Tracking trends in antibiotic effectiveness using the Drug Resistance Index

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Introduction:

Antibiotic resistance is a major global health threat, and antibiotic overuse is a major driver of antibiotic resistance. Owing to the multiplicity of bacterial pathogens and drugs to treat them, quantifying the overall status of antibiotic effectiveness or resistance is challenging.

We used the Drug Resistance Index (DRI), a novel metric which aggregates antibiotic consumption and resistance into a single measure, to compare antibiotic effectiveness by country and time. Several hospitals including those in South Africa and India use this measure, which can be adapted to quantify the antibiotic resistance problem at the level of a hospital, healthcare network, region, and country.

The DRI produces a value from 0 to 100, where 100 indicates no effectiveness of antibiotics and 0 indicates maximum effectiveness. Described by Science Magazine as a “Dow Jones for Drug Resistance,” and by The Scientist as a “Consumer Price Index for antibiotic resistance,” the DRI provides an aggregate trend measure of drug resistance, akin to the way composite economic indices are used to track movements in consumer prices and stock market values.

Methods:

The DRIs presented in this study are based on the methodology described by Laxminarayan and Klugman (2011). Data on antibiotic use (based on sales data from IMS Health) and resistance used in this study were obtained from ResistanceMap, an online tool that summarizes data on antibiotic use and resistance worldwide.

The DRIs were estimated by the following equation:

$$DRI_k = \sum p_i q_i k$$

where, for country t at time k, $p_i$ is the proportion of resistance among all included organisms to drug k and $q_i$ is the proportion of drug k used for their treatment.

Pathogens

E. coli, K. pneumoniae, P. aeruginosa, S. aureus, E. faecium, and E. faecalis.

Antibiotics

Aminoglycosides, broad-spectrum penicillins, carbapenemns, cephalosporins, narrow-spectrum penicillins, and quinolones.

Limitations and conclusion:

The DRIs can only be as accurate as the underlying data. While attempts were made to standardize the data, they may not be entirely comparable across countries and time.

Cross-country comparability of antibiotic consumption data was hindered by the non-availability of data from all sectors: some countries had data from only retail or hospital sectors. This affects the compositions of antibiotics used and impacts the DRI.

Antibiotic resistance data were obtained from disparate sources: some countries had data from only hospitals, while others had data from private laboratories that included community isolates. In addition, the breadth of testing varied across countries, and in some cases, the clinical breakpoints for determining resistance changed during the period of analysis. The number of isolates tested also varied across countries.

Despite these limitations, the DRI can be a helpful tool to quantify, track, and compare antibiotic resistance worldwide. As high-quality data on antibiotic resistance and consumption become available from more countries, the DRI will enable better comparisons across countries and time.

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Reference: