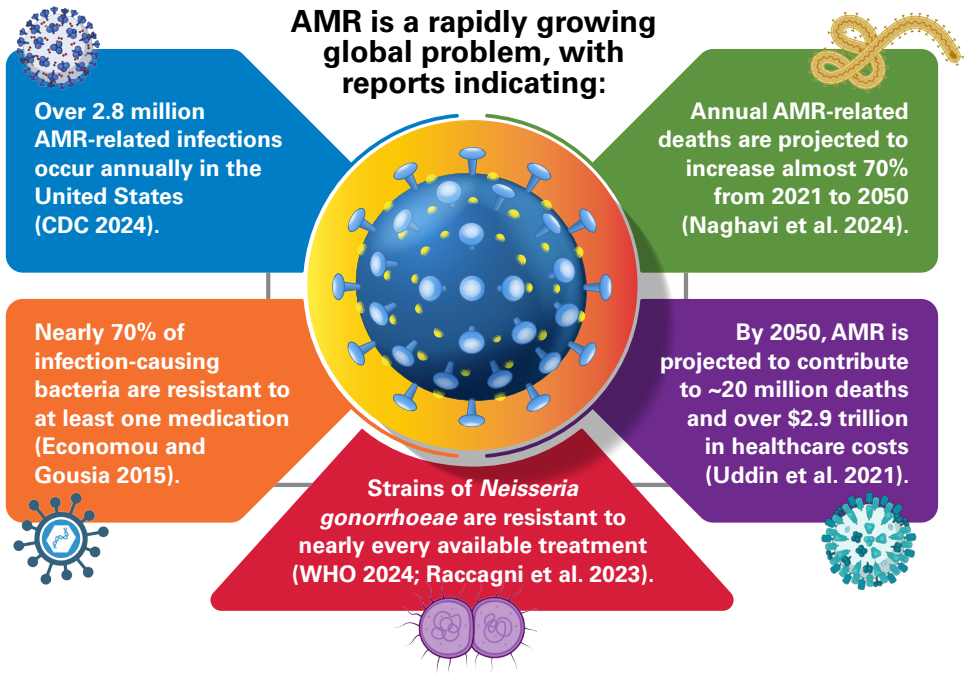
Keeping up with the microbes: Methods for effective AMR detection

TaKaRa

Why is AMR detection important?

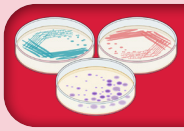
Antimicrobial resistance (AMR) is an emerging public health crisis in which microorganisms—such as bacteria, fungi, viruses, and parasites—acquire antibiotic resistance genes (ARGs) that enable them to withstand antimicrobial drugs. As a result, combatting these microorganisms requires constant AMR surveillance and new antibiotic development.

With AMR on the rise, we need effective methods to identify and limit resistant microbes.



How do scientists detect AMR?

Microorganisms with AMR can be distinguished either by phenotype, such as survival of antibiotic exposure, or molecular indicators, such as expression of ARGs. While AMR detection strategies constantly evolve, there are three primary methods used worldwide:



Bacterial culture plates

Microorganism samples are grown on bacterial culture plates under antibiotic exposure, with surviving microorganisms considered positive for AMR.

- ✔ Simple and straightforward protocol
- ✔ Inexpensive, requiring few materials
- ✘ Long turnaround time (>1 day)
- ✘ Unsuitable for nonculturable microorganisms
- ✘ No quantitative results
- ✘ Labor-intensive

Sequencing

Sequencing identifies ARGs or ARG expression in microorganisms as an indicator of AMR.

- ✔ Covers whole genome or transcriptome
- ✔ Processes multiple samples at once
- ✘ Requires lengthy turnaround time (2–3 days)
- ✘ Involves technical expertise for complex data analysis
- ✘ No quantitative results

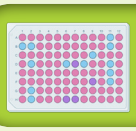


Plate-based qPCR

Plate-based qPCR (with 96 or 384 wells) detects the presence of specific ARG targets in sample microorganisms.

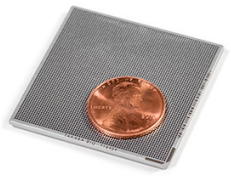
- ✔ Fast turnaround time (~3 hr)
- ✔ Minimal expertise required
- ✔ Quantitative, reliable results
- ✔ Inexpensive at small scale
- ✘ Limited throughput (max 4 samples per plate for traditional 96-target panels)
- ✘ Difficult to scale up, due to high reagent costs and labor needs

As demand grows for routine, large-scale AMR monitoring of hundreds of ARG targets, it is evident that these traditional methods fall short for global AMR surveillance efforts.

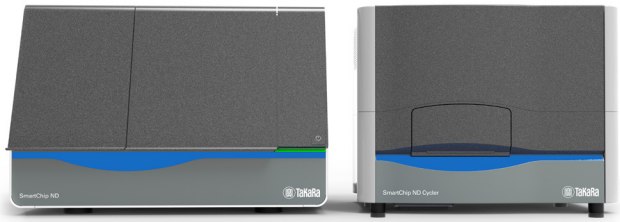
What does effective large-scale AMR look like?

Ideal AMR detection requires:	Automated qPCR with SmartChip ND™ Real-Time PCR System provides:
Scalable high-throughput capabilities	**Large panel size,** accommodating 384 assays for 12 samples, with up to 5,184 reactions per run
Rapid processing with minimal hands-on time	**Fast (3 hr)** semi-automated workflow (30 min hands-on time)
Low costs per reaction for materials	**Nanoliter reaction volume** to reduce reaction costs
Reliable, sensitive results, even for difficult-to-culture microbes	**Reproducible detection** of low-abundance ARGs (LoD of 20 copies/reaction)
Flexibility to accommodate different ARGs and sample types	**Customizable assay configurations** for each qPCR panel

SmartChip ND Real-Time PCR System



5,184 reactions per chip



<1 hr sample and assay dispense

~2 hr qPCR run to data

References

Antimicrobial Resistance Facts and Stats | Antimicrobial Resistance | CDC. at <https://www.cdc.gov/antimicrobial-resistance/data-research/facts-stats/index.html>

Economou, V. & Gousia, P. Agriculture and food animals as a source of antimicrobial-resistant bacteria. *Infect. Drug Resist.* 49–61 (2015).

Multi-drug resistant gonorrhoea. at <https://www.who.int/news-room/fact-sheets/detail/multi-drug-resistant-gonorrhoea>

Naghavi, M. et al. Global burden of bacterial antimicrobial resistance 1990–2021: a systematic analysis with forecasts to 2050. *Lancet* **404**, 1199–1226 (2024).

Raccagni, A. R. et al. Neisseria gonorrhoeae antimicrobial resistance: the future of antibiotic therapy. *J. Clin. Med.* **12**, 7767 (2023).

Uddin, T. M. et al. Antibiotic resistance in microbes: History, mechanisms, therapeutic strategies and future prospects. *J. Infect. Public Health* **14**, 1750–1766 (2021).

Learn more about high-throughput AMR detection: takarabio.com/amr-detection

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