The Role of Next Generation Sequencing for Healthcare-associated infection and Public Health Applications

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Metagenomics in Spaceflight: Establishing an implementation roadmap
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No disclosures

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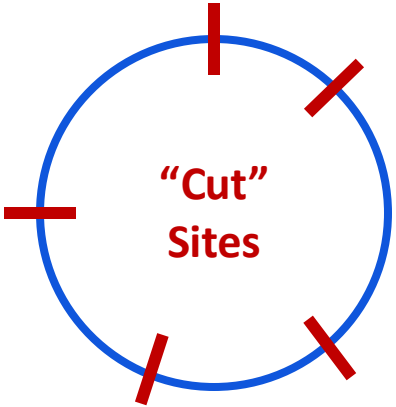
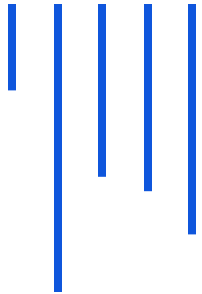
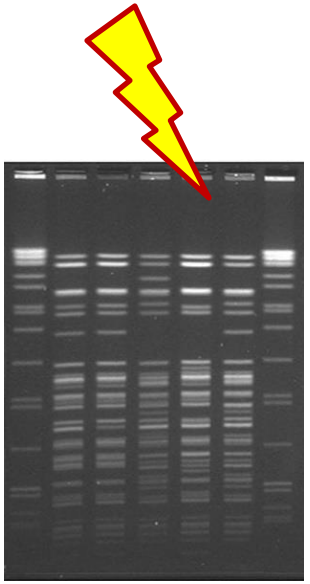
PFGE Subtyping



Bacterial genome



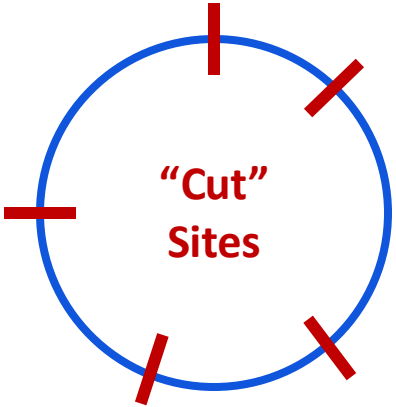
Genome "fragments"



PFGE patterns

Analogous to comparing two books based on the length of each chapter

Sequencing Provides Higher Resolution View of Bacterial Genome



PFGE only gives information at a "cut" site via the banding pattern

A marker for relatedness/evolution

WGS gives information at every position in the bacterial genome

Direct measure of relatedness/evolution

Analogous to comparing two books based on <u>all the words/letters</u>

Sequence Data for Public Health Action

Single strain/isolate

Microbial Ecology

Individuals

Outbreak/ response

Surveillance/ monitoring

Sequencing for HAI/AR bacterial pathogens: Critical Public Health & Infection Control Tool for Action

1. Detecting novel/emerging resistance mechanisms
2. Identifying reservoir/ transmission pathway

→ • Finding the needle in haystack

3. Confirming common source/transmission event

→ • Confirming the needle in haystack

4. Disproving transmission occurred to spare unnecessary investigation

→ • It's just hay

5. Understanding the landscape

→ • Describe the whole haystack (including needles)

ARLABnetwork

https://www.cdc.gov/drugresistance/ar-lab-networks/domestic.html

Global AR Lab & Response Network

https://www.cdc.gov/drugresistance/ar-lab-networks/global.html

Leveraging AR Lab Network for detection and response

The New York Times

Eye Drops Are Recalled After Being Linked to Vision Loss and 1 Death

The maker of EzriCare Artificial Tears said it was recalling the eye drops after U.S. health authorities linked the product to a drug-resistant bacteria strain.

