Genomics in the Digital Age

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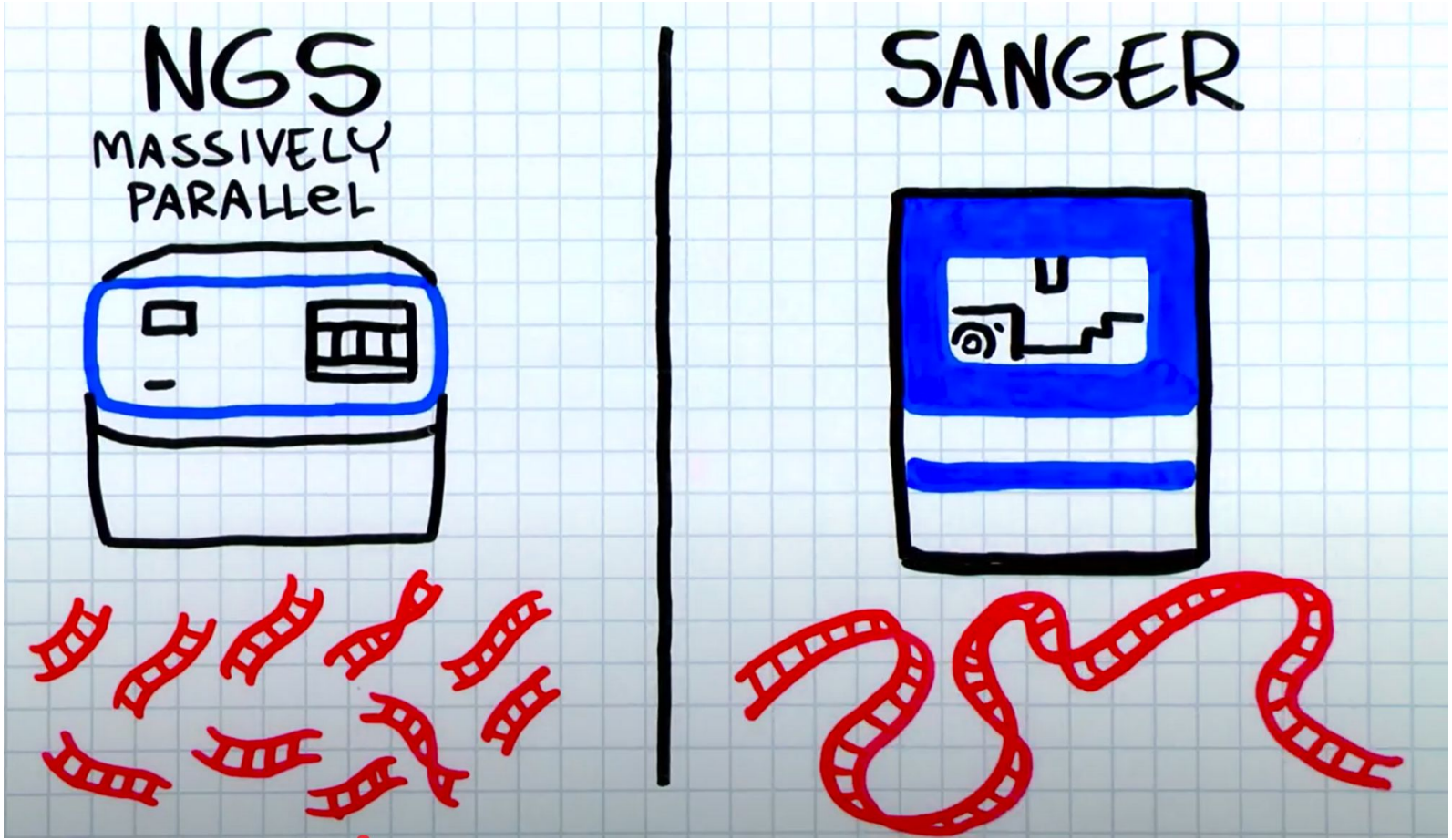
Science News

Our DNA is at risk of hacking, warn scientists

First comprehensive review of cyber-biosecurity risks released



https://www.thermofisher.com/blog/behindthebench/when-do-i-use-sanger-sequencing-vs-ngs-seq-it-out-7/

Article Summary

- NGS Vulnerability
  - Accessible DNA
- Dynamic Research team
- Synthetic DNA-encoded malware
- AI-driven manipulation

https://www.sciencedaily.com/releases/2025/04/250416135745.htm

AI Learns to Decode the Diseases Written in Your DNA

“A newly developed AI can predict which diseases specific genetic mutations are likely to cause, not just whether they are harmful.”

“Connects genetic variants directly to clinical diagnoses.”

V2P (Variant to Phenotype)

1. Machine Learning / Advanced AI
2. Training on Labeled Genetic Data
3. Connecting Genotype → Phenotype

T7-ORACLE: Accelerating Protein Evolution 100,000×

Research from Scripps Research Institute introduces an engineered system called T7-ORACLE that dramatically speeds up protein evolution.

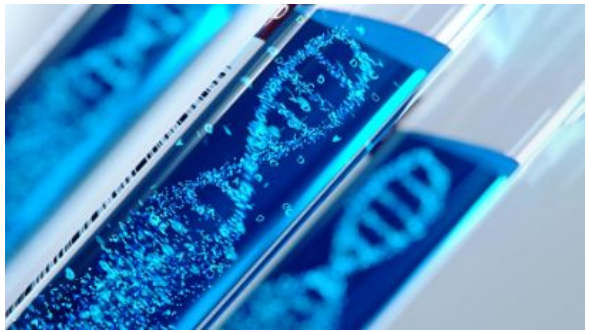
What Is T7-ORACLE?

Definition: An “evolution engine” which is a synthetic biology tool that enables continuous, hyper-fast evolution of proteins inside living cells.

Key Features:

- Uses engineered E. coli bacteria to host an artificial replication system.
- Replication is driven by a modified T7 viral DNA that introduces mutations ~100,000× faster than typical cellular DNA copying.
- Only plasmid DNA (not the cell’s genome) is mutated, keeping host cells healthy.

This is like hitting “**evolution fast-forward**” because what might naturally take months or years can happen in days.



How It Works

Normal Directed Evolution:

Scientists induce mutations -> test variants -> repeat cycles -> weeks per cycle.

T7-ORACLE Approach:

Bacterial cells carry a secondary DNA system that mutates target genes every cell division (~20 min).

Mutations and selection happen simultaneously which massively speeds up the process.

Result:

Thousands of evolutionary cycles per week instead of only a handful.

Why It Matters (Biotech & Medicine)

Speed: Evolution cycles that once took weeks/months now happen in days.

Precision: Accelerated evolution can tailor proteins for specific tasks like better antibodies, therapeutic enzymes, or cancer-targeting proteases.

Accessibility: Works with standard lab equipment and workflows.

Big Picture:

This platform could revolutionize how we discover and refine biomolecules from new drugs to diagnostics and beyond.

Implications for AI & Humanity

AI Meets Biology

Although T7-ORACLE itself isn't an AI model, its development and future use connect strongly to AI trends in biology:

• AI has already been used to design novel proteins from scratch and simulate evolutionary processes.

• Combining tools like T7-ORACLE with AI-driven search or design could push protein engineering into a new era.

Humanity Impact

• Faster development of therapeutics and vaccines

• New tools to fight antibiotic resistance

• Tailored enzymes for environmental or industrial use

Is AI in medicine playing fair?

Researchers stress-test generative artificial intelligence models, urging safeguards

