Standardising the reporting of microbiology and antimicrobial susceptibility data

Defining the burden of antimicrobial resistance has become a global health priority.[1,2] To better understand the extent of the problem and to assess interventions, considerable efforts are under way to collate,[3] model,[4] and map[5] existing and prospectively collected data. These activities are all dependent on high-quality laboratory data.

We highlighted the difficulties surrounding reporting and quality grading of microbiology data and antimicrobial susceptibility results.[6] We observed that non-compliance with stated laboratory methods appears to be relatively common in the published literature. Such non-compliance might invalidate the results reported. Common examples missed during the review process include reporting susceptibility when a species is known to be intrinsically resistant to an antibiotic (eg, *Klebsiella pneumoniae* and ampicillin), reporting susceptibility to an antibiotic when international breakpoints have not been defined (eg, *Streptococcus pneumoniae* and gentamicin), and the use of ambiguous or inappropriate methods for resistance detection (eg, detection of meticillin resistance in *Staphylococcus aureus* by methods other than cefoxitin disc testing, or cefoxitin or oxacillin minimum inhibitory concentration measurement). Unfortunately, these issues might be indicators of more general laboratory problems, often the result of failure to implement appropriate quality management systems. In these circumstances, bacterial identification and subsequent antimicrobial susceptibility data might be compromised, as highlighted in the case of misidentification of *Burkholderia pseudomallei* as *Acinetobacter* sp from Thailand.[7]

In response to these observations, we have devised a framework to improve reporting and permit quality grading of microbiology and antimicrobial susceptibility data, Microbiology Investigation Criteria for Reporting Objectively (MICRO).[8,9] MICRO was developed by an international working group of clinical and laboratory microbiologists, infectious disease physicians, epidemiologists, and mathematical modellers. The framework was designed to complement, rather than replace, existing study reporting guidelines such as STROBE. We hope that the MICRO framework will be used for the planning, reporting, and assessment of studies including microbiologic testing.

The MICRO reporting framework includes 20 items, organised to cover the preanalytical, analytical, and postanalytical phases of microbiology testing and reporting. The intention is not to create substantial additional work for researchers; the laboratory components of the framework would be expected to be readily available in a microbiology laboratory that is quality-assured or accredited, and might assist non-accredited laboratories in resource-limited settings to improve quality management. 13 core items should be reported for all studies: specimen types, sampling period, sampling strategy, geographical setting, clinical setting, laboratory methods (target organism identification methodology, antimicrobial susceptibility testing methodology, and antimicrobial resistance definitions), laboratory quality assurance (participation in an external quality assurance scheme), sources of bias (management of duplicate and sequential isolates from the same patient), and results (population summary and use of appropriate denominators for specimens, isolates, and antimicrobial susceptibility tests to avoid overreporting or underreporting of resistance). If researchers consider these points during study planning, then subsequent reporting of microbiology data will become more consistent and data quality will improve. Non-specialist reviewers can use the framework as an aide-mémoire to identify methodological issues and assess their likely effects. As usage increases, we expect to iterate and update MICRO on the basis of user feedback.

Continued, non-standardised reporting of clinical microbiology data might impede efforts to quantify and control antimicrobial resistance. We urge the global scientific community to adopt the MICRO framework to improve the chances for the meaningful use of such data moving forwards.

Paul Turner, Elizabeth A Ashley
Cambodia Oxford Medical Research Unit, Angkor Hospital for Children, Siem Reap 17252, Cambodia (PT); Lao-Oxford-Mahosot Hospital-Wellcome Trust Research Unit, Microbiology Laboratory,

Mahosot Hospital, Vientiane, Laos (EAA); Centre for Tropical Medicine and Global Health, Nuffield Department of Medicine, University of Oxford, Oxford, UK (PT, EAA)
pault@tropmedres.ac

We declare no competing interests.

1 de Kraker ME, Stewardson AJ, Harbarth S. Will 10 Million people die a year due to antimicrobial resistance by 2050? *PLoS Med* 2016; **13:** e1002184.

2 Limmathurosakul D, Dunachie S, Fukuda K, et al. Improving the estimation of the global burden of antimicrobial resistant infections. *Lancet Infect Dis* 2019; published online Aug 16. https://doi.org/10.1016/S1473-3099(19)30276-2.

3 The Fleming Fund. The importance of data. 2018. https://www.flemingfund.org/about-us/the-importance-of-data (accessed Oct 4, 2019).

4 Temkin E, Fallach N, Almagor J, et al. Estimating the number of infections caused by antibiotic-resistant *Escherichia coli* and *Klebsiella pneumoniae* in 2014: a modelling study. *Lancet Glob Health* 2018; **6:** e969–79.

5 Hay SI, Rao PC, Dolecek C, et al. Measuring and mapping the global burden of antimicrobial resistance. *BMC Med* 2018; **16:** 78.

6 Ashley EA, Dance DAB, Turner P. Grading antimicrobial susceptibility data quality: room for improvement. *Lancet Infect Dis* 2018; **18:** 603–04.

7 Greer RC, Wangrangsimakul T, Amornchai P, et al. Misidentification of *Burkholderia pseudomallei* as *Acinetobacter* species in northern Thailand. *Trans R Soc Trop Med Hyg* 2019; **113:** 48–51.

8 Turner P, Fox-Lewis A, Shrestha P, et al. Microbiology Investigation Criteria for Reporting Objectively (MICRO): a framework for the reporting and interpretation of clinical microbiology data. *BMC Medicine* 2019; **17:** 70.

9 The EQUATOR Network. Microbiology Investigation Criteria for Reporting Objectively (MICRO): a framework for the reporting and interpretation of clinical microbiology data. http://www.equator-network.org/reporting-guidelines/microbiology-investigation-criteria-for-reporting-objectively-micro-a-framework-for-the-reporting-and-interpretation-of-clinical-microbiology-data/ (last accessed July 30, 2019).