Clinical Infectious Diseases

MAJOR ARTICLE

IDSA Infectious Diseases Society of America

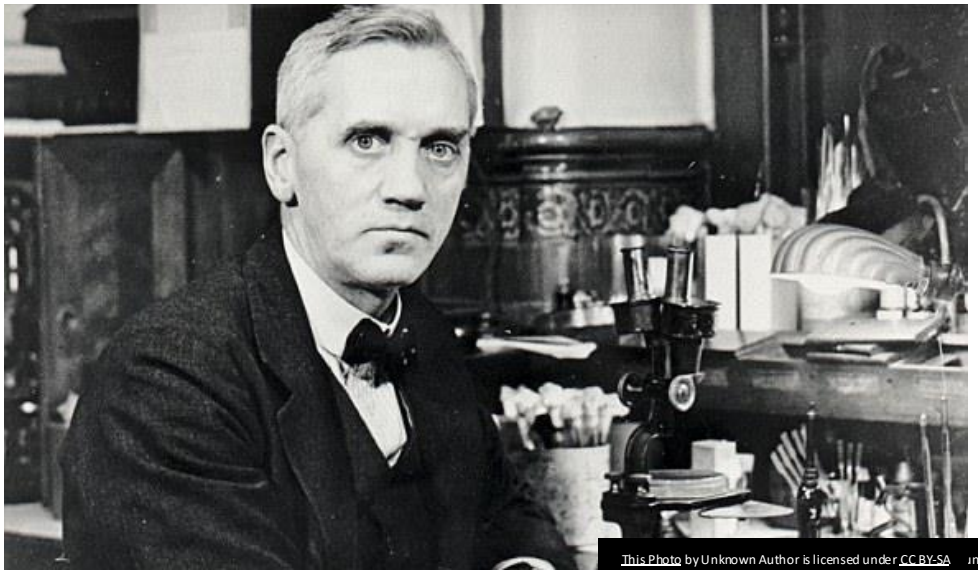
hivma hiv medicine association

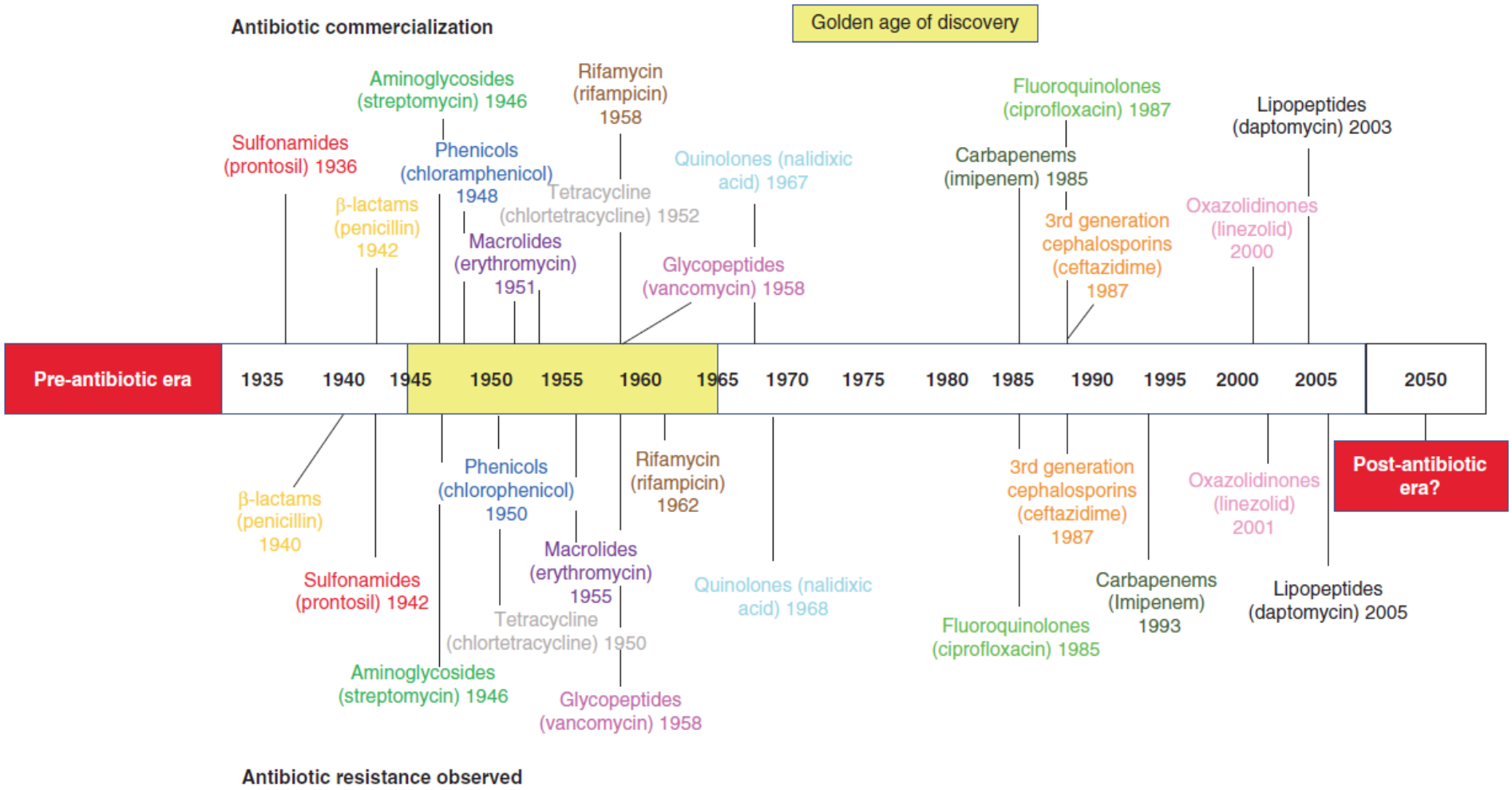
OXFORD

Extensively Drug-Resistant *Pseudomonas aeruginosa* Outbreak Associated With Artificial Tears

Grossman, et al. *Clinical Infectious Diseases*, 2024, https://doi.org/10.1093/cid/ciae052

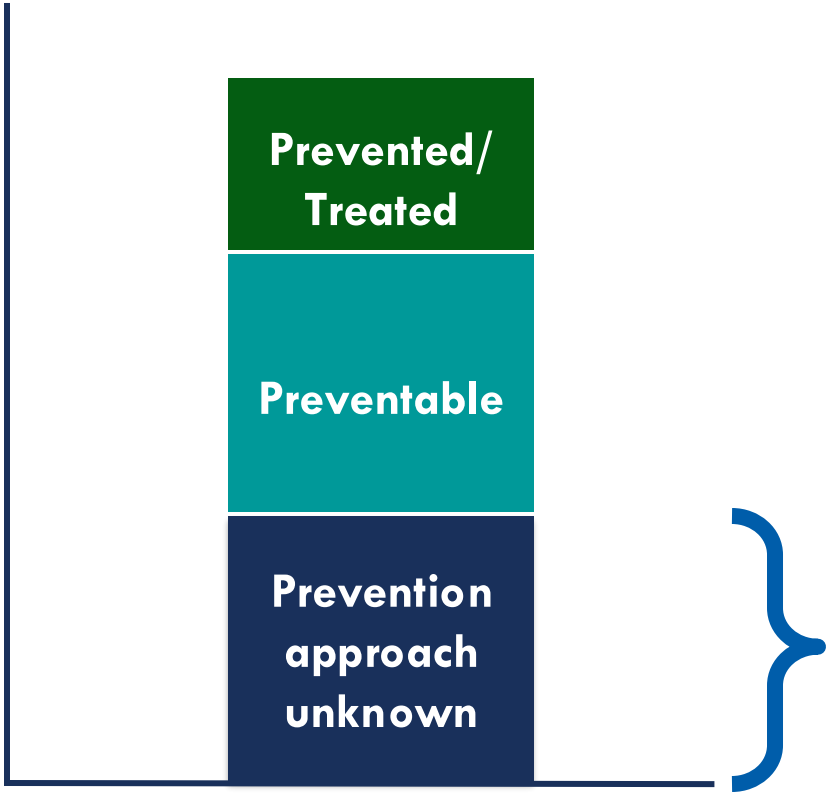
The Bigger Picture





Stephens, L. J., et al. (2020). Antimicrobial innovation: A current update and perspective on the antibiotic drug development pipeline. *Future Medicinal Chemistry*. doi:https://doi.org/10.4155/fmc-2020-0225

We Need Innovation



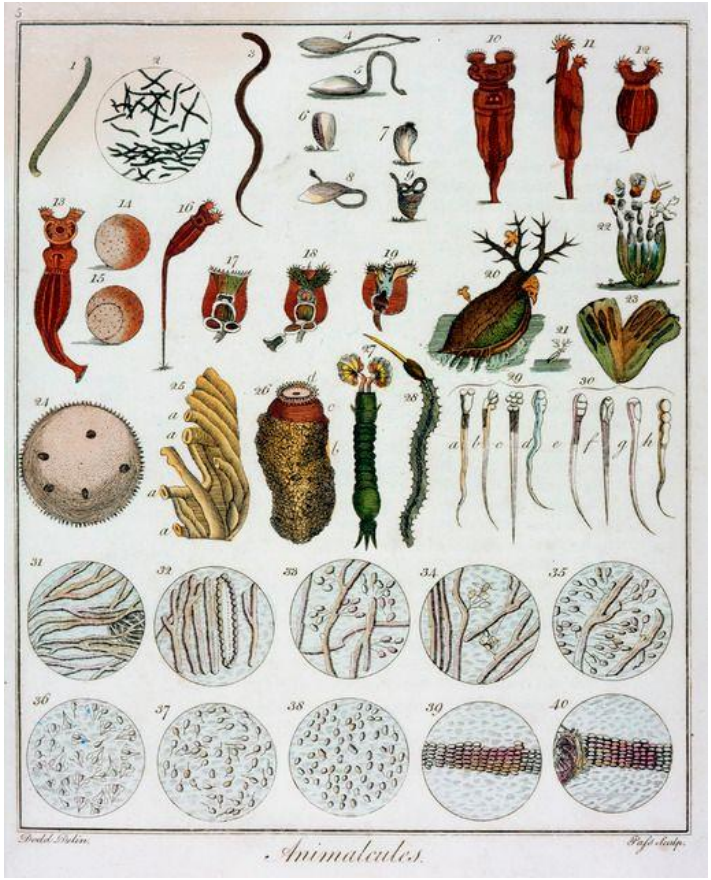
Innovation

Ongoing research for new strategies to:

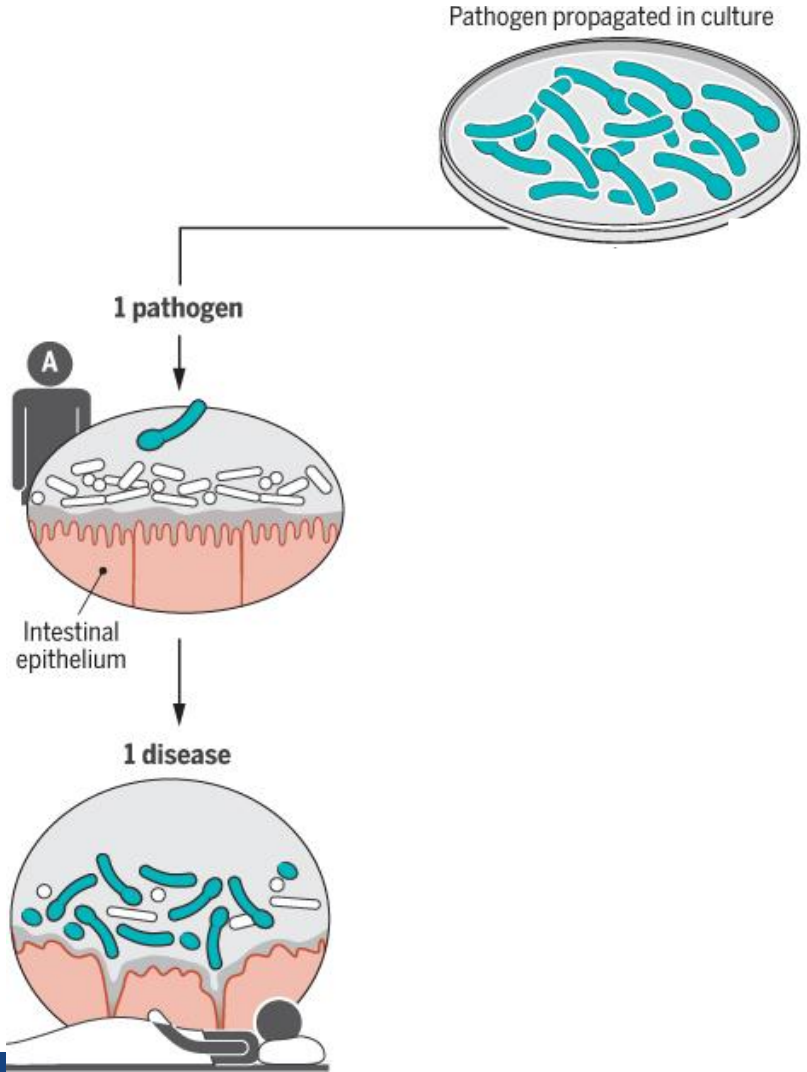
-Detect and respond

-Prevent infection and control transmission

Courtesy Dr. Denise Cardo

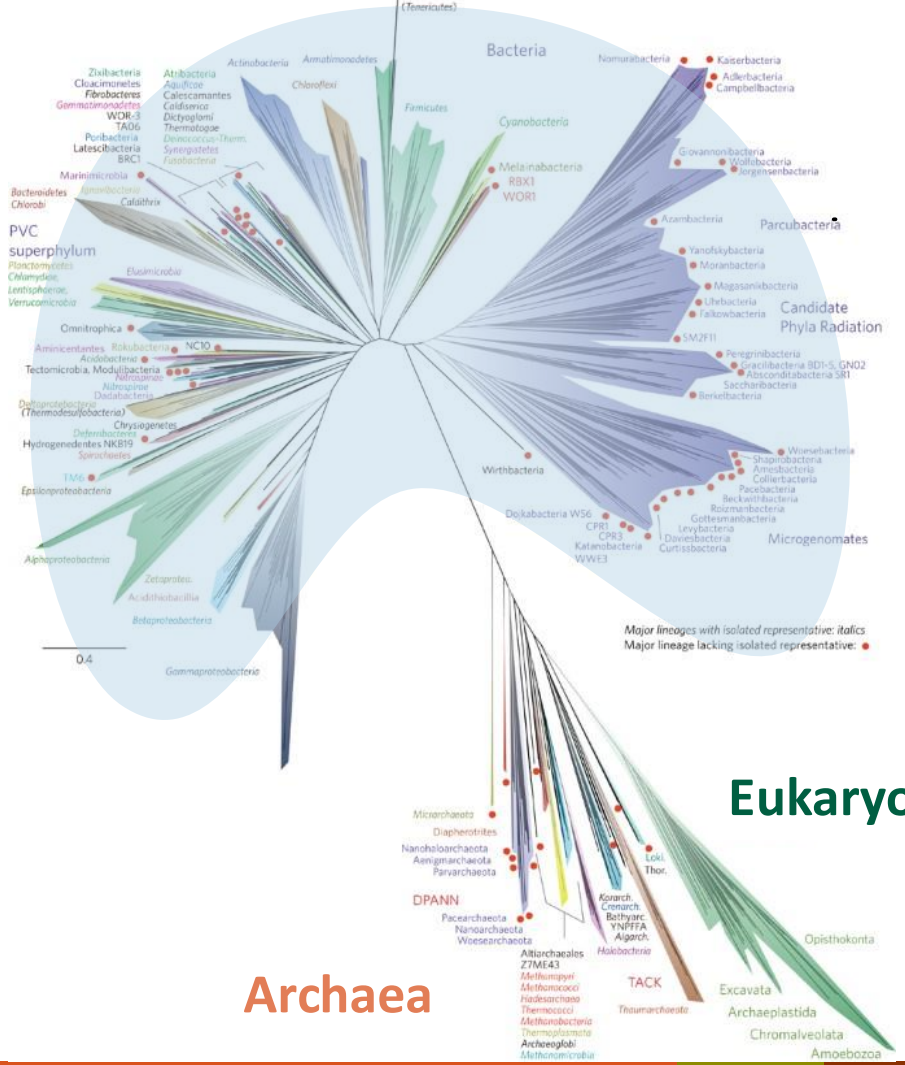

Animalcules.

