Enhancing antimicrobial surveillance: an automated, dynamic and interactive approach

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**Background (87)**

Antimicrobial resistance (AMR) is a global patient safety issue, which is threatening our ability to treat common infectious diseases. There is an emerging interest in the potential secondary use of electronic clinical records to inform therapy decisions, assess consequences of antimicrobial misuse and develop/evaluate antimicrobial stewardship programs to tackle AMR. In this paper, to complement the common antimicrobial resistance index, we present a method to quantify numerically antimicrobial resistance trends. A portable, dynamic and interactive visualization tool facilitates data exploration and comprehensive reporting among clinicians and policy makers.

**Methods and Materials (86)**

Rather than restricting the examination of AMR to particular microorganisms, automated analysis of over 3.5 million susceptibility tests was undertaken. Data were divided by culture (e.g. urine) and combination (organism-antibiotic). To generate the resistance time series, the proportion of resistant isolates at independent time intervals was use. Additionally, overlapping time intervals (through sliding-time windows) were used to generate smoothed time-series for comparison. Finally, ordinary/weighted linear regression and autoregressive integrated moving average (ARIMA) were applied on the time-series to quantify resistance trends.

**Results (179)**

Firstly, it is worth mentioning that approximately half of the susceptibility tests correspond exclusively to Streptococcus Aureus and Escherichia Coli, revealing a clear over-testing tendency on existing guidelines. Ordinary linear regression is greatly affected by outliers often produced when resistance indexes are computed with an insufficient number of observations. By applying weighted linear regression it is possible to reduce the influence of those outliers to obtain more robust trends.

Despite being the most advanced model, ARIMA is not successful at quantifying small resistance trends since they are generally modelled as noise. Furthermore, the large variations present in such model estimations suggest that models are over-fitting external effects instead of focusing on the resistance evolution itself. On the other side, the use of overlapping time intervals on the raw susceptibility tests drops the dependence between granularity and accuracy of traditional surveillance and produces visually more pleasant time-series. In addition, it computes statistically significant trends (p-value<0.05) for a larger amount of combinations (increase by 40%) and they are consistent to those obtained for independent time intervals. The combination of weighted linear regression and overlapping time windows is the most suitable approach to quantify resistance trends.

**Conclusion (70)**

Surveillance is the cornerstone for assessing the burden of AMR. Insights extracted from this study should be considered to enhance existing guidelines and strengthen AMR knowledge, especially in situations with sparse data where local directions are required. This system is being integrated into a clinical decision support system (Enhance Personalize and Integrated Care for Infection Management at Point of Care - EPIC IMPOC) with great potential to revamp prescription practices.