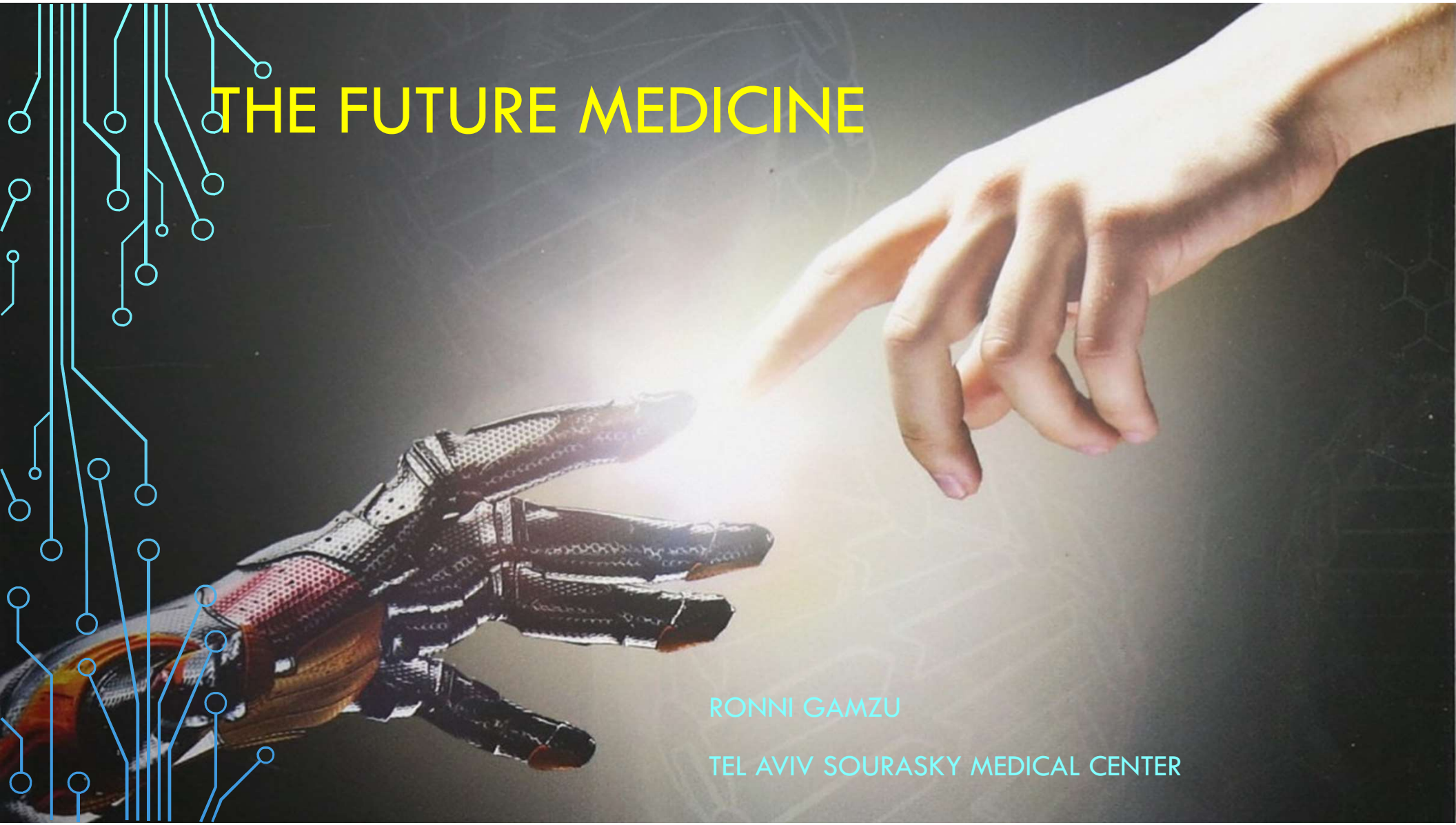

THE FUTURE MEDICINE
RONNI GAMZU
TEL AVIV SOURASKY MEDICAL CENTER

Today's Fringe

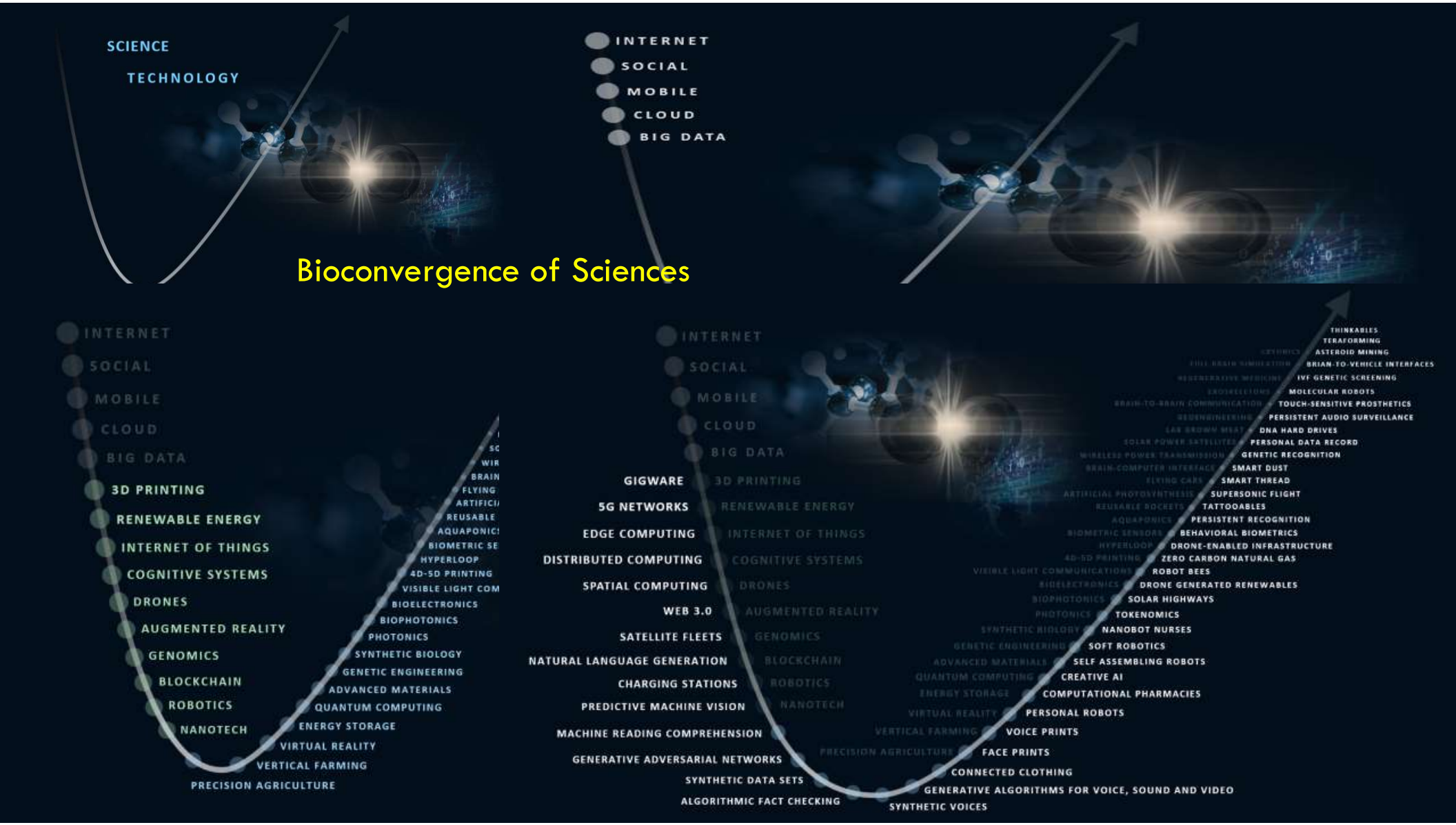
Is Tomorrow's

Mainstream

Futuristic visions of flight from the 1800s

TEN MEGATRENDS

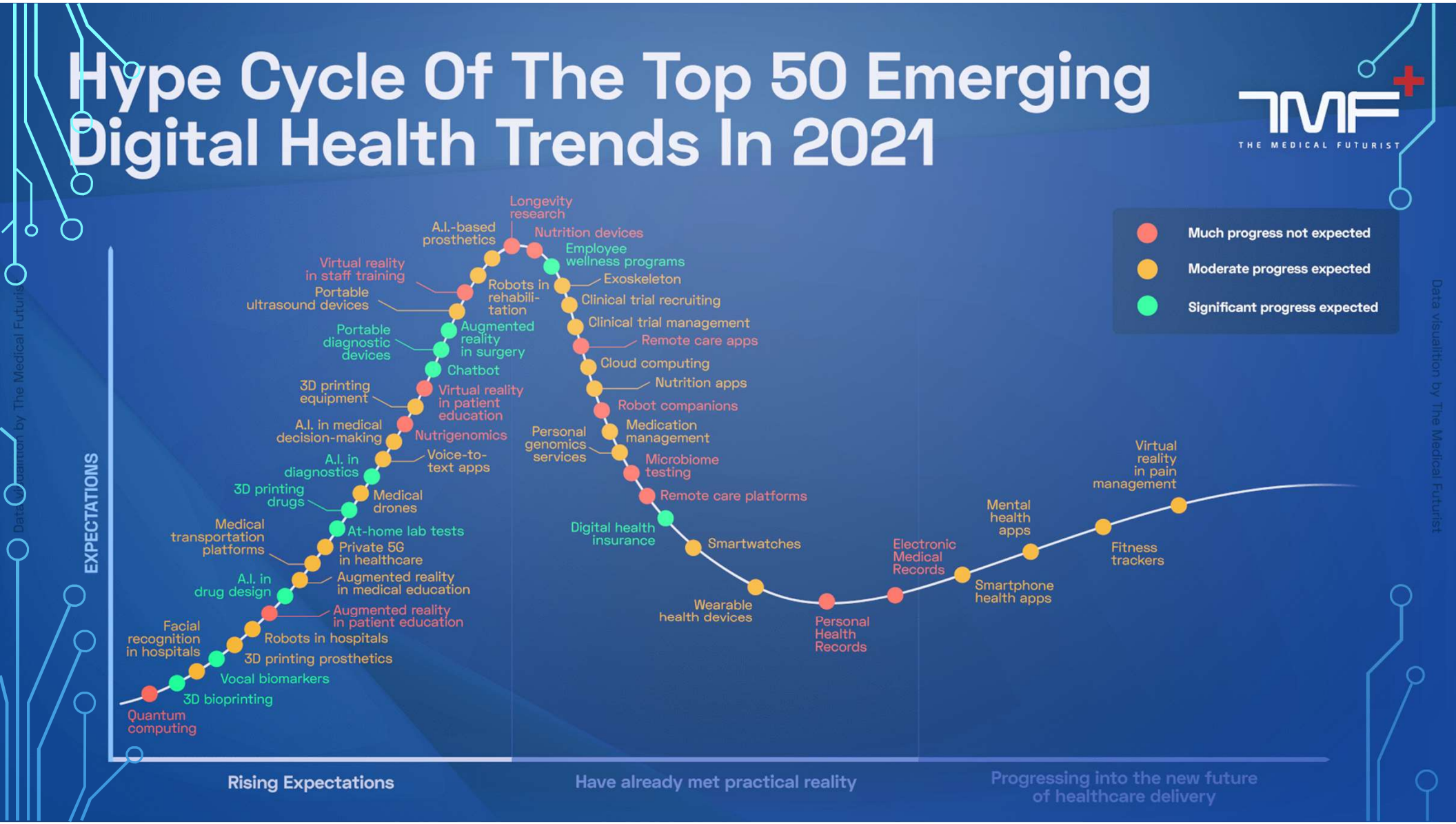
1. Digital health/AI
2. OMICS
3. Molecular Diagnostics and targeted treatment
4. Nanomedicine
5. Cell/gene therapy
6. Stemcells & regenerative medicine
7. Bioprinting
8. Imaging: Augmented/virtual/realview/molecular
9. Robotics
10. Sensors & monitors


SCIENCE
TECHNOLOGY
INTERNET
SOCIAL
MOBILE
CLOUD
BIG DATA
Bioconvergence of Sciences
INTERNET
SOCIAL
MOBILE
CLOUD
BIG DATA
3D PRINTING
RENEWABLE ENERGY
INTERNET OF THINGS
COGNITIVE SYSTEMS
DRONES
AUGMENTED REALITY
GENOMICS
BLOCKCHAIN
ROBOTICS
NANOTECH
ENERGY STORAGE
VIRTUAL REALITY
VERTICAL FARMING
PRECISION AGRICULTURE
QUANTUM COMPUTING
ADVANCED MATERIALS
GENETIC ENGINEERING
SYNTHETIC BIOLOGY
PHOTONICS
BIOPHOTONICS
BIOELECTRONICS
VISIBLE LIGHT COM
4D-5D PRINTING
HYPERLOOP
BIOMETRIC SE
AQUAPONIC
REUSABLE
ARTIFICI
FLYING
BRAIN
WIR
SC
GIGWARE
5G NETWORKS
EDGE COMPUTING
DISTRIBUTED COMPUTING
SPATIAL COMPUTING
WEB 3.0
SATELLITE FLEETS
NATURAL LANGUAGE GENERATION
CHARGING STATIONS
PREDICTIVE MACHINE VISION
MACHINE READING COMPREHENSION
GENERATIVE ADVERSARIAL NETWORKS
SYNTHETIC DATA SETS
ALGORITHMIC FACT CHECKING
SYNTHETIC VOICES
GENERATIVE ALGORITHMS FOR VOICE, SOUND AND VIDEO
CONNECTED CLOTHING
FACE PRINTS
VOICE PRINTS
PERSONAL ROBOTS
COMPUTATIONAL PHARMACIES
CREATIVE AI
SELF ASSEMBLING ROBOTS
SOFT ROBOTICS
NANOBOT NURSES
TOKENOMICS
SOLAR HIGHWAYS
DRONE GENERATED RENEWABLES
ROBOT BEES
ZERO CARBON NATURAL GAS
DRONE-ENABLED INFRASTRUCTURE
BEHAVIORAL BIOMETRICS
PERSISTENT RECOGNITION
TATTOOABLES
SUPERSONIC FLIGHT
SMART THREAD
SMART DUST
GENETIC RECOGNITION
PERSONAL DATA RECORD
DNA HARD DRIVES
PERSISTENT AUDIO SURVEILLANCE
TOUCH-SENSITIVE PROSTHETICS
MOLECULAR ROBOTS
IVF GENETIC SCREENING
BRIAN-TO-VEHICLE INTERFACES
ASTEROID MINING
TERAFORMING
THINKABLES

