchange (EDI) clearinghouse provider [Availity](#) in April 2023 and is now focusing exclusively on provider revenue cycle automation.

Impact of generative AI

Many industry experts we have talked with assert that prior authorization review will never be fully automated. The core concerns are the sophisticated medical judgment required to review complex requests and the worry that an overly automated process will become too lenient or too stringent in its review by learning solely from itself; some degree of human-in-the-loop must be maintained. Because prior authorization decisions directly inform care, we believe adoption of AI for adjudication requiring medical judgment will be extremely slow. The more immediate application for generative AI is to summarize information from a prior authorization request to support human review.

On the provider side, generative AI may soon be used to compile prior authorization requests. The limiting factor is the availability and interoperability of the required clinical supporting information, which can extend far beyond the requesting provider's EHR and into other providers' systems (for example, other specialists, laboratories, and imaging facilities).



PRIOR AUTHORIZATION

Considerations

The dynamic policy landscape around prior authorization creates a challenging balancing act for startups: build tech that has real, concrete use cases to deliver immediate ROI for customers now—but that won't be rendered obsolete by national policy advancements in the next three to four years. While reforming prior authorizations and improving health data interoperability are bipartisan issues and will likely remain that way, the eventual shape of CMS/Office of the National Coordinator for Health Information (ONC) regulation, and how and when these regulations will be implemented, is harder to predict. CMS has a history of both backing away from and accelerating previously proposed policy changes.

A related question is how payers themselves will react to mounting policy pressure, and whether this will reduce the need for third-party automation solutions. In March, [UnitedHealthcare](#) announced it will eliminate nearly 20% of its prior authorizations.¹⁴ This will materially reduce the administrative burden of prior authorization submissions for many providers, especially to

the extent that other payers follow suit. However, experts believe the 20% reduction will focus on authorizations that are routinely approved. [United](#) also stated it would follow other payers in implementing a “gold-card” program, in which providers with a track record of providing appropriate care would have most of their prior authorization requirements eliminated. However, some payers currently administering gold-card programs have struggled to effectively determine which providers will participate successfully and have seen unwarranted utilization by “gold-carded” providers.¹⁵

Despite these considerations, we believe the fundamental incentives of the fee-for-service system ensure there will continue to be significant demand for automated or AI-enhanced prior authorization submission and review.

¹⁴: [“Easing the Prior Authorization Journey,” UnitedHealthcare, March 29, 2023.](#)

¹⁵: [“Effective Gold Carding Programs Are Based on Evidence and Value for Patients,” AHIP, July 2022.](#)



Synthetic data

[Synthetic data](#) refers to artificially generated data that accurately mimics real-world datasets while protecting individual privacy. As healthcare innovators increasingly seek to use AI to uncover new clinical insights, parse risks at population and individual levels, and automate manual processes, access to high-quality clinical data is becoming increasingly important. Synthetic data is an attractive solution because it avoids HIPAA- and General Data Protection Regulation (GDPR)-related friction. Leading companies in the space include [MDCClone](#), which offers the most sophisticated scientific research product, and [Syntegra](#), which announced a partnership with [Datavant](#) in December 2022. Other relevant companies include Berlin-based [Static](#), acquired by information security software provider [Anonos](#) for \$50.0 million in November 2022, and [Replica Analytics](#), which was acquired by real-world data provider [Aetion](#) in January 2022; these commercial providers also compete with a handful of open-source models. We believe that the healthcare industry's utilization of synthetic data will accelerate in the coming years to keep pace with the demand for AI training data and real-world evidence in life sciences research.

Methods and use cases

As technology has improved, it has become possible to move from de-identifying real patient datasets by aggregating and adding noise; to generating new datasets that statistically resemble real populations using assumptions about characteristic distributions; to generating datasets that reproduce unexpected relationships between medical events. Recent developments in

synthetic data generation include the use of autoencoders and generative adversarial networks (GANs). However, applying these techniques to healthcare data can be challenging because they perform best with count and binary variables—whereas healthcare data is discrete, multi-label, and longitudinal. MedGAN is an open-source framework whose contributors are working to solve these problems for healthcare data;^{16,17} [MDCClone](#) also has experience and capabilities using GANs alongside statistical sampling and other techniques.

