

2019 ABSA International Biosafety and Biosecurity Conference

Cyberbiosecurity: New Intersections and Technologies

November 19, 2019



www.merrick.com

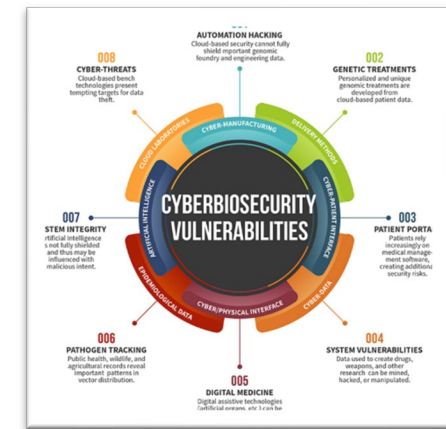




Steve Lewis

Project Manager,
Biotechnology &
Cybersecurity

- Leads IT & biologics development operational planning efforts for the National Bio and Agro-defense Facility (NBAF), the first large animal BSL-4Ag facility in the U.S.
- June 2019: published 2 peer reviewed articles regarding Cyberbiosecurity in *Frontiers in Bioengineering and Biotechnology*
- Invented world's first enzyme-based, battery-free wristband that glows when users become too intoxicated to drive.
- John Hopkins M.S., expertise in IT, synthetic biology, cybersecurity, biologics development



Cyberbiosecurity

“[...] emerging hybridized discipline at the interface of cybersecurity, cyber-physical security and biosecurity.”



<https://www.frontiersin.org/articles/10.3389/fbioe.2019.00099/full>>Cyberbiosecurity: a call for cooperation in a new threat landscape

<https://www.frontiersin.org/articles/10.3389/fbioe.2018.00039/full>>Cyberbiosecurity: An Emerging New Discipline to Help Safeguard the Bioeconomy

Applied Cyberbiosecurity in 2019: Scenario 1

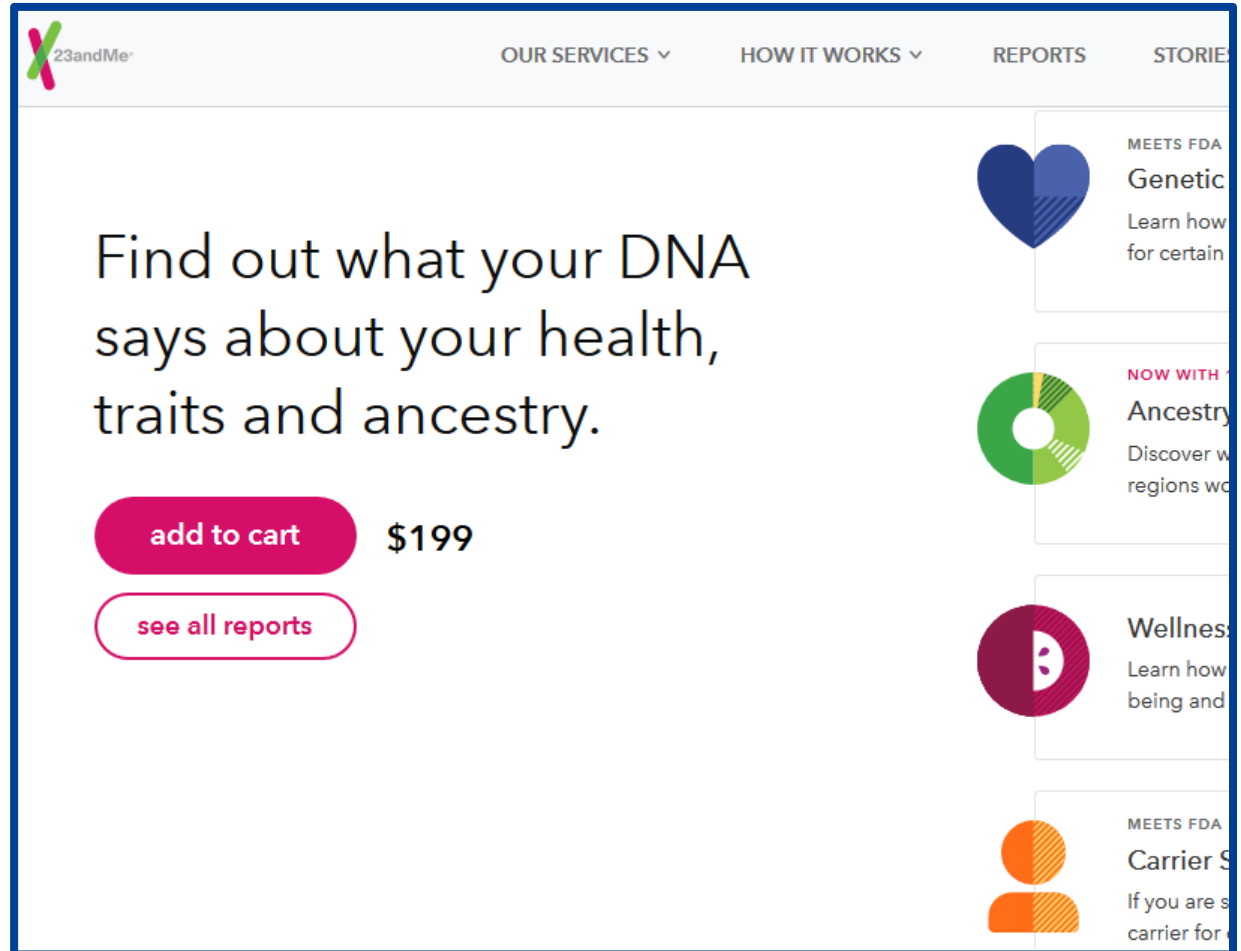


www.merrick.com



Applied Cyberbiosecurity in 2019: Scenario 1

- **Mother buys 18-year old daughter 23andMe DNA kit**
 - No family health insurance
- **Positive BRCA2 tumor suppressor gene mutation.**
- **Mother takes daughter to Urgent Care**
- **Urgent Care provider has never encountered this situation before**
- **Urgent Care Provider orders BRCA2 screening from Quest Diagnostics**



The screenshot shows the 23andMe website interface. At the top, there is a navigation bar with the 23andMe logo on the left and menu items: "OUR SERVICES", "HOW IT WORKS", "REPORTS", and "STORIES". The main content area features a large heading: "Find out what your DNA says about your health, traits and ancestry." Below this heading are two buttons: a pink "add to cart" button and a white "see all reports" button. To the right of the main text, there are four vertical cards. The first card has a blue heart icon and text: "MEETS FDA Genetic Learn how for certain". The second card has a green circular icon and text: "NOW WITH Ancestry Discover w regions wo". The third card has a purple circular icon with a white smiley face and text: "Wellness Learn how being and". The fourth card has an orange circular icon and text: "MEETS FDA Carrier S If you are s carrier for".

Applied Cyberbiosecurity in 2019: Scenario 1

Should the Urgent Care provider assume the result from Quest Diagnostics test is accurate?

A. Yes

B. No

C. Unsure

Applied Cyberbiosecurity in 2019: Scenario 1

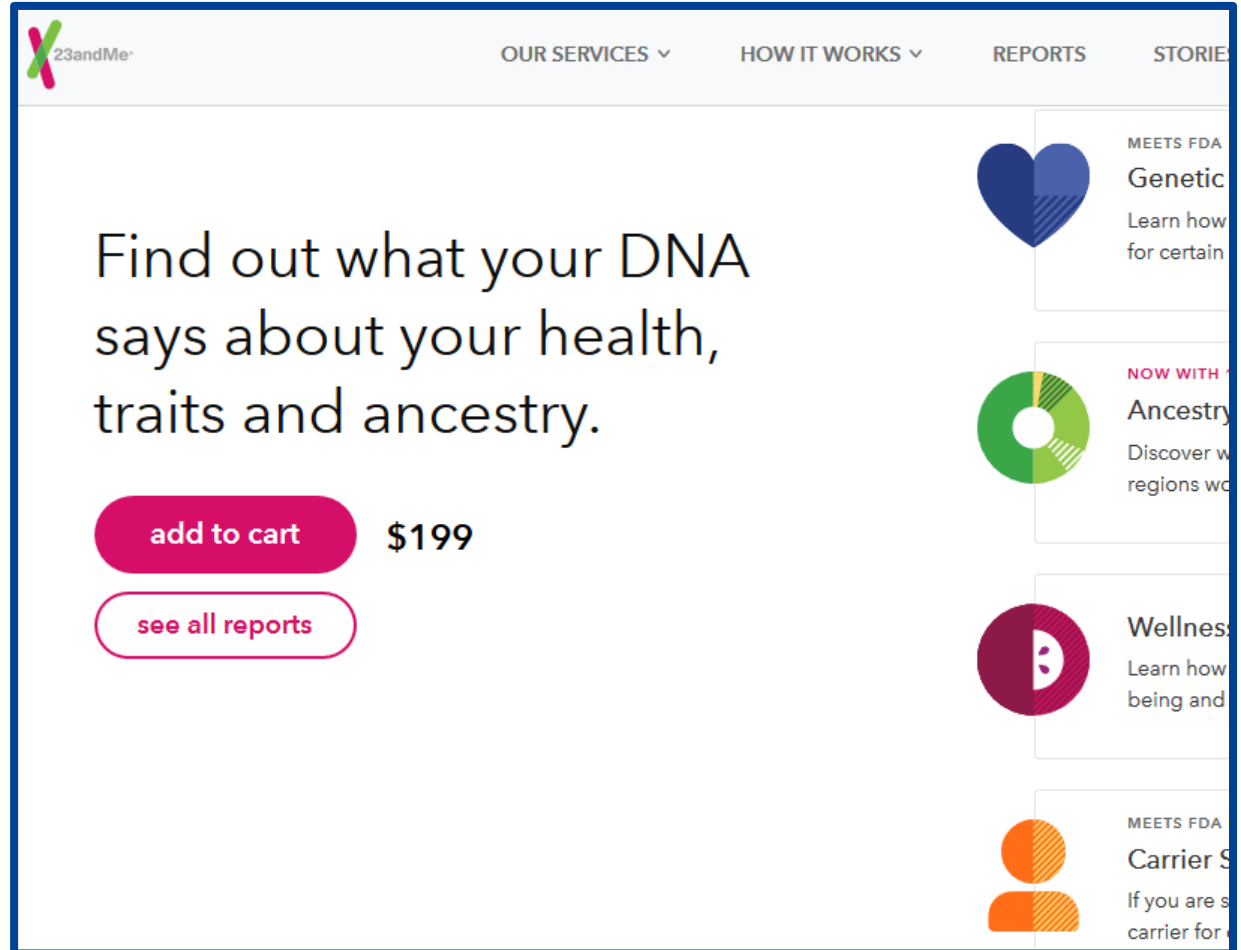
Mother calls 23andMe

“We meet all FDA requirements for ‘Genetic Health Risks’

- Recommends seeing a physician for diagnosis

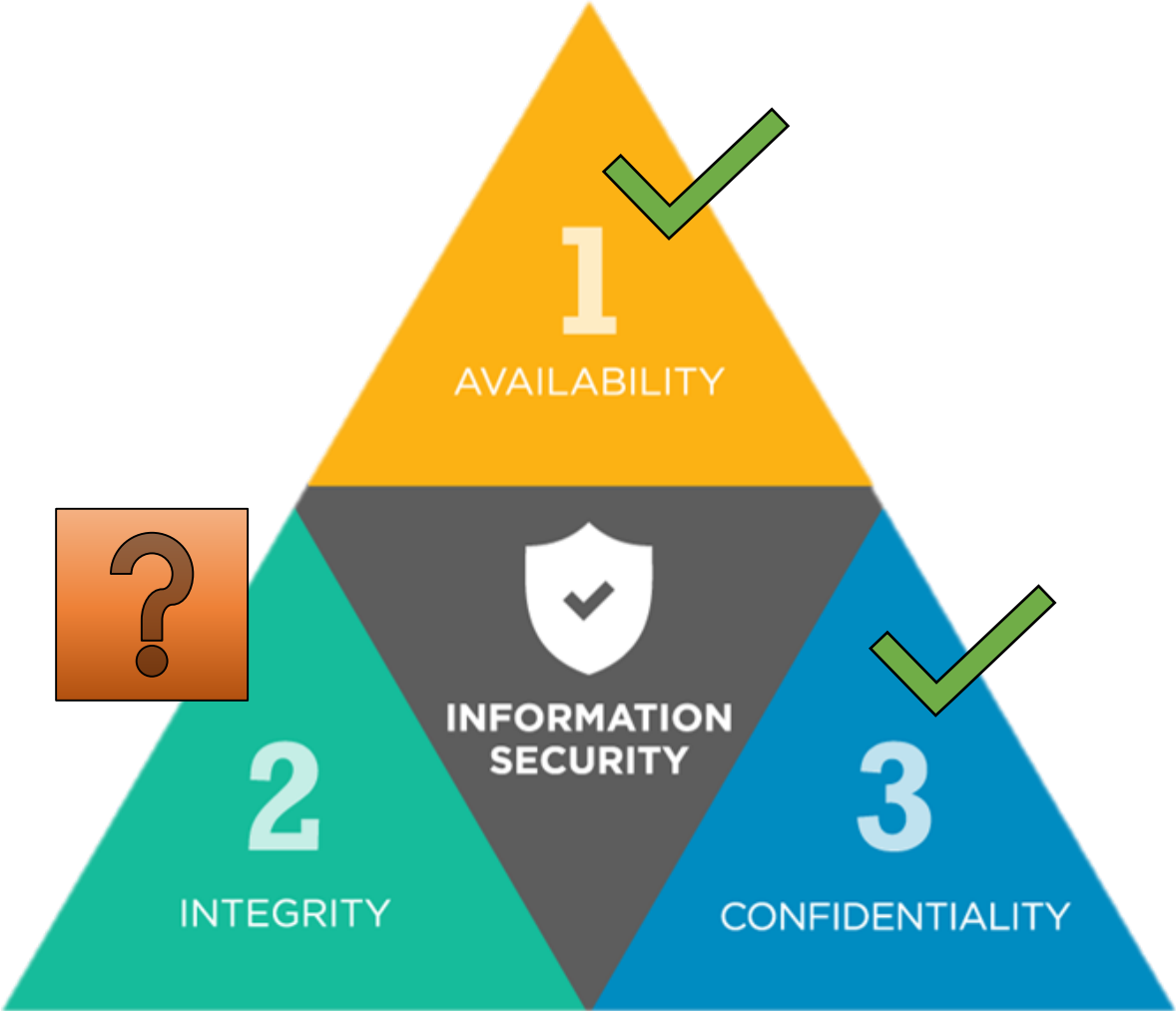
Mother is responsible for overhead charged to Urgent Care provider

- Morally, is that fair?



The screenshot shows the 23andMe website interface. At the top, there is a navigation bar with the 23andMe logo on the left and menu items: "OUR SERVICES", "HOW IT WORKS", "REPORTS", and "STORIES". The main content area features a large heading: "Find out what your DNA says about your health, traits and ancestry." Below this heading are two buttons: a pink "add to cart" button and a white "see all reports" button. To the right of the main text, there are four vertical cards. The first card has a blue heart icon and text: "MEETS FDA Genetic Health Risks Report Learn how to protect your health for certain conditions". The second card has a green circular icon and text: "NOW WITH 23andMe Pro Ancestry Insights Discover which regions you're most closely related to". The third card has a purple circular icon with a white smiley face and text: "Wellness Report Learn how your DNA can help you understand your health and well-being". The fourth card has an orange circular icon and text: "MEETS FDA Carrier Status Report If you are a carrier for certain genetic conditions, you may be able to pass them on to your children".

Applied Cyberbiosecurity in 2019: Scenario 1



Applied Cyberbiosecurity in 2019: Scenario 2



www.merrick.com



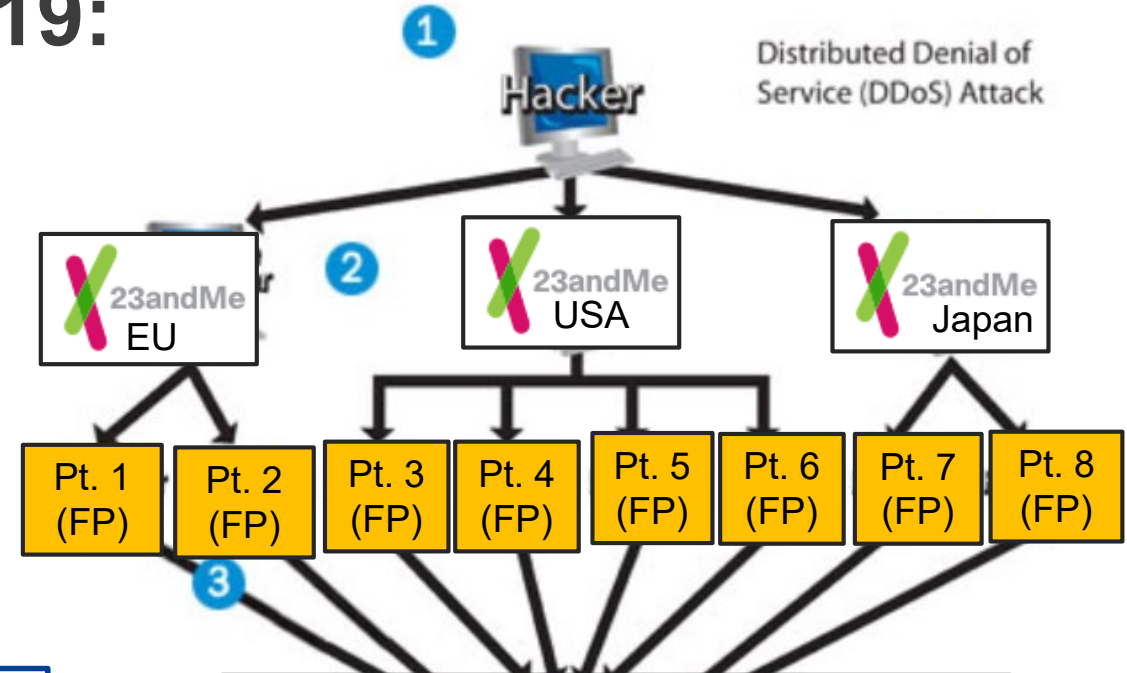
Applied Cyberbiosecurity in 2019: Scenario 2

In cybersecurity, a distributed denial-of-service (DDoS) attack is one in which multiple systems overwhelm the resources of another.

Someone hacks 23andMe servers and hard codes positive BRCA2 mutation results for *all* female users between 27 Feb 2019 and 30 Aug 2019. Is this a biosecurity issue?

- A. Yes
- B. No
- C. Unsure

Applied Cyberbiosecurity in 2019: Scenario 2



Who holds responsibility in this scenario?

- A. Head of Information Security at 23andMe
- B. Hospital systems that don't perform follow-on testing
- C. Unsure

Possible Targets:
Public Health Systems
Customer trust rates in genetic services
Hospital system overhead
Social Stability

What else?

Applied Cyberbiosecurity: The Full Stack Biotechnologist



MERRICK[®]

www.merrick.com



The Full Stack Developer

A **front end** wizard

- e.g. - HTML, CSS, & JavaScript

A **back end** chef

- e.g. - AWS, SQL, NoSQL

An **application protocol** Guru



A new breed of **biotechnologist** is emerging...



The Full Stack Biotechnologist Definition Chart

Upstream (Back End) Skills	Downstream (Front End) Skills
Recombinant DNA technologies	Characterization
Cellular and molecular biology	Filtration + Purification
Cell culture	Electronics
Bioengineering Creativity	Rapid prototyping
Scale-up and bioprocessing	Marketing
Spanning Skills	
Programming/Development	
Design	
Deep/Machine Learning/AI	
Project/Product Development/Management	

Full Stack Biotechnologist Definition

The full stack biotechnologist is a **singular individual** that can demonstrably **design** and **reproducibly develop** a biological product utilizing a range of biological and technological techniques and tools, such as those listed in the *Full Stack Biotechnologist Definition Chart*.

The developed biological product **consistently passes** appropriate characterization and testing to scale-up levels – culminating in **distribution** of the knowledge or the product via open access or private/commercial mechanisms.

Cyberbiosecurity considerations of the Full Stack Biotechnologist...

- These individuals are **real** and their numbers are **multiplying**
- Their expertise and skill sets are growing
- Their skill sets are highly valuable, individually and combined
- They may or may not be trained in biosafety
- When hiring, ask for a portfolio or website

Predictions for the Full Stack Biotechnologist...

- The Full Stack Biotechnologist will *first* become the **unicorn** of the **synthetic biology industry**
 - Existing biotechnology industries will follow within 5-10 years
- Portfolios/websites will become necessary and standard component of successful hiring processes
- Certifications will be forthcoming, like IT industry
 - Ideas: *Registered Cyberbiosecurity Professional, Certified Ethical Biotechnologist, Biotech+, CompTIA Biotech+, etc.*



Steve Lewis

Project Manager, Biotechnology
& Cybersecurity

Steve Lewis, M.S.

Project Manager, Biotechnology & Cybersecurity
Biosafety and Biosecurity Division

Merrick & Company

C: +1 720-453-4085

steve.lewis@merrick.com | www.merrick.com

