Transforming Healthcare Delivery Through Innovation and Technology

Bola Oyegunwa, PhD, MBA, MMB
GO WOLFPACK!

Master’s In Microbial Biotechnology; Ph.D., Microbiology & Immunology; MBA

NC STATE UNIVERSITY
Professional Background

- Management Consultant
- Corporate Strategist (Head of Corporate Strategy & Assistant to the CEO)
- Emerging Technology, Clinical Product Management & Development
- VP, GM Software Solutions (Clinical Technologies & Investigator Solutions)
- CIO, Clinical Drug Development
- SVP, Enterprise Systems
  - Lab systems
  - Corporate & Billing systems
  - Robotics (Protodyne)
  - Business Relationship Management
  - Divisional IT & Subsidiary IT (M&A Integrations)
  - Software Delivery Teams
Labcorp is a leading life sciences company, improving patient health on a global scale

**Our mission:** Improve health and improve lives

**Our objectives:**
- Deliver world-class diagnostics
- Bring innovative medicines to patients faster
- Use technology to improve the delivery of care

- 50+ years’ experience delivering healthcare solutions
- Offers nearly 5,000 clinical laboratory tests with new tests added each year
- Serves more than 3 million patients each week and has data on 50% of US population
Labcorp’s strategic pillars is designed to accelerate enablement of our mission

- **Build on Our Leadership in Oncology**
  and expand lessons to lead in other specialty testing categories

- **Differentiate Through Digital and Data**, seeking opportunities to embed AI, digitization, and analytics throughout the enterprise

- **Drive Customer Centricity**
  and consistently deliver valuable solutions that help them achieve their goals

- **Expand Globally**, leveraging our lab network, scientific capabilities, vast health data and insights, and results-oriented culture
Healthcare Trends: It is important to understand healthcare trends prior to evaluating the role of emerging technologies in the future of healthcare.
**Digital Solutions** have the potential to improve care, reduce physician administrative burden, automate manual processes and improve efficiencies.

**POPULATIONS**  
Identify and monitor at-risk patients, support quality measures and coding, and target gaps in care.

**HEALTH SYSTEMS**  
Clinical decision support, identify the right tests / treatment for the right patient at the right time, reducing costs while improving quality metrics.

**PROVIDERS**  
Physician co-pilot, AI solutions imbedded into the physician workflow to support diagnosis, patient monitoring, and treatment decisions allowing providers to focus on what matters most.

**PATIENTS**  
Improve patient monitoring and care.
**Digital Solutions** that will be explored

**AI**
- Impact on streamlining processes, and improving accuracy of diagnosis

**IoT**
- Improve patient monitoring and preventative health

**Digital Twins**
- Impact on reducing cost of drug development, and improving treatment plans

**Robotic Process Automation**
- Streamline and automate highly repetitive and manual processes
What is AI?

<table>
<thead>
<tr>
<th>Explain AI in simple terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial Intelligence (AI) is like a smart computer program that can learn from experiences, make decisions, and perform tasks that normally need human intelligence. It's designed to mimic human thinking to solve problems, recognize patterns, and adapt to new situations without explicit instructions for each scenario.</td>
</tr>
</tbody>
</table>
What is AI?

Shared Chat  •  Default (GPT-3.5)

Similar to neural networks and machine learning, what are different types of AI

AI encompasses various approaches, including:

1. **Symbolic or Classical AI**: This traditional approach uses symbolic reasoning and logic-based systems to represent knowledge and manipulate symbols to solve problems.

2. **Machine Learning**: It’s a subset of AI that focuses on creating algorithms that enable systems to learn and improve from experience without being explicitly programmed. It includes techniques like neural networks, decision trees, and clustering.

3. **Neural Networks**: These are a specific type of machine learning modeled after the human brain’s structure, composed of interconnected nodes (neurons) that process information and learn patterns.

4. **Natural Language Processing (NLP)**: It involves enabling computers to understand, interpret, and generate human language, allowing interactions between computers and humans via language.

5. **Computer Vision**: This field concentrates on enabling computers to interpret and understand the visual world, processing images and videos.