Synthetic data serves a number of use cases that vary in their quality and privacy requirements.¹⁸ These are summarized in the table below. In general, for synthetic data generated using a real dataset, there is a tradeoff between quality and privacy: The more closely the synthetic data resembles the real patient population, the more possible it is to infer sensitive attributes or to infer that an individual is a member of the real dataset. Privacy risks also increase when working with smaller patient cohorts meeting specific inclusion criteria, as might be required in researching a rare disease, for instance. Measures to mitigate this risk include algorithmically identifying and omitting rare outliers and generating synthetic patient cohorts wherein the number of patients does not precisely match the real patient dataset.¹⁹

¹⁶: "[MedGAN: Medical Image Translation Using GANs](#)," ScienceDirect, Computerized Medical Imaging and Graphics, Karim Armanious, et al., January 2020.

¹⁷: "[Beyond Differential Privacy: Synthetic Micro-Data Generation With Deep Generative Neural Networks](#)," IntechOpen, Ofer Mendelevitch and Michael D. Lesh, September 9, 2020.

¹⁸: "[Synthetic Data in Health Care: A Narrative Review](#)," PLOS Digital Health, Aldren Gonzales, Guruprabha Guruswamy, and Scott R. Smith, January 6, 2023.

¹⁹: "[Spot the Difference: Comparing Results of Analyses From Real Patient Data and Synthetic Derivatives](#)," JAMIA Open, Randi E. Foraker, et al., December 14, 2020.



SYNTHETIC DATA

Overview of synthetic data use cases*

Use case	Privacy requirement	Quality requirement	Example
Testing data for healthcare IT applications	Lower	Lower	Michigan PatientGen ²⁰
Public release of datasets	Higher	Moderate	CMS 2008-2010 Data Entrepreneurs' Synthetic Public Use File
Public health research	Higher	Moderate	SyntheticMass, generated using Synthea ²¹
Academic and life sciences research	Moderate	Higher	MDClone
Clinical investigation	Higher	Moderate	Syntegra, MDClone

Source: PitchBook Emerging Tech Research • *As of March 31, 2023

20: "PatientGen - Synthetic, Realistic Patient Data for Use in Interoperability Testing," HealthIT.gov, January 6, 2014.

21: "SyntheticMass," SyntheticMass, n.d., accessed May 10, 2023.



SYNTHETIC DATA

Another key distinction lies in how users interact with synthetic datasets. For instance, [MDClone](#) offers two products, a population-representative synthetic data lake for clinical investigation and real-time, precision cohorts for scientific research. In clinical investigation use cases, users seek to understand how various factors (including specific clinical practices, patient history, and social determinants of health) affect patient outcomes on a population level in order to inform future approaches. This investigational process is often carried out by clinical or administrative staff who do not have data science backgrounds. It is also iterative; the investigator may approach the data with hypotheses, but will continue investigating different factors until they find a satisfactory answer. Therefore, this use case requires a synthetic dataset that is broadly representative of the institution's patient population but may not precisely replicate characteristics of specific patient cohorts. By contrast, academic researchers and clinical trial investigators require a high degree of data precision, yet will approach datasets with a precise, predetermined set of questions.

Considerations

Critics of synthetic data argue that there is no standard methodology or reporting framework for measuring privacy risks from synthetic datasets, thus creating a “loophole” in data privacy law.²² While we acknowledge this concern, we believe that the privacy risk posed by synthetic

data is dwarfed by healthcare's existing information security vulnerabilities, which include legacy systems, many human actors handling sensitive personal information, and myriad connected devices. In this context, the benefits of giving clinicians and researchers better access to patient data in a secure or relatively secure manner are likely to outweigh the risks. However, investors should be cognizant that the industry (and regulators, at some point) will likely begin to develop and enforce standardized approaches to evaluating synthetic data anonymity in the coming years.

Another consideration stems from the fact that synthetic data utilization is currently concentrated among large health systems, academic medical centers, and large pharmaceutical companies. Because synthetic datasets must be generated using real underlying data—and larger and well-resourced institutions are best equipped to provide that data—scientific research currently being conducted with synthetic data may not be representative of the full range of patient populations. Considerable investment in data cleaning will need to be made in order to bring smaller and less-resourced institutions into the fold. Until that is technologically and economically possible, the pool of potential customers is relatively small, and synthetic data providers will compete on the quality of their underlying technology.

