



Human Longevity Investment Implications

November 12, 2019

Photo courtesy of Donna Trevino

Human longevity overview

- Advances in technology and medicine are elongating the period of life spent free from the diseases and disabilities related to aging (“human healthspan”).
- Chronic conditions are overtaking infectious diseases as the leading cause of death and largest cost to the healthcare system.
- Genetic medicine, the adoption of digital health tools, and high-speed computing are combining to transform the future of healthcare.

Human longevity investment opportunities

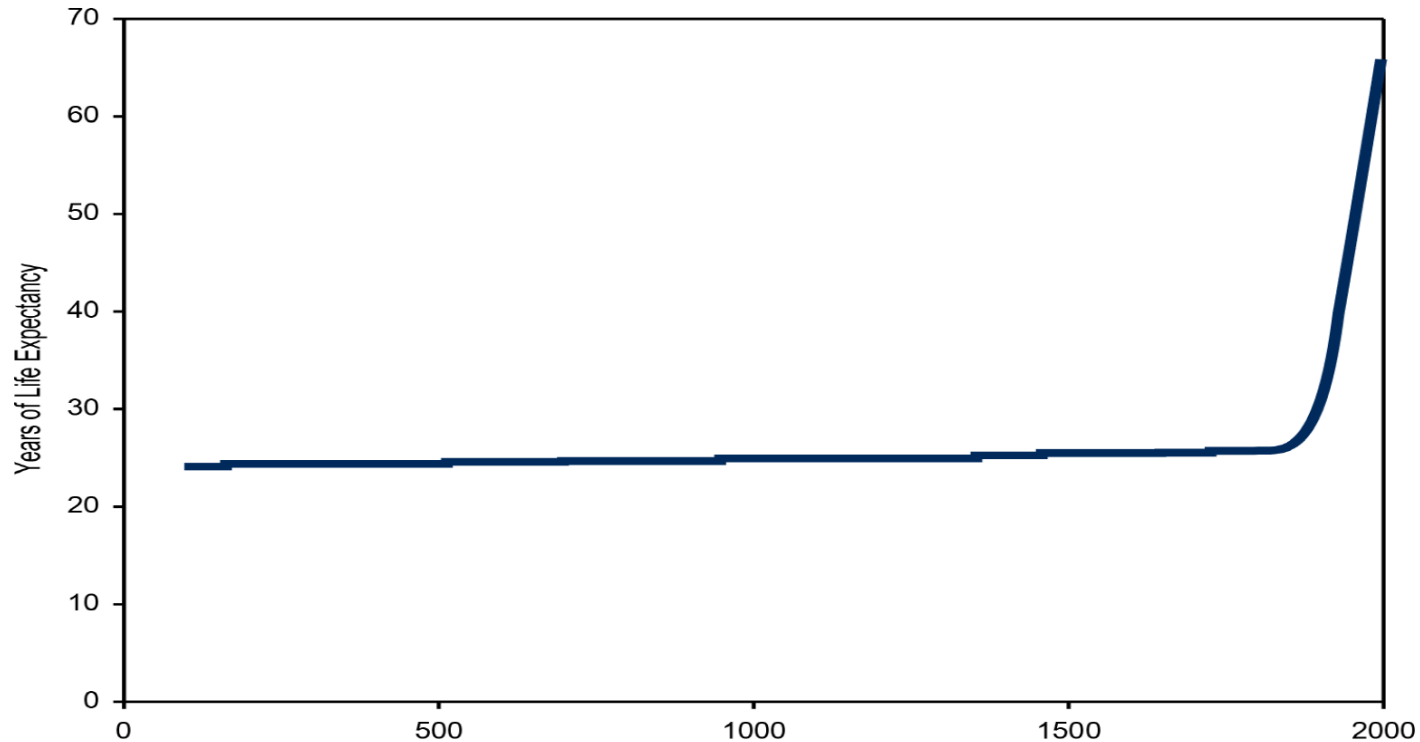
- A broad investment opportunity in companies helping to improve human healthspan and reduce costs to the healthcare system has emerged such as:
 - Companies on the frontier of developing and applying next-generation medical technology ranging from genetic testing to surgical robots.
 - Companies discovering and developing personalized and genetics-based therapies.
 - Companies serving healthcare needs of elderly population.

Drivers of Change in Human Healthspan

Photo courtesy of Donna Trevino

Medical advances have extended lifespans over the past century

Exhibit 9: Life expectancy has exponentially increased since the 1900s



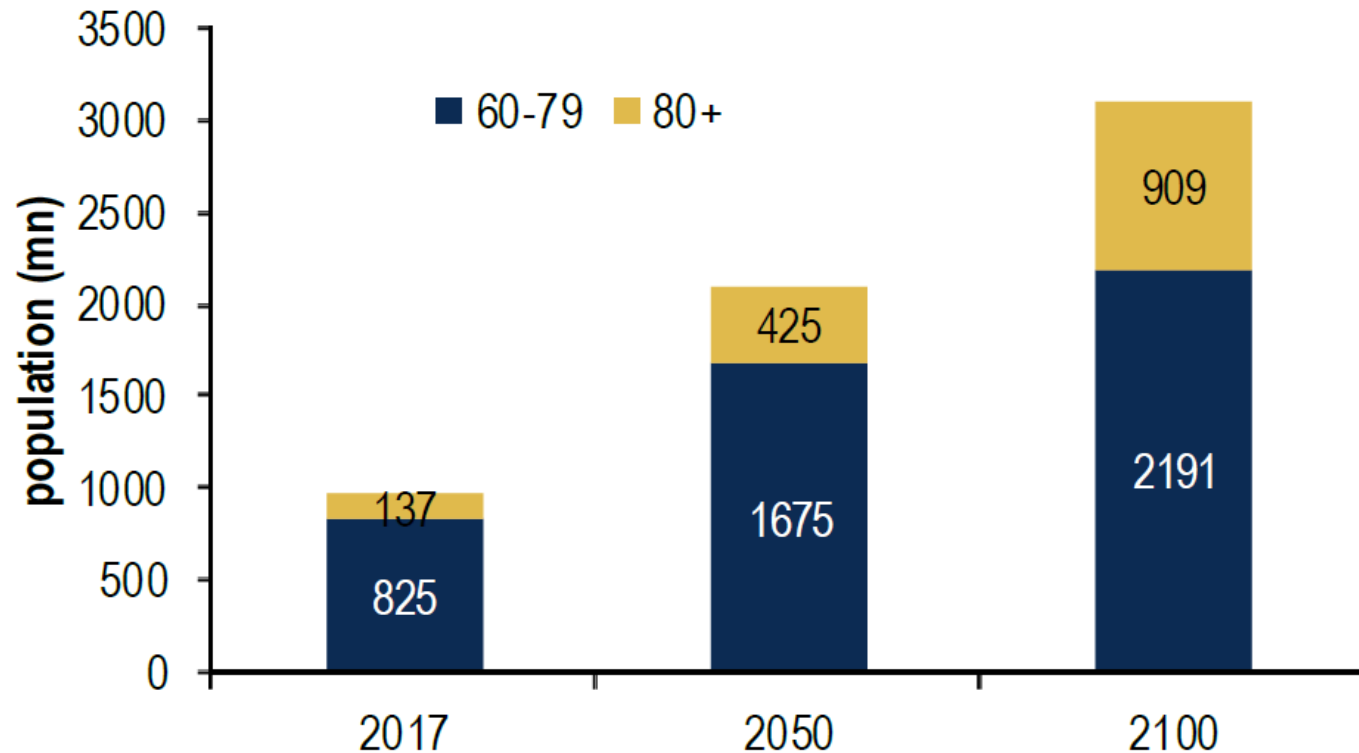
Source: Ray Kurzweil "Singularity", Steemit

Source: BAML Research May 2019

Leading to a growing elderly population

Chart 9: World population aged 60+

Millions

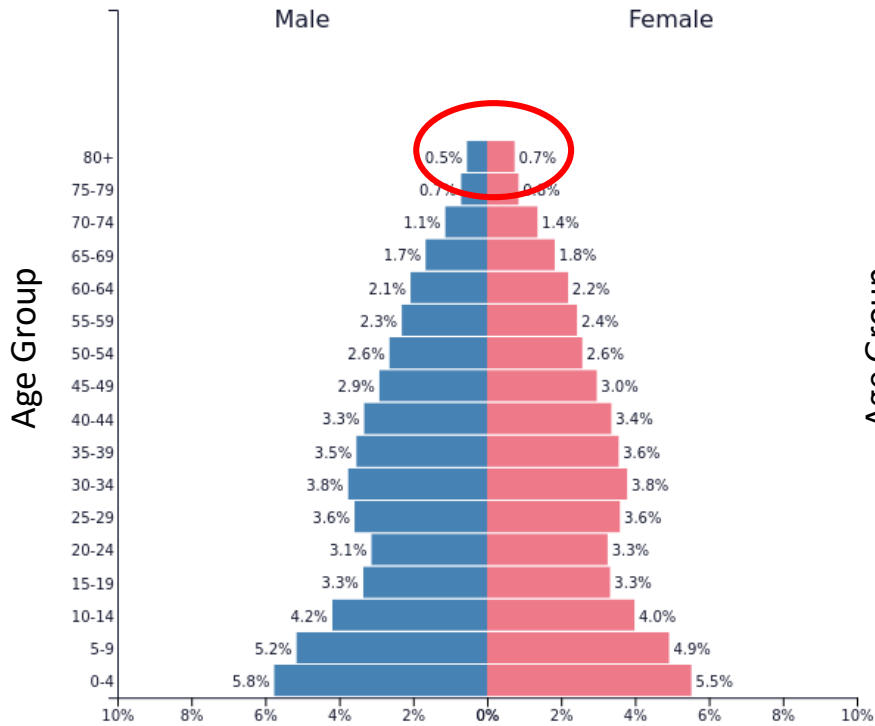


Source: UN 2017

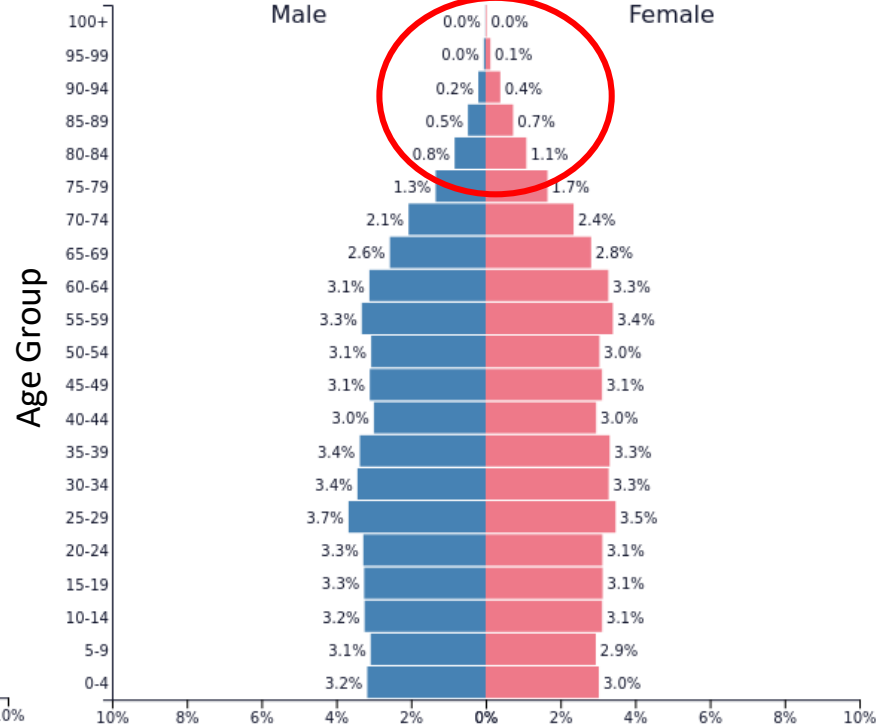
Source: BAML Research May 2019

And a demographic change in the U.S.

U.S. Population - 1955 (170.8 million)



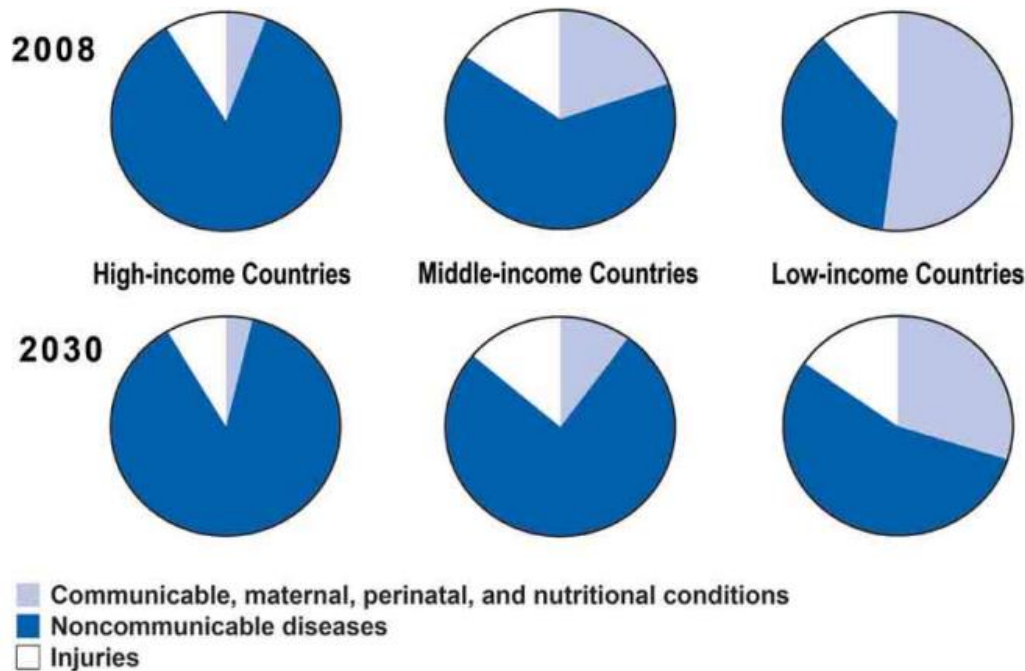
U.S. Population - 2020 (333.5 million)



Source: PopulationPyramid.net

Chronic illness projected to account for majority of global disease burden by 2030

The Increasing Burden of Chronic Noncommunicable Diseases: 2008 and 2030

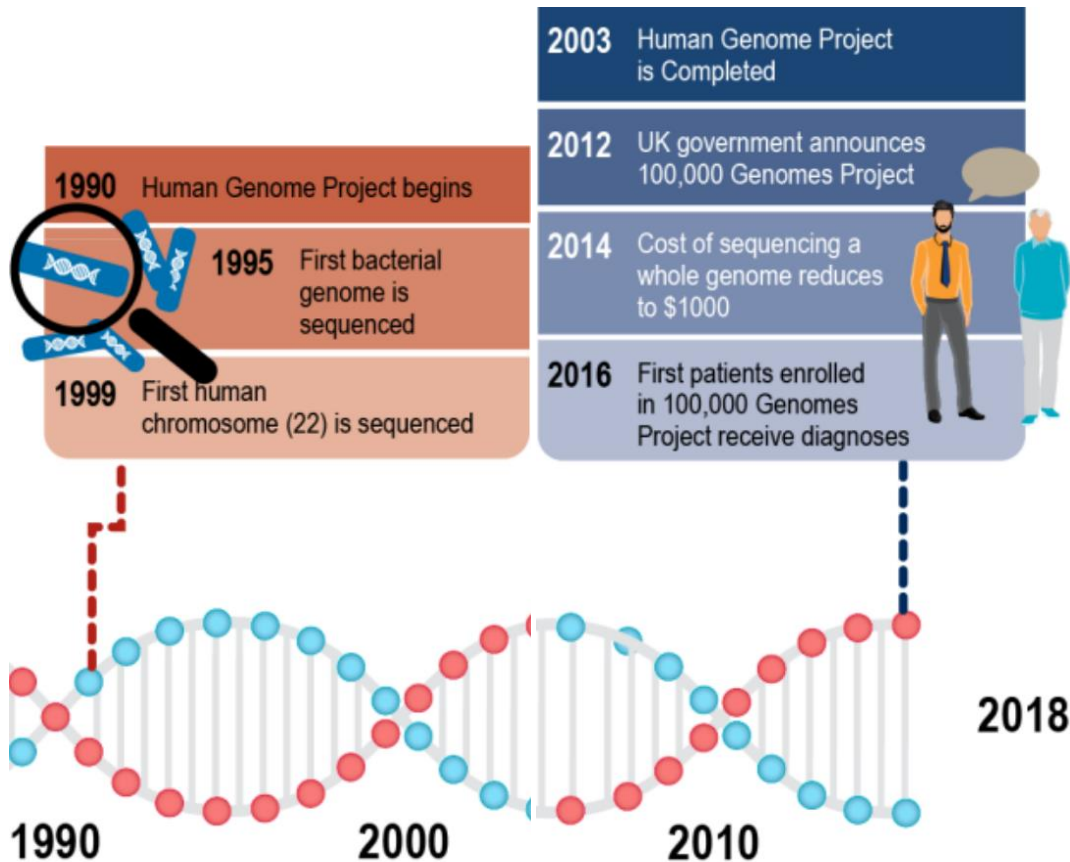


- For the age 60+ population, chronic noncommunicable diseases already account for 87% of the disease burden.

Disease Burden: Loss of healthy years due to a specific cause.

Source: World Health Organization

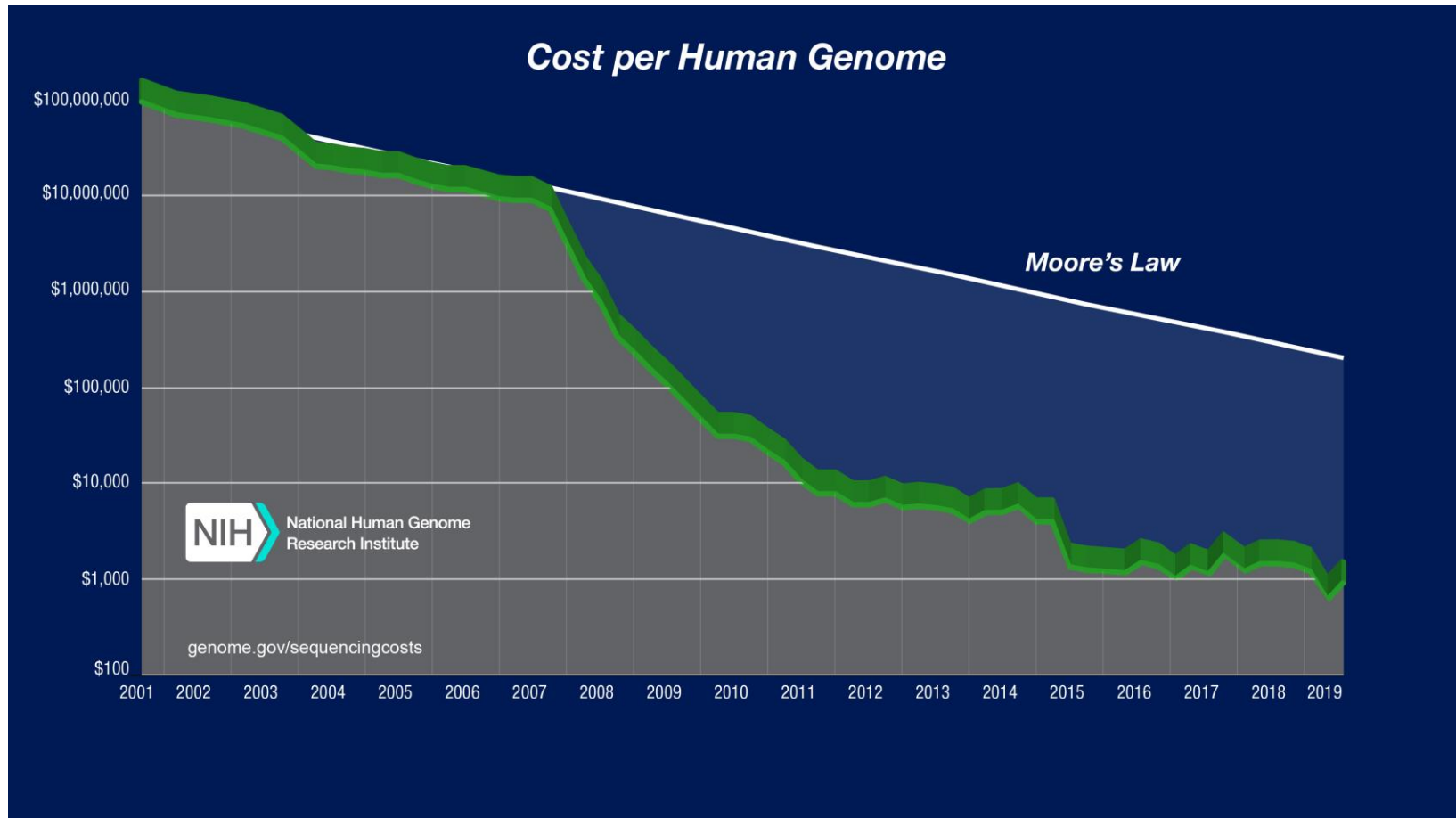
The field of genomics has made significant advances over the past 30 years



- **Genomics** is the study of how our genetic code is structured, how it functions, and how it relates to our health.

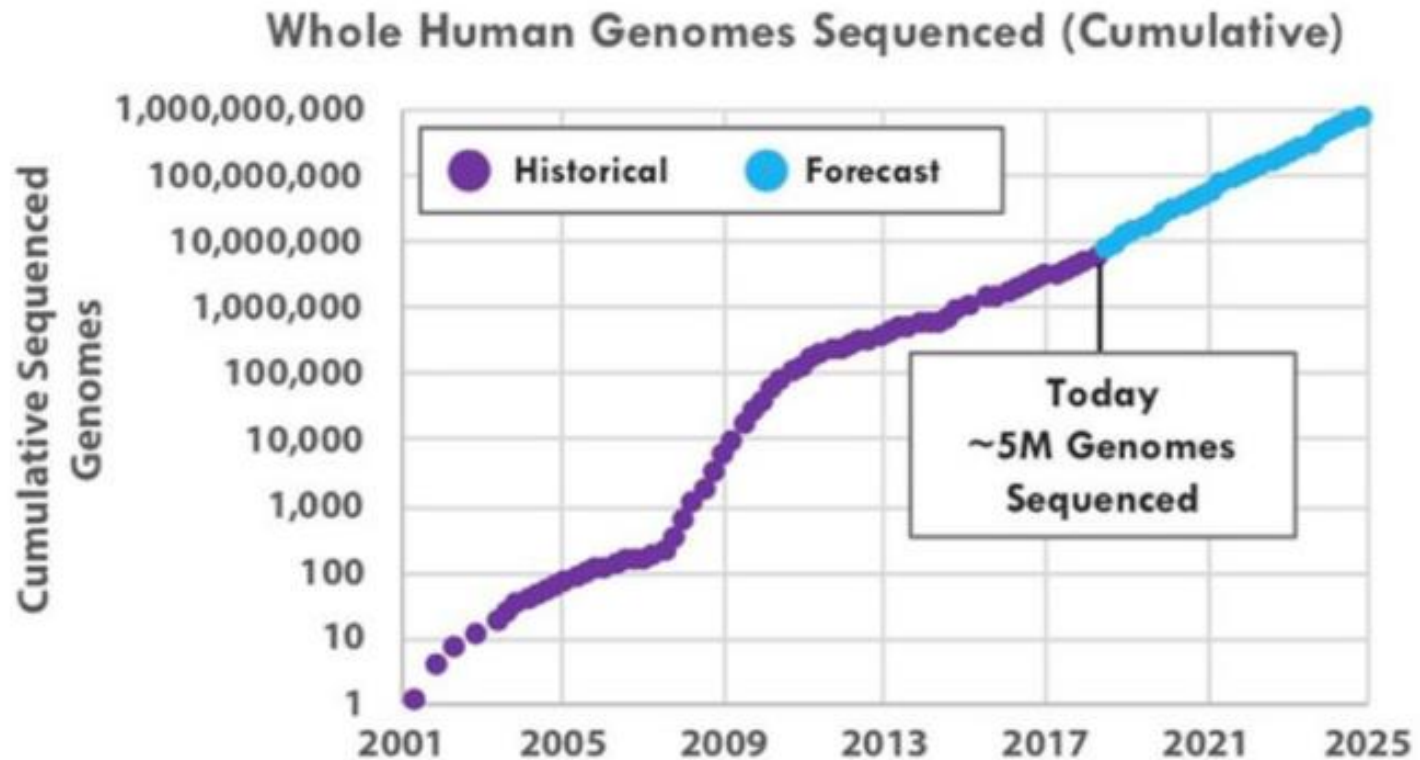
Source: UK National Health Service, BAML Research May 2019

Cost of sequencing DNA has declined from over \$100M in 2000 to ~\$1,000 today



Source: National Human Genome Research Institute

Leading to an explosion in the number of genomes sequenced

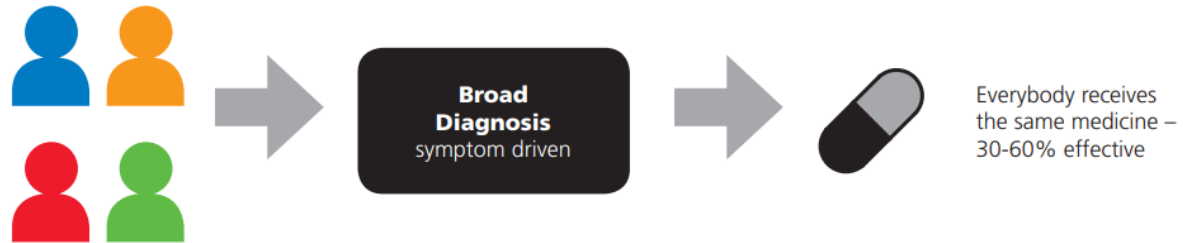


Genomic-related data is expected to increase ten-fold by 2025, exceeding the combined total data generated by YouTube and Twitter.

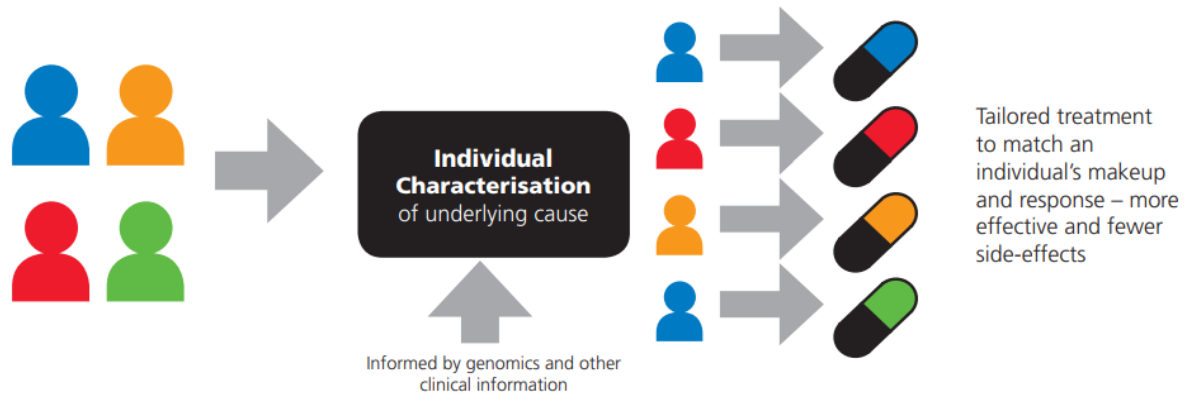
Source: Driehaus Capital Research 2019, BAML Research May 2019

Personalized medicine seeks to match patients with targeted therapies based on their genetic traits

Traditional Approach



Personalized Medicine

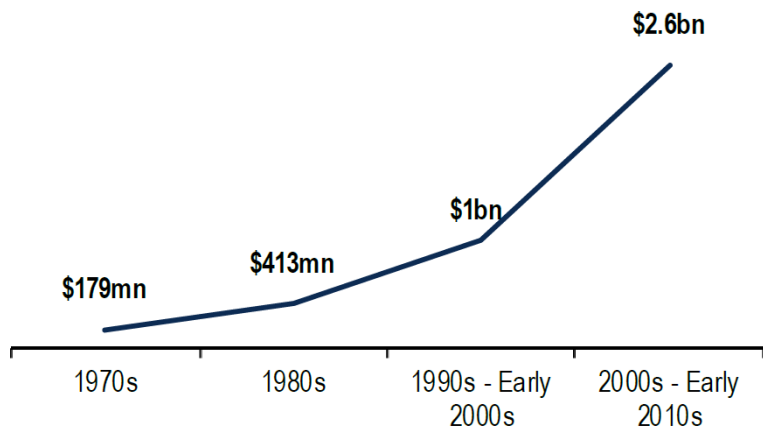


**See appendix for comparison of different genetic medicine approaches.*

Source: UK National Health Service

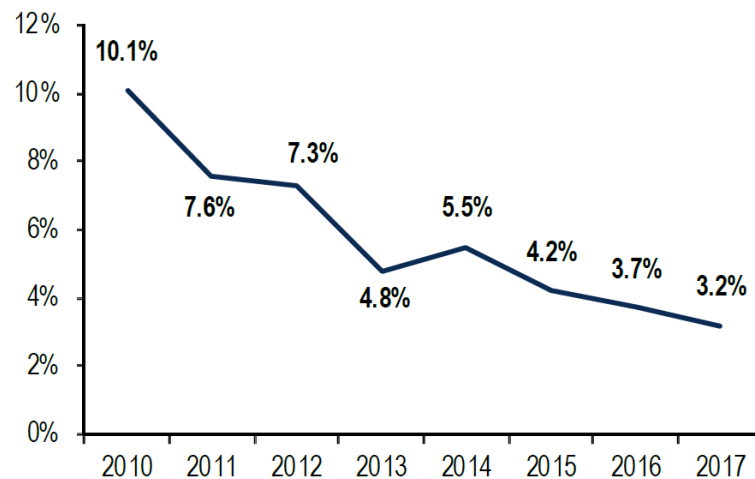
And has the potential to lower the rising costs of traditional drug development and improve the falling returns on research and development

Chart 31: Average cost to develop one new approved drug



Source: pHRMA 2018

Chart 30: Projected IRR for R&D investments, 2010-17



Source: pHRMA 2018

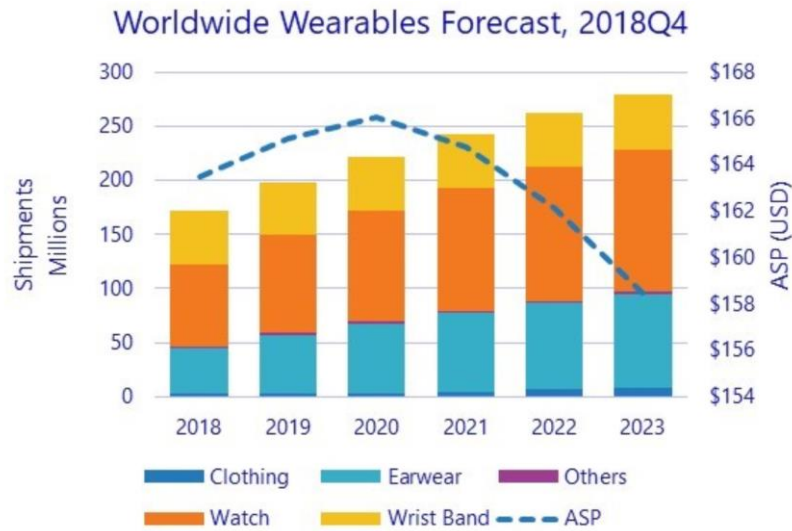
Source: BAML Research May 2019

Genetic data adds value across a wide spectrum of health services

	SUB-SECTORS	DESCRIPTION	VALUE
SAMPLING	NA	The process of collecting and packaging samples (e.g. saliva, blood). The kits used to collect DNA samples are fairly simple	Low: can be performed with basic medical equipment. Complex supply chain as samples need to be stored and shipped appropriately specially.
SEQUENCING	EXTRACTION	Decoding the order of the nucleotides in a genome. DNA sequencing on a large scale is done by high-tech machines.	High but limited headroom: backbone of genomic analysis but hardware may become commoditised
	CONSUMABLES		
	INSTRUMENT		
ANALYSIS	DATA CLEANSING	The process to identify disease-causing variants, often run by bioinformatics software.	Significant value in locally developing software and creating databases to continually refine this information.
	VARIANT CALLING		
	DATA SERVICE		
INTERPRETATION	REPORTING	Taking analysed information and providing clinically useful interpretations and results	High: this is an added-value service that directly caters to the needs of key healthcare system and pharmaceutical buyers
	LINK WITH EHRs		
	TAILORING RESULTS		
APPLICATION	DRUG DEVELOPMENT	The process of directly using genomic information to improve targeting of clinical services	Significant value in targeted sectors e.g. personalised medicine and advancing oncogenomics
	CLINICAL SERVICES		
	DIAGNOSTICS		

Source: BAML Research May 2019

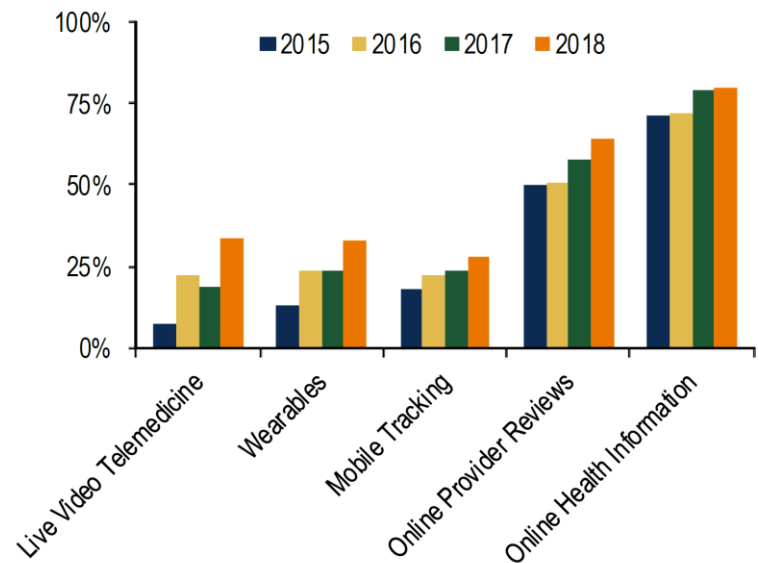
Increased adoption of digital health tools generates clinically useful lifestyle data



Source: IDC 2019

Chart 36: Adoption of Digital Health Tools

2015 - 2018

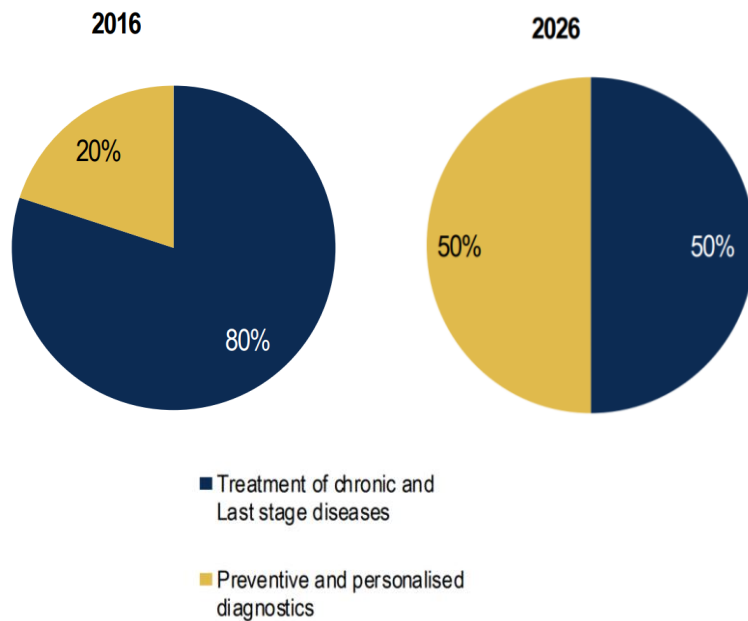


Wearable device shipments are expected to exceed 250 million by 2022, generating large volumes of patient data including pulse rates, respiratory rates, glucose levels, etc.