These various types often intersect and complement each other in developing AI systems to perform diverse tasks and functions.
Is AI Perfect?

I agree with those. However, did you forget Generative AI?

You're absolutely right. Generative AI is a significant subset within artificial intelligence. It involves systems capable of creating new content, whether in the form of images, text, music, or other media. These systems can generate content that is original and not explicitly copied from existing data, often using techniques like Generative Adversarial Networks (GANs) or Variational Autoencoders (VAEs). Generative AI has applications in art generation, content creation, and even synthetic data generation for various purposes.
While there are many buzzwords around the artificial intelligence space, almost all techniques fall under some basic broad categories

- **Artificial Intelligence (AI)**: overarching description of powerful computer systems that can mimic basic human cognition.

- **Machine Learning (ML)**: models trained with data to perform a specific task, potentially without direction or guidance from humans.

- **Deep Learning**: the ability for models to absorb and learn from non-traditional forms of data (text, images, video, audio, etc.).
**AI Solutions** can improve patient and provider outcomes by improving diagnosis accuracy, reduce administrative burden and increase efficiencies

**Physician Digital Resident**
- Aggregate patient history, test results, signs and symptoms for physician review
- Tuned to be a “digital resident” that allows physicians to practice at the top of their license
- Alert physician to areas of concerns that will facilitate physician decisions
- Support physician in determining the right tests/clinical procedures and creating a treatment plan

**Reduce Administrative Burden**
- Complete review of patient notes from previous visits
- Create summary of physician notes and treatment plan
- Rapidly access clinical and operational information

**Clinician Decision Support**
- Guide physician decisions during diagnosis and treatment cascades
- Generate clinical insights from review of clinical data, lab data, prescription data, images
- Improve diagnosis accuracy of images (X-rays, Pathology, MRIs, Digital Cytology)
- Seamlessly imbedded into clinician’s workflow to prevent disruptions
- The physician remains the decision maker
AI Solutions can improve accuracy of cancer diagnosis

AI algorithms trained on images and previous diagnosis to improve accuracy of diagnosis

FDA approved bundle

Storage

Scanner

IMS & Viewer

Monitor*

LIMS
**AI** has the potential to rapidly improve patient outcomes

**Google AI has better bedside manner than human doctors – and makes better diagnoses**

Researchers say their artificial-intelligence system could help to democratize medicine.

By Mariana Lenharo

An artificial intelligence (AI) system trained to conduct medical interviews matched, or even surpassed, human doctors’ performance at conversing with simulated patients and listing possible diagnoses on the basis of the patients’ medical history.¹
Large scale adoption of AI requires improvement in data quality and adoption of common data models to ensure accuracy and reliability of AI models

- Healthcare data is frequently incomplete, inconsistent, and inaccurate. An inconsistent data set introduces biases and errors.

- This can have profound consequences for an AI model trained on such raw data. Biased and inaccurate data can perpetuate healthcare disparities and affect patient outcomes.

- Inconsistency of data formats and protocols hampers the ability to compare and exchange data across different healthcare providers limiting collaboration and insights derived from large-scale data analysis.

- A lack of data normalization poses a significant roadblock, hindering the integration of AI in healthcare.

- Without normalization, the accuracy and reliability of AI models may be compromised, leading to suboptimal performance and prediction errors.

- Organizations can mitigate these challenges with a data strategy. Initiatives such as the adoption of common data models, standardized vocabularies, and structured data formats can enhance data quality and facilitate the seamless exchange of information between systems.

- By fostering standardized data practices, the healthcare industry can unlock the true potential of AI. This will ensure the delivery of accurate, unbiased, and patient-centric care.
Robotic Process Automation uses software to automate repetitive and rule-based tasks such as data manipulation and integration across different systems.

RPA can also be combined with artificial intelligence to create intelligent automation solutions that can handle more complex and unstructured data sets, such as natural language processing and optical character recognition. Collectively, this can enable healthcare organizations to leverage cognitive capabilities such as machine learning, computer vision and natural language generation to further enhance their automation potential.

RPA use cases can reduce cost, enhance quality and compliance, improve efficiency and patient outcomes.

