**Background**

With the rise of ‘superbugs,’ it has become clear, not just to the medical profession, but also to those following media stories, that antibiotics are losing effectiveness around the world. Despite increased attention to the resistance problem, there has been little progress in allocating financial resources either to conserve the effectiveness of existing drugs, or to incentivize the development of new antibiotics. There are hundreds of bacteria-antibiotic combinations, resistance patterns are in constant flux, and some antibiotics are more important to preserve than others. These factors make it difficult for a non-expert to track the evolution of the antibiotic resistance problem.

The Drug Resistance Index (DRI) was developed as a composite measure that combines the ability of antibiotics to treat infections with the extent of their use in clinical practice. The DRI helps quantify and communicate overall antibiotic effectiveness over time across hospitals, regions, states or countries. It is a tool that expresses antibiotic resistance and antibiotic use into a single scale from 0 to 1.

**What is the Drug Resistance Index (DRI)?**

The **Drug Resistance Index** (DRI) aggregates information about antibiotic resistance and antibiotic use into a single composite measure that quantifies the decay of antibiotic effectiveness over time.

It is an epidemiological and communications tool to convey trends in drug resistance to non-experts: healthcare managers, policymakers, and media about the overall extent and evolution of antibiotic resistance of acute and non acute patient settings.

The DRI expresses the resistance*use relationship in a scale from 0 to 1.

- A value of 1 means that infections are untreatable with any of the antibiotics used in the given setting.
- A value of 0 means all isolates included in the calculation were susceptible.
- Values in between express overall susceptibility of infections, adjusted for local prescribing practices.

**Methodology**

1. The DRI should be comparable across time and location so that it can be used to measure changes in drug effectiveness over time across hospitals, regions, states or countries.
2. The DRI should be calculated with minimal data requirements that include the maximum level of detail (disaggregated by month or date, and by patient location). Calculation involves two major components: proportion of non-susceptible isolates and weighted antibiotic use.

\[
R_{i,j}^{\text{fixed-use}} = \sum_{k} p_{ik} q_{jk} \\
R_i = \sum_{k} p_{ik} q_{ik}
\]

Two forms of the DRI are calculated: the fixed use (static) and the adaptive (dynamic). Comparison of the two allows for the assessment of the effectiveness of antimicrobial stewardship interventions. \(p_{ik}\) is the proportion of resistance among organism \(i\) to drug \(k\) at time \(t\) and \(q_{ik}\) is the weighted antibiotic use of drug \(k\) used to treat organism \(i\) in the base year of the analysis, while \(q_{ik}\) tracks antibiotic use over time.

- **Antibiotic Resistance**: measured by the susceptibility information on clinical isolates tested at a facility’s lab.
- **Weighted antibiotic use**: Volume of antibiotics dispensed.

**Assessing an intervention with the DRI**

**Clinicians and antimicrobial stewards:**
- Summarize trends for epidemiological reporting.
- Utilize routine generated data more efficiently.

**Administrators and policymakers:**
- Benchmark performance against other DRI adopters to communicate policy.
- Utilize routine generated data more efficiently.
- Summarize trends for epidemiological reporting.

**Conclusions**

- **Antibiotic resistance imposes a substantial public health burden.** Quantifying overall changes in resistance over time and across locations is difficult because resistance of pathogens to individual drugs must be aggregated to assess overall burden. Here, we take a first step towards the development of resistance indices, summarizing resistance at the level of the infectious agent.
- **A DRI can be a valuable part of an antimicrobial stewardship toolkit, helping clinicians tailor antibiotic purchasing and prescribing policies to an individual hospital’s resistance profile, and informing hospital administrators about the relative success of different interventions.**

**References**


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