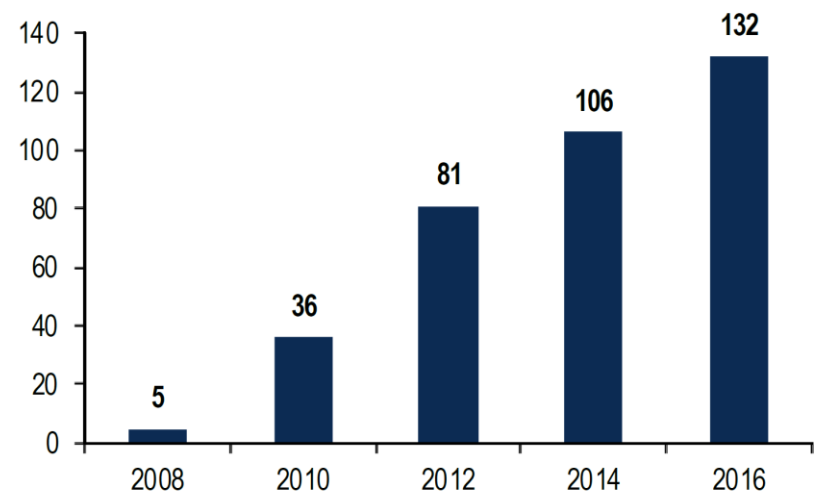
Source: BAML Research May 2019, International Data Corporation 2017

Intersection of genomics, lifestyle data and high-speed computing will make personalized medicine a more routine part of healthcare

Paradigm Shift from Spending on Treatment to Prevention (2016-2026)



Number of Personalized Medicines



Source: BAML Research May 2019

What does the future of medicine look like?

Medicine is changing

Today:

'One-size-fits-all' treatment based on symptoms

Services and professions organised according to organ/speciality

Limited use of genomic and molecular markers

Diagnostic and clinical data not linked

By 2020:

Whole genome sequencing for specific conditions

Improved diagnosis of rare conditions and better understanding of cancer

Comprehensive, linked diagnostic data coupled with effective informatics analysis to give a full picture of patients

By 2025:

New taxonomy of medicine based on underlying cause and personal response

Integrated clinical services taking a 'whole body' approach

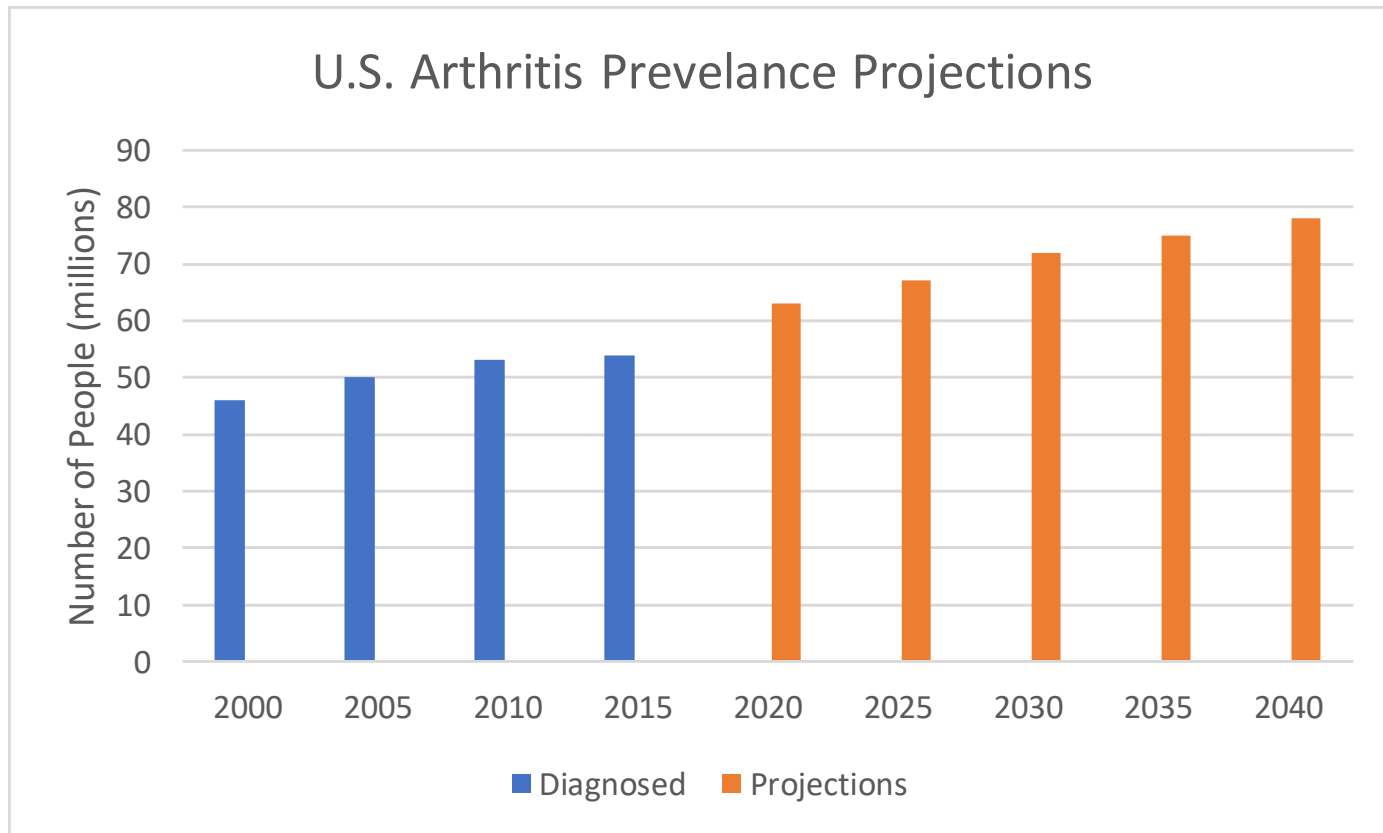
Tailored, optimised and more effective therapies for better outcomes

New NHS relationships with academia, industry, patients & patient groups

- As the medical field shifts away from a one-size-fits all treatment approach based on symptoms, medicine will become **increasingly preventative and targeted** toward an individual's genetic make-up.

Source: UK National Health Service

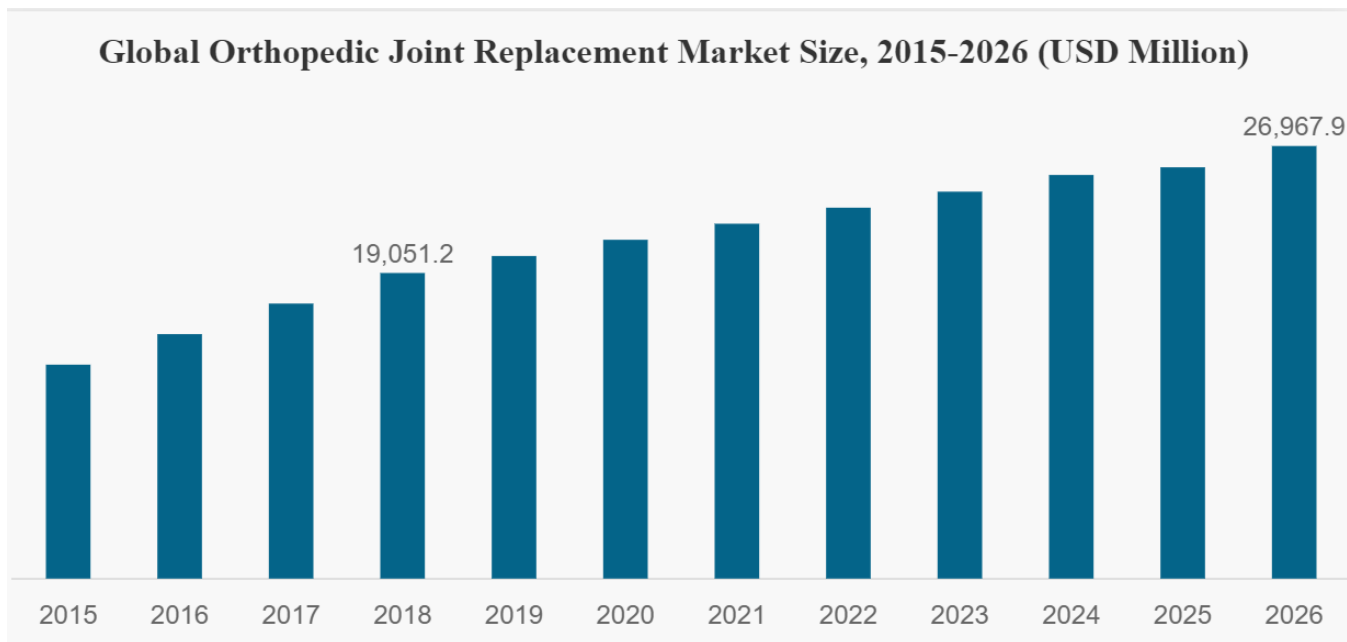
Prevalence of arthritis is increasing as population ages



Arthritis diagnoses are also increasing worldwide. 9.6% of men and 18% of women over 60 years of age suffer from osteoarthritis.