**Streamline Administrative Processes**
- Patient billing
- Appointment scheduling
- Claims processing
- Data entry
- Coding and billing: Apply appropriate codes and modifiers based on clinical documentation
- Improved compliance and revenue cycle management

**Improve Clinical Documentation**
Assist clinicians with documenting patient encounters, diagnoses, treatments and outcomes by capturing data from EMR, voice recognition systems.

**Enhance Patient Care**
- Data review and entry for remote patient monitoring
- Tracking patient progress (alerts and notifications)
- Personalized patient communications
- Identify data from various sources and identify high-risk patients that need proactive intervention
Digital Twin Technology Has the Potential To Radically Disrupt Healthcare

Digital twin is a digital version, model or representation that is meant to replicate a real-world physical counterpart.

**Reduce Time and Cost of Developing New Drugs and Therapeutics**
- Digital twins can be used to mimic whole cells or systems
- Safety and efficacy of the drug / therapeutic can be tested
- Increase insights on whole cell behavior vs specific pathways

**Discovery of New Biological Targets**
- Rapidly develop specific disease models
- Generate insights on multiple pathways
- Integrate inference logic using multi-agent distributed AI to create specific domains personalized to patients

**Model the Human Genome**
- Generate insights on genetic diseases
- Near-real time understanding of therapeutic impact
DT can be divided into two categories, statistical model driven by data and a mechanical model that integrates multi-scale knowledge and data.
DT shows promising results in reducing invasiveness and improving accuracy of diagnosis treatment plan and patient outcomes

- The application of the DT to the cardiovascular system includes the establishment of DT heart models and the precise treatment of cardiovascular disease.
- Models can be used to accurately determine the most valuable diagnostic basis and reliably infer biomarkers through non-invasive procedures.
- The key to DT-guided diagnosis is the personalized construction of the model.
- This approach has been adopted for the computation of pressure drops in flow obstruction and has proved to be more accurate than following clinical guidelines.

Cardiovascular Models

- The idea of using the DT in the surgical field is to create a patient model for multi-disciplinary teams to plan a surgery and verify the anatomy and thus avoid inadvertent damage to structures.
- Several surgical specialties evaluated patient-specific simulation, including neurosurgery, vascular surgery and interventional radiology.
- The use of the DT in treating cardiovascular disease is growing and there is an emerging interest in the application of AI in vascular surgery.
- The virtual model established using DT technology can be used to develop diagnostic tools.

Surgery

- With the development of numerical simulation and worn devices, the use of a DT for the real-time monitoring and analysis of the lumbar spine has become a highly promising cutting-edge technology in the biomechanical field.
- In applying the DT in the field of orthopaedics, it is important to develop physics-based experimental models and data-driven numerical models, which have the advantages of low cost and high integrity.
- DTs with agents and multi-agent systems technologies in healthcare and presented a first case study about the application of agent-based DT to the management of severe traumas.

Orthopedics
CGT: Multiple novel approaches to treat disease

**Cell Therapy**
1. Collect T-cells from your blood
2. Change the T-cells in the lab to become CAR T-cells
3. CAR T-cells multiply in the lab
4. CAR T-cells delivered back into your bloodstream
5. CAR T-cells find and attack cancer cells

**Gene Therapy**
- DNA mutation results in disease
- DNA code for a therapeutic gene
- Gene encapsulated in viral vector
- Viral vector releases gene into cell
- Gene expresses proteins
- Secreted protein

**CELL & GENE THERAPY DEVELOPMENT DIFFERENCES**
- Living Drugs
- One Time Treatment
- Potentially Curative
- Complex Logistics
- Rapid Timelines

©2023 Laboratory Corporation of America® Holdings. All rights reserved.
What is cell therapy?

Cell therapy is an investigational therapeutic approach in which viable cells are injected, grafted or implanted into a patient in order to effectuate a medicinal effect and they have the potential to treat a wide range of diseases.

- A variety of cell types being utilized (pluripotent & multipotent stem cells, fully differentiated cells) and optimal cell type depends on therapeutic application

- They fall into 2 general categories:
  - Autologous cell therapy: derived directly from the patient – one patient, one drug
  - Allogenic cell therapy: derived from healthy donor cells and are considered “off-the-shelf” therapies

- The cells can be:
  - Genetically modified: CAR T cells, CAR NK cells, etc. Most common type of cell therapy, predominantly for oncology indications, 6/7 FDA approved cell therapy products are autologous cell therapies
  - Non-genetically modified: Stem cells and/or differentiated cells, tumor infiltrating lymphocytes, used/investigated in a broad range of therapeutic areas (cartilage replacement, cardiovascular

[Link to more information: https://www.thegenehome.com/how-does-gene-therapy-work]
What is gene therapy?

Gene therapy is an investigational therapeutic approach that aims to add, delete, or correct genetic material to treat a disease.

There are two approaches for gene therapy: Gene Addition and Gene Editing.

**Gene Addition:** adds genetic material to either replace or silence a patient’s cells to replace a “faulty” gene.

**Gene Editing:** disrupt or correct the function of a gene through direct, targeted modification of the DNA.

The vehicle that carries the corrected material is called a vector—this can be viral or non-viral.

**Gene Replacement**
- Introduction of therapeutic protein to correct a non-functional gene.
- Inherited blindness, Duchene’s Muscular Dystrophy, etc.

**Gene Silencing**
- Expression of an inhibitory RNA (si/shRNA, miRNA) that prevents expression of a defective gene.
- Huntington’s Disease, ALS, etc.

**Gene Editing**
- Expression of gene editing enzymes (e.g. CRISPR) that directly corrects a disease-causing mutation.
- CRISPR edited T cells (ex vivo, oncology).
- Non-oncologic heme malignancies (sickle cell disease, β-thalassemia, etc.)
- Rare monogenic diseases (transthyretin amyloidosis, hereditary blindness, etc.)
- 140 clinical trials with gene-edited products.

IoT (Internet of Things) enables seamless connectivity and communication of devices and sensors to a network to orchestrate data collection and sharing

- IOT enables network connected devices, wearables and sensors to collect and share data with minimal human interaction

- In this hyperconnected world, digital systems can record, monitor, analyze data and generate alerts and notifications
IoT (Internet of Things) technology continues to proliferate for daily use

**Access to low-cost, low-power sensor technology.** Affordable and reliable sensors are making IoT technology possible for more manufacturers.

**Connectivity.** A host of network protocols for the internet has made it easy to connect sensors to the cloud and to other “things” for efficient data transfer.

**Cloud computing platforms.** The increase in the availability of cloud platforms enables both businesses and consumers to access the infrastructure they need to scale up

**Machine learning and analytics.** With advances in machine learning and analytics, along with access to varied and vast amounts of data stored in the cloud, businesses can gather insights faster and more easily

**Conversational artificial intelligence (AI).** Advances in neural networks have brought natural-language processing (NLP) to IoT devices (such as digital personal assistants Alexa, Cortana, and Siri) and made them appealing, affordable, and viable for home use.
IoT (Internet of Things) has the potential to improve patient monitoring and outcomes

### Improve Patient Monitoring

- **Sensors / Wearables Enabled Patient Monitoring**
  - Monitor patient vitals
  - Rapidly alert healthcare providers of abnormalities
  - Detect SAEs/AEs during clinical trials
  - Incorporate data into patients' medical records for improved understanding of natural history and disease progression
  - Potential opportunities for virtual hospital ward monitoring
  - Increase drug compliance and improve patient outcomes

### Challenges to Broad Adoption

- **Precision Medicine Test Journey**
  - Improvements in clinical device miniaturization
  - Limited availability of clinical devices (12-lead ECG)
  - Availability of devices that can collect / process blood
Technology-Enabled value capture hinges on establishing clear corporate goals and objectives with compelling and measurable return on investment.

Key Considerations for Success

- Enhanced Cyber Security Posture
- Improvements in Data Quality
- Regulatory Compliance
- Cost Containment (Infrastructure, cloud hosting, storage)
- Development of a prioritized strategic roadmap with clear ROI
- Experimentation, fail fast, rapid prototyping