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Flaws in reporting antimicrobial resistance

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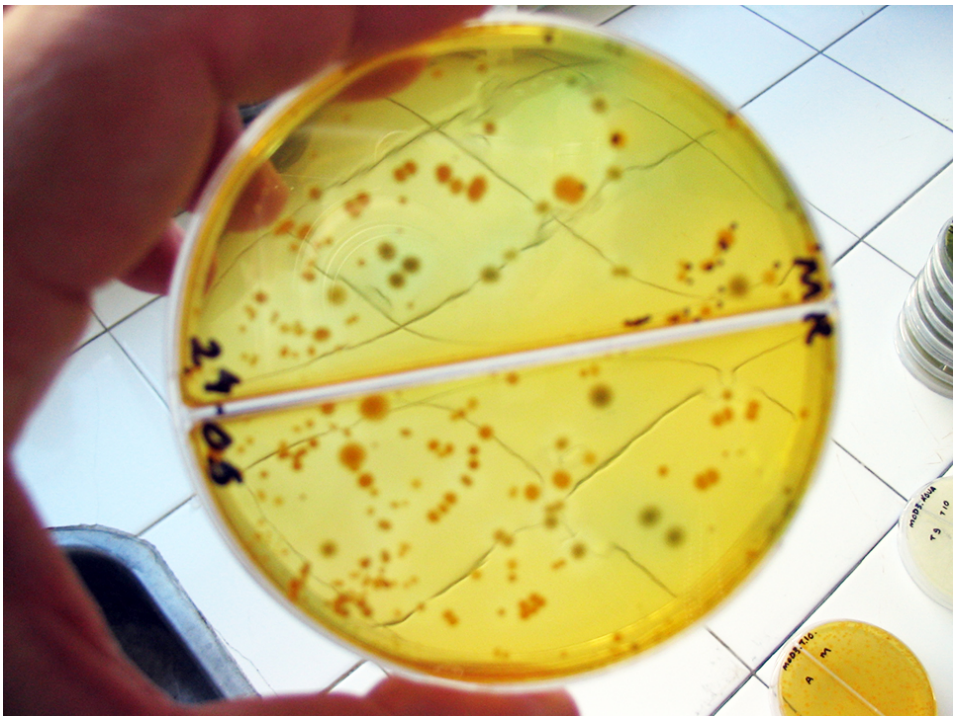
It’s time to improve testing methodology



Bacteria resistant to an antimicrobial are also frequently resistant to other members of the same antimicrobial group. More standardized testing could lead to clearer understanding of such traits.

It is tempting to think that antimicrobial resistance (AMR) has evolved only recently in response to the use of antibiotics. That is the general perception. Antibiotics, however, do not play a role in the emergence of resistance, but in its spread.

Emergence of resistance occurs mostly by chance and is independent of the presence of the antibiotic. The antibiotic only provides the positive selective pressure on resistant mutants.

Phylogenetic analysis has shown that this mechanism evolved millions of years ago, indicating the importance of antibiotic resistance genes in bacterial evolution. Lacking this understanding has led to incorrect interpretations in aquaculture's reported AMR science.

Presence is not evidence

One of the most common misinterpretations is assuming that the detection of AMR is evidence of the use of antimicrobials. As we now understand, when reporting the presence of resistance isolates, detection of the increase in resistance to a particular compound should be reported rather than simply the presence of isolates.

Controls needed

A large number of studies have reported significant to high levels of resistance in the microflora of relatively pristine, unpolluted water or water bodies free of known anthropogenic influence. Others have identified the increase of resistance frequency in environments impacted by an aquaculture facility but not by any antimicrobial agent used in the facility.

Furthermore, a dramatic increase of resistance in environments where there is significant nutrient enrichment has also been documented. For example, in laboratory mesocosm, environmental samples can increase their resistance frequency to oxytetracycline from 2 to 100 percent purely by their incubation in the presence of drug-free fish feed.

Temporal and spatial controls of the background resistance frequencies are absolutely necessary. If adequate controls are lacking, the data presented in studies cannot be treated as contributing to our understanding of this issue.

Methodology problems

There are no standard methods for the determination of resistance frequencies. The use of different methods, media and breakpoint concentrations in different studies has the consequence that little or no comparison can be made of the available data.

The initial step toward universal standard test protocols was taken by a group of 24 international scientists who met in the 1990s. The current disk diffusion protocols are presented in Clinical and Laboratory Standards Institute document M42-A, and the minimum inhibitory concentration protocols are in M49-A. Adherence to standard protocols does not guarantee that all laboratories will generate quantitative data that is absolutely comparable. Interlaboratory variation still remains a problem.

Recommendations

Aquaculture's scientific community needs to improve its understanding of AMR processes to provide the best interpretations of its work and result in correct decisions. Improving the methodology of AMR testing, the obligatory use of temporal and spatial controls, and the implementation of laboratory ring tests are the first steps to start producing reliable information.

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