²²: [“Synthetic Patient Data in Health Care: A Widening Legal Loophole,” The Lancet, Anmol Arora, March 23, 2022.](#)



Select company highlights



SELECT COMPANY HIGHLIGHTS: HEALTH GORILLA



Founded
2014

Total raised:
\$76.9M

Last financing valuation:
\$300.0M

Last financing:
Raised \$50.0M in a Series C deal

Lead investors:
SignalFire, IA Capital
Group, PIK Ventures, DCVC,
True Ventures

Overview

[Health Gorilla](#) is a leading healthcare data interoperability platform. Founded in 2014 with a focus on aggregating diagnostic laboratory data, the company was an early adopter of FHIR APIs and has been heavily engaged in informing federal health data policy. In addition to co-founders Steve Yaskin (CEO), Sergio Wagner (Chief Strategy Officer), and Andrei Zudin (CTO), the company's leadership team includes Dave Cassel, SVP of Operations and Customer Success, who formerly led interoperability initiatives such as Care Everywhere at [Epic](#), and Steven Lane, Chief Medical Officer, who led the early adoption of the Epic EMR at Sutter Health and has held governing and advisory committee positions across leading private- and public-sector interoperability initiatives. [Health Gorilla](#) raised a \$50.0 million Series C at a \$350.0 million valuation in March 2022, led by [SignalFire](#).

In April, [Health Gorilla](#) announced its certification as a QHIN under the Trusted Exchange Framework and Common Agreement (TEFCA), joining [CommonWell Health Alliance](#), eHealth Exchange, [Kona](#), [Epic](#), and [Kno2](#) as one of the first six organizations approved. The company's Patient360 product enriches and completes patients' health records by using data from over 120,000 care sites, including with supplemental social determinants of health data, while its ADT

Data solution provides risk-bearing entities with admission, discharge, and transfer alerts from hospitals nationwide. The platform is built on FHIR R4 architecture and carries SOC-2 Type 2 and HITRUST R2 security certifications.

Competitive landscape

[Epic](#), the EHR industry's 800-pound gorilla (pun intended), represents [Health Gorilla](#)'s most formidable competitive threat. In creating information exchange infrastructure to connect institutions that are largely run on [Epic](#), [Health Gorilla](#) is betting that it can outmaneuver [Epic](#) and other industry giants in technology development and driving early adoption of specific use cases. The company's recent hires of senior executives with [Epic](#) pedigrees underscore this point. [Health Gorilla](#) also competes with a number of startups offering interoperability architecture that have attracted significant venture funding in recent years, including [Zus](#), [Capable Health](#), [Healthie](#), and [League](#).



SELECT COMPANY HIGHLIGHTS: HEALTH GORILLA

Strategic direction

[Health Gorilla's](#) future is closely aligned with TEFCA, and the organization plans to continue engaging closely with policymakers to help shape regulatory decisions and mitigate stroke-of-the-pen risk. A major strategic question for [Health Gorilla](#) is how its first-mover advantage will evolve over time. [Health Gorilla's](#) leadership foresees and is working toward commoditization of interoperable health data; as a QHIN, the company must be noncompetitive in accepting new partnerships and will exchange data with competitors. Moving forward, the company plans to focus on data quality and data enrichment as commercial differentiators, and is also interested

in moving downstream to provide more off-the-shelf and developer-enabling products around specific data use cases. The company will look to acquire data science, AI, analytics, and decision-support capabilities through M&A following its next fundraise.

Given the current market correction, it is likely that [Health Gorilla](#) will also seek to diversify its customer base, which has heretofore been concentrated among digital health companies. This will become more feasible as ONC begins to permit additional use cases under TEFCA, including public health, payment, benefits determination, healthcare operations, and patient data access.²³

²³: "A Guide to TEFCA's Six Exchange Purposes," Health Gorilla, Ryan Kelly, January 6, 2022.

Financing history

Seed	Series AA	Series A	Series B	Series C
August 20, 2014	May 7, 2015	July 6, 2018	March 2, 2021	March 7, 2022
Total raised: \$1.2M	Total raised: \$2.4M	Total raised: \$8.2M	Total raised: \$15.0M	Total raised: \$50.0M
Pre-money valuation: \$6.7M	Pre-money valuation: \$6.5M	Pre-money valuation: \$25.0M	Pre-money valuation: \$40.0M	Pre-money valuation: \$300.0M
Investor(s): True Ventures	Investor(s): DCVC	Investor(s): PIK Ventures	Investor(s): IA Capital Group	Investor(s): SignalFire



SELECT COMPANY HIGHLIGHTS: MODERNIZING MEDICINE



Founded
2010

Total VC raised:
\$80.5M

Last reported ARR:
Approximately \$400.0M

Last financing:
Raised \$231.0M in a PE growth deal

Largest investor:
Warburg Pincus

Overview

[Modernizing Medicine](#) (ModMed) is a provider of vertical EHR and practice management and patient engagement software to physician group practices, including many PE-backed platforms. Co-founded in 2010 by CEO Dan Cane, a seasoned technology leader, and Chief Medical and Strategy Officer Michael Sherling, a dermatologist, the company has differentiated itself through a strong focus on aligning with the needs of physicians in specific specialties. [ModMed](#) has expanded beyond its roots in the dermatology market to offer solutions across 10 additional specialties: allergy, gastroenterology, Ob/Gyn, ophthalmology, orthopedics, otolaryngology, pain management, plastic surgery, podiatry, and urology. The company raised venture funding through a Series E between 2011 and 2015 before selling a minority stake to [Warburg Pincus](#) for \$231.0 million in 2017. [Warburg](#) was rumored to be exploring a partial-stake sale in November 2022, but no deal materialized.²⁴

[ModMed](#) develops unique, PC- and iPad-based applications for each of its supported specialties in consultation with physicians. Although [ModMed](#)'s systems provide some customizability, the company prefers to create workflows and care pathways tailored to specific physician types in order to simplify the user experience.

Implementation support and change management have been a key area of focus for [ModMed](#). Healthcare providers can be slow to adopt new technologies, and the disruption associated with learning new systems can have significant revenue and burnout impacts—particularly in the current period of tight margins and limited staff resources. While some implementations can be completed in a number of days, others are extremely complex—overhauling the tech stack of a large, multipractice roll-up running different systems at different sites can take one to two years. [ModMed](#) has developed a mature customer support function that includes an internal knowledge services team to help the company learn from past implementations. The company can provide

²⁴: "Scoop: Warburg's ModMed Explores Partial-Stake Sale," Axios Pro, Sarah Pringle, November 10, 2022.



SELECT COMPANY HIGHLIGHTS: MODERNIZING MEDICINE

clients with enterprise change management resources, including communication templates, project planning frameworks, training resources, and postdeployment analytics. Because of this, [ModMed](#)'s team can identify challenges with adoption and training early in an implementation and proactively intervene to maximize the customer's success on the new system.

Competitive landscape

[ModMed](#) competes with generalist/multispecialty EHR and practice management providers focused on the large physician group market, including athenahealth, [Veradigm](#), [NextGen](#), [eClinicalWorks](#), [Meditech](#), and [Practice Fusion](#). It also competes with specialist software providers in the categories in which it operates. [ModMed](#) has the dominant market position in its original specialty, dermatology, and is growing at above-market rates in more fragmented spaces such as Ob/Gyn and orthopedics.

PE-backed physician practice management (PPM) consolidation has been a tailwind for [ModMed](#), because it creates scaled buyers and because PE firms with multiple investments in the space are familiar with the platform and may encourage additional portfolio companies to adopt it. On the other hand, health system-driven consolidation of independent physicians shrinks [ModMed](#)'s addressable market because acquired groups are then migrated onto the health system's enterprise EHR.

Strategic direction

[ModMed](#) has grown through a combination of M&A and organic new product launches. Acquisitions have allowed the company to rapidly acquire market share in new specialties and geographies as well as to add important functionality. For instance, the company launched an allergy solution in 2022 before acquiring allergy testing and immunotherapy management software from [Xtract Solutions](#) in January 2023. In acquiring specialty EHRs, [ModMed](#) typically maintains the acquired platform separately while gradually working to integrate relevant features and migrating customers onto the relevant [ModMed](#) module. The company also invests heavily in research & development (R&D) to develop new features for its existing products. It acquired [Klara](#), a digital patient engagement technology provider, in February 2022. The company expects to launch approximately one new specialty module per year. As of 2022, its annual recurring revenue was reportedly around \$400 million.²⁵

²⁵: "[Scoop: Warburg's ModMed Explores Partial-Stake Sale](#)," Axios Pro, Sarah Pringle, November 10, 2022.

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