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HIGHLIGHTS

TOP OF THE NEWS

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Upcoming Events

Conference:

Lab Leadership Summit
Designing, Implementing & Managing a High-Profit Lab Outreach Program
Friday, April 27, 2018
www.lableadershipsummit.com

Diagnostic Deals: A roundup of the key mergers, acquisitions, alliances, licenses and other strategic transactions from the past month

As the calendar turned to 2018 and Medicare turned to PAMA, diagnostic deal making revved up. Deal volume was relatively heavy although short on drama. But what looks to be a big year is just beginning.

M&A

Continuing recent patterns, most of the month's M&A action focused on the acquisition of molecular diagnostic companies including the tying up of a loose end from the Abbott-Alere merger. To make the deal happen, Alere sold its Triage business to Quidel. The package included The Summer Ridge campus which Quidel flipped to Alexandria Real Estate Equities for $148.7 million in a sale-leaseback that will allow Quidel to stay in the campus's four buildings for 15 years.

On Dec. 19, Siemens Heathineers completed its purchase of Fast Track Diagnostics (FTD), which produces CE Mark approved

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The Year in Dx VC Investment: Dx/Tools Outperforms Health Care & Liquid Biopsy/AI/Informatics Outperforms Dx/Tools

In a year that witnessed venture capital health care investment reaching an all-time high, diagnostics/tools (Dx/Tools) companies made out particularly well, according to Silicon Valley Banks' preliminary *2018 Healthcare Investments and Exits Report*. Investment was especially strong in Dx/Tools companies using artificial intelligence, informatics and liquid biopsy technologies. "As Dx/Tools companies integrate computational methods such as artificial intelligence, we see tech investors, many new to health care, starting to invest in these

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Diagnostic Deals, *from page 1*

tests for infectious disease detection, acquiring over 80 platform-agnostic assays and syndromic panels for its Siemens' Versant kPCR Molecular System test menu. FTD and its 80 employees will be folded into the Siemens Healthineers' business while continuing to operate under the FTD brand name.

Other notable M&A deals in the molecular space included:

- Roche's $27 per share tender offer for Ignyta, a developer of precision medicine cancer treatments guided via diagnostic tests, as part of a merger agreement between the two firms;
- Biocrates Life Sciences' agreement to acquire Metanomics, the Austria-based metabolomics biomarker developer, for an undisclosed price. The deal "will enable us to provide deep metabolic phenotyping through targeted metabolomics profiling services, customized assays, targeted screening kits, and comprehensive data interpretation," noted Biocrates' CEO;
- The acquisition of metagenomics technology developer Radiant Genomics by Zymergen; and
- Mars Petcare's acquisition of Finnish animal molecular diagnostics developer Genoscoper Laboratories.

Meanwhile, a pair of potential blockbusters not directly involving labs are expected to have major repercussions on diagnostics, including Becton Dickinson's $24 billion acquisition of device maker C.R. Bard, which closed on Dec. 29, and CVS' proposed $69 billion purchase Aetna. Stay tuned...

Strategic Alliances

The same three patterns that shaped strategic alliances in 2017 drove deal making in January, namely Biopharm/Dx collaboration, product integration and academic research. With regard to the former, no company was more active than Pfizer, which in addition to new collaborations with Foundation Medicine for cancer companion diagnostics and Berkeley Lights for nanofluidics platform development was one of the five pharmaceutical companies to enter into a pre-competitive consortium with Regeneron Pharmaceuticals aimed at sequencing exomes of UK Biobank participants. Other notable Dx/Biopharm collaborations included:

- Merck KGaA + HTG Molecular Diagnostics which agreed to expand a deal originally designed to develop companion diagnostics for Merck's investigational BTK inhibitor M7583 to other drugs;
- AstraZeneca + Myriad Genetics to codevelop companion tests for AstraZeneca's PARP inhibitor Lynparza and Avastin; and
- Rhythm Pharmaceuticals + WuXi NextCode to create new treatments for rare obesity-related genetic disorders.

Significant product integration deals included collaborations of Qiagen with DiaSorin, Illumina with Thermo Fisher, and 10x Genomics with MGI.

Arguably, the month's sexiest deals were the partnerships pairing lab companies with corporate tech giants from outside the world of diagnostics, including GE which partnered with Roche to develop clinical decision support

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software and Microsoft which announced it was working with Adaptive Biotechnologies to map human immune system genetics for use in developing early stage cancer detection blood tests.

Here's a graphic summary of the key diagnostic deals from late November to mid-January:

MERGERS, ACQUISITIONS & ASSET SALES		
Acquiring Company	**Target(s)**	**Deal Summary**
Becton Dickinson	C.R. Bard	▪ Price: $24 billion cash ($317 per share) and stock ▪ Status: Closed Dec. 29, 2017 ▪ To gain FTC approval, BD must sell its soft tissue core-needle biopsy product line and CR Bard must sell its Aspira tunneled home drainage catheters and accessories products line
Roche	Ignyta	▪ Price: $27 per share for all outstanding shares of Ignyta common stock ▪ Status: Due to close in first half 2018 ▪ Cash tender offer made under Dec. 21 merger agreement by Ignyta and Roche
Agilent Technologies	Luxcel Biosciences	▪ Price: Undisclosed ▪ Status: Closed ▪ Agilent expands its cell analysis portfolio via acquisition of Luxcel, which produces real-time fluorescence plate reader-based cell assay kits ▪ Agilent entered cell analysis market in 2015 with acquisition of Seahorse Bioscience
Siemens Healthineers	Fast Track Diagnostics	▪ Price: Undisclosed ▪ Status: Closed Dec. 19, 2017 ▪ Target to continue operating under FTD name
Thermo Fisher Scientific	Phenom-World	▪ Price: Undisclosed ▪ Status: Closed Jan. 5, 2018 ▪ Thermo Fisher to integrate Phenom-World, a Netherlands-based electron microscopy producer, into its analytical instruments segment
Quidel	Summers Ridge campus	▪ Price: $148.7 million, including $142 million in immediately available net cash ▪ Status: Closing of sale included as part of Quidel's acquisition of Triage from Alere
Zymergen	Radiant Genomics	▪ Price: Undisclosed ▪ Status: Closed ▪ Zymergen to use Radiant's platform combining sequencing, bioinformatics, synthetic biology and other technologies to identify and commercialize novel molecules for uses in healthcare, chemicals and agriculture ▪ Zymergen to keep Radiant's entire team intact
Centre Lane Partners	Alternative Biomedical Solutions	▪ Price: Undisclosed ▪ Status: Closed December 2017 ▪ Investment firm acquires Texas-based ISO-certified mass spectrometry, toxicology and chemistry measurement systems supplier
Biocrates Life Sciences	Metanomics	▪ Price: Undisclosed ▪ Status: Agreement reached with no closing date announced ▪ Merger of Austria-based Biocrates which produces metabolomic kits and Berlin-based Metanomics, which features novel metabolite-based cancer and cardiometabolic clinical biomarkers ▪ Merged firm to provide deep metabolic phenotyping via targeted metabolomics profiling services, customized assays, targeted screening kits and comprehensive data interpretation
Maravai LifeSciences	Glen Research	▪ Price: Undisclosed ▪ Status: Closed ▪ Maravai acquires Virginia-based provider of DNA and RNA synthesis reagents
GenScript Biotech	CustomArray	▪ Price: Undisclosed ▪ Status: Agreement of GenScript to acquire 100% of CustomArray's issued shares with no closing date announced ▪ GenScript acquires CustomArray's oligonucleotide synthesis and microarray manufacturing technology and expertise
Mars Petcare	Genoscoper Laboratories	▪ Price: Undisclosed ▪ Status: Closed Dec. 27, 2017 ▪ Genoscoper is a Finnish animal molecular diagnostics company