Pathogenesis



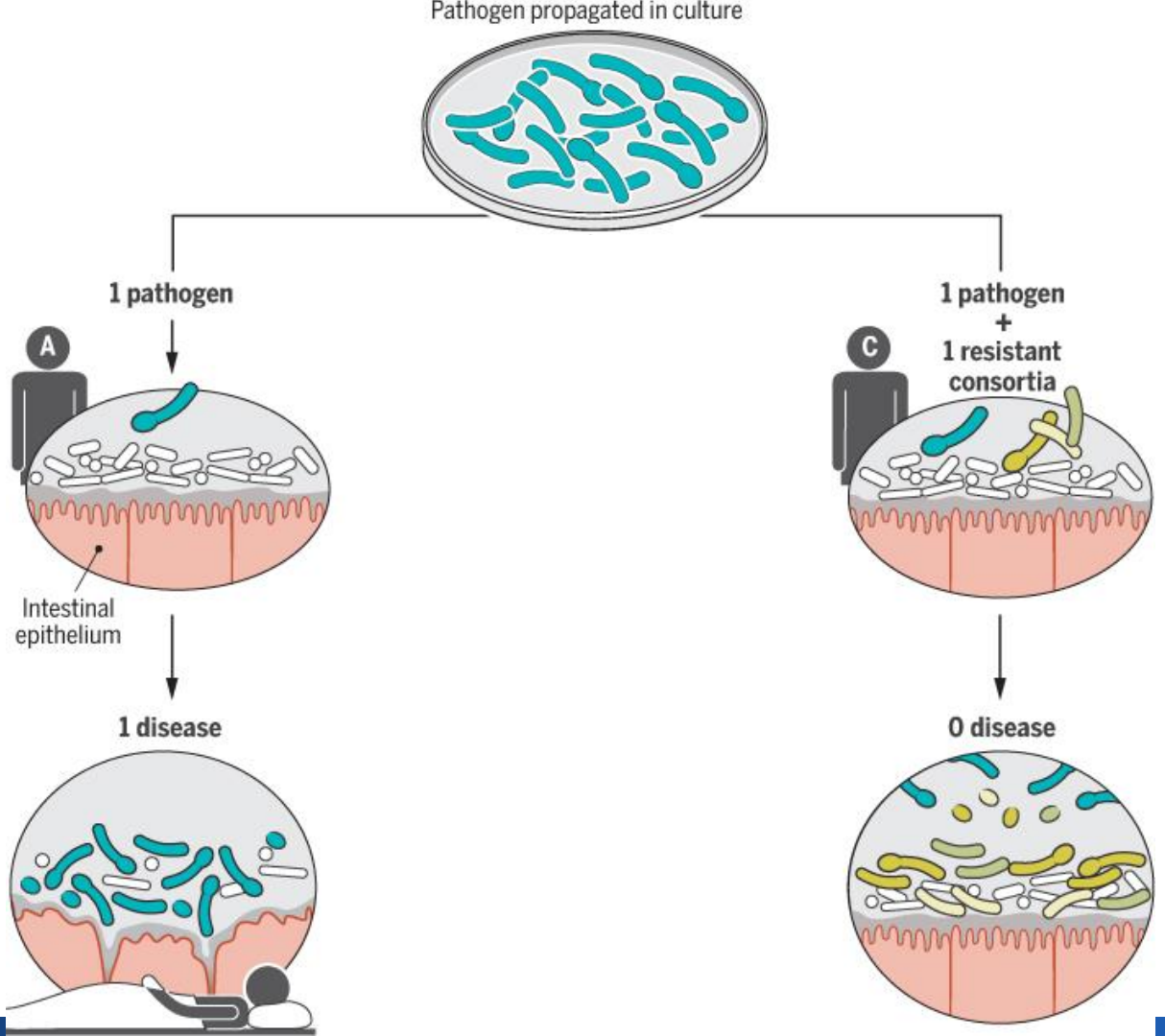
Allyson L. Byrd, Julia A. Segre. Adapting Koch's postulates. *Science* (2016). DOI:10.1126/science.aad6753

Bacteria

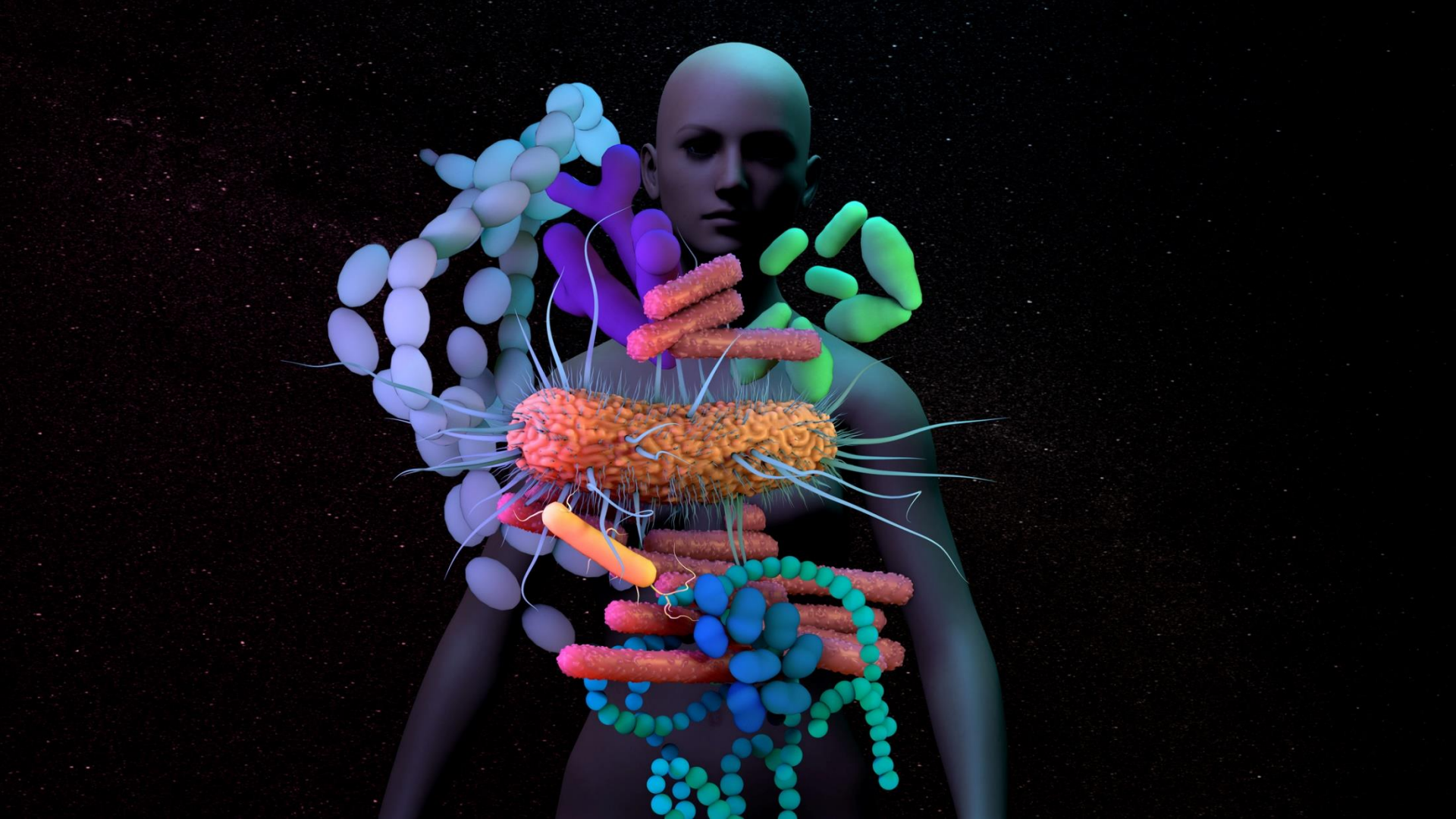


Hug, L., Baker, B., Anantharaman, K. *et al*. A new view of the tree of life. *Nat Microbiol* **1,** 16048 (2016). https://doi.org/10.1038/nmicrobiol.2016.48

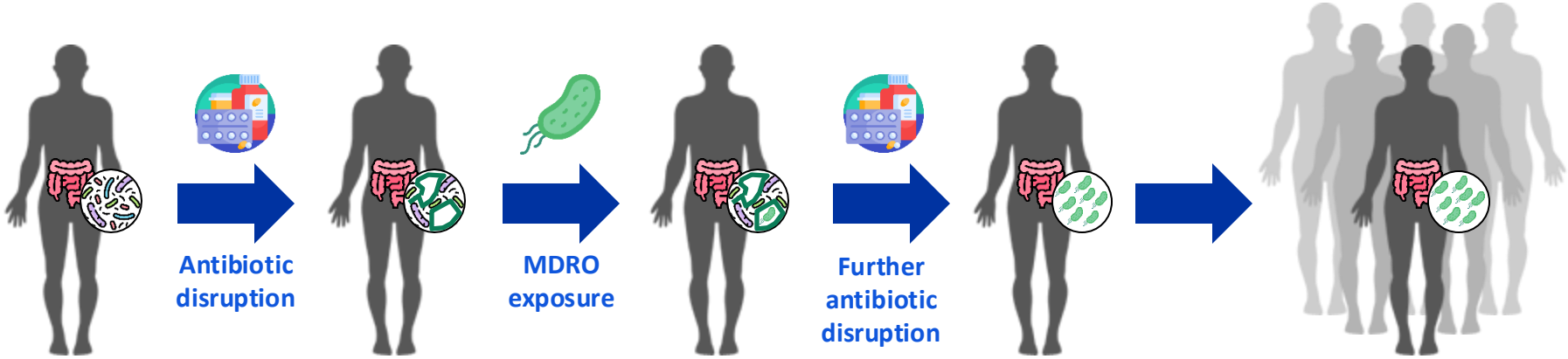
Pathogenesis



Allyson L. Byrd, Julia A. Segre. Adapting Koch's postulates. *Science* (2016). DOI:10.1126/science.aad6753



The cascade from antibiotic-mediated microbiome disruption to infection and transmission



Functional microbiome
Resistant to colonization

Disrupted microbiome
Susceptible to colonization

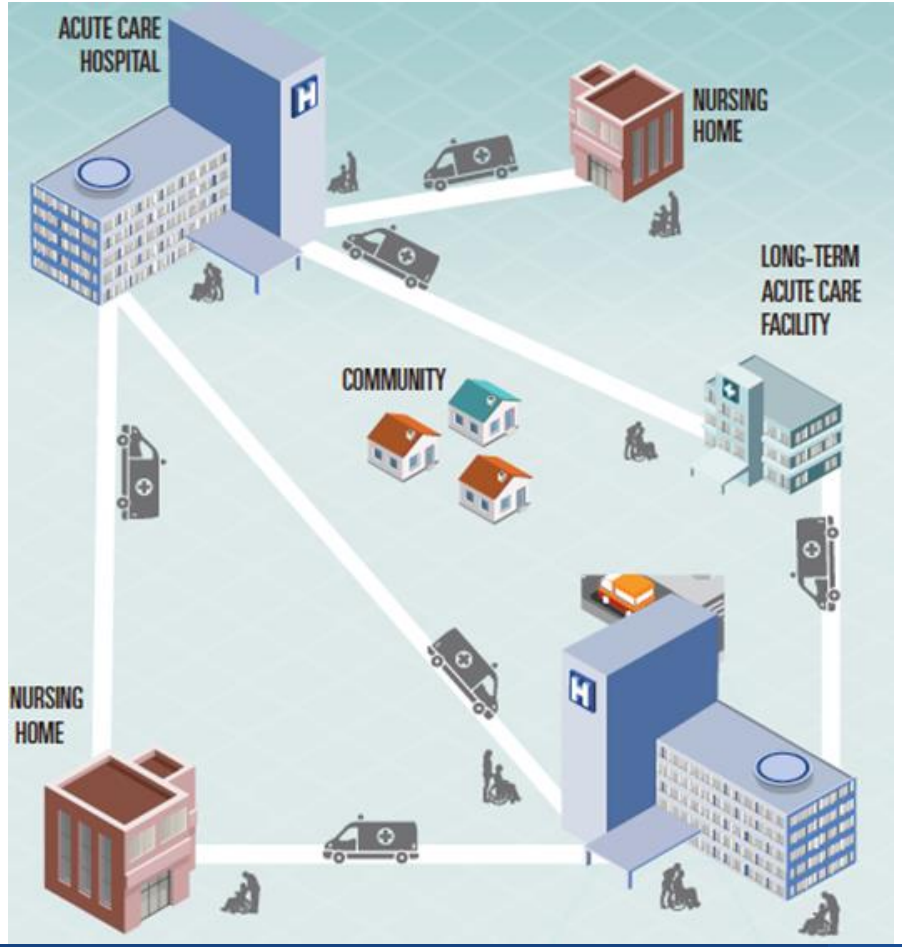
MDRO colonization
(including *C. difficile*)