1 / DIGITAL HEALTH / AI

Hype Cycle Of The Top 50 Emerging Digital Health Trends In 2021

THE MEDICAL FUTURIST



Data visualition by The Medical Futurist

Top 10 AI Applications

Robot-Assisted Surgery**

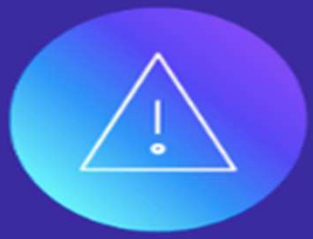
$40B

Virtual Nursing Assistants

$20B

Administrative Workflow Assistance

$18B



Fraud Detection

$17B

Dosage Error Reduction

$16B

Connected Machines

$14B

Clinical Trial Participant Identifier

$13B

Preliminary Diagnosis

$5B

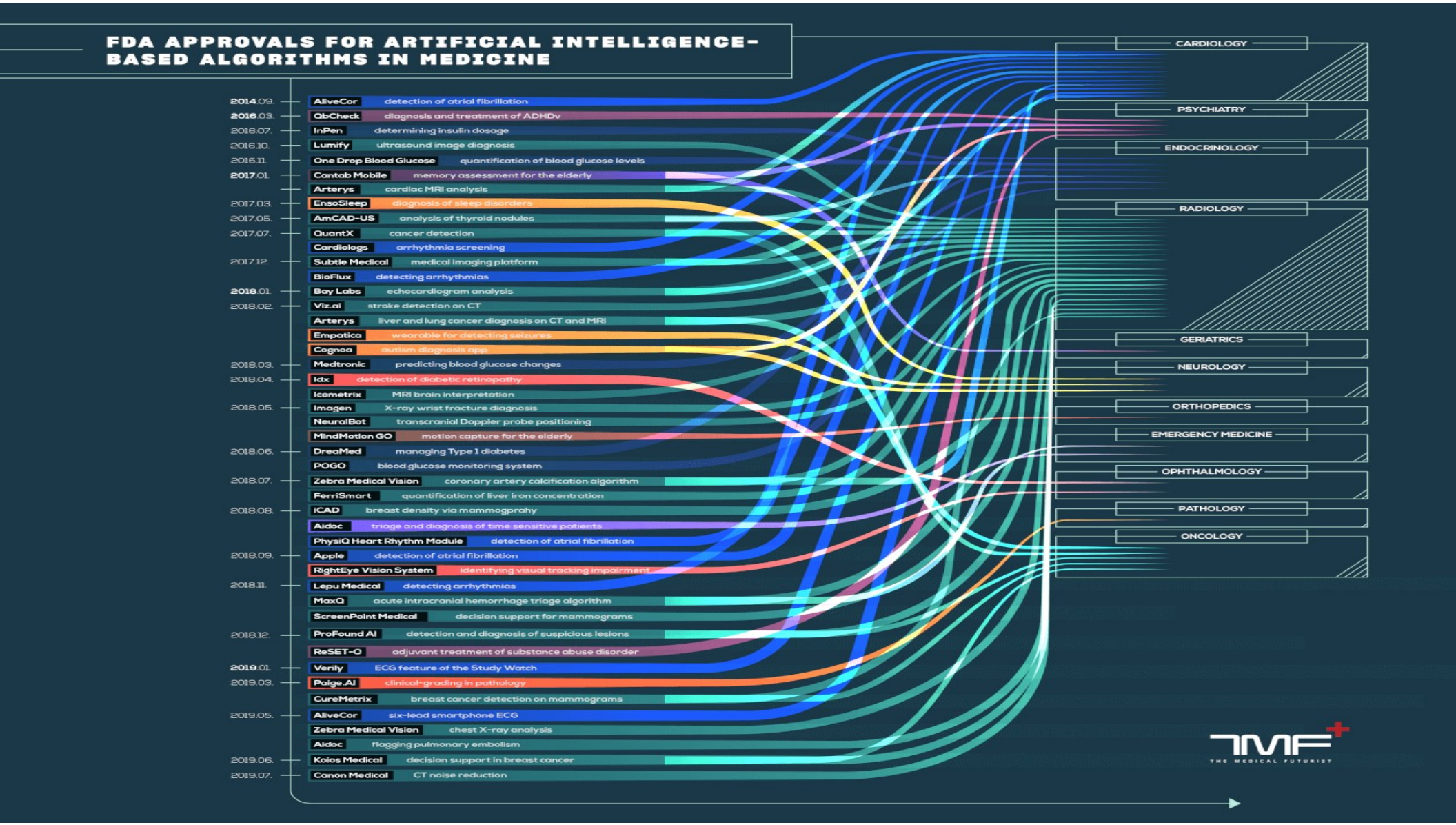
Automated Image Diagnosis

$3B

Cybersecurity

$2B

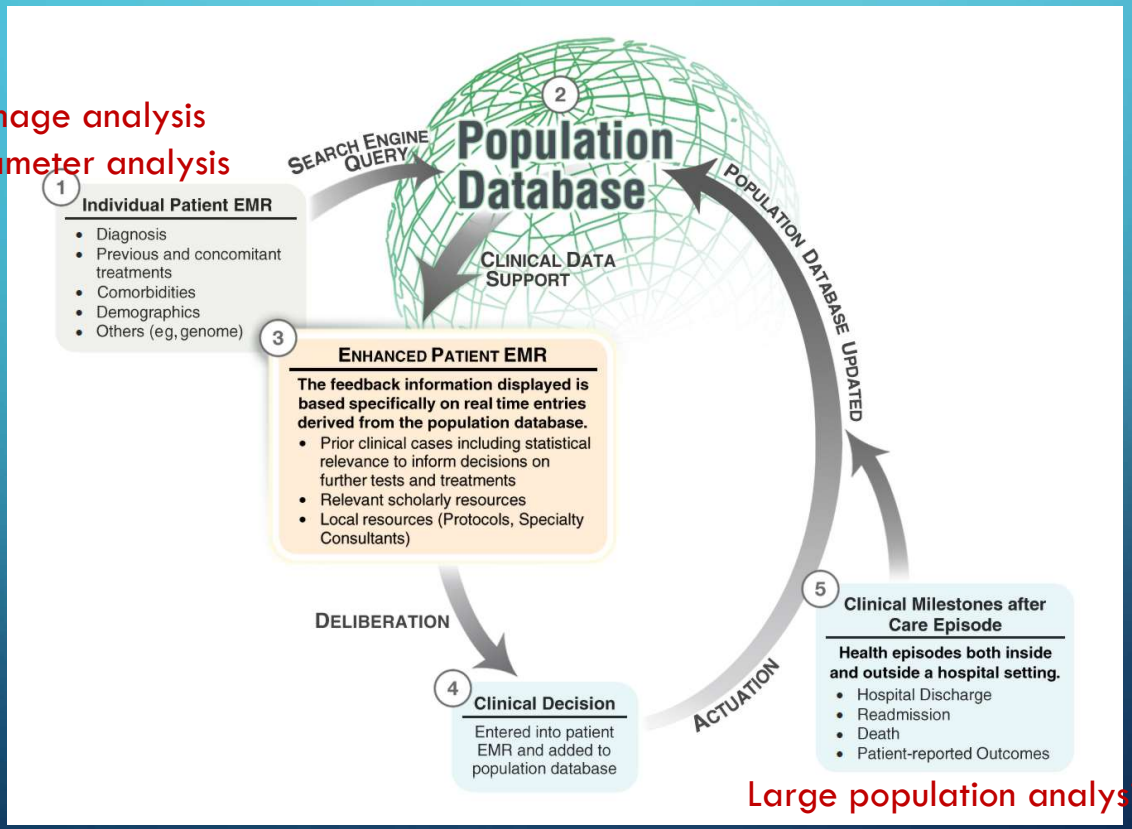
FDA APPROVALS FOR ARTIFICIAL INTELLIGENCE-BASED ALGORITHMS IN MEDICINE



TMF
THE MEDICAL FUTURIST

ARTIFICIAL INTELLIGENCE & DECISION SUPPORT
ENHANCED EMR

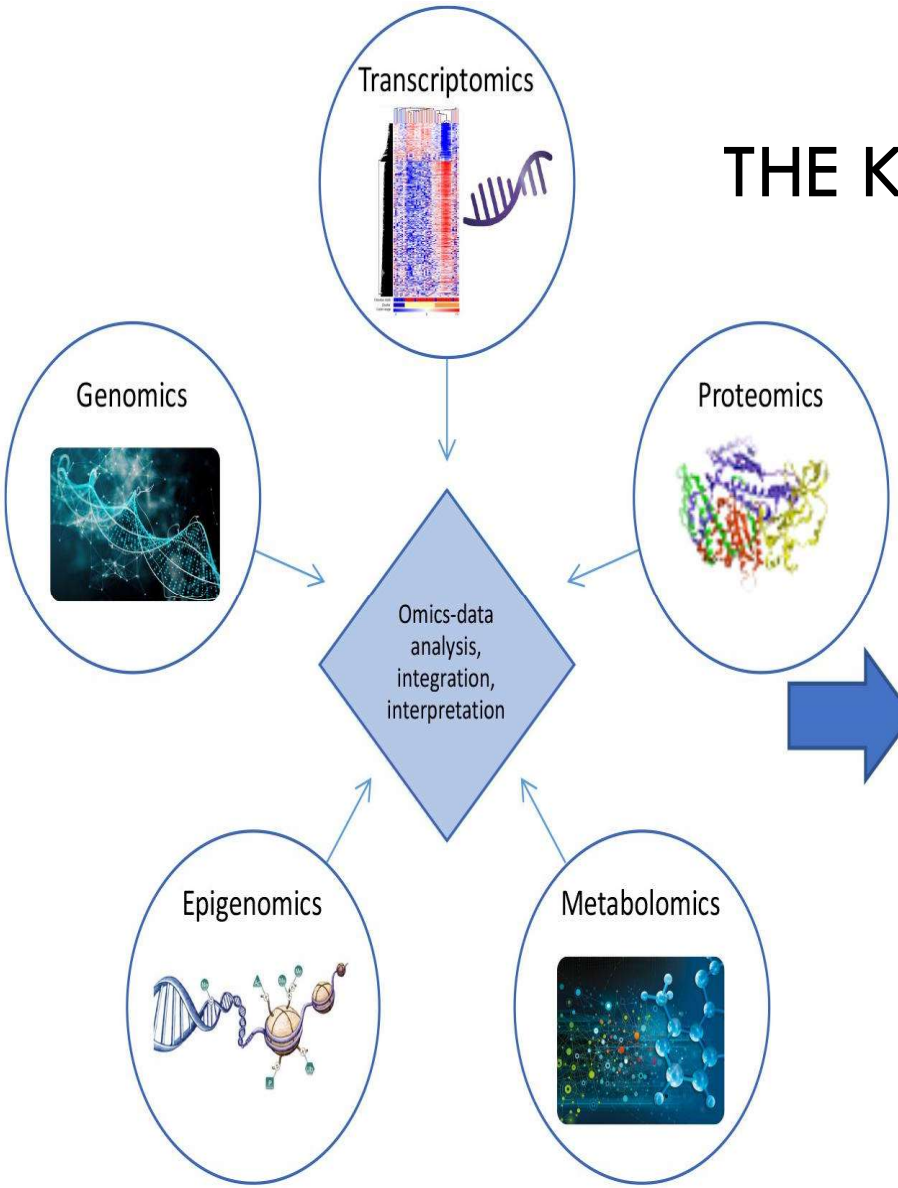
Assisted Image analysis
Multi-parameter analysis



Large population analysis

2 / OMICS

OMICS-
THE KEY TO PRECISION MEDICINE

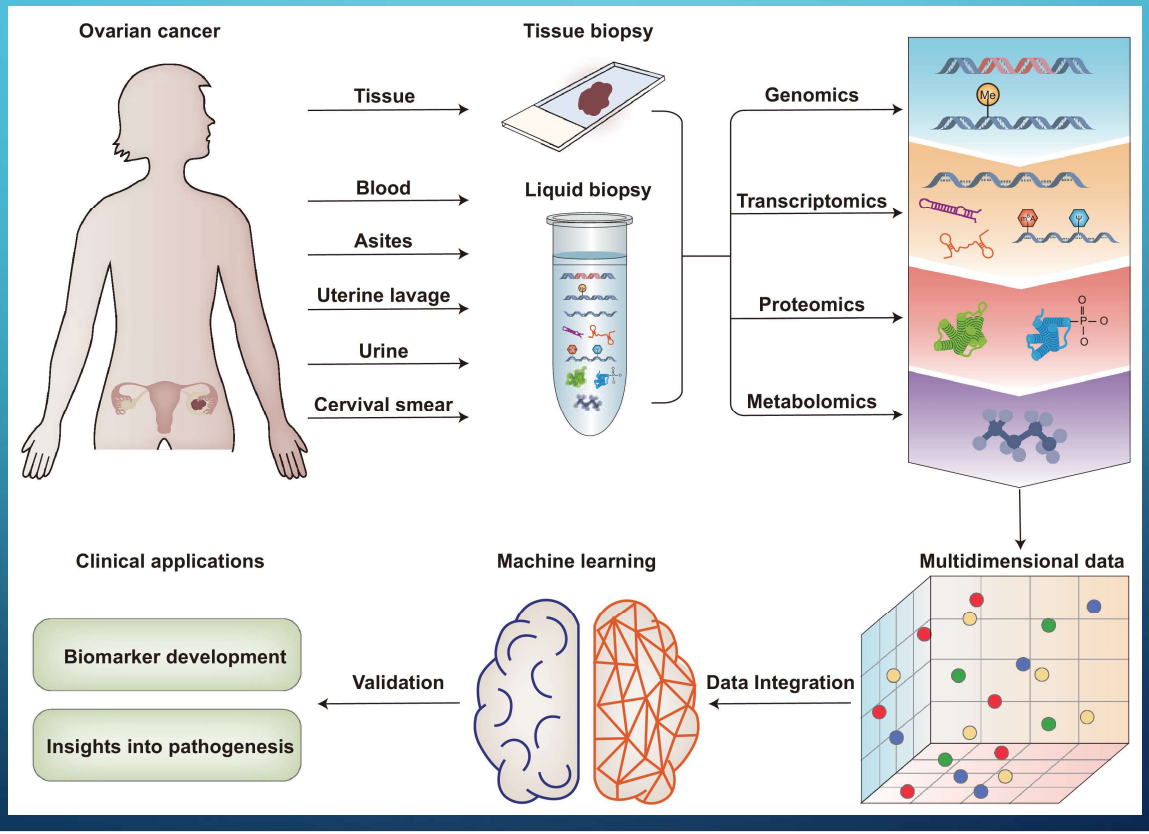


Identification of:

- *Diagnostic and prognostic biomarkers*
- *Molecular Signatures*
- *Networks*
- *New potential therapeutic targets*

