A Turnkey, Fully-Automated, Cloud Computing-Integrated Genomics Solution for Public Health Surveillance of Tomorrow

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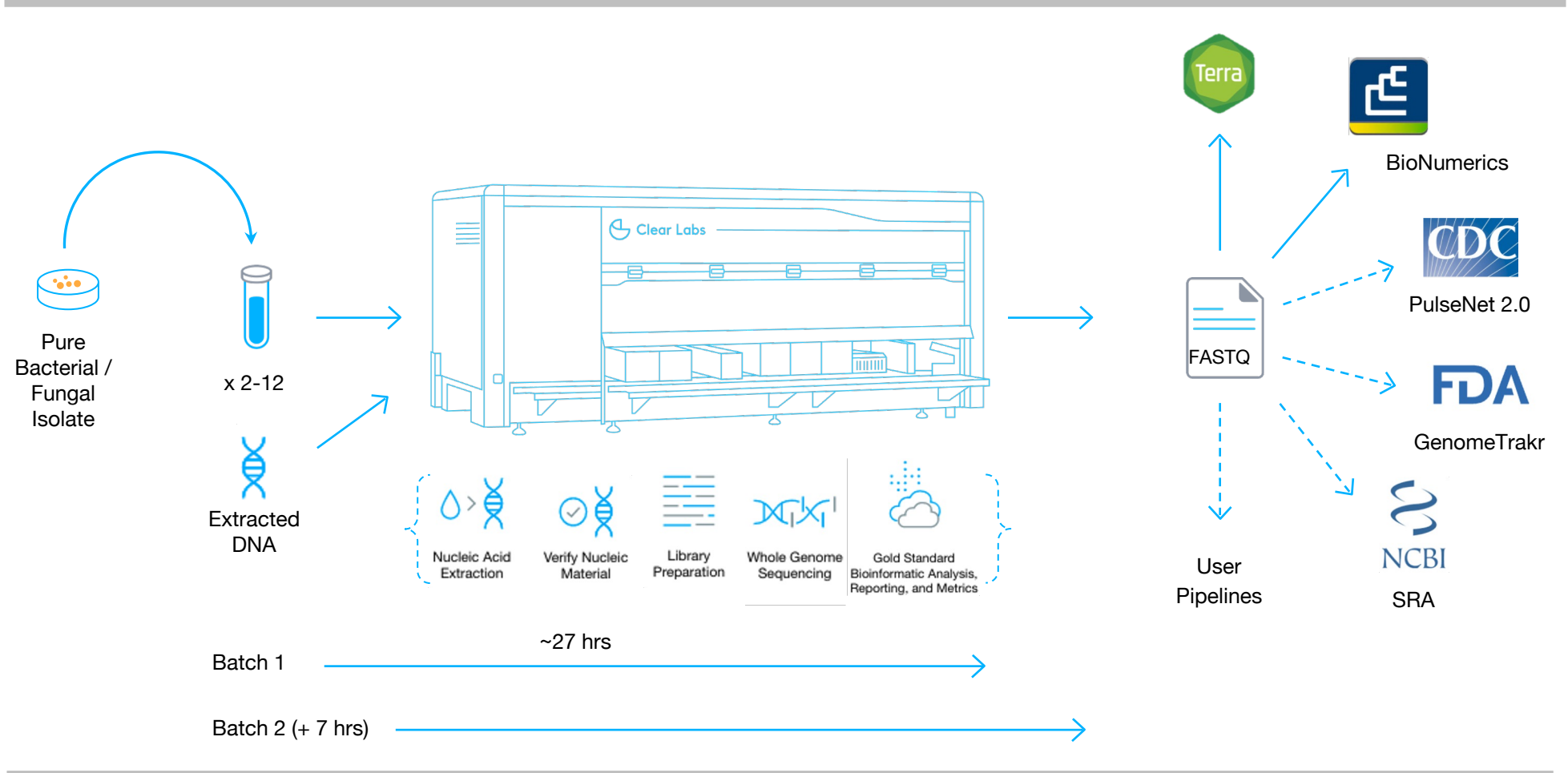
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INTRODUCTION

- Next generation sequencing (NGS) becoming method of choice for outbreak investigation & antimicrobial resistant (AMR) profiling.[1]
- Highly complex & manual NGS workflows typically lead to inaccurate results and costly reruns of tests due to operator-to-operator variability and errors.[2]
- Automating NGS workflow, from sample extraction to library preparation and sequencing, would significantly improve laboratory efficiency, reduce turnaround times and labor costs.[2]
- A turnkey, end-to-end, fully automated whole genome sequencing (WGS) solution was developed.
- Cost-effective, gram-agnostic, single touchpoint workflow for surveillance and characterization of bacterial and fungal pathogens.
- Increase productivity and operation efficiency in resource-constrained public health laboratories.[3,4,5]
- Expedite generation of actionable data during outbreak investigation.[1,3,4,5]
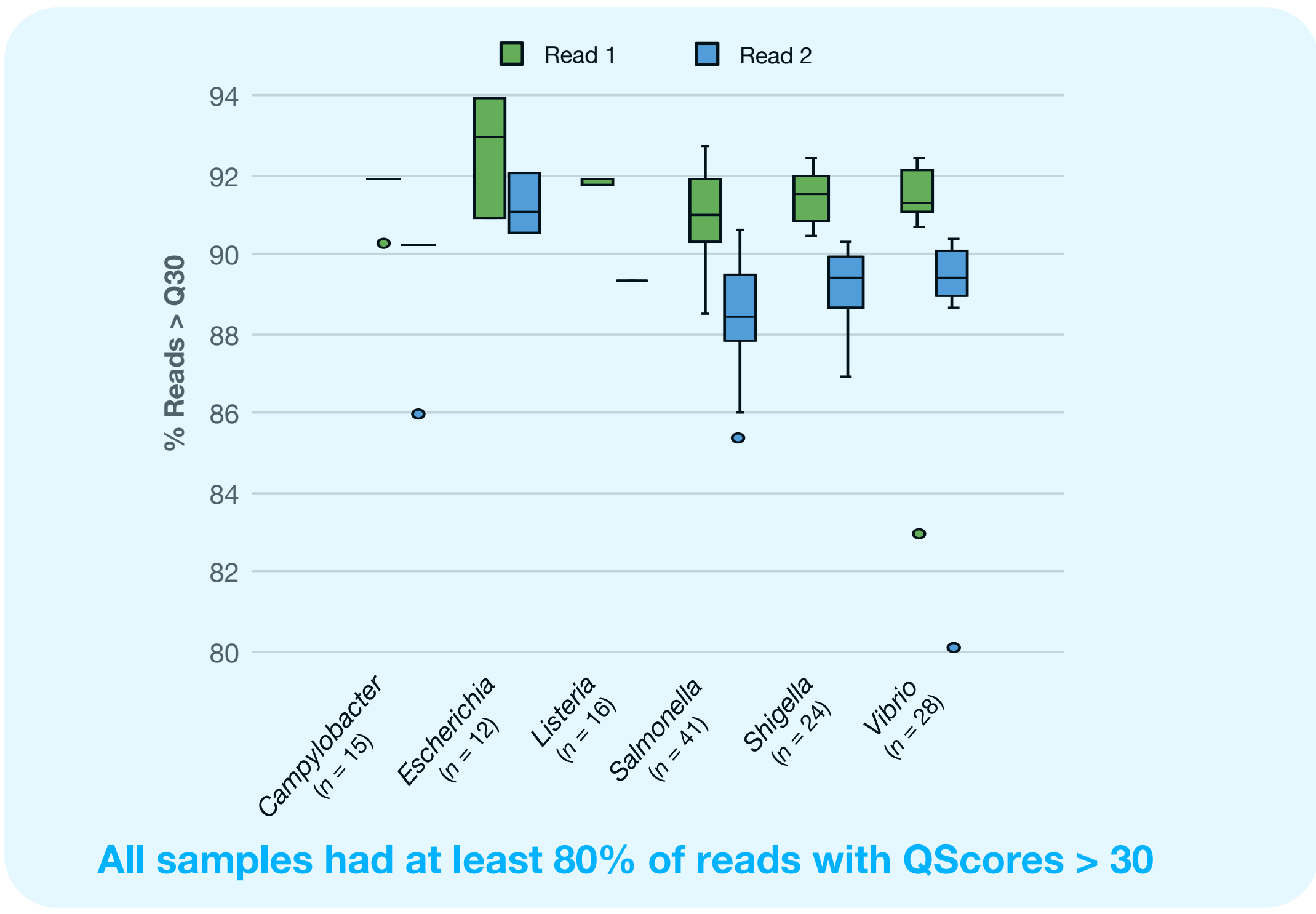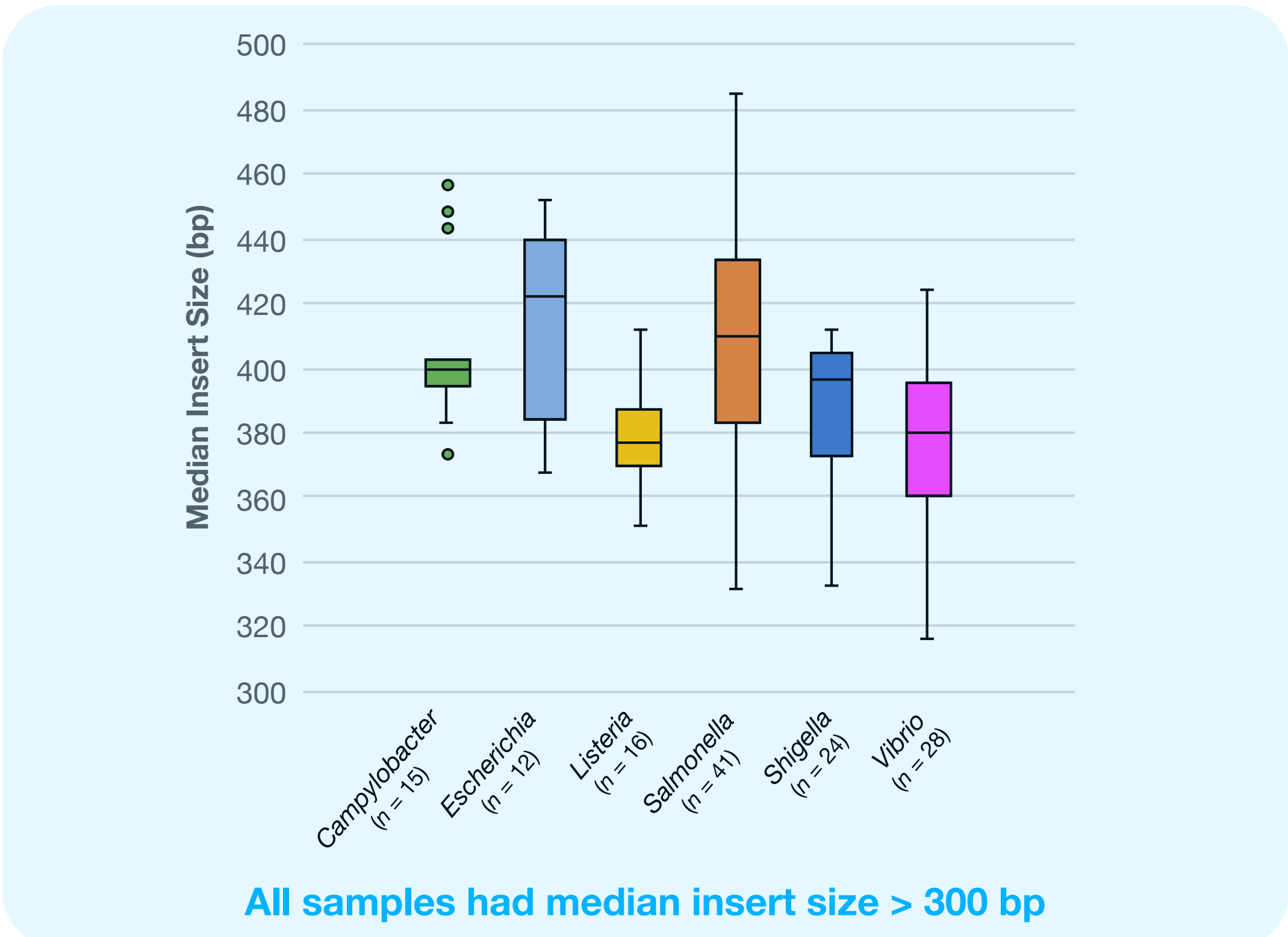
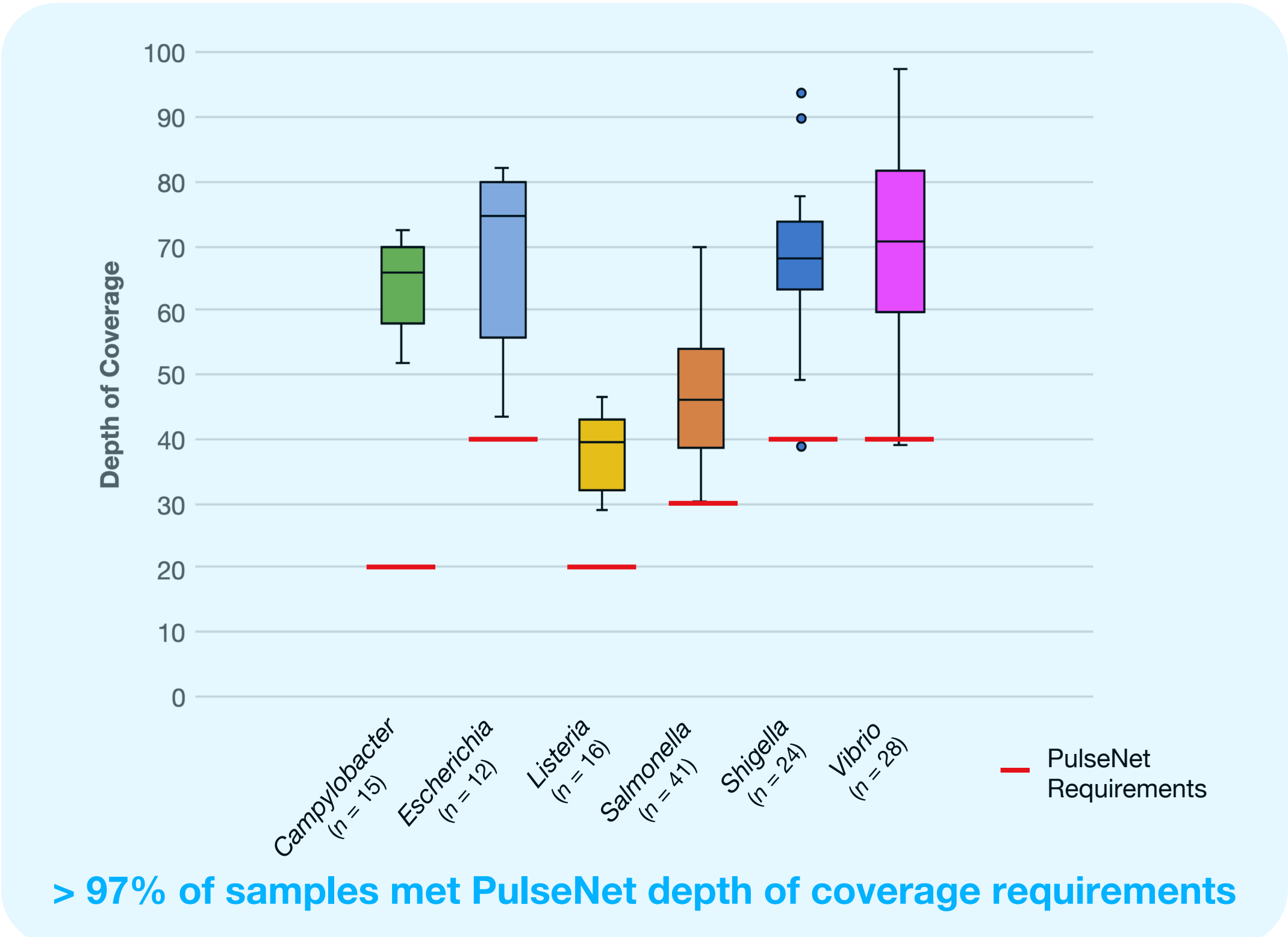### The Clear Dx™ Automated Platform