Source: World Health Organization, Center for Disease Control

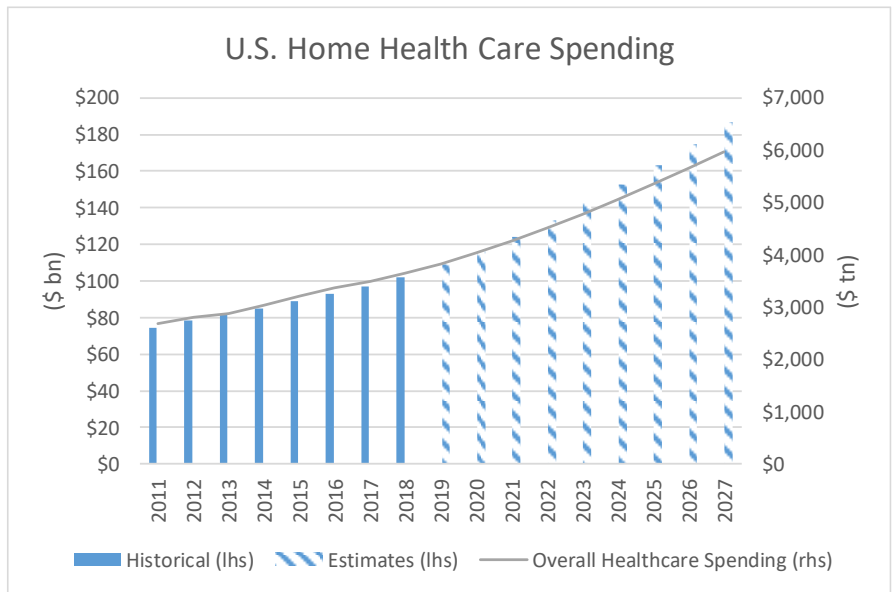
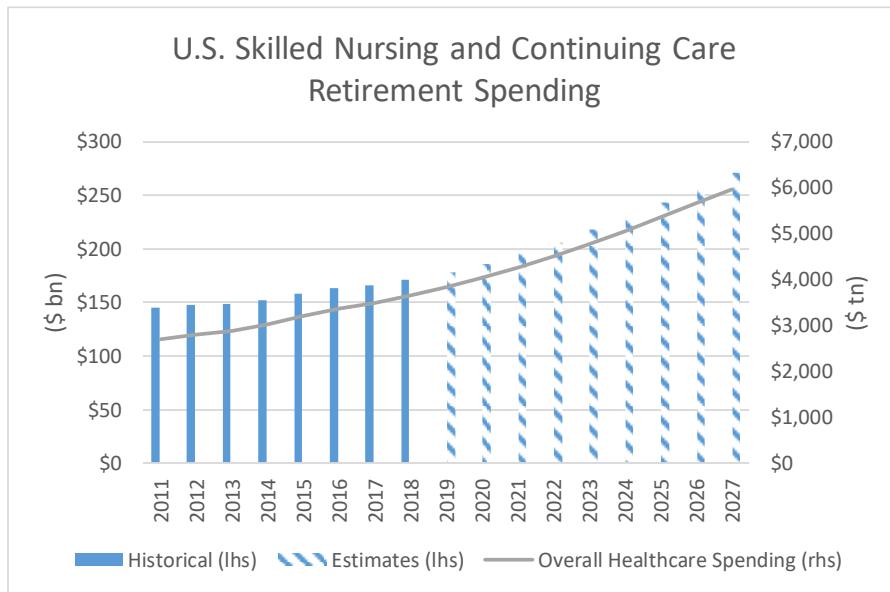
Contributing to growing demand for joint replacement



- Osteoarthritis is the most common reason for hip and knee replacement surgeries, which totaled 2.8 million across the U.S. and Europe in 2018.
- Robotic surgery allows for less invasive procedures with reduced bleeding, faster recovery, decreased chance of damage to important nerves, and smaller scars than traditional surgeries.

Source: Intuitive Surgical Investor Presentation, Fortune Business

Spending on assisted living is expected to rise due to healthcare needs of elderly population

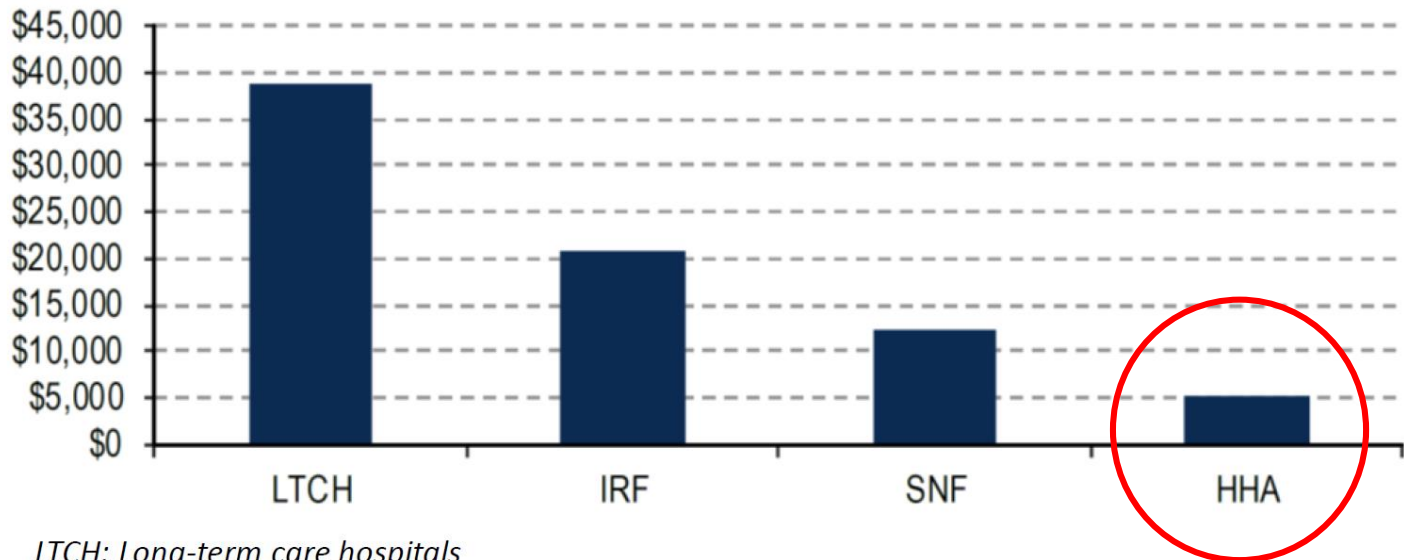


Market for skilled nursing, assisted living retirement facilities, and home healthcare projected to grow 6% annually through 2027 to \$440 billion.

Source: Centers for Medicare and Medicaid Services

Home healthcare is most economic form of post-acute medical care

Average Medicare payment per case from 2017-2019



LTCH: Long-term care hospitals

IRF: Inpatient rehab facility

SNF: Skilled-nursing facilities

HHA: Home Healthcare

Patients recover from illnesses or manage chronic conditions with skilled nursing, occupational therapy, and pain management in their homes.

A photograph of a small wooden bridge crossing a narrow stream in a forest. The trees have autumn foliage in shades of green, yellow, and brown. The bridge is made of wood and has a simple railing. The water in the stream is calm and reflects the surrounding trees and sky. The overall scene is peaceful and natural.

Investment Landscape

Photo courtesy of Donna Trevino

Investment opportunities

- Companies leveraging science and technology to improve human healthspan and companies serving healthcare needs of aging population:
 1. **Genetic testing and diagnostic tools:** Low-cost genome sequencing has a growing range of clinical applications addressing unmet needs.
 2. **Digital healthcare and surgical technology:** Wearable devices, telehealth, and robotic surgery can reduce costs to healthcare system, help patients more effectively monitor chronic conditions, and improve clinical outcomes.
 3. **Drug discovery and development:** Personalized medicine to treat patients suffering from a range of diseases and chronic conditions.
 4. **Assisted living:** Aging population will increase demand for skilled healthcare and daily living assistance.

**See appendices for specific company examples.*

1) Genetic testing and diagnostic tools

- Genetics companies are developing next-generation DNA sequencing technology deployed in fast-growing markets such as:
 - **Diagnostic tests** including blood tests and DNA stool samples. Tests are faster, more accurate, and less invasive than current methods, such as colonoscopies.
 - **Personalized therapeutics** targeted to an individual's genetic make-up.
 - **Clinical trials** primarily involving cancer biomarker research, HIV/AIDS research, and associated drug development.
- Increasing accuracy and accessibility of genetic testing and diagnostics can reduce the \$2.9 trillion of U.S. healthcare spending on treatment of chronic conditions.

Genetic testing and diagnostics: Example

Range of Genetic Testing Applications

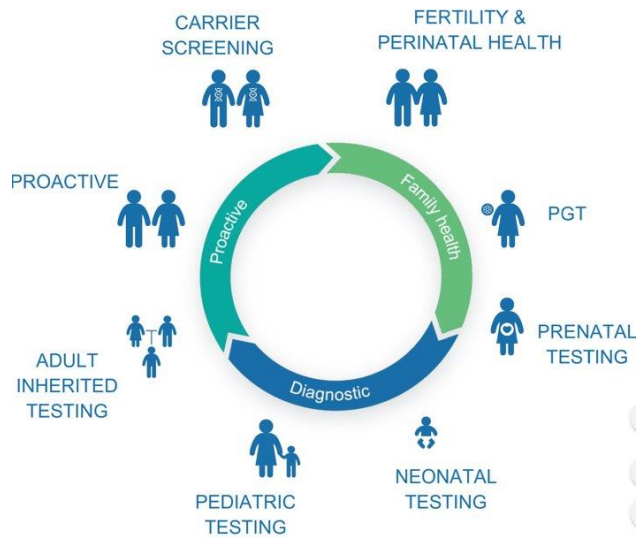
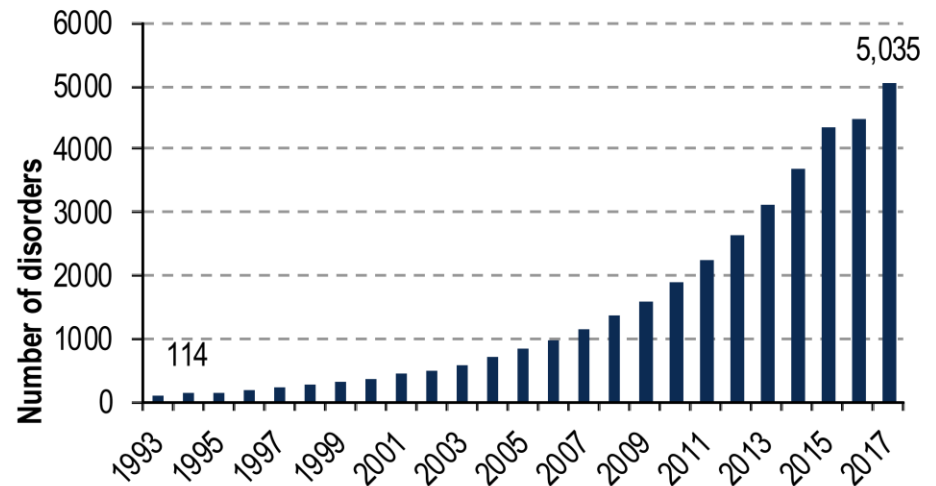


Chart 21: Genetic disorders with diagnostic tests available

As of July 18 2017



- Applications of proactive and preventative genetic testing are expanding to pre-natal health, adult inherited testing, and carrier screening.
- Available tests for genetic disorders have more than doubled in the past decade, increasing capacity to treat the rare diseases affecting 30 million Americans.

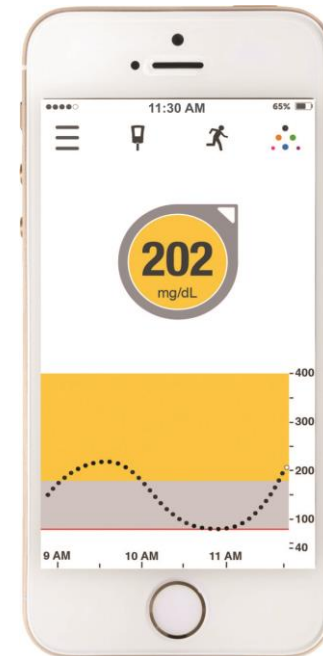
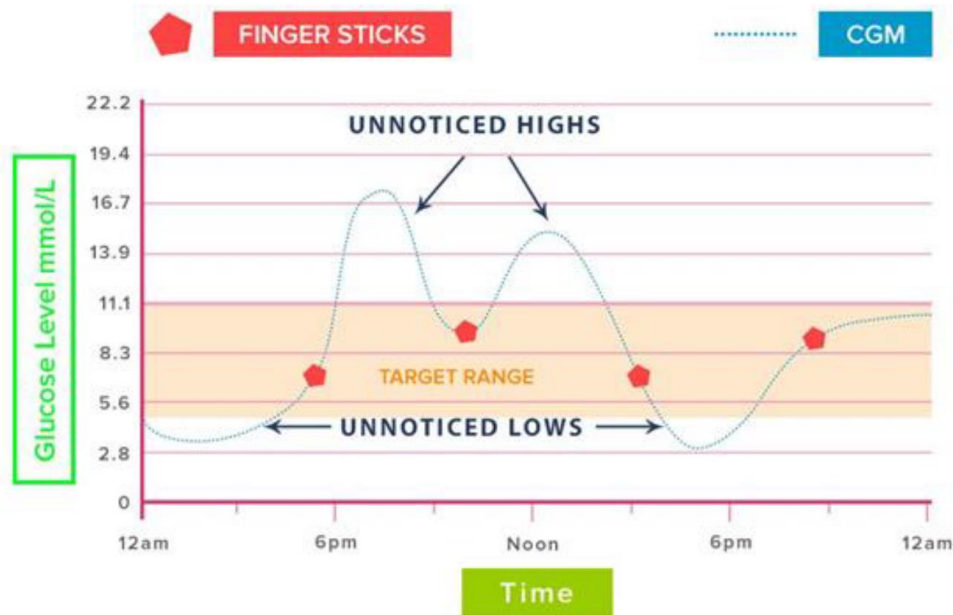
Source: BAML Research May 2019, Exact Sciences Investor Presentation

2) Digital healthcare and surgical technology

- Digital healthcare companies are developing technology for monitoring and analyzing health data, as well as administering treatment.
- Remote healthcare companies (telehealth) offer video, telephonic, and text consultation with doctors. Services leverage machine learning and artificial intelligence to diagnose patients and improve treatment decisions.
- Leading global orthopedics companies are developing surgical robots expected to enhance the precision and accuracy of surgery.
- Medical device companies offer comprehensive portfolios of patient-specific, full and partial joint replacement products.

Digital healthcare and surgical technology: Example

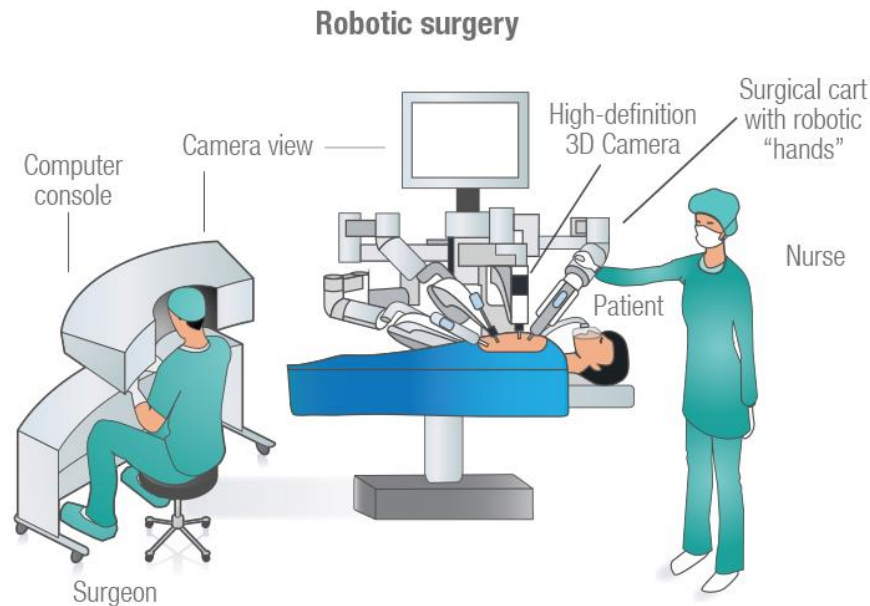
Exhibit 3: A CGM catches unnoticed highs and unnoticed lows not caught by finger sticks



- Wearable devices provide real-time health metrics for early intervention and management of chronic conditions, such as diabetes.
- Continuous glucose monitoring devices offer diabetes patients a less invasive and more effective way to stay within a healthy glucose range.

Source: Dexcom 2019 Investor Presentation

Digital healthcare and surgical technology: Example



- Robotic surgeries, first approved by the FDA in 2000, are performed by tiny electromechanical instruments inserted in the patient's body through small ports. Surgeons use 3-D visualization and are afforded greater range of motion and improved ergonomics than in traditional surgeries.
- The number of procedures performed annually using the market leading robotic surgical system has grown from 136,000 in 2008 to 877,000 in 2018. The system costs between \$1.5-2 million.

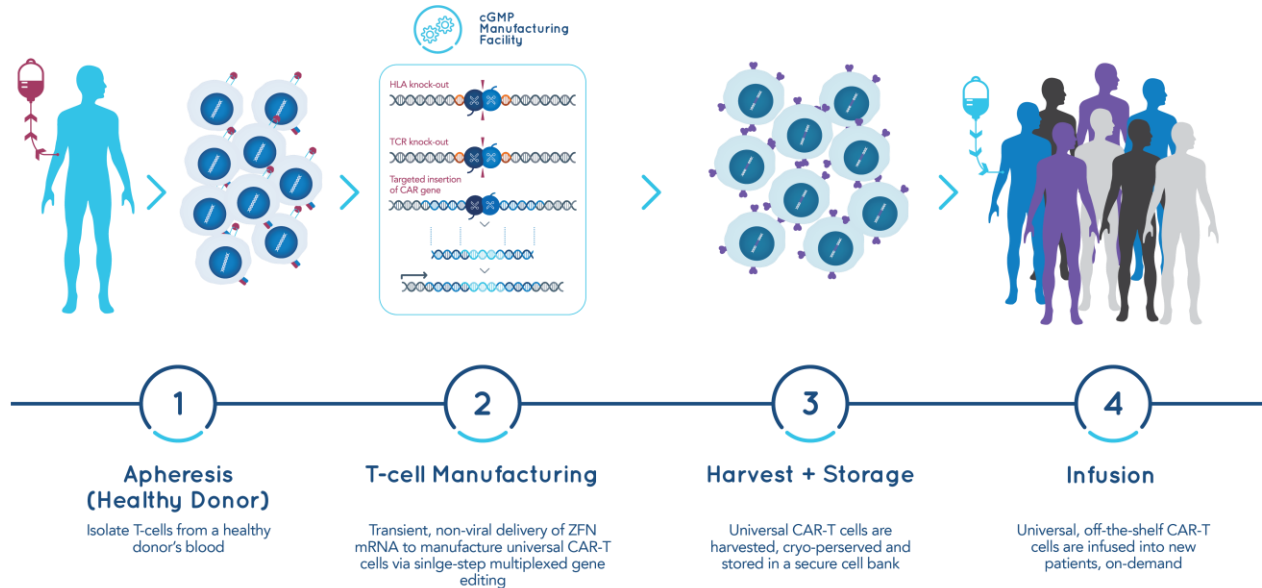
Source: Google Images, Intuitive Surgical

3) Drug discovery and development

- Biotechnology firms are developing personalized and genetics-based therapies to treat patients suffering from ailments ranging from cancer to rare diseases along with other chronic conditions. These are high risk, high reward opportunities.
 - The ability to make targeted corrections or silence mutations in the human genome via gene therapy (which has a 20-year history of clinical testing) and gene editing (just now entering the clinic) will transform the current medical treatment paradigm from chronic to curative.
 - There are currently over 700 genetic medicine-based trials underway in the U.S., Europe and Israel (per the Alliance for Regenerative Medicine).
 - Several genetic therapies have received commercial approval, most notably the spinal muscular atrophy gene therapy Zolgensma (Novartis) and first-generation CAR-T Cell cancer therapies such as Yescarta (Gilead).
- Some biotech firms benefit by partnering with contract research and manufacturing organizations that provide clinical trial support and drug manufacturing services, enabling the biotech firms to focus exclusively on R&D.

Drug discovery and development: Example

Next Generation Allogeneic CAR-T Cell Cancer Therapy



- Current generation of CAR-T cancer therapies, such as Gilead's Yescarta, work by enhancing an individual patient's chimeric antigen receptor T-cells outside the body and then reinfusing the cells back into the patient to fight off cancer.
- Next generation allogeneic CAR-T therapies promise to cut down on time and cost of the current treatment process. As illustrated above, T-cells are harvested from healthy donors, modified, and then cryogenically stored for on demand availability to treat multiple patients, reducing costs and treatment time.

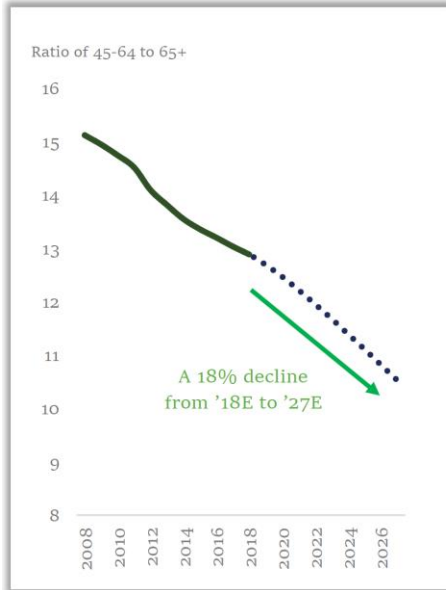
Source: Sangamo Therapeutics

4) Assisted living

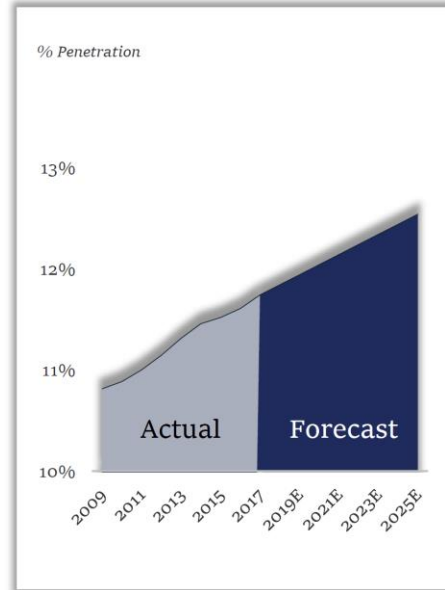
- Healthcare real estate investment trusts (“REITs”) manage properties ranging from senior housing communities to skilled nursing facilities to hospitals.
- Operators of these properties provide services including personal care, memory care, recreation, and emergency response.
- Home health providers offer skilled clinical treatment in patients’ homes to help them manage chronic illness or recover from acute illness.
 - Home health market exceeded \$100 billion in 2019 and is projected to reach \$186.6 billion by 2027.
 - 20% of elderly population in the U.S. suffers from five or more chronic conditions.

Assisted living: Example

DECLINING CAREGIVER RATIOS



STEADILY INCREASING PENETRATION RATES⁽¹⁾



Penetration rates represent the percentage of elderly population living in senior housing communities. Data is for U.S. only.

The declining ratio of available caregivers is expected to drive more demand for senior housing over time (represented by rising penetration rates).

- Healthcare REITs develop, lease and own diversified portfolios of senior housing communities which cater to different segments of the elderly population.
 - 23,500 senior housing and care properties are in the U.S.
 - Properties are often owned through triple-net lease structures that generate long-term, stable income.
 - Depending on the type of facility and care provisioned, annual costs for residents range from \$48,000 to \$181,000 per unit.

Source: HCP Investor Presentation 2019, National Investment Council for Seniors



Appendix: Companies Involved in the Human Longevity Opportunity

**Companies listed are not investment recommendations*

Photo courtesy of Donna Trevino

1) Genetic Testing / Diagnostics companies

Stock	Company Name	Description	Stock Price	Market Cap (\$, Millions)	Net Debt To EBITDA	Dividend Yield (%)	Sales (\$, Millions)		Price to Earnings Ratio		EV to EBITDA		Free Cash Flow Margin	
							2019 E	2020 E	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E
GH	Guardant Health Inc	Guardant Health, Inc. operates as a biotechnology company. The Company provides sequencing and cell diagnostics services for the cancer patients. Guardant Health serves patients worldwide.	71.23	6,624.74	-	-	186.50	254.17	-	-	-	-	-	-
QGEN	QIAGEN NV	QIAGEN N.V. is a global provider of Sample to Insight solutions to transform biological materials into valuable molecular insights. The Company provides its workflows to customers in Molecular Diagnostics (human healthcare), Applied Testing (forensics, veterinary testing and food safety), Pharma (pharmaceutical and biotechnology companies) and Academia (life sciences research).	29.24	6,621.98	2.08	-	1,530.71	1,629.38	21.20	19.88	15.19	13.74	15.00%	15.44%
ILMN	Illumina Inc	Illumina, Inc. develops, manufactures and markets integrated systems for the large scale analysis of genetic variation and biological function. The Company provides a comprehensive line of products and services that currently serve the sequencing, genotyping and gene expression markets for genomic research centers, pharmaceutical companies, academic institutions and biotechnology companies.	308.17	45,300.99	-1.10	-	3,530.07	3,968.67	48.14	43.52	36.74	31.59	21.94%	25.34%
NVTA	Invitae Corp	Invitae Corporation operates as a genetic information company. The Company specializes in providing information for genetic diagnostics, preimplantation and carrier screening for inherited disorders, miscarriage analysis, and hereditary cancer. Invitae serves customers in the State of California.	17.74	1,687.93	-	-	219.88	330.13	-	-	-	-	-	-
NEO	NeoGenomics Inc	NeoGenomics, Inc. operates a network of clinical laboratories that specializes in cancer genetics diagnostic testing services. The Company's services include cytogenetics, fluorescence in-situ hybridization (FISH), flow cytometry, morphology, anatomic pathology, and molecular genetic testing. NeoGenomics serves pathologists, oncologists, urologists, and hospitals.	21.06	2,187.50	-0.64	-	399.75	447.63	80.70	58.83	38.30	30.41	-0.20%	5.94%
A	Agilent Technologies Inc	Agilent Technologies, Inc. provides core bio-analytical and electronic measurement solutions to the communications, electronics, life sciences, and chemical analysis industries. The Company offers electronic and bio-analytical measurement, semiconductor, and board testing.	76.41	23,646.43	0.03	0.86	5,128.08	5,551.00	24.78	22.26	18.41	16.57	13.53%	19.89%
TMO	Thermo Fisher Scientific Inc	Thermo Fisher Scientific, Inc. manufactures scientific instruments, consumables, and chemicals. The Company offers analytical instruments, laboratory equipment, software, services, consumables, reagents, chemicals, and supplies to pharmaceutical and biotech companies, hospitals and clinical diagnostic labs, universities, research institutions, and government agencies.	300.93	120,515.17	2.29	0.25	25,489.23	26,927.69	24.42	22.12	20.82	19.46	16.16%	18.55%
EXAS	Exact Sciences Corp	Exact Sciences Corp., is focused on developing and commercializing a non-invasive molecular screening test for the early detection and prevention of colorectal cancer. The Company's test is a stool-based DNA test that identifies both pre-cancer and cancer by detecting genetic mutations in colorectal cancer cells.	92.93	12,032.59	-	-	810.92	1,336.17	-	-	-	-	-	2.74%
CDNA	CareDx Inc	CareDx, Inc. develops, markets, and delivers a diagnostic surveillance solution for heart transplant recipients. The Company aims to transform long-term patient care in transplantation by offering novel surveillance management solutions.	27.43	1,162.59	-	-	125.60	170.00	457.17	95.91	352.56	81.24	1.04%	15.53%
BRKR	Bruker Corp	Bruker Corporation designs, manufactures, and markets proprietary life science systems based on spectrometry technology platforms. The Company also sells a range of field analytical systems for substance detection and pathogen identification. Bruker develops life science and advanced materials research tools based on X-ray technology.	44.62	6,901.19	0.80	0.36	2,043.70	2,157.30	27.78	24.40	17.72	16.01	9.26%	11.86%
NTRA	Natera Inc	Natera, Inc. operates as a diagnostics company. The Company provides preconception and prenatal genetic testing services. Natera also offers pre-implantation genetic diagnosis, aneuploidy screening, translocation, and single gene testing services.	39.00	2,987.59	-	-	293.17	343.33	-	-	-	-	-	-

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2) Digital healthcare and surgical technology companies...

Stock	Company Name	Description	Stock Price	Market Cap (\$, Millions)	Net Debt To EBITDA	Dividend Yield (%)	Sales (\$, Millions)		Price to Earnings Ratio		EV to EBITDA		Free Cash Flow Margin	
							2019 E	2020 E	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E
DXCM	DexCom Inc	DexCom Inc. operates as a medical device company focused on the design and development of continuous glucose monitoring systems for people with diabetes. The Company has developed a small implantable device that continuously measures glucose levels in subcutaneous tissue just under the skin and a small external receiver to which the sensor transmits glucose levels at specified intervals.	151.73	13,835.65	-	-	1,367.79	1,623.47	165.28	102.94	89.60	53.88	4.31%	11.18%
PODD	Insulet Corp	Insulet Corporation operates as a medical device company. The Company develops, manufactures, and markets an insulin infusion system for people with insulin-dependent diabetes. Insulet markets its products in the United Kingdom, Canada, and United States.	146.65	8,838.84	5.03	-	711.44	850.61	584.26	186.58	148.41	82.44	-8.61%	6.61%
TDOC	Teladoc Health Inc	Teladoc Health, Inc. provides healthcare services. The Company diagnoses, recommends treatment, and prescribes medication for routine medical issues through phone and video consultations. Teladoc Health serves patients worldwide. Omnicell, Inc. provides an integrated suite of clinical infrastructure and workflow automation solutions for healthcare facilities. The Company offers solutions include pharmacy and supply systems, clinical reference tools, an internet-based procurement application, and decision support. Omnicell sells and leases its products and services to a range of healthcare facilities.	71.92	5,181.16	-	-	543.37	677.90	-	-	174.81	80.86	-1.68%	2.59%
OMCL	Omnicell Inc	Omnicell, Inc. provides an integrated suite of clinical infrastructure and workflow automation solutions for healthcare facilities. The Company offers solutions include pharmacy and supply systems, clinical reference tools, an internet-based procurement application, and decision support. Omnicell sells and leases its products and services to a range of healthcare facilities.	70.67	2,943.81	-0.05	-	892.50	989.00	25.05	23.46	17.36	15.51	7.49%	11.32%
LVGO	Livongo Health Inc	Livongo Health, Inc. operates as a biotechnology company. The Company develops applied health signals for the treatment of chronic health conditions. Livongo Health serves patients in the United States.	22.70	2,143.90	-	-	160.75	275.63	-	-	-	-	-	-
MDSO	Medidata Solutions Inc	Medidata Solutions, Inc. provides hosted clinical development solutions. The Company offers solutions include comprehensive platform that integrates electronic data capture (EDC) with a clinical data management system (CDMS) in a single solution that replaces traditional paper-based methods of capturing and managing clinical data.	92.25	5,761.60	-0.14	-	740.60	848.00	49.49	42.91	32.25	26.58	6.62%	10.73%
MDT	Medtronic PLC	Medtronic, PLC develops therapeutic and diagnostic medical products. The Company's principal products include those for bradycardia pacing, tachyarrhythmia management, atrial fibrillation management, heart failure management, heart valve replacement, malignant and non-malignant pain, and movement disorders. Medtronic's products are sold worldwide.	106.18	142,458.46	1.76	2.03	31,547.70	33,085.48	19.09	17.66	14.86	13.96	22.36%	22.03%

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...Digital healthcare and surgical technology companies

Stock	Company Name	Description	Stock	Market Cap	Net Debt	Dividend	Sales (\$, Millions)		Price to Earnings Ratio		EV to EBITDA		Free Cash Flow Margin	
			Price	(\$, Millions)	To EBITDA	Yield (%)	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E
MDRX	Allscripts Healthcare Solution	Allscripts Healthcare Solutions, Inc. develops and markets clinical software. The Company offers electronic health records, electronic prescribing, revenue cycle management, practice management, document management, medication services, hospital care management, emergency department information systems and homecare automation solutions.	11.02	1,835.69	3.64	-	1,790.67	1,874.38	16.20	14.31	8.82	8.03	-	-
PHG	Koninklijke Philips NV	Koninklijke Philips NV is a health technology company focused on improving people's health across the health continuum from healthy living and prevention, to diagnosis, treatment, and home care. The Company offers products and services in diagnostic imaging, image-guided therapy, patient monitoring and health informatics, as well as in consumer health and home care.	43.48	39,361.36	1.44	2.21	21,550.12	22,554.86	21.28	18.41	12.08	10.93	7.13%	8.37%
AAPL	Apple Inc	Apple Inc. designs, manufactures, and markets personal computers and related personal computing and mobile communication devices along with a variety of related software, services, peripherals, and networking solutions. Apple sells its products worldwide through its online stores, its retail stores, its direct sales force, third-party wholesalers, and resellers.	248.49	1,122,971.04	-1.34	1.24	259,020.21	270,359.60	21.28	19.52	13.53	13.06	-	-
ISRG	Intuitive Surgical Inc	Intuitive Surgical, Inc. design, manufactures, and markets surgical systems. The Company offers endoscopes, endoscopic retractors and dissectors, scissors, scalpels, forceps, needle holders, electrocautery, ultrasonic cutters, and accessories during surgical procedures. Intuitive Surgical operates worldwide.	559.63	64,677.92	-1.88	-	4,410.33	5,040.50	44.55	39.86	35.24	31.87	30.03%	27.83%
BSX	Boston Scientific Corp	Boston Scientific Corporation develops, manufactures, and markets minimally invasive medical devices. The Company's products are used in interventional cardiology, cardiac rhythm management, peripheral interventions, electrophysiology, neurovascular intervention, endoscopy, urology, gynecology, and neuromodulation.	41.58	57,919.84	3.67	-	10,764.53	12,047.70	26.50	23.16	20.45	18.07	15.99%	19.93%
SYK	Stryker Corp	Stryker Corporation develops, manufactures, and markets specialty surgical and medical products. The Company's products include implants, biologics, surgical, neurologic, ear, nose and throat and interventional pain equipment, endoscopic, surgical navigation, communications and digital imaging systems, as well as patient handling and emergency medical equipment.	213.06	79,704.64	2.13	0.98	14,863.27	15,893.58	25.96	23.65	20.55	18.88	16.60%	18.21%
SNN	Smith & Nephew PLC	Smith & Nephew plc develops and markets advanced medical devices. The Group is involved in orthopaedics, endoscopy, and advanced wound management.	43.48	19,014.61	1.50	1.32	5,097.73	5,331.64	21.58	20.08	14.12	13.03	17.77%	14.51%

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10/28/2019

3) Drug Discovery & Development companies...

Stock	Company Name	Description	Stock Price	Market Cap	Net Debt	Dividend	Sales (\$, Millions)		Price to Earnings Ratio		EV to EBITDA		Free Cash Flow Margin	
				(\$, Millions)	To EBITDA	Yield (%)	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E
PFE	Pfizer Inc	Pfizer Inc. operates as a pharmaceutical company. The Company offers medicines, vaccines, medical devices, and consumer healthcare products for oncology, inflammation, cardiovascular, and other therapeutic areas. Pfizer serves customers worldwide.	37.24	205,920.93	1.63	3.87	51,425.31	47,149.58	13.21	13.72	10.42	11.13	17.34%	28.20%
MRK	Merck & Co Inc	Merck & Co., Inc. is a global health care company that delivers health solutions through its prescription medicines, vaccines, biologic therapies, animal health, and consumer care products, which it markets directly and through its joint ventures. The Company has operations in pharmaceutical, animal health, and consumer care.	81.91	209,709.02	1.26	2.69	45,957.06	48,634.60	16.64	14.94	12.37	11.54	21.48%	28.49%
GILD	Gilead Sciences Inc	Gilead Sciences, Inc. is a research-based biopharmaceutical company that discovers, develops, and commercializes therapeutics to advance the care of patients suffering from life-threatening diseases. The Company primary areas of focus include HIV, AIDS, liver disease, and serious cardiovascular and respiratory	63.21	80,017.53	-0.36	3.99	22,285.81	22,379.42	8.99	9.12	6.30	6.30	32.80%	40.80%
NVS	Novartis AG	Novartis AG manufactures pharmaceutical and consumer healthcare products. The Company uses innovative science and digital technologies to create transformative treatments in areas of great medical need. Novartis offers patent protected prescription medicine and generic pharmaceuticals and biosimilars.	87.19	220,361.81	1.54	3.25	47,314.53	49,601.14	17.00	15.38	15.52	14.37	22.05%	24.64%
SRPT	Sarepta Therapeutics Inc	Sarepta Therapeutics, Inc. is a biopharmaceutical company focused on the discovery and development of unique RNA-based therapeutics for the treatment of both rare and infectious diseases. The Company offers its products to the medical industry in countries around the world.	88.21	6,557.20	-	-	379.52	478.19	-	-	-	-	-	-
BMRN	BioMarin Pharmaceutical Inc	BioMarin Pharmaceutical Inc. develops and commercializes therapeutic enzyme products. The Company has applied its proprietary enzyme technology to develop products for lysosomal storage diseases and for the treatment of serious burns. BioMarin Pharmaceutical through its subsidiaries provides analytical and diagnostic products and services in the area of carbohydrate biology.	71.75	12,886.61	-	-	1,706.96	1,940.09	79.37	45.35	-	100.21	-2.58%	2.79%
BLUE	Bluebird Bio Inc	Bluebird Bio, Inc. provides biotechnological products and services. The Company offers gene therapies for severe genetic disorders such as childhood cerebral adrenoleukodystrophy, neurodegenerative disorders, and beta-thalassemia. Bluebird Bio operates in the United States.	87.46	4,833.57	-	-	47.02	110.21	-	-	-	-	-	-
QURE	uniQure NV	uniQure N.V. delivers gene therapy with single treatments for curative results. The Company develops a modular platform to bring new disease modifying therapies to patients with severe genetic diseases, as well as offers ongoing clinical programs in hemophilia B and pre-clinical proof-of-concept in Huntington's disease.	43.41	1,886.59	-	-	7.82	11.87	-	-	-	-	-	-
RGNX	REGENXBIO Inc	REGENXBIO Inc. operates as a biotechnology company. The Company focuses on the development, commercialization, and licensing of recombinant, and adeno-associated virus gene therapy. REGENXBIO serves customers worldwide.	38.94	1,433.25	-	-	57.65	202.75	-	100.36	-	-	-	-
SGMO	Sangamo Therapeutics Inc	Sangamo Therapeutics, Inc. operates as a biotechnology company. The Company focuses on research and development of genomic therapies, as well as develops medicines for patient with genetic diseases. Sangamo Therapeutics serves customers in the United States.	8.62	997.12	-	-	52.40	86.74	-	-	-	-	-	-

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10/28/2019

...Drug Discovery & Development companies

Stock	Company Name	Description	Stock Price	Market Cap (\$, Millions)	Net Debt To EBITDA	Dividend Yield (%)	Sales (\$, Millions)		Price to Earnings Ratio		EV to EBITDA		Free Cash Flow Margin	
							2019 E	2020 E	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E
MGTX	MeiraGTx Holdings plc	MeiraGTx Holdings plc operates as a clinical stage gene therapy company. The Company offers a broad pipeline of preclinical and research programs, as well as provides gene therapy manufacturing and transformative gene regulation technology. MeiraGTx Holdings serves patients in the United States.	14.44	527.50	-	-	3.00	-	-	-	-	-	-	-
CLLS	Collectis SA	Collectis SA is a biopharmaceutical company focused on developing immunotherapies based on gene edited CAR-T cells (UCART). The company's mission is to develop a new generation of cancer therapies based on engineered T-CRISPR Therapeutics AG is a bio-technology company. The Company researches, develops, and manufactures biological transformative gene-based medicines and other related products. CRISPR Therapeutics operates in Switzerland.	10.50	445.88	-	-	13.38	45.99	-	-	-	-	-	-
CRSP	CRISPR Therapeutics AG	CRISPR Therapeutics AG is a bio-technology company. The Company researches, develops, and manufactures biological transformative gene-based medicines and other related products. CRISPR Therapeutics operates in Switzerland.	39.11	2,137.85	-	-	43.66	25.89	-	-	-	-	-	-
EDIT	Editas Medicine Inc	Editas Medicine, Inc. operates as a biotechnology company. The Company offers transformative genome editing technology with the aim to translate the technology into a novel class of human therapeutics that enable precise and corrective molecular modification for the treatment of diseases. Editas Medicine serves the healthcare sector in the United States.	21.39	1,059.13	-	-	16.27	24.20	-	-	-	-	-	-
NTLA	Intellia Therapeutics Inc	Intellia Therapeutics, Inc. operates as a biotechnology company. The Company focuses on the research and clinical development of gene editing therapies for patients with genetically-based diseases.	11.57	565.48	-	-	39.26	31.98	-	-	-	-	-	-
IQV	IQVIA Holdings Inc	IQVIA Holdings Inc. focuses on technology solutions and contract research services. The Company offers a broad range of solutions which includes clinical development strategies, therapeutic expertise, predictive and prescriptive analytics, and patient retention services. IQVIA Holdings serves consumer health, biopharma, and medical technology industries globally.	148.00	28,992.39	5.09	-	11,078.39	11,903.33	23.38	20.51	16.89	15.37	-	-
PRAH	PRA Health Sciences Inc	PRA Health Sciences, Inc. is a global contract research organization. The Company provides outsourced clinical development services to the biotechnology and pharmaceutical industries.	98.76	6,201.67	2.61	-	3,056.70	3,313.70	19.60	17.24	13.91	12.53	7.99%	9.15%
ICLR	ICON PLC	ICON PLC provides contract clinical research services to the global pharmaceutical industry. The Company manages clinical studies in addition to providing data management, regulatory, and central laboratory services. ICON currently operates offices in multiple countries.	149.34	8,076.11	-0.24	-	2,813.79	3,030.80	21.68	19.44	16.12	14.68	9.80%	12.98%
CRL	Charles River Laboratories Int	Charles River Laboratories International, Inc. provides research tools and support services for drug discovery and development. The Company offers animal research models in research and development for new drugs, devices, and therapies. Charles River Laboratories International serves pharmaceutical and biotechnology companies, hospitals, and academic institutions worldwide.	131.35	6,410.82	3.76	-	2,633.77	2,899.31	20.13	17.80	14.07	12.50	11.97%	11.36%
PRVL	Prevail Therapeutics Inc	Prevail Therapeutics Inc. operates as a biotechnology company. The Company develops gene therapies for patients with parkinson's disease and neurodegenerative disorders. Prevail Therapeutics serves patients and customers in the State of New York.	10.61	360.79	-	-	-	-	-	-	-	-	-	-

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10/28/2019

4) Assisted Living companies

Stock	Company Name	Description	Stock Price	Market Cap (\$, Millions)	Net Debt To EBITDA	Dividend Yield (%)	Sales (\$, Millions)		Price to Earnings Ratio		EV to EBITDA		Free Cash Flow Margin	
							2019 E	2020 E	2019 E	2020 E	2019 E	2020 E	2019 E	2020 E
AMED	Amedisys Inc	Amedisys, Inc. is a multi-regional provider of alternate-site health care services. The Company offers home health care nursing, home infusion therapy, and ambulatory surgery centers. Amedisys operates offices within a network of subsidiaries in the southern and southeastern United States.	135.45	4,358.09	1.61	-	1,971.73	2,101.17	32.63	29.36	21.86	19.72	8.29%	9.03%
LHCG	LHC Group Inc	LHC Group, Inc. provides post-acute healthcare services primarily to medicare beneficiaries in rural markets in the southern United States. The Company provides home-based services through home nursing agencies and hospices and facility-based services through long-term acute care hospitals and outpatient rehabilitation clinics.	113.83	3,586.58	1.27	-	2,103.42	2,217.58	26.23	24.91	18.40	17.14	6.06%	7.10%
CHE	Chemed Corp	Chemed Corporation operates as a holding company. The Company, through its subsidiaries, provides hospice and palliative care services to its patients through a network of physicians, registered nurses, home health aides, social workers, clergy, and volunteers. Chemed conducts business in the United States.	410.40	6,541.86	0.55	0.31	1,939.00	2,150.50	29.81	26.68	19.67	17.44	-	-
ADUS	Addus HomeCare Corp	Addus HomeCare Corporation provides a broad range of social and medical services in the home. The Company offers services include personal care and assistance with activities of daily living, skilled nursing, rehabilitative therapies, and adult day care. Addus consumers are individuals with special needs who are at risk of hospitalization and institutionalization.	84.25	1,298.14	0.03	-	621.56	723.78	36.19	28.56	24.49	18.54	3.26%	6.07%
BKD	Brookdale Senior Living Inc	Brookdale Senior Living Inc. operates senior living facilities in the United States. The Company offers its residents access to a full continuum of services across all sectors of the senior living industry. Brookdale Senior operates independent living and assisted living facilities, continuing care retirement communities, and a skilled nursing.	7.70	1,427.75	8.32	-	4,066.25	3,944.75	-	-	17.08	16.12	-	-
OHI	Omega Healthcare Investors Inc	Omega Healthcare Investors, Inc. is a real estate investment trust (REIT). The Company invests in and provides financing to the long-term care industry. Omega operates healthcare facilities in the United States which are operated by independent healthcare operating companies.	43.75	9,878.35	5.98	6.13	895.86	995.43	29.97	26.48	17.43	15.28	-	-
HCP	HCP Inc	HCP, Inc. is a real estate investment trust. The Trust invests in health care related real estate properties such as senior housing, life sciences, medical offices, hospitals, and skilled nursing homes throughout the United States.	36.13	17,745.29	7.20	4.10	1,929.70	2,101.80	53.37	41.01	23.66	21.90	-	-
VTR	Ventas Inc	Ventas, Inc. is a real estate investment trust. The Trust owns seniors housing communities, skilled nursing facilities, hospitals, and medical office buildings in the United States and Canada.	64.80	24,153.29	6.52	4.89	3,768.38	3,916.00	43.72	49.81	20.07	18.43	-	-
ENSG	Ensign Group Inc/The	The Ensign Group, Inc. operates facilities offering nursing and rehabilitative care services in multiple states. The Company provides a broad spectrum of nursing and assisted living, physical, occupational and speech therapies, and other rehabilitative and healthcare services for both long-term residents and short-stay rehabilitation patients.	41.92	2,237.96	3.79	0.45	2,299.40	2,366.60	18.78	17.96	15.20	14.36	-	-
WELL	Welltower Inc	Welltower Inc. operates as a real estate investment trust. The Trust invests in senior housing and health care real estate properties. Welltower serves customers in the United States.	87.11	35,301.05	7.52	3.99	5,234.83	5,495.50	37.50	44.69	22.37	21.56	-	-

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Comparison of genetic medicine approaches

Genome medicine: Three inter-related technologies

	Approach	Delivery	Examples	Pros/Cons	Current Uses	Future Enhancements
Gene Therapy	inject corrected gene	viral vector	AAV	(+): produces missing or fixed protein (-): virus supply	severe diseases	repeat dosing
Cell Therapy	reinfuse enhanced cells	viral vector + cell infusion	CAR T TCR	(+): efficacy in last line cancer setting (-): virus supply; manufacturing time	cancer	allogeneic (off the shelf)
Gene Editing	"molecular scissors"	viral vector or fat-lined capsule	ZFN TALEN CRISPR meganucleases	(+): permanent change in genome (-): virus supply; no clinical data	severe diseases agriculture	multiple gene targeting

Source: Goldman Sachs, *The Genome Revolution*

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