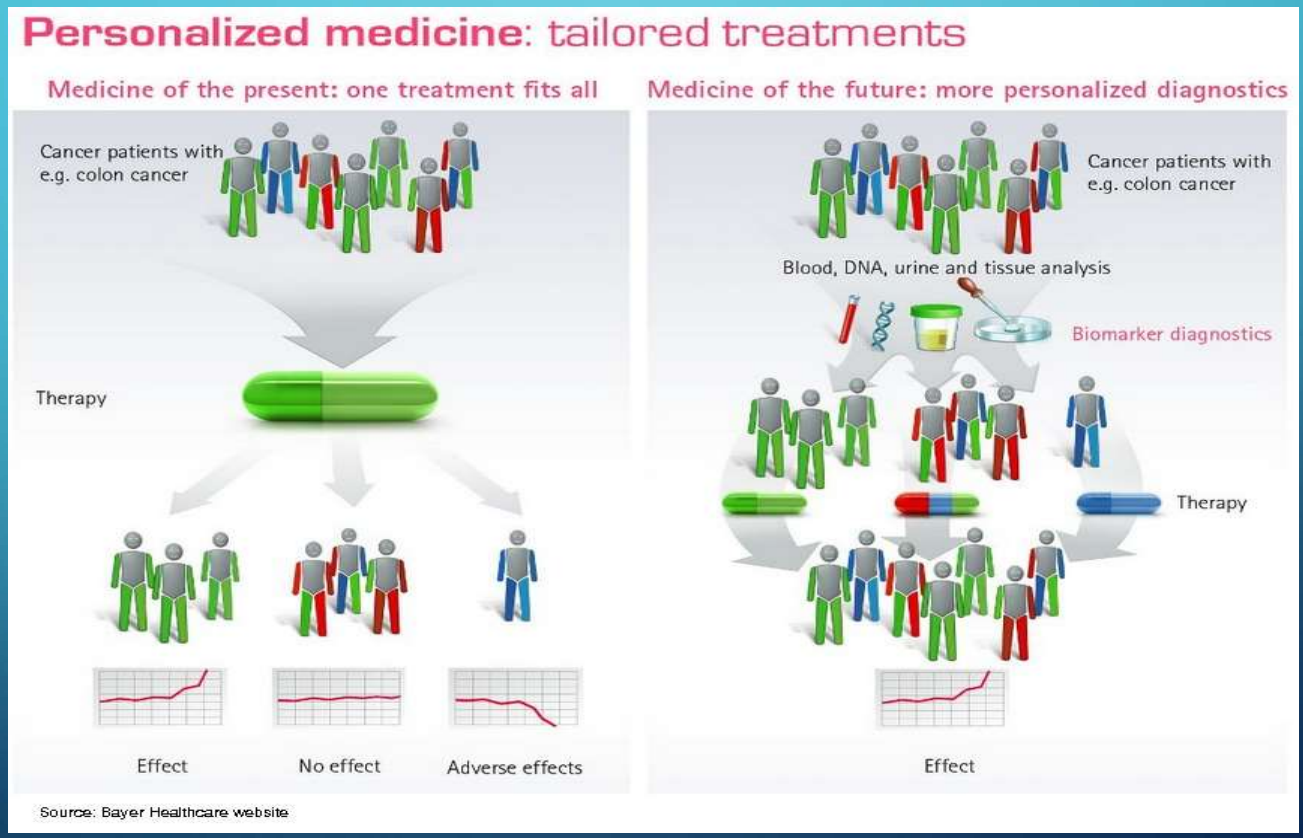
Personalized Medicine

OMICS TO PATHOGENESIS TO TREAT

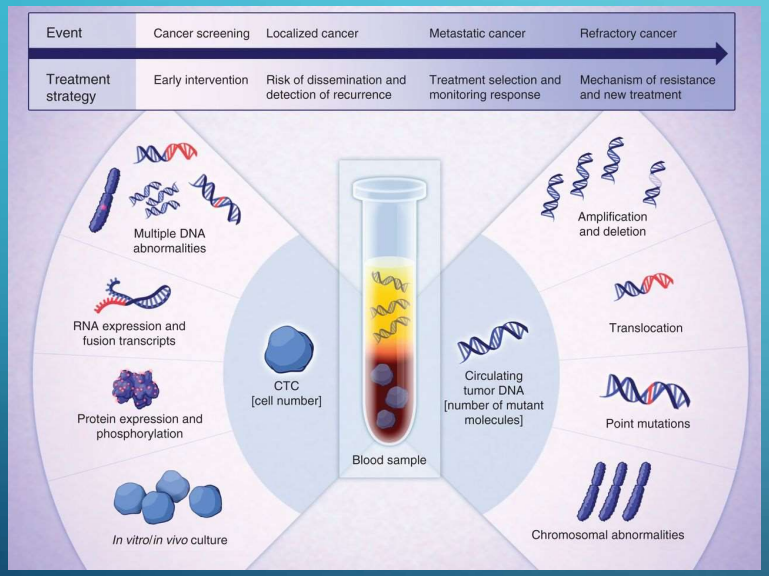


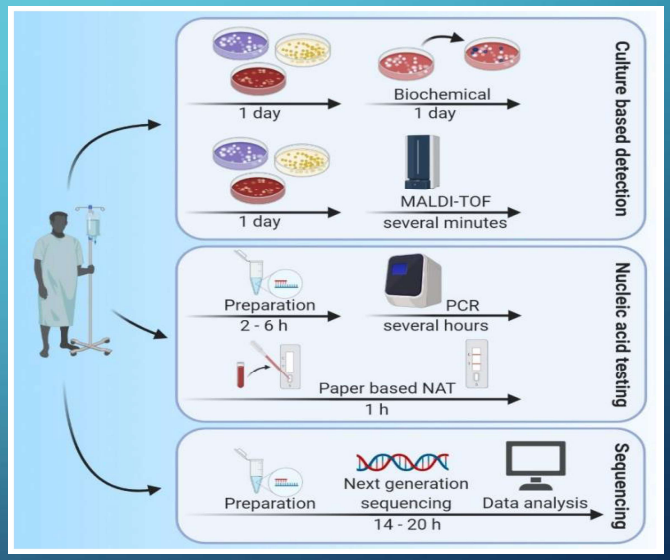
3/ PERSONALIZED MEDICINE

MOLECULAR DIAGNOSTIC & TARGETED TREATMENT

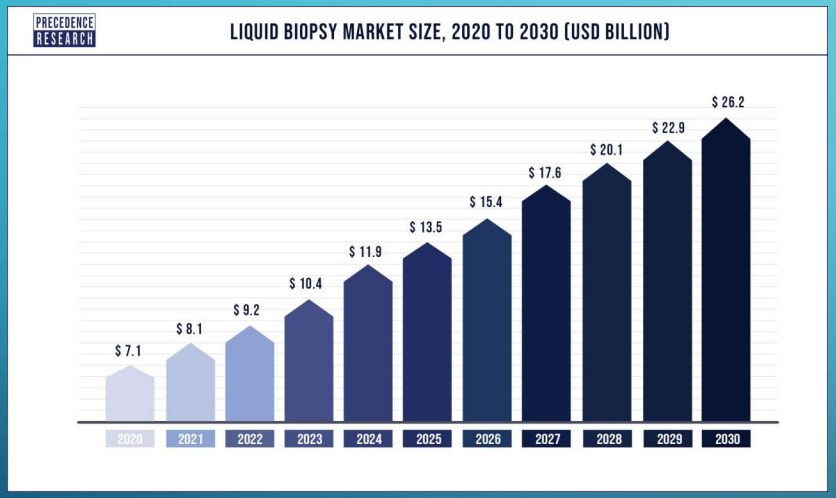


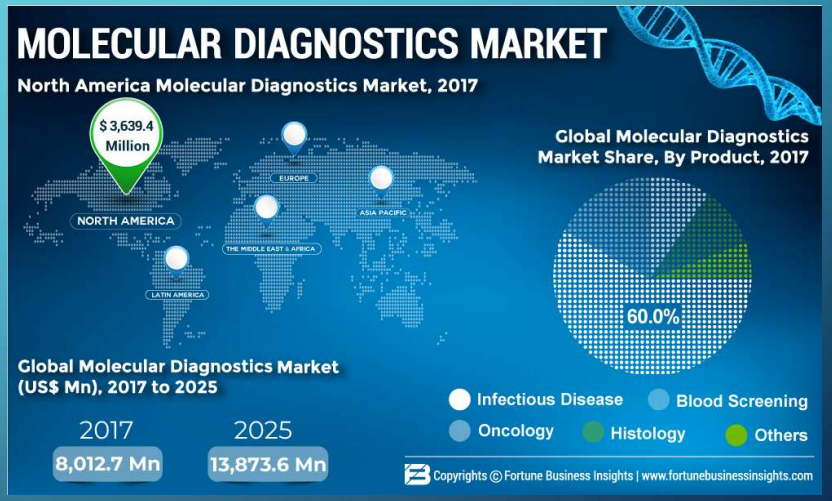
MOLECULAR DIAGNOSIS / LIQUID BIOPSY





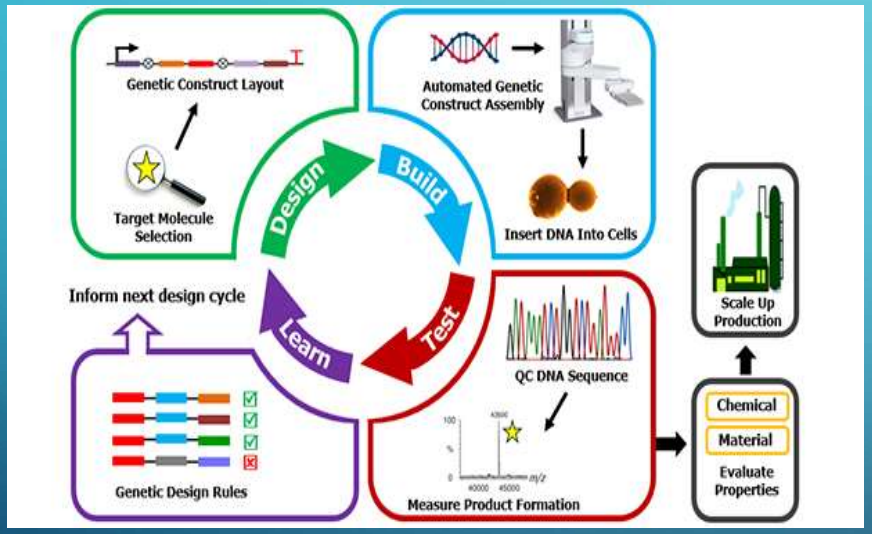
THE PROSPECTS

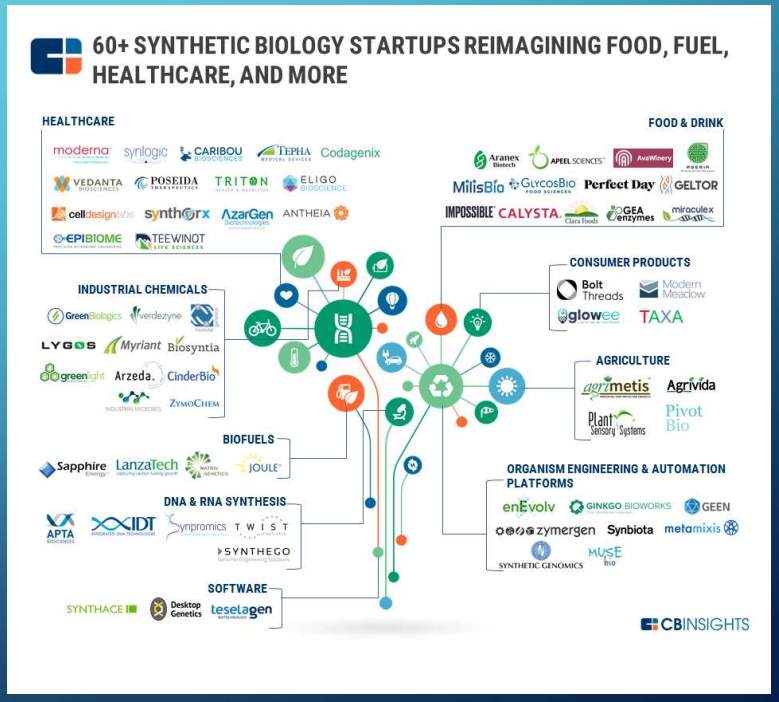




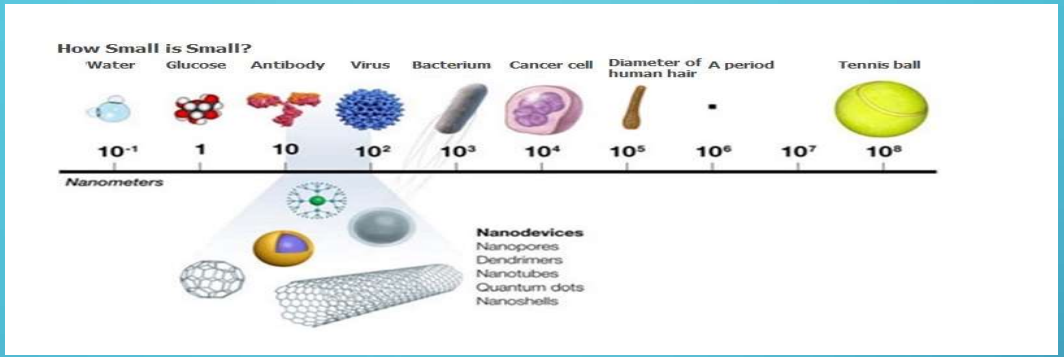
4/ SYNTHETIC BIOLOGY & NANOMEDICINE

SYNTHESIS OF BIOMOLECULES



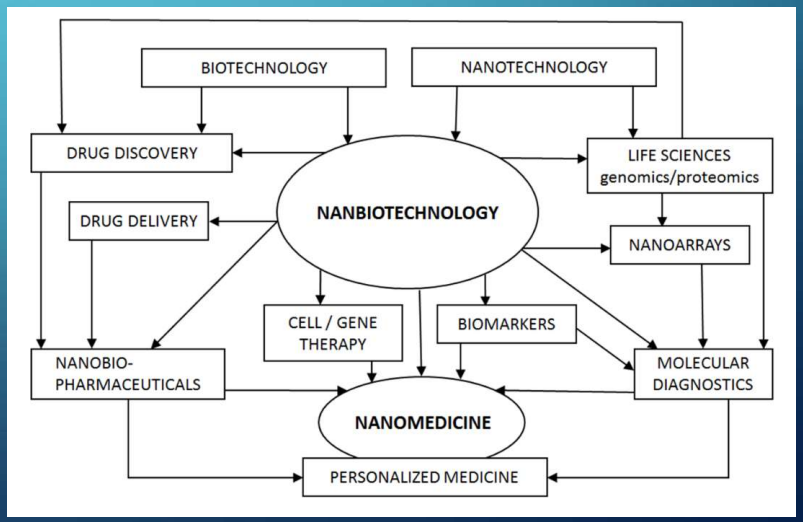


NANOMEDICINE



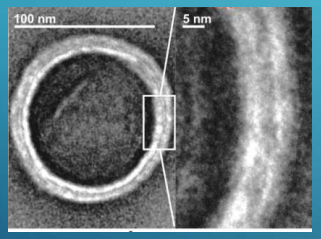
Nanomaterials, Biological Devices, Nanoelectronic Biosensors, Nanobots

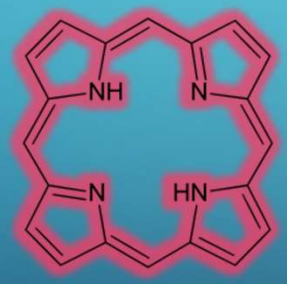
- Drug Delivery
- Teranostics
- Nanobiosensors
- Nanobots