METHODS

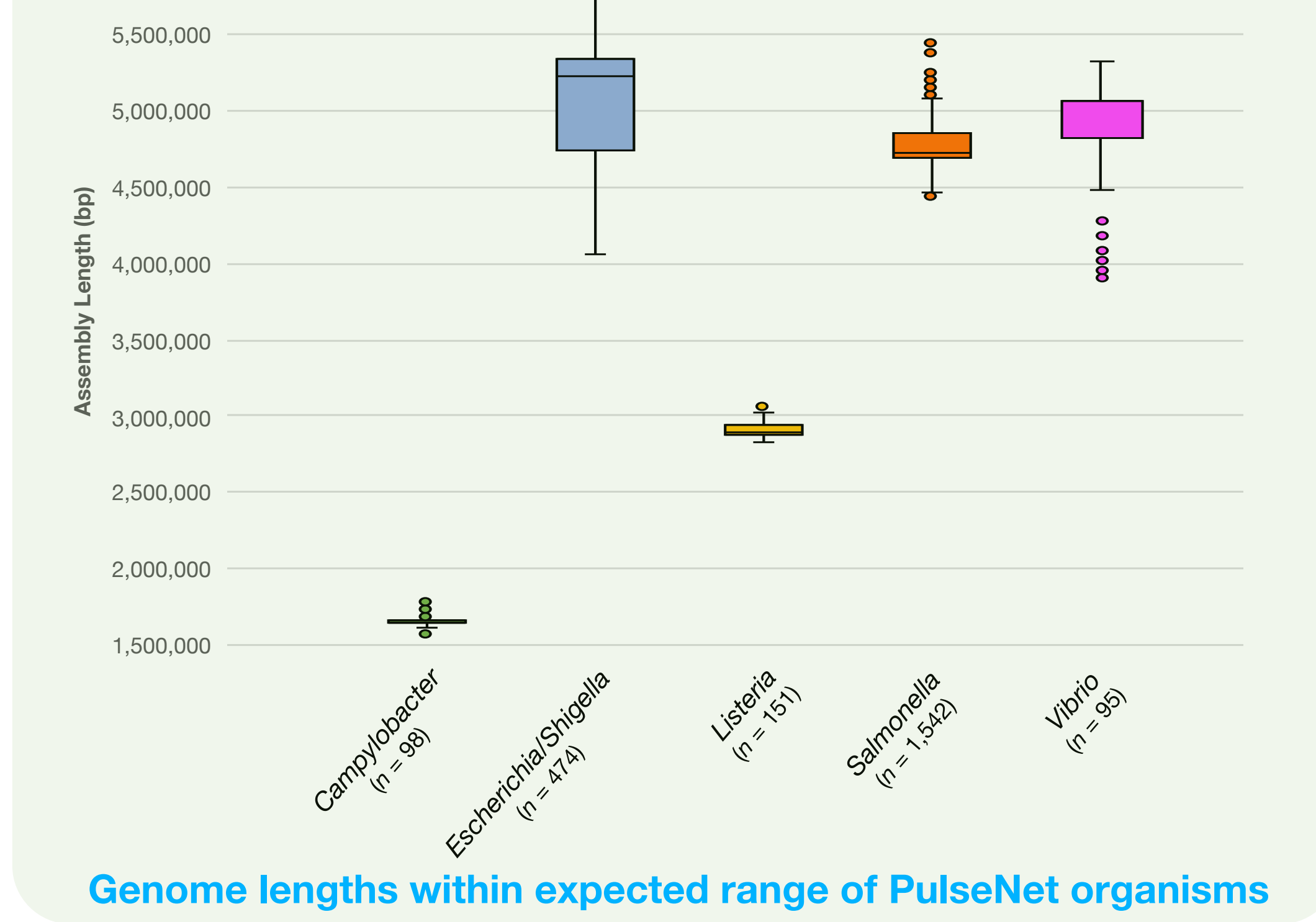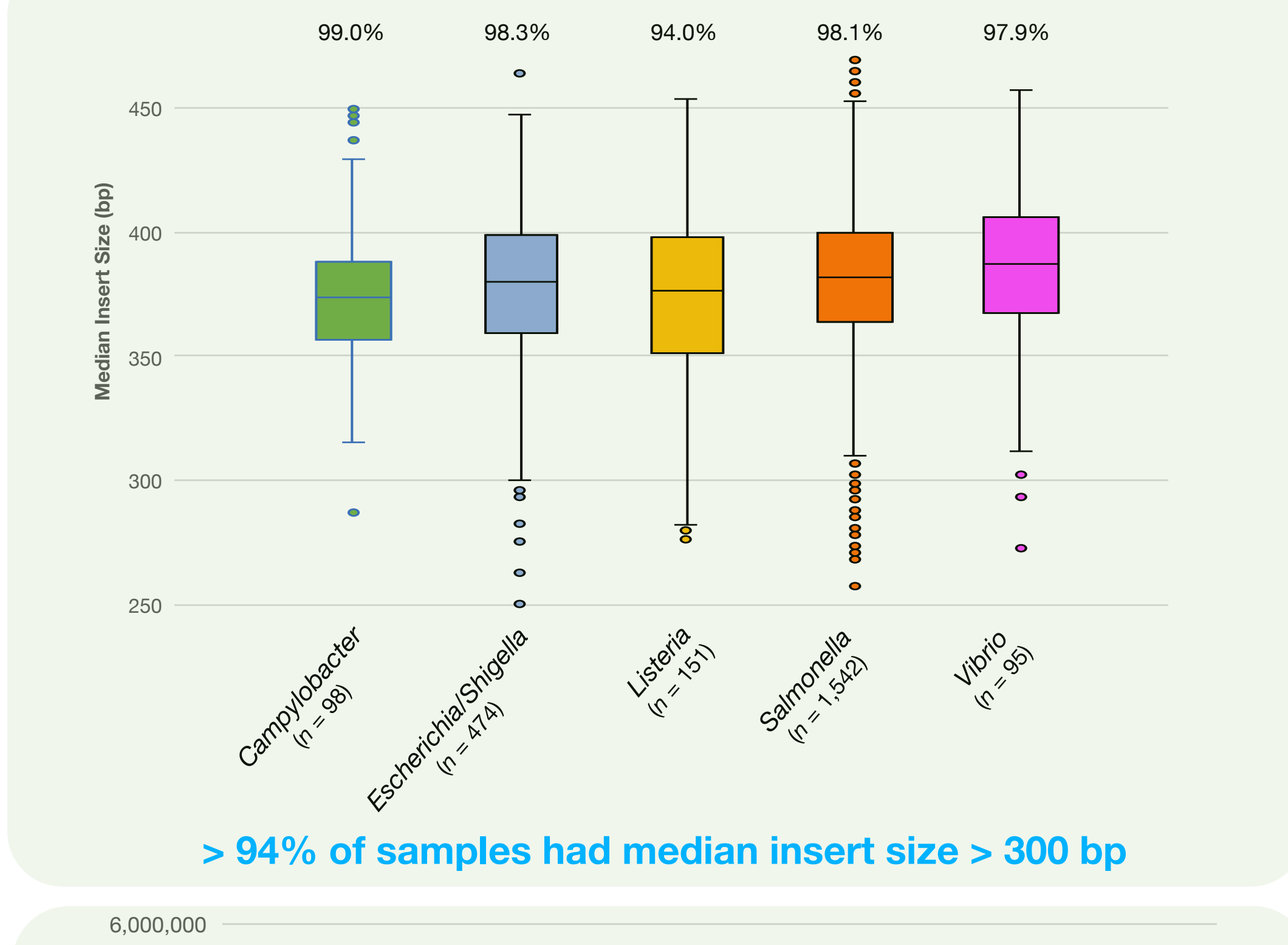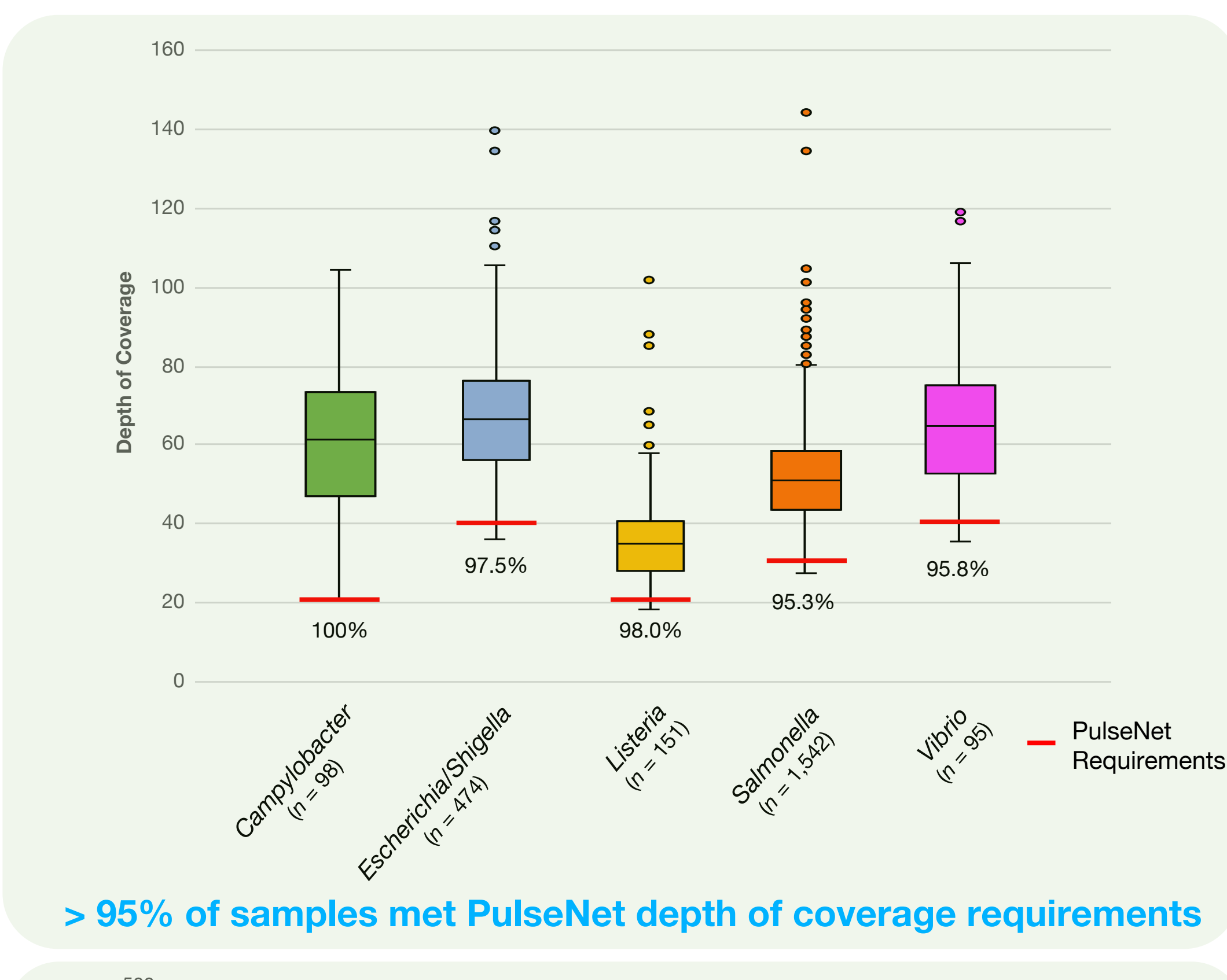### Overview of the Microbial Surveillance WGS Workflow

[1] Gilchrist, C.A. et al. Whole-genome sequencing in outbreak analysis. Clin Microbiol Rev. 2015, 28(3), 541-563.
[2] Holland, I. & Davies, J.A. Automation in the Life Science Research Laboratory. Front. Bioeng. Biotechnol. 2020, 8, 571777.
[3] Abdullah, K., Iwen, P.C. & Abdalhamid, B. Applications of Clear Dx whole genome sequencing system in SARS-CoV-2 diagnostics. J. Infect. Public Health. 2022, 15(8), 894-895.
[4] Lam-Hine, T. et al. Outbreak Associated with SARS-CoV-2 B.1.617.2 (Delta) Variant in an Elementary School — Marin County, California, May–June 2021. MMWR. 2021, 70, 1214–1219.
[5] Ramaiah, A. et al. Genomic Surveillance Reveals the Rapid Expansion of the XBB Lineage among Circulating SARS-CoV-2 Omicron Lineages in Southeastern Wisconsin, USA. Viruses, 2023, 15, 1940.

RESULTS

CDC PulseNet Organisms – Internal Validation

> 97% of samples met PulseNet depth of coverage requirements

All samples had median insert size > 300 bp

All samples had at least 80% of reads with QScores > 30

CDC PulseNet Organisms – Field Data

> 95% of samples met PulseNet depth of coverage requirements

> 94% of samples had median insert size > 300 bp

Genome lengths within expected range of PulseNet organisms

Time and Motion Study

	Clear Dx™	Legacy NGS
Time to results	~27 hrs	4-10 days
Approximate hands-on time	45 min	9-10 hrs
Human touchpoints	1	10+

Other Use Cases: Healthcare-Associated Infection (HAI)

Gram Negative

Salmonella, Escherichia, Shigella, Vibrio, Campylobacter, Klebsiella, Pseudomonas, Acinetobacter, Enterobacter, Shigella, Serratia, Citrobacter, Raoultella, Cronobacter, Providencia, Yersinia, Proteus, Aeromonas, Edwardsiella, Neisseria, Legionella, Burkholderia, Stenotrophomonas, Shewanella, Kluyvera, Pluralibacter, Elizabethkingia, Eikanella, Moraxella, Rahnella, Haemophilus, Kingella, Mycoplasma, Photobacterium

Gram Positive

Listeria, Streptococcus, Staphylococcus, Enterococcus, Bacillus, Clostridioides, Aerococcus, Mycobacterium, Mycolicibacterium, Mycobacterioides, Erysipelothrix

Fungi

Candida

- Universal lysis buffer & extraction method for all pathogens
- Universal automated workflow for all pathogens
- Gram-stain based colony input

46 pathogens internally verified using the application to date

Foodborne Associated Outbreaks · Sexually Transmitted Infections (e.g., N. gonorrhoeae) · Healthcare Associated Outbreaks · Antimicrobial Resistance · Tuberculosis · Fungal (e.g., Aspergillus) · Fungal (e.g., Candida) · Respiratory Viruses · Protozoa (e.g., Cryptosporidium) · Enteric Viruses (e.g., Norovirus)

Clear Labs Verified / Customer Verified

CONCLUSION

- Clear Dx™ Microbial Surveillance WGS is a fully automated, end-to-end solution for bacterial and fungal characterization.
- Robust, field-tested and easy-to-use application.
- High quality and reproducible data meeting CDC PulseNet's stringent requirements.
- System accepts dsDNA and amplicons as input material.
- Empower public health laboratories to effectively characterize, monitor and survey pathogens of interest.