MDRO overgrowth & dominance

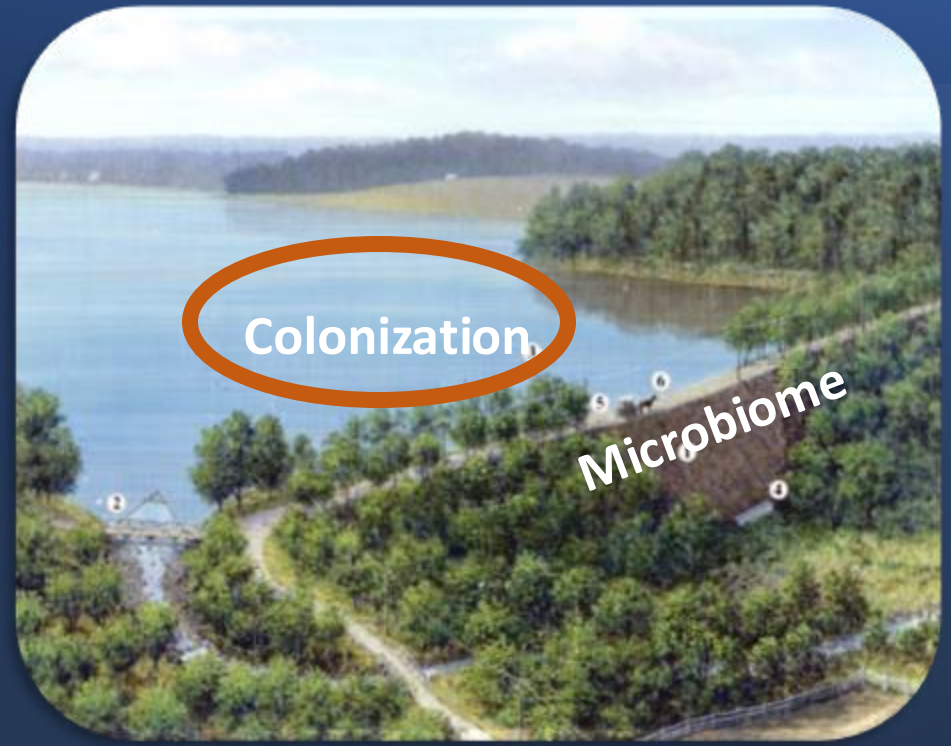
Infection & transmission of MDRO

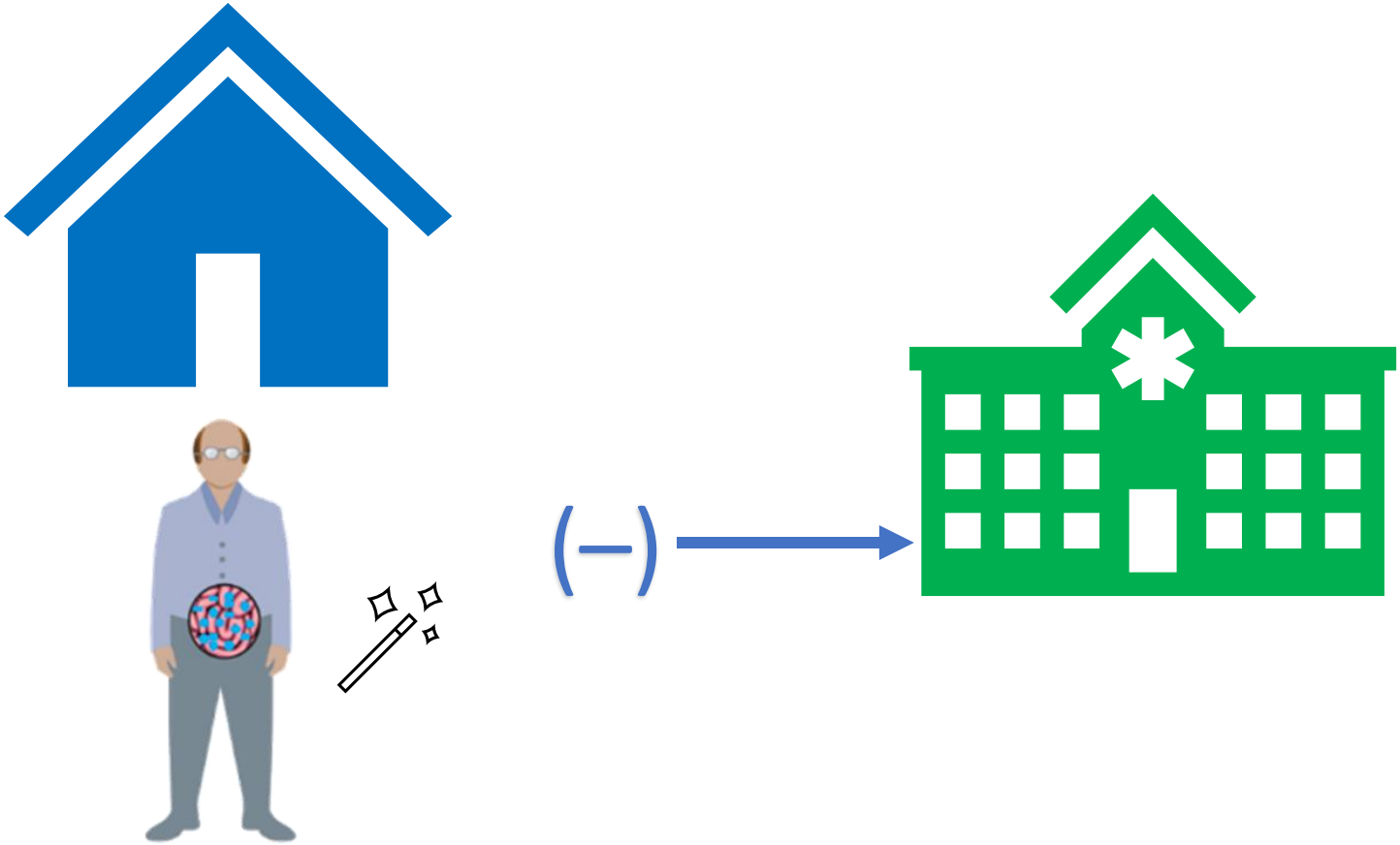
*MDRO: multidrug-resistant organism

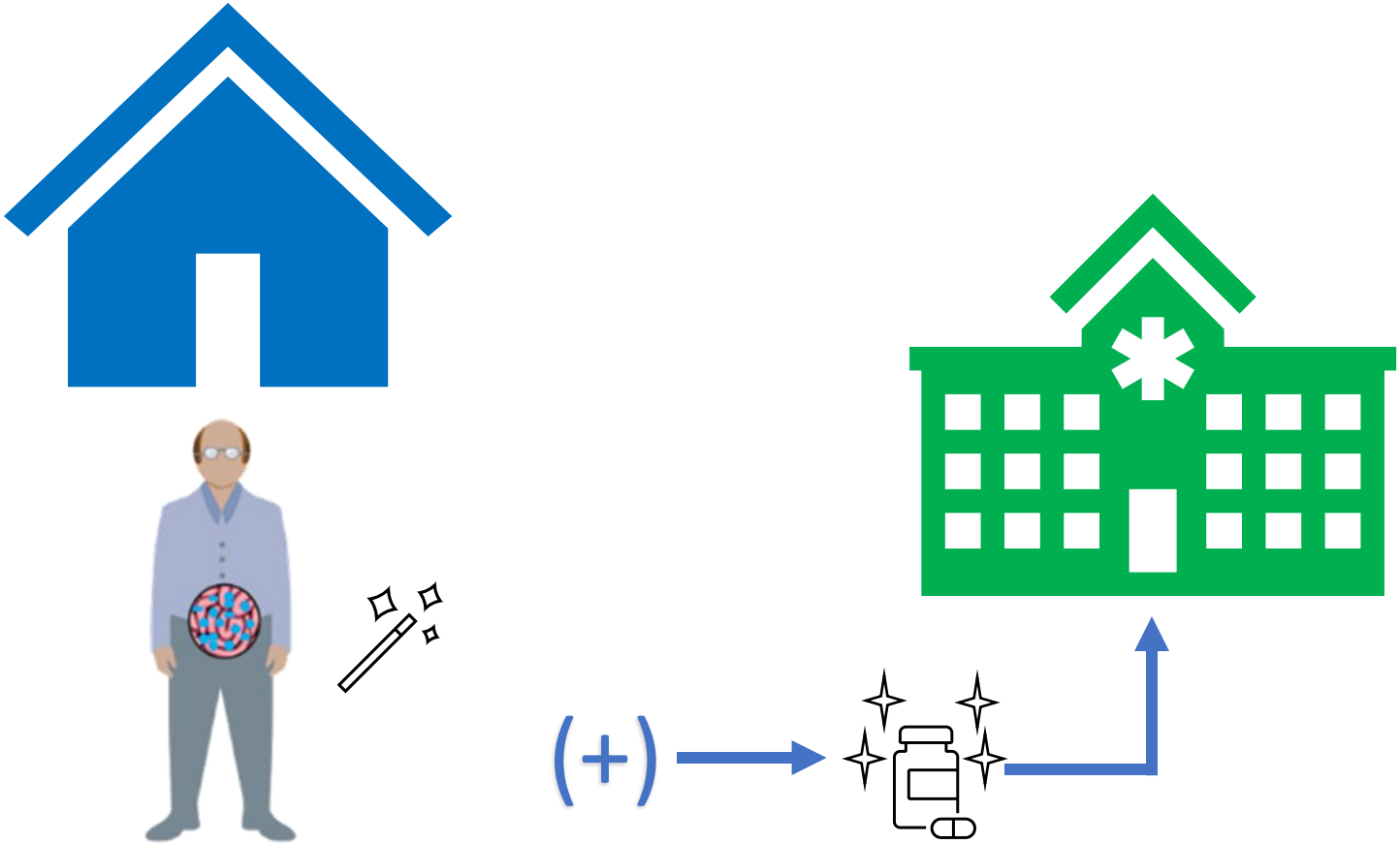
It’s All Connected

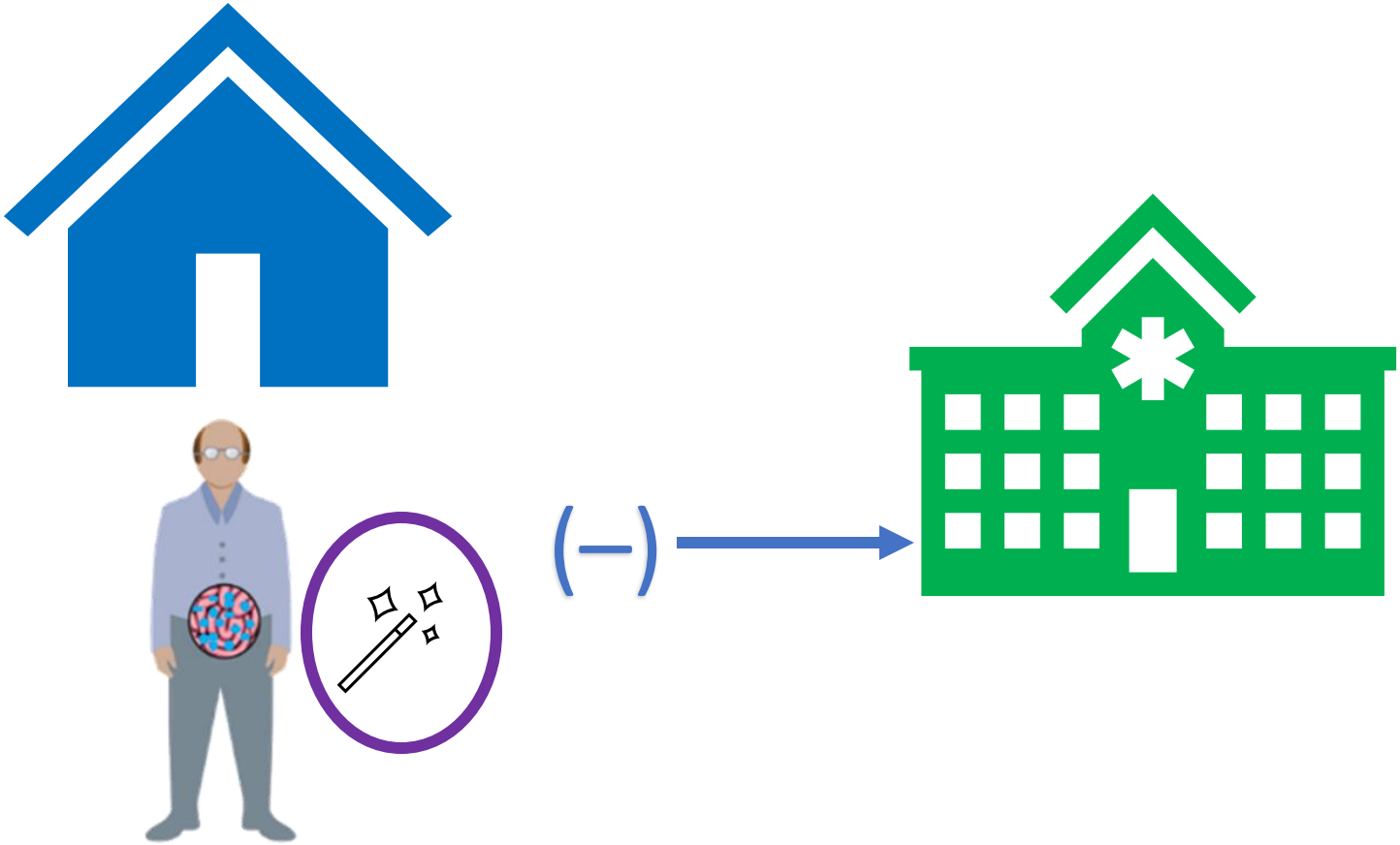


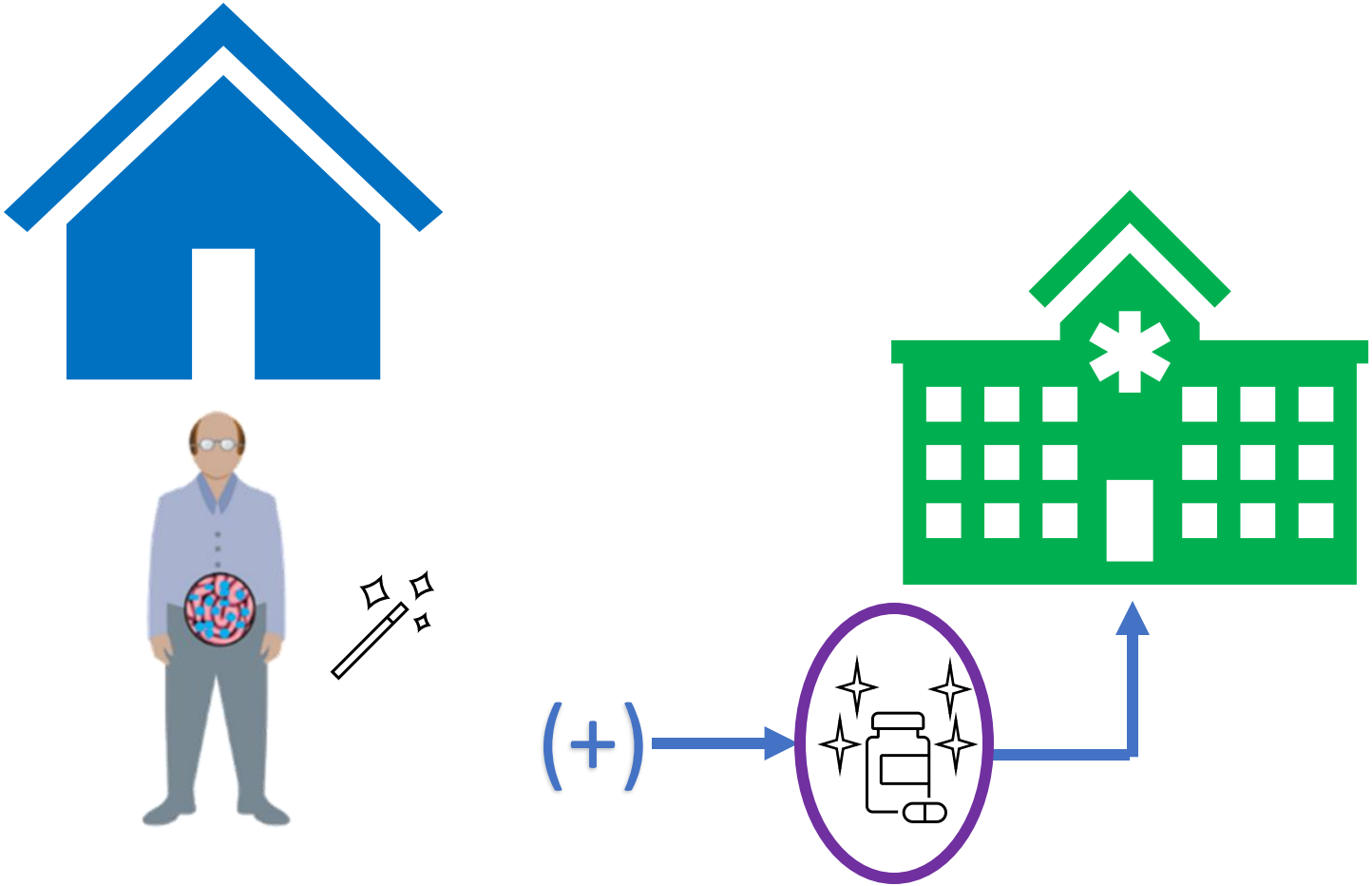
Disruption







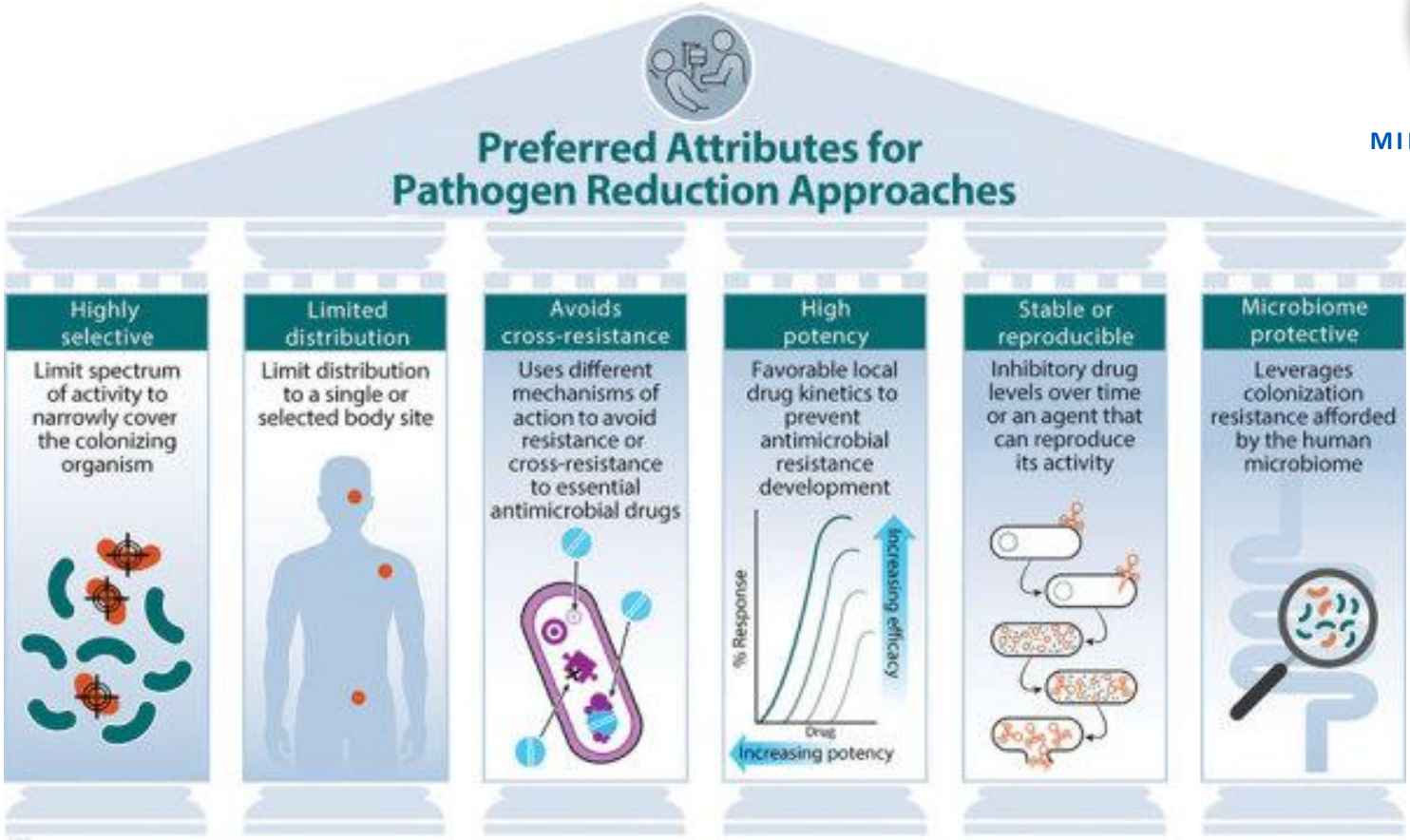




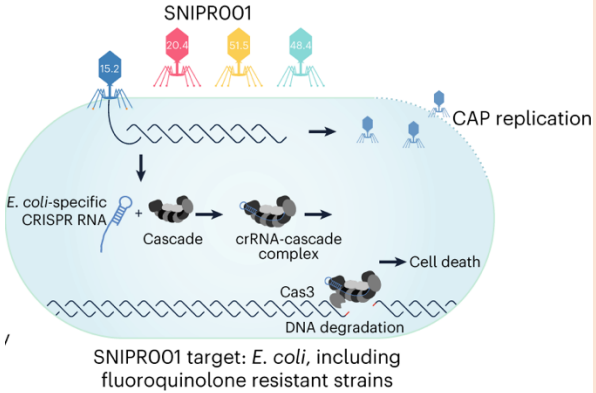
https://info.rescueagency.com/en-us/drug-development-consideration-virtual-public-workshop-cdc-fda

MIKE MANGALEA

Preferred Attributes for Pathogen Reduction Approaches



Mangalea MR, Halpin AL, Haile M, Elkins CA, McDonald LC. Decolonization and pathogen reduction approaches to prevent antimicrobial resistance and healthcare-associated infections. Emerg Infect Dis. 2024 Jun. https://doi.org/10.3201/eid3006.231338



SNIPR001 target: *E. coli*, including fluoroquinolone resistant strains

Microbiome-complementary therapeutics

SERES THERAPEUTICS

Nestlé HealthScience