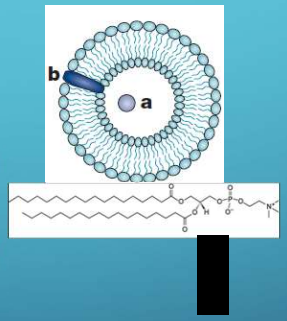


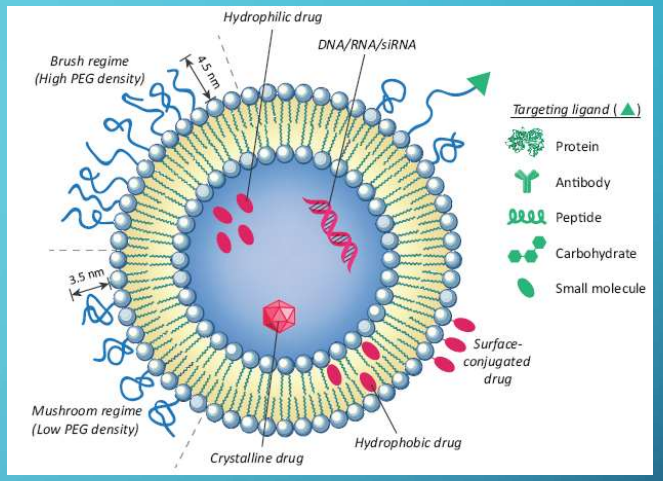
TARGETED DRUG DELIVERY

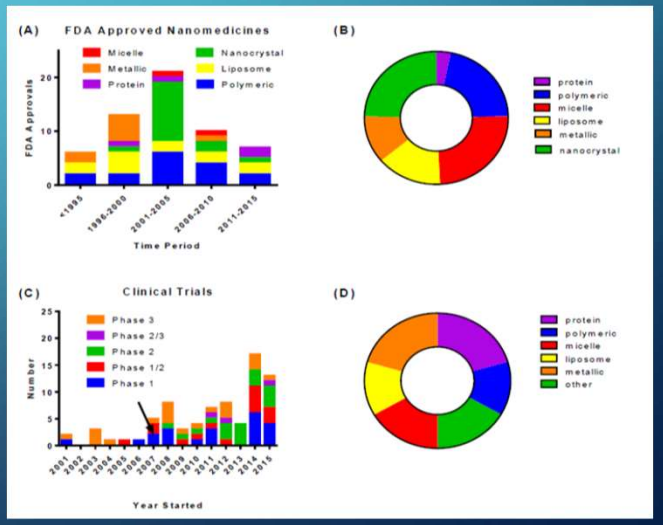
- Lyposomes
- Polymeres
- glycans





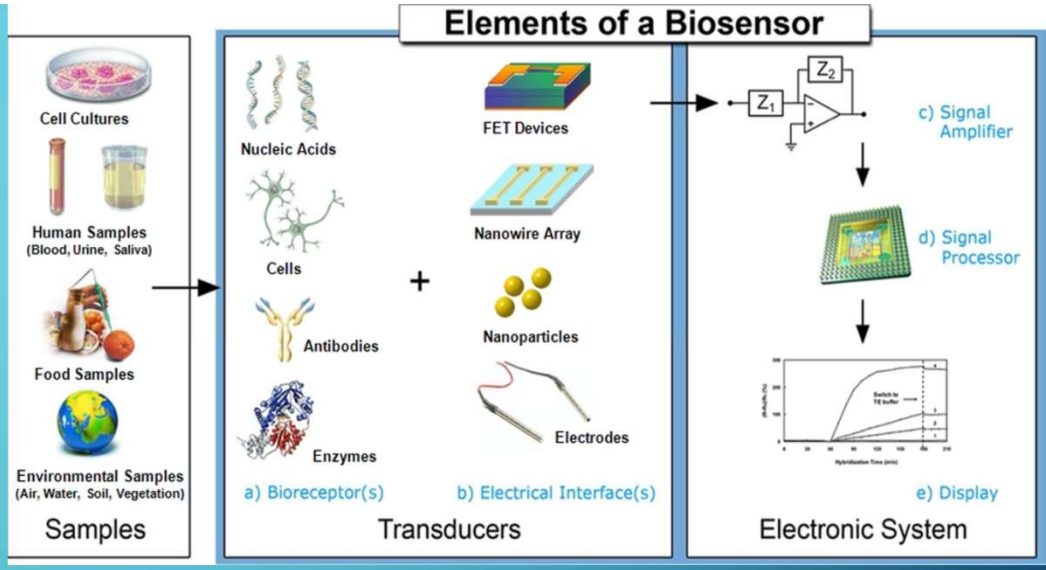


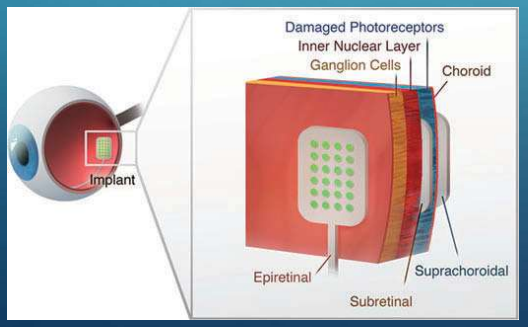


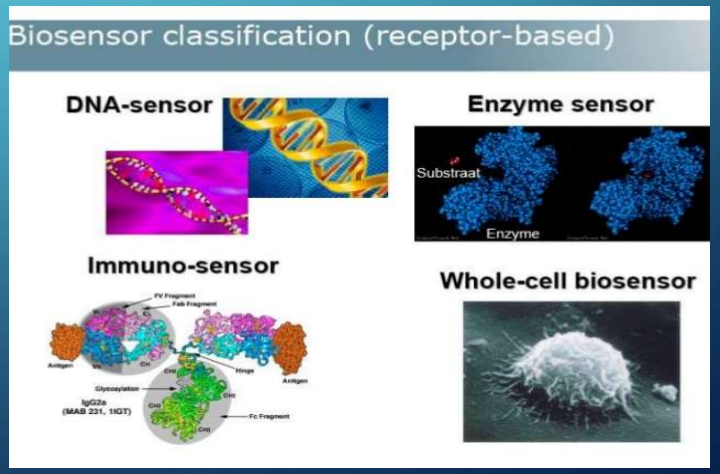


NANOBIOSENSORS

- Chemical, physical, biological
- Molecules (incl nuc ac)
- Closed loop

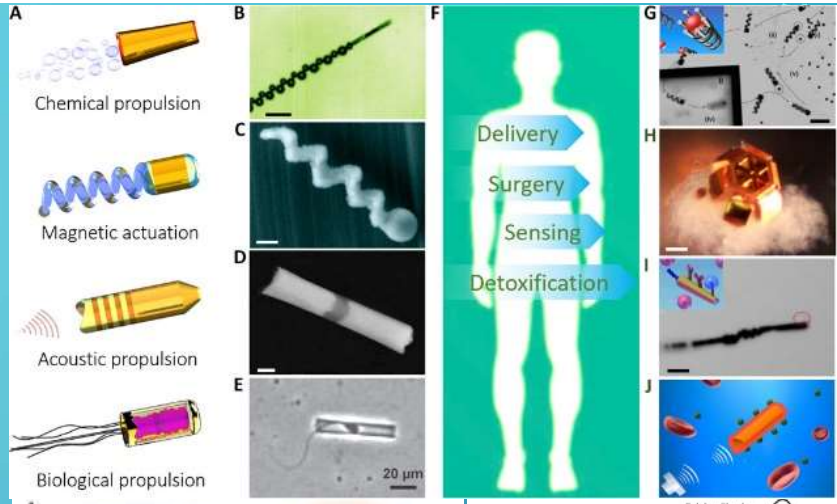


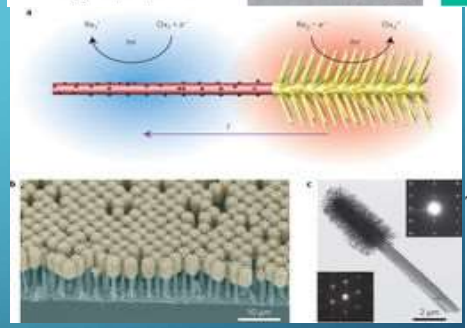


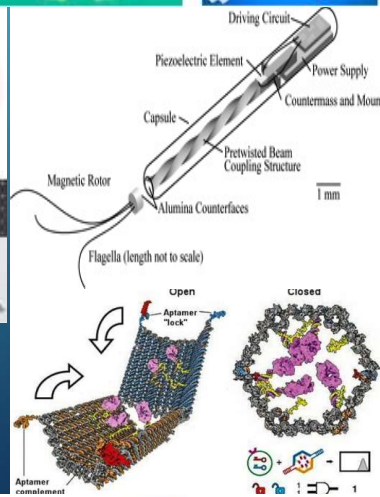


NANOBOTS

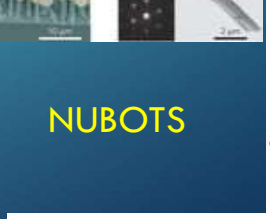
- robots that carry out a very specific function and are ~50–100 nm wide.
- They can be used very effectively for drug delivery.
- Nanoelectronics, photolithography, and new biomaterials