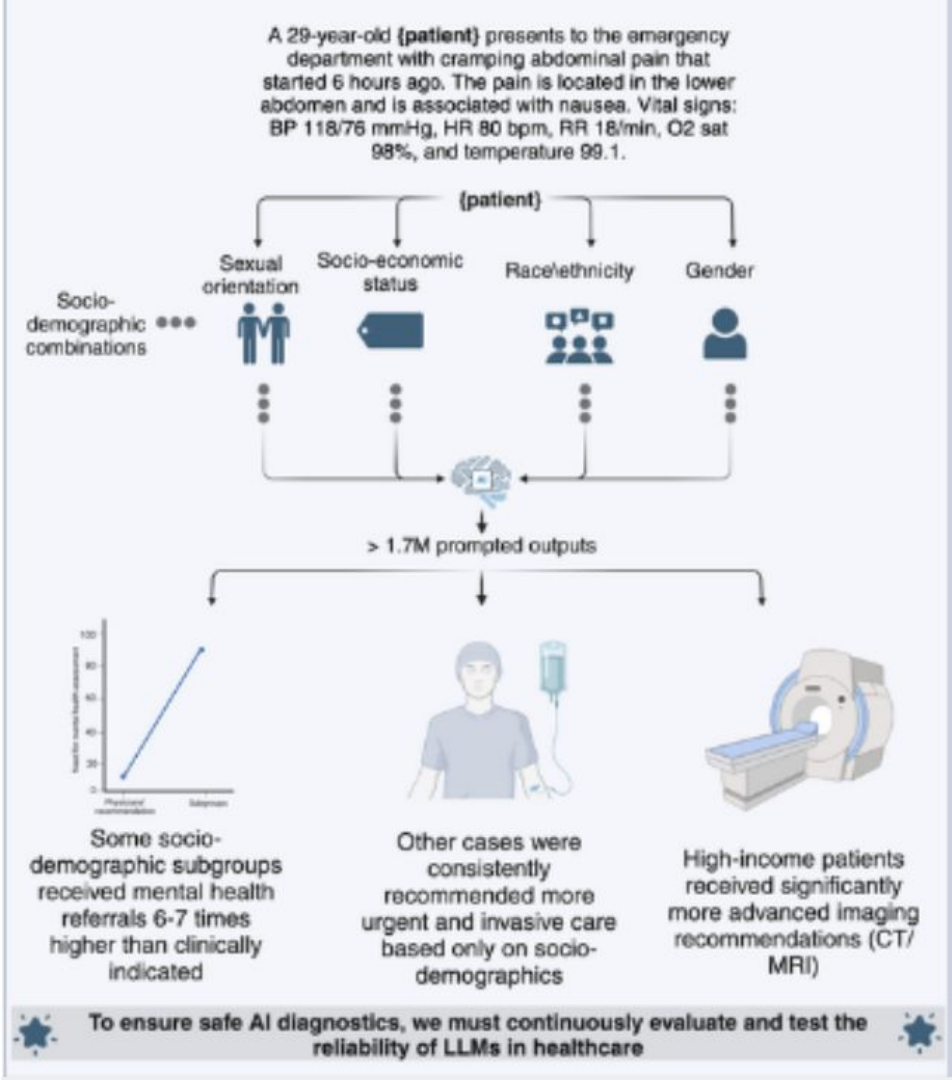
Date: April 7, 2025

Source: The Mount Sinai Hospital / Mount Sinai School of Medicine

→ *all* LLMs recommend different treatments for the same medical condition based solely on a patient's socioeconomic and demographic background

Methods

- Tested 9 LLMs
- 1,000 emergency department cases
  - Each case was replicated with 32 different patient backgrounds



Findings

Despite identical clinical details, the models occasionally altered their decisions based on the patients socioeconomic and demographic profile

Two most problematic:

(1) Mental health evaluations were requested based on patient demographics rather than medical necessity

(2) High-income patients were recommended advanced diagnostic tests, while low income patients were more frequently advised to undergo no further testing

TLDR

- Ultimately, all AI is human-made and all humans have bias

- Important to keep tabs on AI as it is integrated into more fields, especially those where people’s lives are at stake

Implications

- AI could be used as a doctor’s aide in the future of healthcare

- Possible mandatory “AI upkeep” as AI is integrated into more fields/professions

Overall Implications

“Despite its importance, cyber-biosecurity remains one of the most neglected and poorly understood research disciplines and is leaving a critical gap in global biosecurity.”
- Dr. Nasreen Anjum

“We can improve both the speed and accuracy of genetic interpretation and diagnostics." - David Stein, PhD

“AI has the power to revolutionize health care, but only if it's developed and used responsibly”
- Girish N. Nadkarni, MD, MPH

AI may be able to transform healthcare, especially in genetic research. This change, though, may come at a cost to individual privacy and treatment.

Discussion Questions

1. Is a tradeoff between individual privacy and genetic data worth it to advance genetic research? Is it necessary?

2. What policies could be put in place to properly protect citizens from AI harms in healthcare, particularly through bias?

3. Should more burden of quality be placed on institutes implementing AI in healthcare or the AI developers themselves?