VOWST™ (fecal microbiota spores, live-brpk) capsules

Available microbiota-based therapies: *C. difficile* (Q1 2024)

Company	Product	Regulatory status	Formulation	Approx Cost	Setting
Rebiotix	Rebyota	FDA Approved 11/2022	Rectal instillation (enema)	$9k/dose	Clinic/ Inpatient
Seres Therapeutics	VOWST	FDA Approved 4/2023	4 capsules PO daily x 3 days	$17,500/course	Outpatient
Vedanta	VE303	Entering Phase 3 trials	Capsule	TBD	Outpatient
OpenBiome	MTP-101LR MTP101LF	Pivoted to descriptive research; distributing FMT preparations manufactured under Good Manufacturing Practice by Univ MN under IND	Lower or upper delivery Lower delivery	$1695/dose +$150 shipping	Clinic/ inpatient
Univ MN	Stool donor program	Focusing on non-profit provision of microbiota	Colon prep or capsule	No patient cost	
Finch	CP101	Phase 3 study discontinued 1/2023; focusing on intellectual property	Capsule		

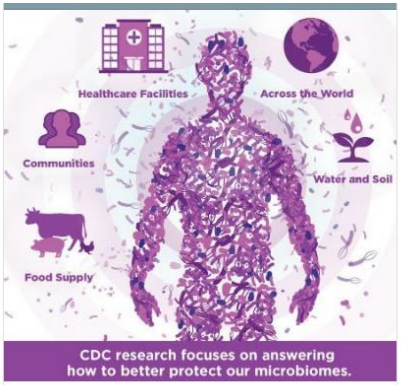
Launched! – CDC's Microbial Ecology for Health

About Harnessing Microbial Ecology for Public Health

Print

Germs, or microbes, are found everywhere, including on and in people, animals, and the environment, where they exist in communities called microbiomes. People have their own microbiomes (e.g., on their skin, in the gut) that help maintain good health and protect people from infections.

CDC invests in research around microbial ecology, which looks at the relationships within and across these microbial communities to determine how germs interact with one another and their environment. Microbial ecology includes interactions with people, animals, plants, food, and surfaces (e.g., healthcare bed rails or



CDC Studies Microbial Ecology to Protect People from

https://www.cdc.gov/drugresistance/microbial-ecology.html

Prevention is our Goal and Responsibility

Acting locally to prevent infections globally, now and always.

Alicia Cole

Nile Moss

Peggy Lillis

Rory Staunton

Erin Flatley

Catherine Duff

Joshua Nahum

Dana Mirman

Thank you!

Questions?

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov