# *AMROrbit Scorecard*: A Dynamic Phase Space Model for Strategic Monitoring and Actionable Insights on Global AMR Trajectories in Urinary Tract Infections

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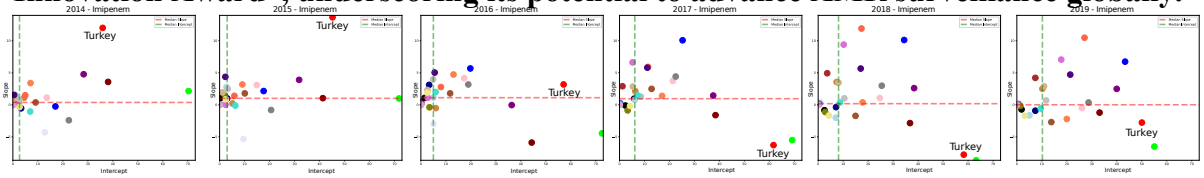
**Background & Objectives:** Antimicrobial resistance (AMR) is an escalating global health emergency, projected to cause up to 10 million deaths annually by 2050, threatening decades of medical and public health progress. Despite ongoing efforts, there is a lack of data-driven evidence to guide stewardship and surveillance. To address this, we utilized Pfizer Atlas data, hosted on the Vivli platform, to create the *AMROrbit Scorecard* an innovative, scalable, and dynamic phase space model that integrates AI and physics-based visualizations to deliver actionable policy insights and drive targeted interventions.

**Methods:** Longitudinal data from Pfizer Atlas for 2014 to 2022 focusing on countries with complete datasets was analysed. Temporal trends in antimicrobial resistance were modelled using a parsimonious multi-level framework, leveraging cluster-robust regression and sandwich estimators to concurrently estimate country-level and global parameters across 4-year rolling windows. Model outputs were represented through a dynamic phase space reconstruction, visualizing country orbits on a 2D plane, where the X-axis represented baseline resistance and the Y-axis the rate of resistance change.

**Results:** For urinary tract infections (UTIs) caused by *Klebsiella pneumoniae*, a global yearly increase in resistance was observed for Imipenem (1.4%, $p<10^{-13}$) while a statistically significant decrease was noted for Colistin (0.09%, $p<10^{-6}$). The segmentation of countries into quadrants based on the global median identified countries with encouraging trajectories (including those with low baseline resistance with a stable or declining slope) and worrisome trajectories (rising resistance). For example, in the *Klebsiella*-Imipenem combination, while some countries such as the Turkey and Hungary demonstrated positive trajectories some like Argentina exhibited worrisome patterns. The dashboard presenting the scorecard is available at https://amrorbit.tavlab.iiitd.edu.in:3002

**Conclusions:** The *AMROrbit Scorecard*, introduced in this study, serves as a dynamic phase space model for strategically monitoring global AMR trajectories. It is an innovative and scalable solution adaptable across bespoke temporal and geographical granularity offering actionable insights for policy makers, paving the way for a more effective global response to this pressing health crisis.

**This research was recognized with the 2024 Vivli Surveillance Data Challenge "Innovation Award", underscoring its potential to advance AMR surveillance globally.**



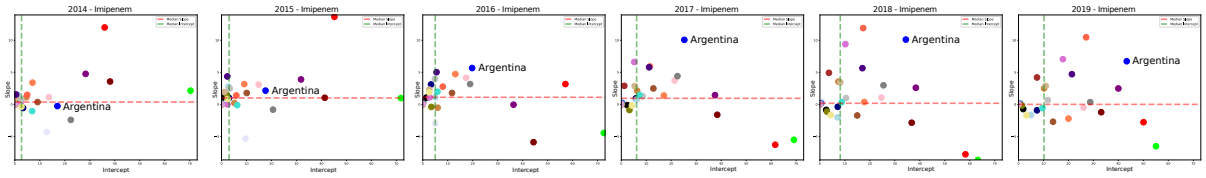



**Figure -** AMROrbit Scorecard illustrates the trajectories of countries based on resistance (x-axis) and the rate of change in resistance (y-axis). The bottom-left quadrant signifies countries with favourable AMR profiles—low initial resistance and a slow rate of increase. The remaining three quadrants highlight countries requiring targeted interventions to address rising resistance, high baseline resistance, or both. The top and bottom figures depict the trajectories of Turkey and Argentina for the *Klebsiella-Imipenem* combination, calculated using four-year rolling windows with a one-year overlap. Turkey is on a positive trajectory, moving from Quadrant IV to II between 2014 and 2018 and remaining stable in 2019, indicating progress in AMR containment. In contrast, Argentina is trending negatively, shifting from Quadrant II to IV, signalling an urgent need for targeted interventions.