

The Relationship Between Antibiotic Consumption and Emerging Infectious Disease

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Background As literature builds about how anthropogenic forces change the environment around us, this paper aims to determine how these forces change the microbial environment within us. The aim of this paper is to determine antibiotic consumption rates at the national level and show how they connect to patterns of emerging infectious diseases (EIDs).

Methods A literature review was carried out to create the most complete dataset of antibiotic consumption in animals, hospitals, and the community. A log-linear predictive model of antibiotic consumption was developed using economic and health indicators from the World Development Indicators Online. A linear predictive model of EIDs was developed using a gridded human EID event database and the observed antibiotic consumption data for the date closest to 2000 for which data was available. Separate analyses were performed using drug resistant and then all EID events as the dependent variable and population density, population growth, mammalian diversity, and either antimicrobial consumption in the inpatient or outpatient setting as independent variables. All statistical analysis was done using SPSS.

Results Data on antimicrobial consumption is rich in Europe but poor in all other parts of the world, and often the units of collection from the first and third world countries are incomparable. The highest total consumption of the countries with data was Iran (1997-1998, 42.45 DID) and the lowest was Uruguay (1997, 6.6 DID). The country consuming the largest amount of antibiotics in animals was the USA (in 1998, 8073944 kg) and the country consuming the least was Malta (in 2004, 2030kg). The relationship between available health and economic indicators and antimicrobial consumption was insignificant. For any one-degree grid in the database, the relationship between outpatient antimicrobial consumption and the presence of a drug-resistant EID was positive but insignificant ($b = 0.02$, $p > .25$). The relationship between inpatient consumption and the presence of a drug-resistant EID was negative and insignificant. When a regression was run with all EID events as the dependent variable and population density, population growth, mammalian diversity, and ambulatory antimicrobial consumption as independent variables, the relationship between consumption and EIDs was positive and the significance of the test improved drastically. Analysis on the agricultural antibiotic consumption data is incomplete at this stage.

Conclusions

The model developed using world development indicators to predict antimicrobial consumption was judged inadequate to map worldwide antibiotic consumption, as was the model relating consumption to drug-resistant EIDs. The relationship between antibiotic consumption and all EIDs was stronger, suggesting that our test lacked power. A better EID dataset with less reporting bias against third world countries and a more complete antimicrobial consumption dataset may show a significant relationship. The relatively strong relationship between antibiotic consumption and EIDs of all types suggests that antimicrobial drug consumption may increase susceptibility to zoonotic and vector-borne EIDs. However, our results are not clear enough to strongly support any conclusion.