STRATEGIC ALLIANCES, PARTNERSHIPS & COLLABORATIONS		
Partner 1	**Partner 2**	**Deal Summary**
Roche	GE	▪ Objective: Develop clinical decision support software ▪ Dynamic: Data pooling—partners to create joint-branded dashboards combining data from each firm's diagnostics and medical scanners to help oncology and critical care teams make better, faster decisions
Adaptive Biotechnologies	Microsoft	▪ Objective: Map genetics of human immune system for early stage detection of cancers and other diseases from single blood test ▪ Dynamic: Combine Adaptive's immune sequencing technology with Microsoft's research and large-scale machine learning and cloud computing capabilities ▪ Microsoft also makes unspecified financial investment into Adaptive
Qiagen	HTG Molecular Diagnostics	▪ Objective: Assay clinical trials development ▪ Dynamic: Expansion of existing master assay development and commercial agreement to third project involving NGS assay being developed by unnamed pharma company
Qiagen	DiaSorin	▪ Objective: Combine Qiagen's QuantiFeron-TB diagnostic test with DiaSorin's Liaison automated analyzers to develop fully automated version of QuantiFeron test readout components that can be used with QFT-Plus ▪ Dynamic: Launch CE-marked version of new QuantiFeron readout components for use on Liaison XL in 3Q 2018, with US availability in 2019 ▪ To also launch new tests in China in 2020
Thermo Fisher Scientific	Illumina	▪ Objective: Make Thermo Fisher's AmpliSeq chemistry compatible with Illumina's sequencers ▪ Dynamic: Allow Thermo Fisher customers to use AmpliSeq on Illumina instruments for research only ▪ Illumina to sell product directly to its customers under name AmpliSeq for Illumina ▪ Thermo Fisher retains right to make AmpliSeq technology available on other NGS platforms and keep selling AmpliSeq kits to its own sequencing customers for both research and diagnostic uses
10x Genomics	MGI (subsidiary MGI of BGI)	▪ Objective: Make MGI sequencers compatible with 10x Genomics' Chromium system ▪ Dynamic: BGISEQ-500RS system is now compatible with Chromium, and firms plan to make MGISEQ sequencers compatible before MGI begins shipping them to customers in February
Curetis	MGI (subsidiary MGI of BGI)	▪ Objective: Commercialization of NGS-based infectious disease testing technology ▪ Dynamic: Combine Curetis' Unyvero Lysator-based sample preparation technology and MGI's NGS to create fully automated workflow for processing any type of native clinical sample with subsequent NGS-based detection of microbial pathogens and genetic markers for antibiotic resistance ▪ MGI to reimburse Curetis for supporting workflow integration and transferring ▪ technology and pay technology access fees, ▪ and royalties on product sales
10x Genomics	Berry Genomics	▪ Objective: Offer new sequencing-based technology for non-invasive prenatal testing in China ▪ Dynamic: Partners to develop services leveraging technology for using linked-read sequencing for haplotyping of cell-free fetal DNA in maternal plasma for prenatal diagnosis to be offered by Barry Genomics in Chinese market
WuXi AppTec	Mayo Clinic Laboratories	▪ Objective: Offer Mayo-developed tests in China ▪ Dynamic: Form new joint venture JV leveraging Mayo's lab testing expertise in combination with WuXi AppTec's lab and manufacturing services
BGI	Federation of Shenzhen Commerce	▪ Jointly develop BGI Global Innovation Center
Illumina	KingMed Diagnostics (China)	▪ Objective: Develop NGS-based oncology and hereditary disease tests for China market ▪ Dynamic: Partners to codevelop system based on Illumina's MiniSeq technology and KingMed's library prep kits
Oncimmune	Genostics	▪ Objective: Commercialize and manufacture Oncimmune's EarlyCDT autoantibody-based diagnostics products in China ▪ Dynamic: License giving Hong Kong-based Genostics exclusive rights to manufacture and distribute EarlyCDT (and develop future) products in China ▪ Genostics also agreed to buy approximately 6.4 million new Oncimmune shares at a 49% premium (£1.56 per share) and gets seat on Oncimmune's board of directors
NanoString Technologies	Riken Genesis (subsidiary of Sysmex)	▪ Objective: Bring NanoString's nCounter-based diagnostic tests to Japanese market ▪ Dynamic: Work together to commercialize, register and gain reimbursement for companion diagnostic tests, including lymphoma subtyping test to be marketed as the nCounter Dx LymphMark assay

STRATEGIC ALLIANCES, PARTNERSHIPS & COLLABORATIONS		
Partner 1	**Partner 2**	**Deal Summary**
Biocartis	Amgen	▪ Objective: Develop companion diagnostic biomarker tests on Biocartis' Idylla platform for new Amgen compound treating solid tumors ▪ Dynamic: Second Biocartis second recent CDx agreement between firms following Dec. 2017 agreement to seek FDA premarket approval for Biocartis' Idylla KRAS Mutation Test and Idylla NRAS-BRAF Mutation Test as companion diagnostic tests for Amgen's Vectibix (panitumumab)
IDbyDNA	Locus Biosciences	▪ Objective: Develop companion diagnostic Dynamic: Use IDbyDNA's Explify NGS platform to develop companion test for use in selecting patients for Locus' LBx-PAO1 antimicrobial product clinical trial
Myriad Genetics	AstraZeneca	▪ Objective: Drug/DX codevelopment ▪ Dynamic: AstraZeneca to use Myriad's myChoice HRD Plus diagnostic panel in clinical trial to identify advanced ovarian cancer patients who respond best to combined maintenance treatment of AstraZeneca's PARP inhibitor Lynparza (olaparib) and Avastin (bevacizumab)
HTG Molecular Diagnostics	Merck KGaA	▪ Objective: Drug/DX codevelopment ▪ Dynamic: Expand existing companion diagnostic agreement between the firms covering Merck's investigational Bruton's tyrosine kinase (BTK) inhibitor M7583 to other drugs and to earlier stages of research process, including custom assay development programs
Regeneron Pharmaceuticals	*AbbVie *Alnylam Pharmaceuticals *AstraZeneca *Biogen *Pfizer	▪ Objective: Sequence exomes of all 500,000 UK Biobank participants by end of 2019 ▪ Dynamic: Pre-competitive consortium in which AbbVie, Alnylam, AstraZeneca, Biogen and Pfizer to each contribute $10 million ▪ Regeneron to provide undisclosed amount of its own funding, and Regeneron Genetics Center to conduct the sequencing ▪ Other companies may also join consortium
Foundation Medicine	Pfizer	▪ Objective: Develop companion diagnostics for Pfizer oncology therapies ▪ Dynamic: New assay to be added to FoundationOne CDx, Foundation's recently FDA approved solid tumor genomic profiling assay ▪ Pfizer also gets access to Foundation's FoundationInsights platform for biomarker discovery and clinical trial design
Berkeley Lights	Pfizer	▪ Objective: Advance development of Berkeley Beacon platform and streamline Pfizer workflows ▪ Dynamic: Combine Berkeley's light-based nanofluidics platform for single-cell selection, characterization, culture and export with Pfizer's expertise in gene editing, sequencing, molecular biology and B-cell screening
WuXi NextCode	Rhythm Pharmaceuticals	▪ Objective: Development therapies for treating rare genetic disorders of obesity ▪ Dynamic: Rhythm to leverage WuXi's deep learning capabilities to identify key genetic markers for rare metabolic syndromes
Two Pore Guys	Maxim Integrated Products	▪ Objective: Develop analog signal-processing technologies for 2PG's handheld MoM solid-state nanopore diagnostic testing platform ▪ Dynamic: Maxim has invests unspecified amount in 2PG via its Maxim Ventures branch
OneOme	PWNHealth	▪ Objective: Give PWNHealth patients access to OneOme's RightMed pharmacogenetics test via firm's website without the need to talk to a doctor first ▪ Dynamic: PWNHealth clinical team to review request for test and health information patient provides ▪ If test approved, a licensed, independent physician will order it ▪ When test results are ready, patient must schedule phone or video consult with a PWNHealth licensed genetic counselor trained in pharmacogenetics to discuss results
Celsee	IncellDx	▪ Objective: Co-commercialization of Celsee products including 20-marker lung cancer genomics and proteomics panel, CTC-based screening test for breast, colorectal, prostate and other cancers, and a cell-based NIPT assayNantHealth's GPS Cancer molecular analysis test to conduct study on samples collected by NantHealth ▪ Dynamic: Deal follows successful completion of feasibility study assessing PD-L1 expression in lung cancer biopsy and blood specimens using IncellDx OncoTect iO Single Cell Quantitative PD-L1 assay and the Celsee C-Prep Genesis platform
Celsee	Zomedica	▪ Objective: Develop Celsee's liquid biopsy platform for veterinarians to use as a cancer diagnostic ▪ Dynamic: 7-year exclusive under which Zomedica is responsible for assays' clinical development and commercialization ▪ Celsee to supply Zomedica the assays and consumables on an exclusive basis in the veterinary market ▪ Zomedica to pay Celsee up-front fees of $500K and issue Celsee unregistered common shares having a value of $250K

STRATEGIC ALLIANCES, PARTNERSHIPS & COLLABORATIONS		
Partner 1	**Partner 2**	**Deal Summary**
Ovation	Coriell Life Sciences	▪ Objective: Product integration ▪ Dynamic: Combine Ovation's data management and Coriell's reporting technologies into a single platform for sample and workflow management, genetic data interpretation and client communication
IQuity	Analyte Health	▪ Objective: Expand access to IQuity's IsolateMS multiple sclerosis detection test ▪ Dynamic: Patients will be able to access test immediately via Analyte's Health Test Express website
Datavant	Global Genomics Group (G3)	▪ Objective: Develop new models for designing drug development clinical trials ▪ Dynamic: Newly launched Datavant to use its artificial intelligence-driven Clinical Trial Cloud to support G3's G3LOBAL database
Datavant	Verge Genomics	▪ Objective: Develop new models for designing drug development clinical trials ▪ Dynamic: Datavant to provide Verge analytics tools and access to 150 different data sources
Indivumed	Salk Institute	▪ Objective: Cancer research ▪ Dynamic: Multi-year strategic alliance under which Indivumed will support Salk researchers in planning and acquiring annotated cancer biospecimens for research projects
Datavant	Duke Clinical Research Institute	▪ Objective: Develop new models for designing drug development clinical trials ▪ Dynamic: Datavant to provide DCRI analytics tools and access to 150 different data sources
GeneDx (subsidiary of Opko's BioReference Laboratories)	Radboud University Medical Center (Netherlands)	▪ Objective: Identify novel genes and pathways to explain causes and manage symptoms of genetic diseases ▪ Dynamic: GeneDx to expand its diagnostic exome sequencing study cohort of patients with developmental delay or intellectual disability with approximately 3,000 additional cases from Radboud
Premier Biosoft	Florida International University	▪ Objective: Develop mass spectrometry-based data analysis software for lipidomics research use ▪ Dynamic: Premier to work with FIU researcher to create lipidomics workflows using mass spec technologies to help Premier improve data interpretation, heuristics and product databases
Veritas Genetics	Mayo Clinic	▪ Objective: Make whole-genome sequencing available to masses ▪ Dynamic: Veritas to integrate Mayo' Center for Individualized Medicine expertise into its myGenome WGS platform ▪ Mayo to offer myGenome sequencing test in study of healthy adults ▪ Mayo also takes unspecified ownership stake in Veritas
Tempus	Vanderbilt-Ingram Cancer Center (VICC)	▪ Objective: Develop personalized cancer treatments ▪ Dynamic: Use Tempus O informatics platform to collect and structure clinical data from VICC's electronic health records ▪ Tempus to also perform NGS analysis to identify gene alterations in VICC patients ▪ Recent academic collaborators of Tempus include Ohio Univ., Univ. of Penn. Abramson Cancer Center and Mayo Clinic
Tempus	CancerLinQ and Precision HealthAI	▪ Objective: Develop clinical databases for oncology use ▪ Dynamic: CancerLinQ responsible for data integration and providing platform to oncologists and oncology care sites ▪ Tempus and Precision HealthAI responsible for further structuring dataset and working with industry partners to generate practical applications

DISTRIBUTION, SALES & MARKETING AGREEMENTS		
Property Owner	**Distributor**	**Deal Summary**
IncellDx	Premas Life Sciences	▪ Products: IncellDx's immune-oncology and oncology single cell products including OncoTect, HPV E6/E7 mRNA detection assay and IncellPrep preparation kit ▪ Territory: India ▪ Exclusive ▪ IncellDx named GIMDx exclusive distributor in China in Dec. 2017
VHLGenetics	Weatherbys Scientific	▪ Products: VHLGenetics' genotyping and mutation detection assays for animals such as cats and dogs ▪ Territories: UK, Ireland and US
ThermaGenix	MilliporeSigma (US operation of Merck KGaA's life science business)	▪ Products: ThermaGenix's ThermaStop, ThermaGo and ThermaStop-RT reagents for PCR improvement ▪ Territory: Global distribution agreement

LICENSES		
Licensor	**Licensee**	**Deal Summary**
NRGene	Syngenta	■ Property: NRGene's GenoMagic genome analysis platform ■ Non-exclusive
KeyGene	University of Wisconsin-Madison	■ Property: KeyGene's patented sequence-based genotyping (SBG) technology ■ Scope: Global ■ UW-Madison gets right to offer SBG services in all species to its research collaborators and clients worldwide
Netherlands Cancer Institute (NKI)	Desktop Genetics	■ Property: TIDE, NKI's TIDE, a web-based tool that quantifies efficacy of genome-editing methods and identifies the predominant types of insertions and deletions in targeted pool of cells ■ Scope: Global ■ Exclusive
New York Genome Center	BioLegend	■ Property: NYGC's CITE-seq technology for cellular indexing of transcriptomes and epitopes by sequencing, for research use ■ Scope: Global ■ Exclusive
IntegraGen	GoPath Laboratories	■ Property: Test based on IntegraGen's proprietary miR-31-3p biomarker ■ Scope: GoPath to commercialize test in US and Canada (already available in Europe) ■ Non-exclusive
Circulogene	Circulogene Saglik (Turkish lab and subsidiary of GGT Global Genetik)	■ Property: Circulogene's liquid biopsy technology ■ Scope: Parts of Europe, Africa, Middle East, Armenia, Azerbaijan, Belarus, Georgia, Kazakstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan ■ Exclusive
SUPPLY, SERVICE & TESTING AGREEMENTS		
Supplier/Servicer	**Client**	**Deal Summary**
Cota	Baptist Health South Florida	■ Cota to help build precision medicine and research programs at new Miami Cancer Institute
Theradiag	MSD France	■ Theradiag's Lisa Tracker monitoring kits to be referenced in supply contracts for Merck's immunosuppressant Remicade (infliximab) made by MSD France in France ■ Theradiag to not only supply and implement kits but also train lab personnel in their use

■ The Year in Dx VC Investment, *from page 1*

deals," writes lead author of the report Jonathan Norris, managing director at Silicon Valley Bank.

The Big Picture

In total, U.S. health care venture fundraising reached a record $9.1 billion in 2017, shattering the previous record of $7.5 billion set in 2015 and 26% above 2016 levels. The Dx/Tools sector enjoyed a disproportionate share of the wealth with a year-over-year increase of 40%, $2.8 billion in total.

AI, Liquid Biopsy Attract Lion's Share of Capital

Success *within* the Dx/Tools sector was also disproportionate with 60% of total sector investment ($1.6 billion) going to liquid biopsy companies Guardant Health (Redwood City, Calif.) and GRAIL (Menlo, Park, Calif.), an Illumina spin off. A total of 19 Dx/Tools companies received more than $2 billion of the total sector investments. Liquid biopsy investment "exploded" with $1.8 billion (85% of the total raised) in Guardant Health, GRAIL and Human Longevity.

"We anticipate that tech-focused investors will continue to apply their software expertise in Dx Analytics deals that leverage artificial intelligence. While tech corporate venture participation has increased, these investors focus on a small set of deals most compatible with their own technologies."

— Jonathan Norris

R&D Tools Subsector

R&D Tools, the Dx/Tools subset that Silicon Bank defines as research equipment and services for biopharma and academia, closed 42 deals valued at $981 million during the year, up 50% from 2016. These investments benefited the analytics platform company Human Longevity (San Diego, Calif.) and liquid biopsy tools makers Quanterix (Lexington, Mass.) and RareCyte (Seattle, Wash.).

Dx Analytics

Big investments were also made in the Dx Analytics space with 16 companies receiving a combined $749 million, including 23andMe (Mountain View, Calif.), WuXiNextCode (Cambridge, Mass.), Color (South San Francisco, Calif.) and AccuraGen (Menlo Park, Calif.).

Early-Stage Investments Are Smaller

In contrast to previous years, series A investments were made in early-stage Dx companies. Overall, the Dx/Tools sector saw an increase in the number of series A investments (73 in 2017 vs. 55 in 2016). However, the *value* of investments fell slightly from $516 million to $500 million. This caused the median round size to drop from $5.3 million in 2016 to $4.7 million in 2017.

The R&D Tools subset had four series A investments of $25 million or more. Norris attributes this interest in R&D Tools companies to the lack of regulatory and reimbursement hurdles facing the other Dx/Tools subsectors.

However, the majority of deals valued at $10 million or more were companies using artificial intelligence, like PathAI (Cambridge, Mass.) and M2Gen (Tampa, Fla.).

Dx/Tools Companies Lacking Exits in 2017

Dx/Tools had no big mergers and acquisitions in 2017 and only one IPO. Given the strength of investments in Dx/Tools, Norris anticipates big exits in the sector in the next few years. Tech giants who have been making investments in the sector will emerge as potential acquirers.

"We anticipate that tech-focused investors will continue to apply their software expertise in Dx Analytics deals that leverage artificial intelligence," explains Norris. "While tech corporate venture participation has increased, these investors focus on a small set of deals most compatible with their own technologies."

Predictions for 2018

Overall, Norris expects a slight pullback in health innovation-related investment in 2018 While fundraising will "be strong," it will decline to below $7 billion, he predicts. Dx/Tool investments will also decline. On paper, the decline may be dramatic given that the 2017 numbers were substantially boosted by large investment in just a few deals, namely GRAIL. But while anticipating decline in investment value, Norris also expects the number of Dx/Tool deals to remain "steady" in 2018.

The Dx Pipeline: A Roundup of the Month's Key New Product Launches

Here's a rundown of the key diagnostic product launches from mid-December through late January:

NEWLY LAUNCHED PRODUCTS & SERVICES

Company(ies)	Product(s)
Thermo Fisher Scientific	Ion GeneStudio S5 Prime sequencing instruments leveraging firm's S5 semiconductor sequencing technology
Thermo Fisher Scientific	Ion GeneStudio S5 Plus sequencing instruments leveraging firm's S5 semiconductor sequencing technology
Thermo Fisher Scientific	Ion Torrent Oncomine Pan-Cancer Cell-Free Assay for tumor DNA and RNA analysis
Ilumina	iSeq 100 semiconductor based sequencing instrument
Wamberg Genomic Advisors	Expansion of life insurance clients offered firm's Cancer Guardian personalized medicine program used to provide treatment-related tumor sequencing and analysis services to cancer patients at no cost to them
Castle Biosciences	DecisionDx-UMSeq NGS panel for identifying somatic mutations in genes relevant to uveal melanoma
Dovetail Genomics	Dovetail Hi-C Kit enabling researchers to generate chromosome-scale assemblies in house
Mobidiag	Novodiag, a fully automated solution for syndromic and targeted testing for infectious disease
Quanterix	Commercial availability of SR-X Ultra-Sensitive Biomarker Detection system design assays to detect both proteins and nucleic acids directly from blood previously available for research use only
Precipio	New version of its ICE-COLD PCR enrichment kit for use in Sanger Sequencing platforms

FDA Watch: Off-Label Marketing Rule Put Back on Ice & Extra Comment Time for CLIA Waiver Proposals

For the second time in less than a year, the FDA indefinitely delayed a controversial rule expanding its authority to regulate off-label marketing, i.e., promotion of medical products for additional uses not spelled out in the original approval. The rule was slated to take effect but the agency wants more time to consider its effect, according to the official FDA announcement. The delay is a clear win for the pharma and device industry which claims that the proposed rule chills innovation to the detriment of public health.

FDA Extends Comment Period for CLIA Device Waivers

Much more popular with industry is the FDA's proposed loosening of the rules governing the granting of CLIA waivers for *in vitro* diagnostic (IVD) medical devices. The agency has announced that it is pushing back to March 30 the deadline for commenting on a pair of draft guidances.

The first draft guidance lays out two options sponsors can use to demonstrate accuracy, i.e., "insignificant risk of erroneous result," of in vitro diagnostic tests for purposes of obtaining a CLIA waiver:

- Demonstrate accuracy of the test when performed by trained operators as part of the marketing submission via comparison to a traceable calibration (or reference) method and then leveraging the data in combination with a new study to demonstrate agreement between results of the test performed by untrained and trained operator in the waiver by application submission; or
- Where the sponsor chooses to demonstrate the test's substantial equivalence or safety and efficacy when performed by trained operators in the marketing application without demonstrating accuracy via comparison to a traceable calibration (or reference) method, "the sponsor [may] demonstrate accuracy of the test when performed by untrained operators through direct comparison to a traceable calibration method (or reference method), or other comparative method performed in a laboratory setting by trained operators in the waiver application."

The second draft guidance aims to make the dual CLIA waiver and Section 510(k) clearance pathway for certain Class I and Class II IVD devices created in 2012 less burdensome. Among other things, the guidance recommends that manufacturers include as part of a dual submission:

- A device description and determination that the device is "simple";
- A risk analysis for the device;
- A description of its failure-alert and fail-safe mechanisms;
- Results of flex, analytical, comparison and reproducibility studies; and
- Proposed device labelling.

New FDA Approvals

Here's a rundown of the key new FDA approvals announced in mid-December through mid-January:

NEW FDA APPROVALS

Manufacturer(s)	Product(s)
Myriad Genetics	Expanded indication of BRACAnalysis CDx test for identifying breast cancer patients with germline BRCA mutations likely to benefit from AstraZeneca's PARP inhibitor Lynparza (olaparib)
Cepheid	Approval and CLIA waiver for Xpert Xpress Flu molecular test used in near-patient settings to detect both A and B strains of influenza from nasopharyngeal or nasal swabs
BioMérieux	Approval of Vitek 2 AST-GN test was cleared for use with Amikacin drug
BioMérieux	Approval of Vitek 2 AST-GN test was cleared for use with Ceftazidime/Avibactam drug
Siemens Healthineers and Sysmex	Approval of Sysmex Automated Blood Coagulation Analyzer CS-2500
Siemens Healthineers	Approval of Advia Chemistry Enzymatic Hemoglobin A1c test
Beckman Coulter Diagnostics	Approval of MicroScan Dried Gram-Negative MIC /Combo Panels with CeftazidimeAvibactam assay
Beckman Coulter Diagnostics	Approval of MicroScan Dried Gram-Negative MIC /Combo Panels with Ciprofloxacin-S assay
Beckman Coulter Diagnostics	Approval of MicroScan Dried Gram-Negative MIC /Combo Panels with Ceftolozane/Taxobactam assay
Alere (now part of Abbott)	Approval of BinaxNOW Influenza A & B Card 2 and Alere Reader assay for detecting influenza A and B nucleoprotein antigens in nasopharyngeal swab and nasal swab specimens
Euroimmun (now part of PerkinElmer)	Approval of Anti-Borrelia burgdorferi US Euroline-WB kit for qualitative determination of IgM class antibodies against *Borrelia burgdorferi* in human serum and plasma
Fujirebio Diagnostics	Approval of Lumipulse G BRAHMS PCT test for quantitative determination of procalcitonin in human serum and plasma
Inova Diagnostics	Approval of Quanta Flash Calprotectin assay for detection of fecal calprotectin in stool samples to run on Lumipulse G system
MolecularMD	Approval of MRDx BCR-ABL molecular test to help physicians determine if Philadelphia chromosome-positive chronic myeloid leukemia can stop treatment with Novartis' drug Tasigna (nilotinib)

New CE Marks & Global Certifications

Notable European CE certifications:

NEW CE CERTIFICATIONS

Manufacturer(s)	Product(s)
Asuragen	Approval of QuantideX qPCR BCR-ABL IS Kit for identifying major (e13a2, e14a2) fusions for use on Roche Cobas z 480 Analyzer
Asuragen	Approval of QuantideX qPCR BCR-ABL minor kit for identifying minor (e1a2) BCR-ABL fusion transcripts in patients with chronic myeloid leukemia for use on Roche Cobas z 480 Analyzer
Roche	Approval of Ventana MMR IHC Panel for diagnosing colorectal cancer
Abbott	Approval of Alinity h-series system for hematology testing, which integrates the Alinity hq standalone hematology analyzer with its Alinity hs slide maker-and-stainer module

NEW CE CERTIFICATIONS, *Cont'd.*

Becton Dickinson and Check-Points Health	Approval of BD MAX Check-Points CPO assay, PCR-based NGS screening test for antibiotic-resistant carbapenemase-producing organisms
Hologic	Approval of Brevera breast biopsy system with CorLumina imaging technology
Accelerate Diagnostics	Approval of Accelerate Pheno system for detecting severe bacterial pneumonia infections
Stat-Dx	Approval of DiagCore syndromic molecular testing platform
Stat-Dx	Approval of Respiratory Panel 1for detecting 21 common bacteria and viruses that can cause respiratory infections from nasopharyngeal specimens

Other key international clearances during the period included:

- World Health Organization granting of prequalification status to Hologic's CE-marked Aptima HIV-1 Quant Dx, the first HIV-1 viral load assay with a dual claim for both diagnosis and treatment monitoring;
- Approval of Vela Diagnostics' Sentosa SX101 instrument in Taiwan;
- Approval of IGene Laboratory's iGene noninvasive prenatal test in Singapore;
- Approval for DermTech licensee DermTech Canada to market the company's pigmented lesions assay and noninvasive biopsy kit for melanoma detection in Canada.