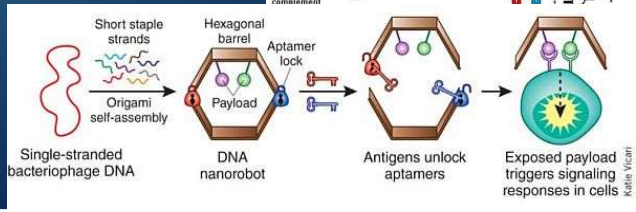






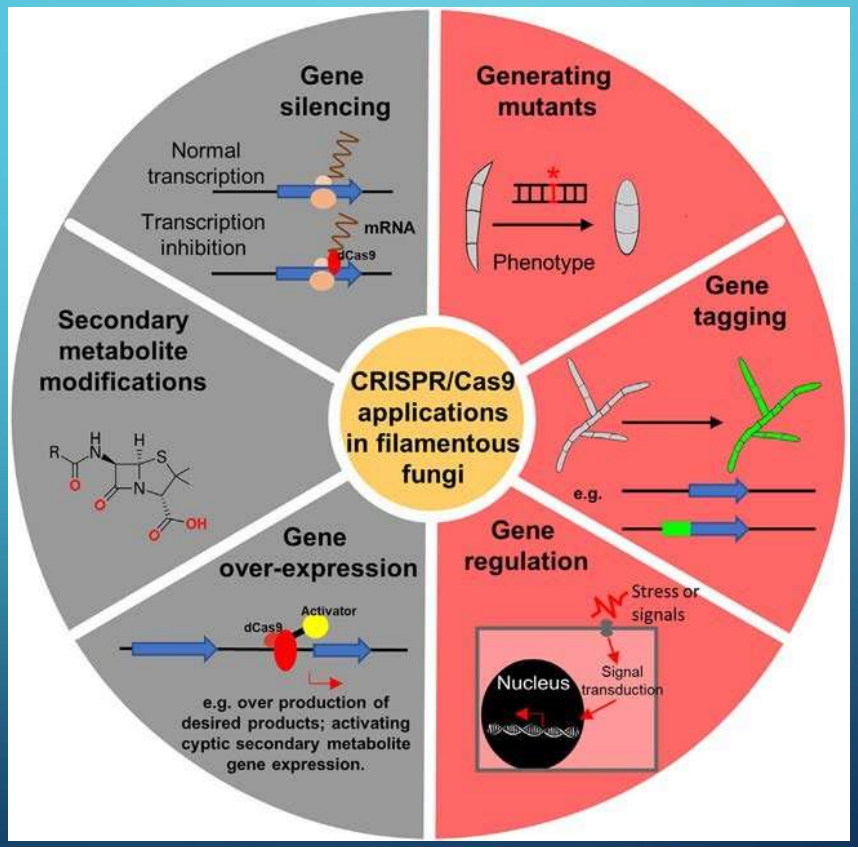
NUBOTS



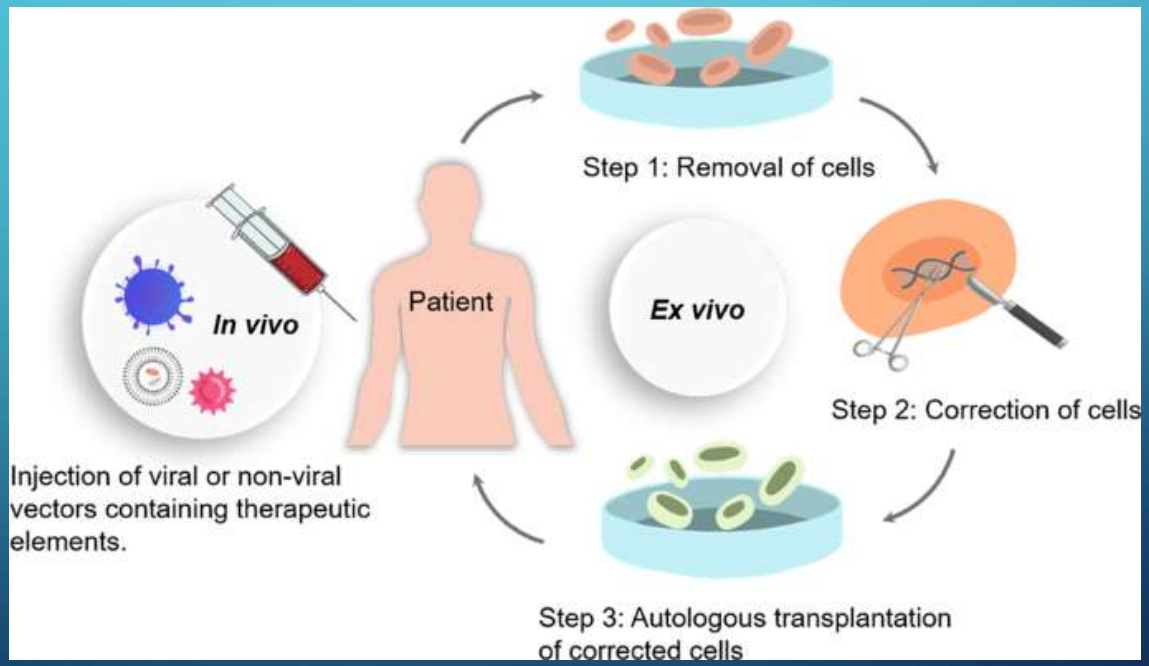


5/ CELL / GENE THERAPY

CELL THERAPY / GENE-EDITING



THE TECHNOLOGY



Gene Editing Business Development Deals

Date/s	Companies	Agreement Details	# of Indications	Type	Upfront	Milestones
2021	AbbVie - Caribou	Discover and develop allogeneic CAR-T cell therapies using Caribou's Cas12a CRISPR hybrid chRDNA	4	Allo-CAR T	$40M	$300M
2021	Apellis - Beam	Discover novel therapies for complement-driven diseases using base editing	6	C3, Eye, Liver, Brain	$75M	u/d
2022	Bayer - Mammoth	Discover and develop in vivo CRISPR-based gene editing therapies	5	Liver-targeted	$40M	$1B
2021	Biogen - Scribe	Discover and develop CRISPR-based genetic medicines for neurological diseases	2	ALS, Neuro	$15M	$400M
2015, 2019	BMS - Editas	Develop and commercialize autologous and allogeneic T-cell therapies for cancer and autoimmune diseases	-	Alpha-Beta T cells	$25M + $70M	$22M
Jul-05	CRISPR - ViaCyte	Discovery, development, commercialization of gene-edited stem cell therapies for diabetes	1	diabetes	$15M	$10M
2021	Epsilen Bio - Chroma Medicine	Chroma acquires Epsilen Bio for epigenetic editing	-	-	u/d	N/A
2020	LifeEDIT - ElevateBio	ElevateBio acquires LifeEDIT for its next-generation gene-editing platform	-	-	u/d	N/A
2022	Pfizer - Beam	Discover and develop in vivo base-editing therapies	3	Liver, muscle, CNS	$300M	$1.05B
2021	Moderna - Metagenomi	Discover and develop next-generation in vivo gene-editing therapeutics	u/d	u/d	u/d	u/d
2021	Nkarta - CRISPR	Develop and commercialize gene-edited cell therapies for cancer	7	CD70 tumor antigen	u/d	u/d
2015 - 2019	Novartis - Intellia	Discover and develop CRISPR-based therapies using CAR Ts and HSCs	u/d	eye disorders	$6M + $10M	u/d
2016, 2020	Regeneron - Intellia	Discover and develop in vivo and ex-vivo CRISPR-based therapies for up to 10 targets including hemophilia A and B	15	Hemophilia A and B	$75M + $70M	$50M
2022	Rewrite - Intellia	Intellia acquired Rewrite to obtain its proprietary DNA writing platform	-	-	$200M	N/A
2021	Sana - Beam	Sana licenses Beam's CRISPR Cas12b gene-editing technology to enable engineered cell programs	u/d	Cancer, diabetes, cardio	$50M	u/d
2018, 2021	Vertex - Arbor Bio	Develop ex vivo cell therapies using Arbor's CRISPR gene-editing technology	u/d	T1 diabetes, SCD, BT	$30M	$1.2B
2015, 2019, 2021	Vertex - CRISPR	Discover and develop CRISPR-based therapies with amendment toward manufacturing and commercialization of CTX001 in SCD and BT; DMD, DM1	4	SCD, BT, DMD, DM1	$105M + $171M + $900M	$200M
2015, 2022	Vertex – Exonics Therapeutics	Vertex acquires Exonics Therapeutics to enhance its gene-editing capabilities for DMD and DM1	2	DMD, DM1	$254M	Up to $1B
2021	Vertex - Mammoth	Discovery and develop in vivo gene-editing therapies	2	u/d	$41M	$650M
2021	Verve - Beam	Discover and develop gene-editing therapies for heart disease	2	HeFH, HoFH	u/d	u/d

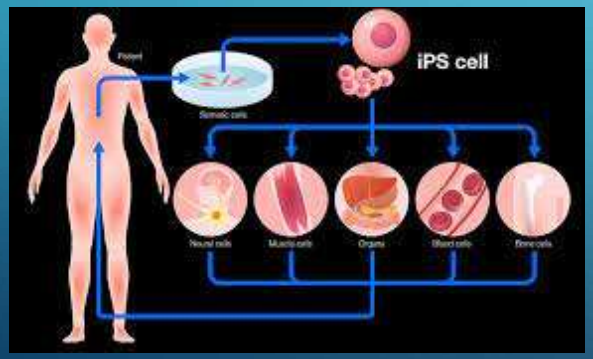
Source: Company reports; William Blair Equity Research

