Data Impact Challenge II

Question 2

What is the current antimicrobial consumption in a particular sector/unit/common condition?

Team BUGS

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Data and Analysis

To answer this question, we used data housed at the Institute for Clinical Evaluative Sciences (ICES), an independent, non-profit organization with the capacity to link patient-level, population-based health information for 13 million Ontarians.

Our team used the *Registered Persons Database (RPDB)*, *Ontario Drug Benefits (ODB) database*, *Ontario Health Insurance Plan (OHIP) database,* and the *Canadian Institute for Health Information Discharge Abstract Database* (*DAD*). The RPDB contains demographic and residential information for all individuals who have ever held an OHIP health card. The OHIP database contains billing information for all physician services reimbursed by the Ontario government. The ODB records prescription drug claims made by Ontario residents aged 65 and over; this database yields greater than 99% concordance with pharmacy chart review (Levy *et al.* 2003). The DAD contains patient-level data for all acute care, rehabilitation, complex continuing care, and day surgery hospitalizations in Ontario.

We used the RPDB to identify Ontario residents over the age of 65 as of January 1 2014 with a valid health card. We excluded non-Ontario residents and those with no health system contact in the preceding 7 years. Using ODB data, we measured the number of prescriptions of each of the four major categories of antimicrobial drugs: antibiotics, antifungals, antiparasitics, and antivirals. Because antibiotics were the most heavily prescribed type of antimicrobial, and antibiotic resistance poses the greatest current public health threat, we then focused further investigation on this category. For each specific antibiotic and antibiotic class, we calculated the number of defined daily doses (DDDs) per 1000 person days. DDDs were calculated from prescribed antibiotic quantities using the World Health Organization ATC/DDD Index 2016 (WHO Collaborating Centre for Drug Statistics Methodology 2009). Based on diagnosis codes obtained from OHIP and DAD, we then determined the presence of infectious disease diagnoses recorded within 7 days of a patient's antibiotic prescription. We grouped these diagnoses as follows: upper respiratory tract infection, lower respiratory tract infection, urinary tract infection, cellulitis, other infection, and no recorded infection (diagnostic codes available on request). Finally, we examined seasonal trends in antibiotic usage over the 12-month study period.

Datasets were linked using unique encoded identifiers and analyzed at the Institute for Clinical Evaluative Sciences (ICES). This study received approval from the research ethics board of Sunnybrook Health Sciences Centre.

Findings

We identified 2,174,576 Ontario residents over the age of 65 as of January 1 2014 with a valid health card. We excluded 4,197 non-Ontario residents and 66,769 individuals with no health care system contact in the past 7 years. This left 2,103,610 persons in the study cohort, representing 754,094,752 person days in calendar year 2014.

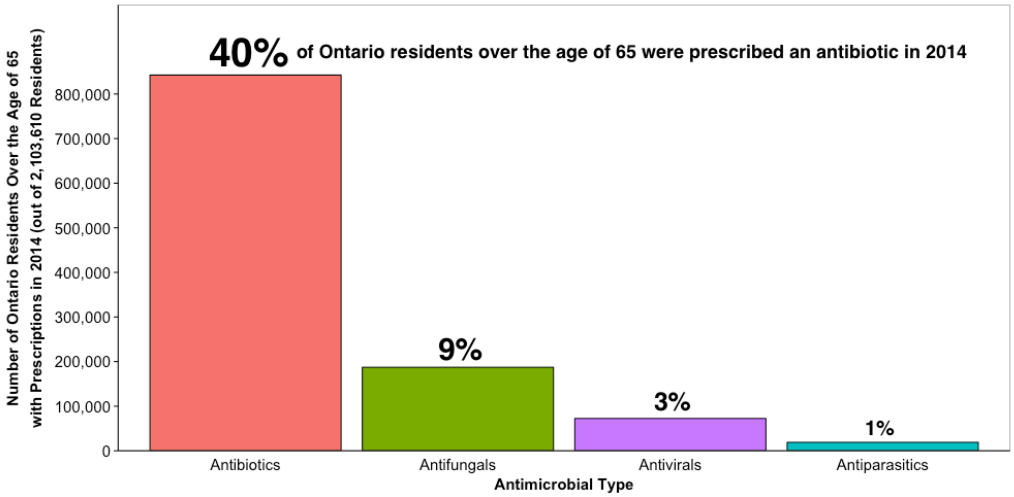

Figure 1: Number of Ontario residents over the age of 65 with antimicrobial prescriptions between January 1 to December 31 2014

From January 1 to December 31 2014, there were a total of 2,693,329 antimicrobial claims among Ontarians aged 65 and older. 40% of our patient population were prescribed antibiotics, while 9%, 3%, and 1% were prescribed antifungals, antivirals, and antiparasitics, respectively (**Figure 1**). Of the 2,693,329 antimicrobial prescription claims, 74% were for antibiotics. Considering that antibiotics represented the largest proportion of antimicrobial claims, and that antibiotic resistance is the most pressing concern we focused our subsequent analyses on this group.

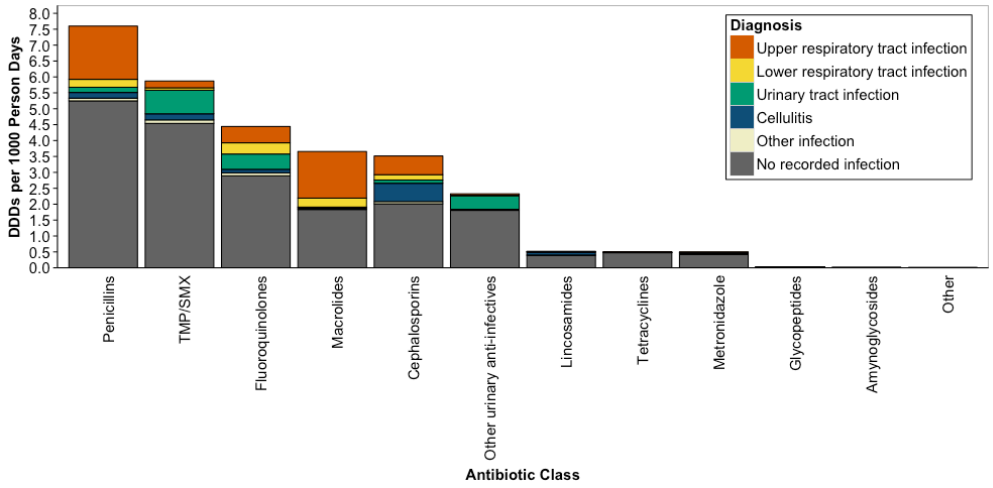

Figure 2: DDDs/1000 person days for each antibiotic class, stratified by diagnosis type

Ontario residents over the age of 65 were prescribed 28.5 DDDs of antibiotics per 1000 person days. Penicillins were the most frequently prescribed class (7.5 DDD/1000 person days), followed by sulfonamides and/or trimethoprim (5.8 DDD/1000 person days) (**Figure 2**).

Among individuals with an infection diagnosis within 7 days of the prescription, upper respiratory tract infections were the most common, accounting for 4.5 DDDs/1000 person days. Urinary tract infections were second, accounting for 2.0 DDDs/1000 person days, followed by cellulitis (1.2 DDDs/1000 person days), lower respiratory tract infections (1.2 DDDs/1000 person days), and other infections (0.4 DDDs/1000 person days). However, for the majority of antibiotic prescriptions (69%), there were no recorded infection diagnoses in hospital, emergency room, or physician claim records.

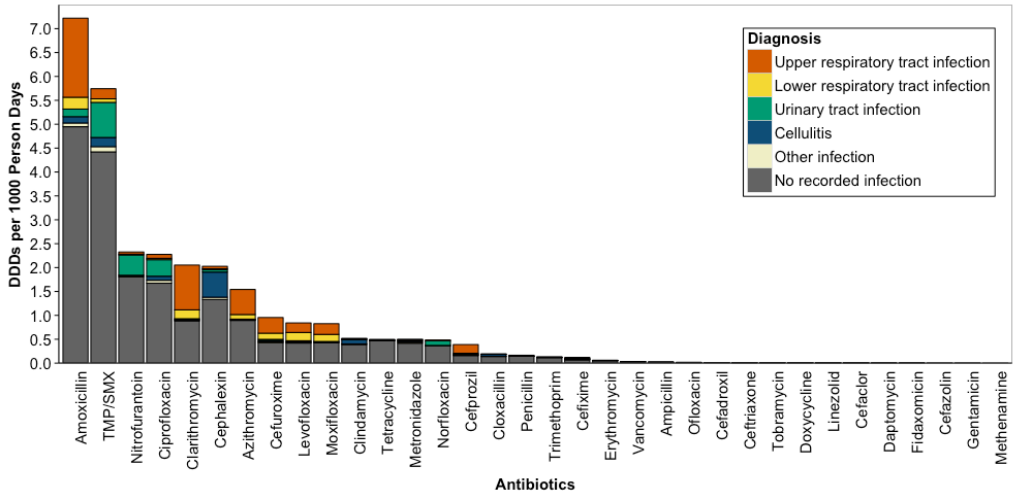

Figure 3: DDDs/1000 person days for each antibiotic, stratified by diagnosis type

Figure 3 shows utilization of individual antibiotic drugs. Amoxicillin was the most frequently prescribed antibiotic (7.1 DDDs/1000 person days), followed by trimethoprim-sulfamethoxazole (5.7 DDDs/1000 person days). Together, these two drugs accounted for 45% of all antibiotic consumption. Upper respiratory tract infections were the most common diagnoses associated with amoxicillin prescriptions, whereas urinary tract infections were most common for trimethoprim-sulfamethoxazole prescriptions.

We observed seasonal trends associated with antibiotic prescriptions (**Figure 4**). Antibiotic use was highest from November to January, particularly in December, and lowest in August, with a 35% increase between December and August ($p<0.002$). Penicillins, macrolides, and sulphonamides and/or trimethoprim showed the greatest seasonality.

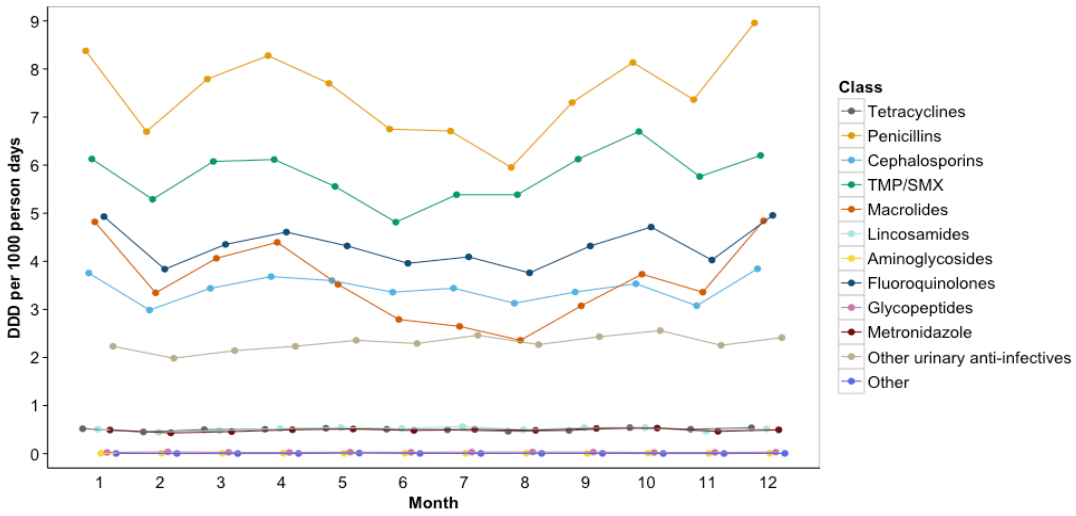

Figure 4: DDDs/1000 person days of each antibiotic class by month

A major strength of our study was our ability to link patient-level drug claims with health care utilization data to determine infection diagnoses associated with each prescription. At the same time, our study has several limitations that should be noted. The ODB drug benefits are limited to coverage of individuals over age 65, and thus we were not able to examine antibiotic use among children and young adults. In addition, the ODB measures drug dispensing, but we cannot be sure that patients actually used the medication. Since diagnoses are not recorded for antimicrobial claims in the ODB data, we had to link the database to physician billing claims, emergency room visits and hospitalizations within 7 days of the prescription claim. We were unable to identify an associated diagnosis for the majority of claims, which may have been a function of physician documentation practices but may also be due to coding issues. Thus, we may have underestimated the contribution of specific diagnoses to prescription drug use. Lastly, we were unable to account for private drug plan claims or those paid out of pocket, although this is likely to account for only a very small proportion of antibiotic use in the over 65 population.

Implication of this analysis for policy

This study provides valuable insight into antimicrobial drug use among older adults in Ontario. The data could inform policies to decrease utilization of specific antibiotics, particularly those that are associated with high levels of resistance, *C. difficile* infections, or other adverse drug events. Our finding that less than half of antibacterial prescriptions had a recorded diagnosis within 7 days suggests there is significant room for improvement in documentation of indications for antimicrobial prescriptions. For example, requiring mandatory inclusion of an infection diagnosis with any antimicrobial prescription could lead to improved tracking of treatment practices, as well as targeting of antibiotic stewardship interventions. In addition, seasonal trend analyses could help focus antimicrobial awareness and education efforts during the winter surge in antibiotic use.

Acknowledgements

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