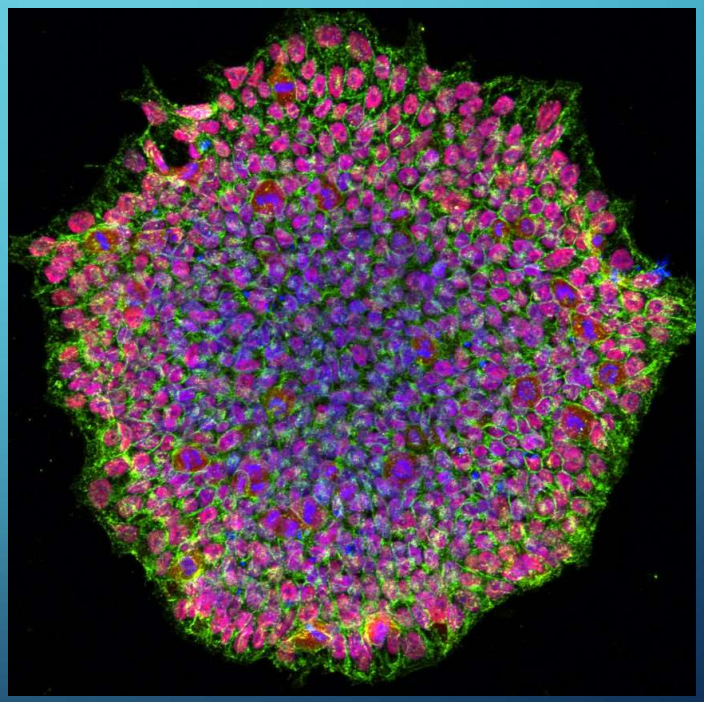
6 / STEM CELLS REGENERATIVE MED

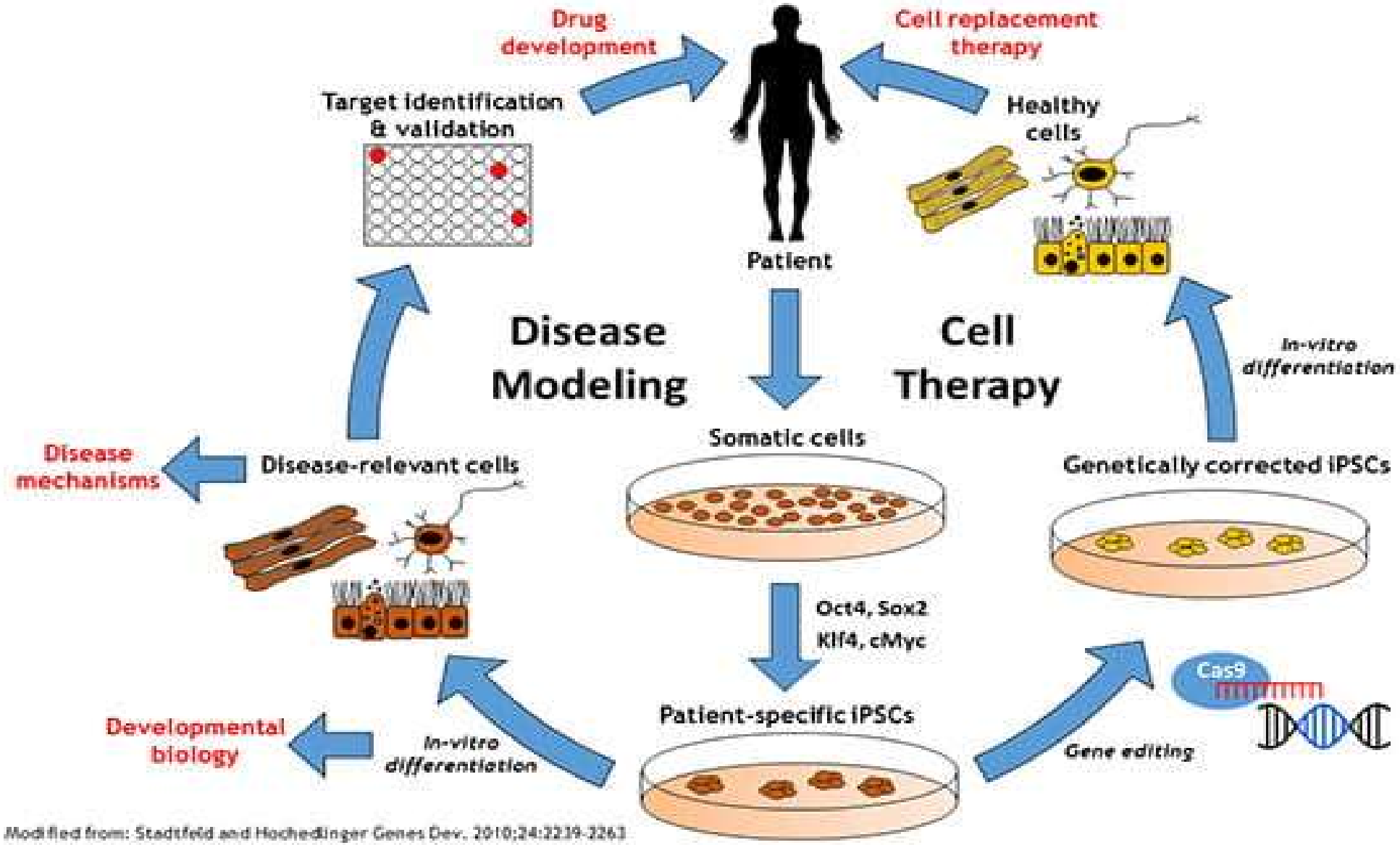
STEM CELLS & REG MED

IPSC

Induced Pluripotent Stem Cells



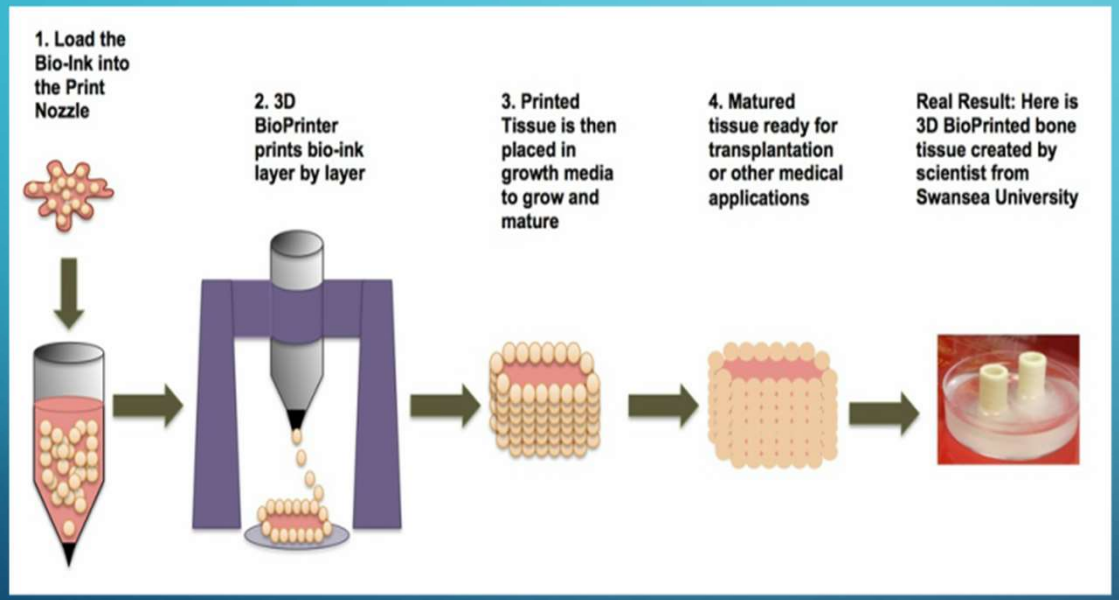


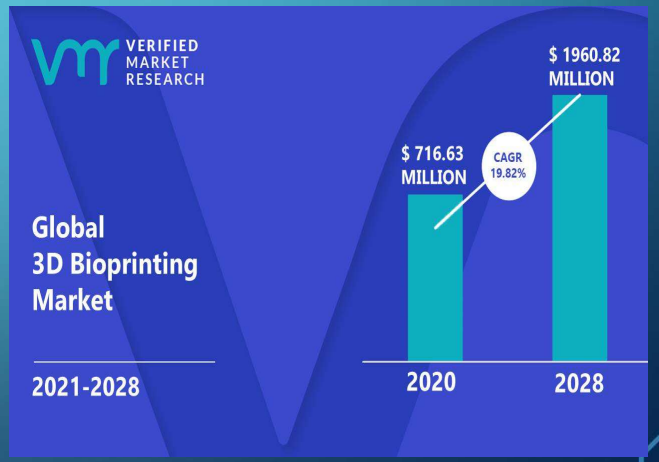


Modified from: Stadtfeld and Hochedinger Genes Dev. 2010;24:2239-2263

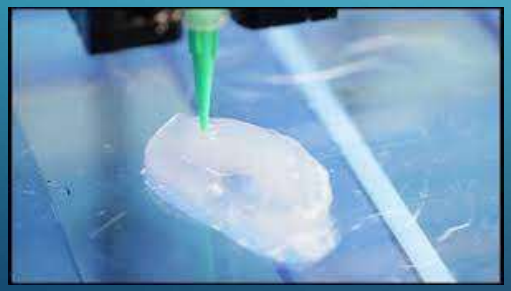
7/ BIOPRINTING

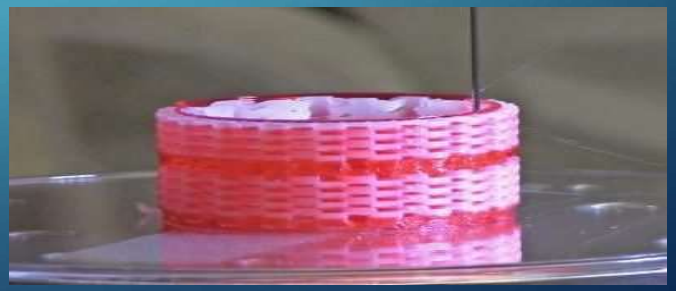
3D BIOPRINTING





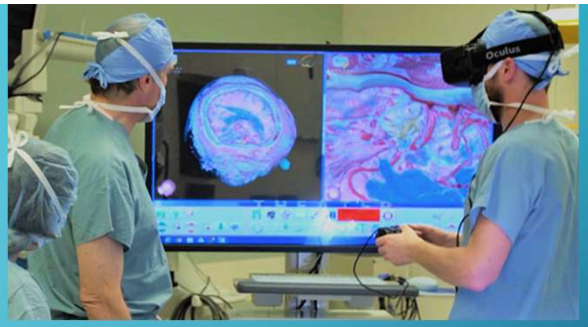
BIOPRINTED TISSUES





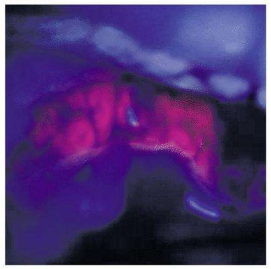
8/ ADVANCED IMAGING

VIRTUAL/AUGMENTED REALITY

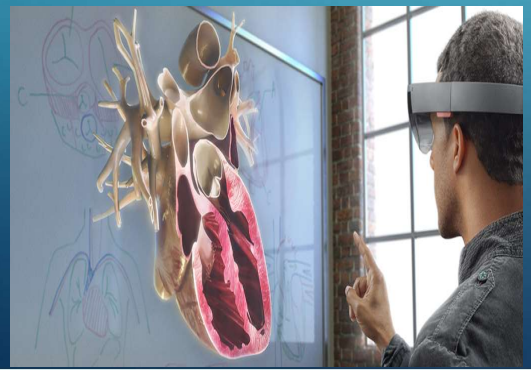


Accuvein

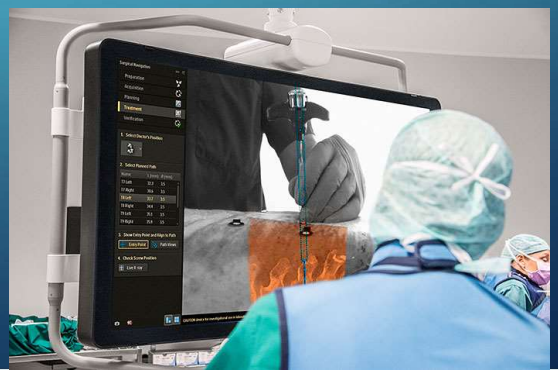
Augmented-reality surgical procedures



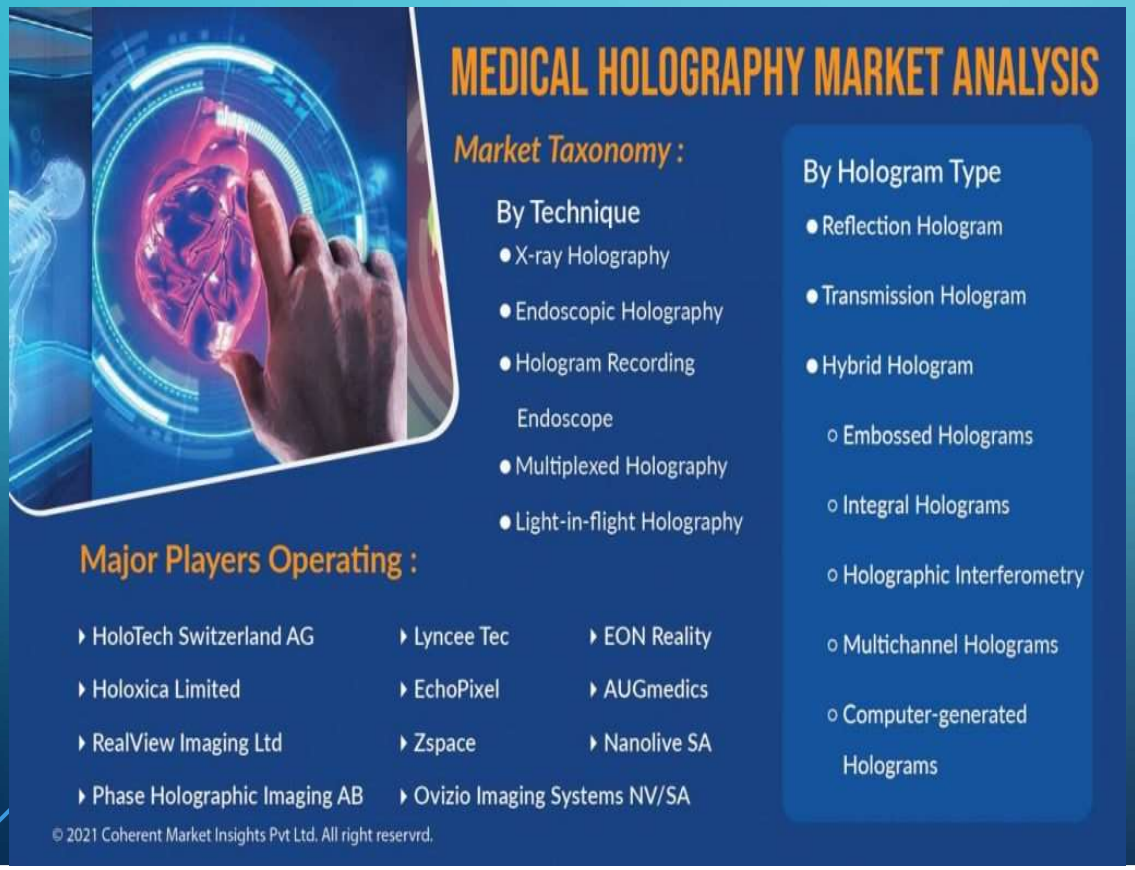
VR imaging

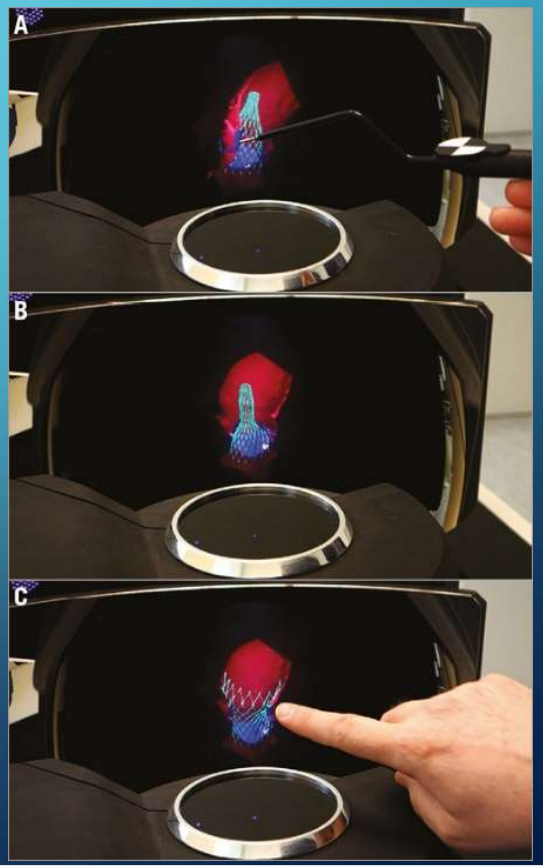


Augmented-reality surgical navigation

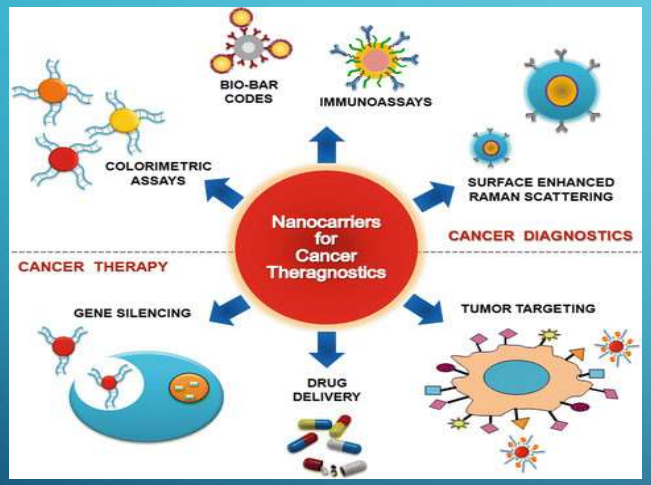


MEDICAL HOLOGRAPHY

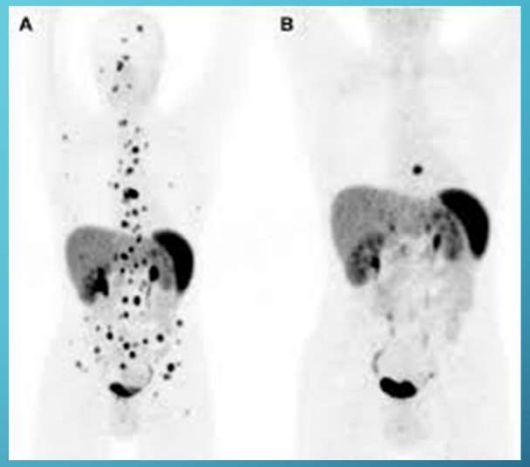




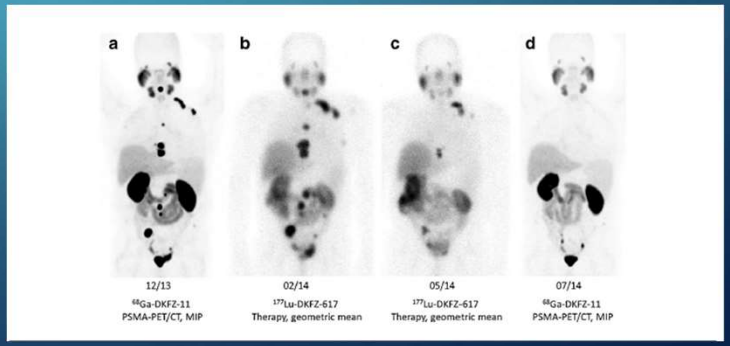
MOLECULAR IMAGING&TREAT TERANOSTICS



^{68}Ga-somatostatin receptors



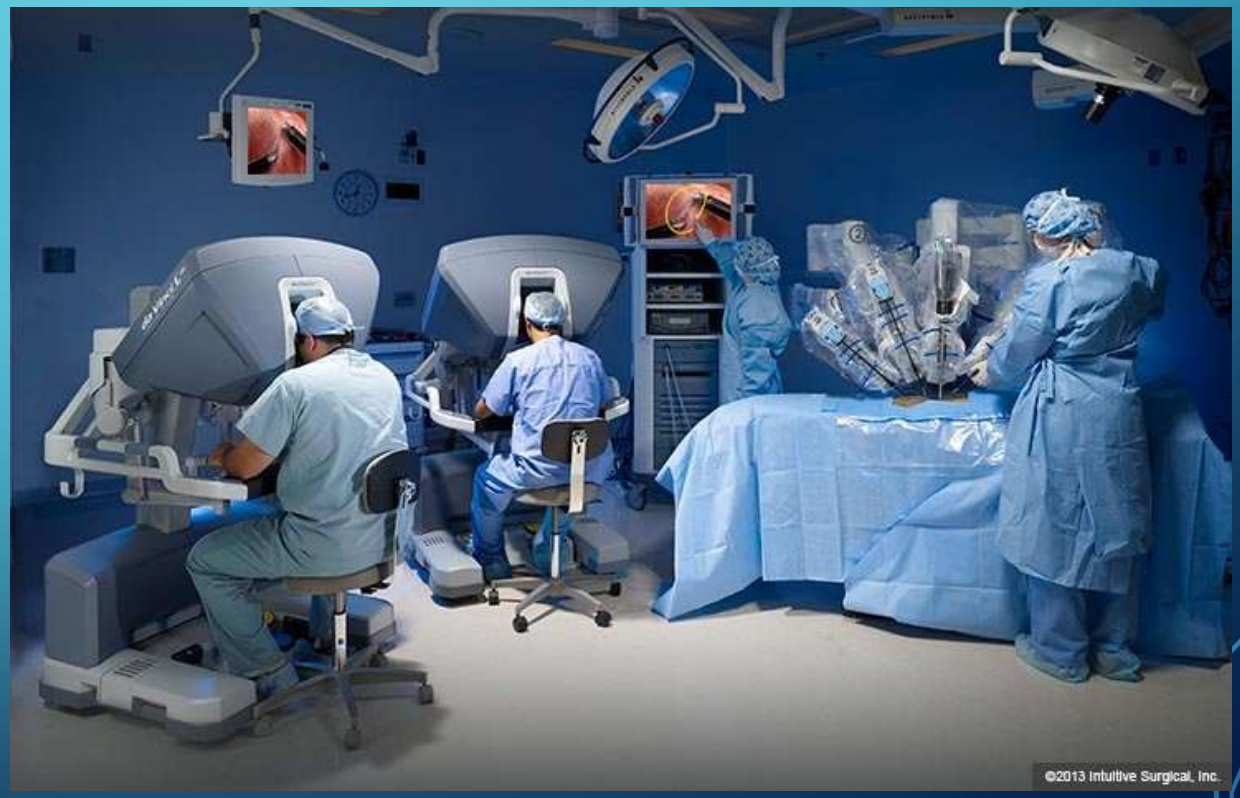
68-Ga-PSMA and therapy with 177Lu-PSMA



10/ ROBOTS

ROBOTICS

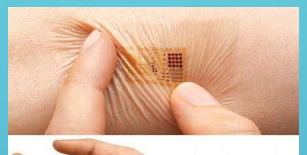
- Unlimited move
- More gentle
- More accurate
- Align to
  - Imaging
  - AR
  - navigation

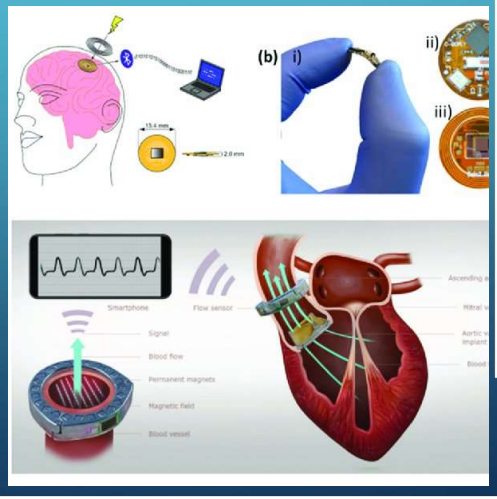


9/ SENSORS & MONITORS

MEDICAL WEARABLES & SENSORS

- Wearable
- Skin
- Implant
- Closed loop

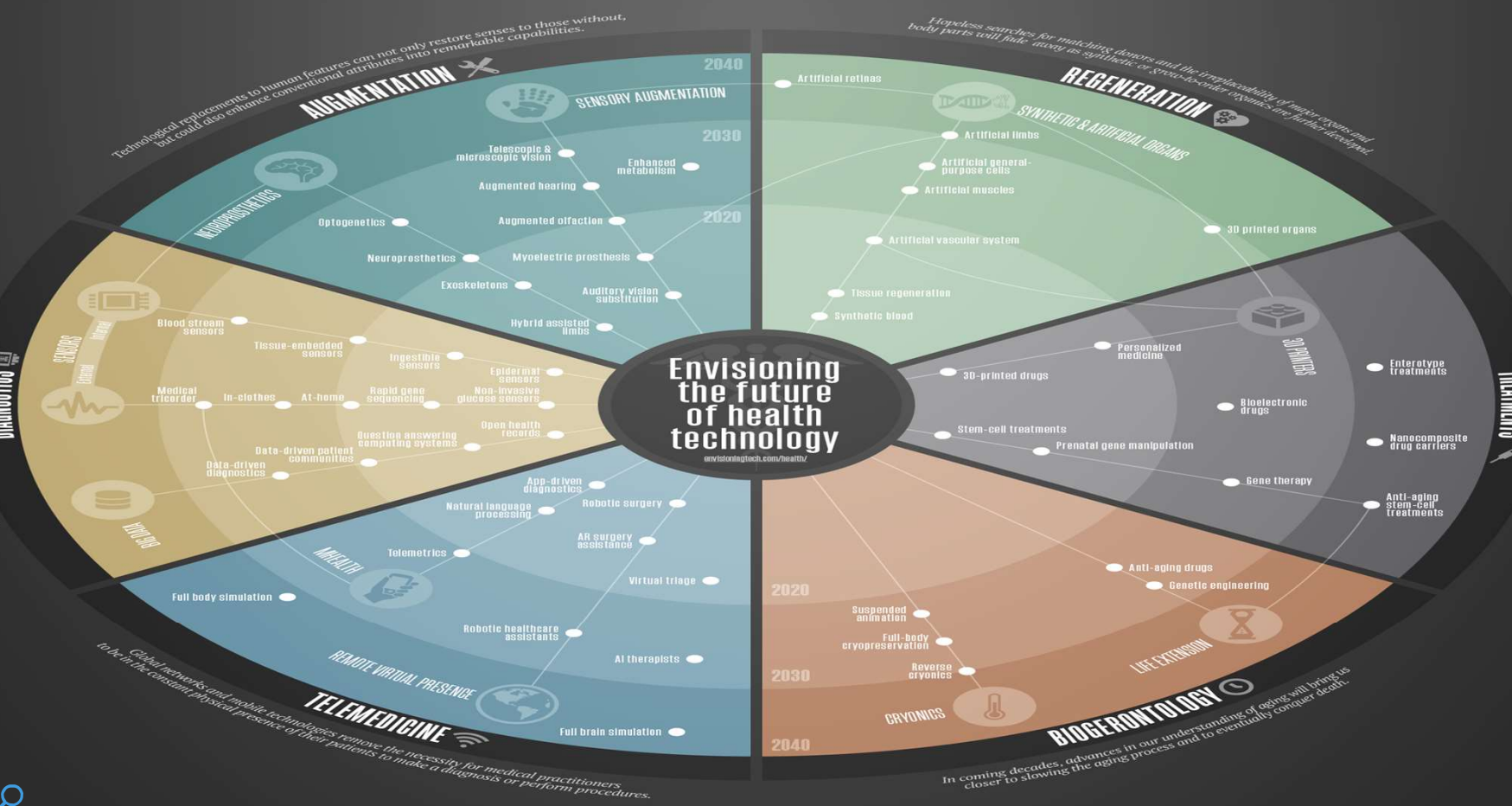




Envisioning the future of health technology

Technology is the ultimate democratizing force in society. Over time, technology raises lowest common denominators by reducing costs and connecting people across the world. Medical technology is no exception to this trend: previously siloed repositories of information and expensive diagnostic methods are rapidly finding a global reach and enabling both patients and practitioners to make better use of information.

This visualization is an exercise in speculating about which individual technologies are likely to affect the scenario of health in the coming decades. Arranged in six broad areas, the forecast covers a multitude of research and developments that are likely to disrupt the future of healthcare.



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First flight 1903