Community-based antibiotic dispensing attributable to common respiratory viruses: a population-based study of Scottish children

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BACKGROUND

- Research suggests inappropriate antibiotic prescribing, such as that for viral illness, is common in primary care.
- Many antimicrobial resistance (AMR) strategies aim to reduce unnecessary antibiotic prescriptions.
- Vaccination has shown to help reduce inappropriate prescribing by reducing the burden and severity of respiratory illness, such as influenza. Several novel vaccines for common pathogens, such as respiratory syncytial virus (RSV) and human metapneumovirus (HuMPV), are currently being developed.
- **The objective of this study was to estimate the proportion of community-prescribed antibiotics to Scottish children <5 years of age attributable to common respiratory viruses, including RSV, influenza, HuMPV and human parainfluenza virus (HPIV) types 1-4.**

METHODS

- **Data:** All antibiotics dispensed in community and positive laboratory tests for viral respiratory pathogens were identified from population-based administrative health data for Scottish children <5 yo during 1 Apr 2009 through 27 Dec 2017.
- **Model:** We fit time series negative binomial models to predict weekly antibiotic dispensing rates from positive viral tests rates using a backwards model selection approach to select the best-fitting, based on AIC values, and most parsimonious model.
- Annual, bi-annual and quarterly Fourier terms were included, as well as indicators for the 2013 UK AMR Strategy and the weeks of Christmas, New Years, and Easter due to holiday closures.
- We estimated the proportion of antibiotics explained by virus circulation according to type of virus, age group, presence of high-risk chronic conditions, and antibiotic class.
- **Sensitivity analyses:** we investigated 1) potential differences before versus after the 2013 UK AMR Strategy and 2) possible testing biases through use of a secondary outcome: hospital admissions for acute bronchiolitis or viral pneumonia.
- **Software:** We used SAS version 9.4 (SAS Institute Inc.; Cary, NC).

Table 1. Proportion (95% CI) of dispensed antibiotics attributable to included respiratory viruses, among Scottish children <5 yo

|	Influenza	RSV	HuMPV	HPIV-1	HPIV-3
Age Group					
<5 yo	2.4 (1.7, 3.1)	6.9 (5.6, 8.3)	2.3 (0.8, 3.9)	0.6 (0.2, 1.1)	1.5 (0.5, 2.6)
<1 yo	0.6 (0, 1.2)	5.2 (3.9, 6.4)	1.5 (0.3, 2.6)	0.3 (0, 0.7)	1.6 (0.7, 2.4)
1-4 yo	2.3 (1.6, 3.1)	5.8 (4.6, 7.0)	1.6 (0.2, 3.0)	0.5 (0.1, 0.9)	0.7 (0, 1.7)
Chronic Medical Condition diagnosed Before 5th Birthday					
Yes	1.5 (0.9, 2.1)	4.3 (3.2, 5.4)	0.7 (0, 1.7)	0.4 (0.0, 0.8)	0.9 (0.1, 1.7)
No	2.3 (1.6, 3.0)	7.1 (5.7, 8.5)	2.3 (0.8, 3.8)	0.6 (0.1, 1.0)	1.3 (0.3, 2.3)
Antibiotic Class					
Amoxicillin	2.6 (1.7, 3.5)	8.1 (6.4, 9.8)	3.5 (1.6, 5.4)	0.6 (0.1, 1.1)	1.9 (0.7, 3.1)
Other Penicillins	2.0 (1.4, 2.6)	2.4 (1.3, 3.6)	2.2 (0.7, 3.6)	0.7 (0.2, 1.2)	0.4 (0, 1.5)
Macrolides	2.9 (2.0, 3.7)	7.7 (6.1, 9.2)	3.9 (2.1, 5.7)	0.8 (0.3, 1.3)	1.6 (0.4, 2.9)
Cephalosporins	0.9 (0, 2.0)	1.3 (0, 3.2)	2.8 (0.6, 5.0)	0.3 (0, 1.1)	0
Before versus After UK Antimicrobial Resistance (AMR) Strategy					
Before	1.9 (1.0, 2.9)	5.1 (2.6, 7.6)	1.9 (0, 4.0)	0 (0, 0.9)	3.3 (1.4, 5.2)
After	2.3 (1.1, 3.6)	8.8 (6.9, 10.7)	2.7 (0.1, 5.2)	1.0 (0.3, 1.6)	1.4 (0, 2.9)
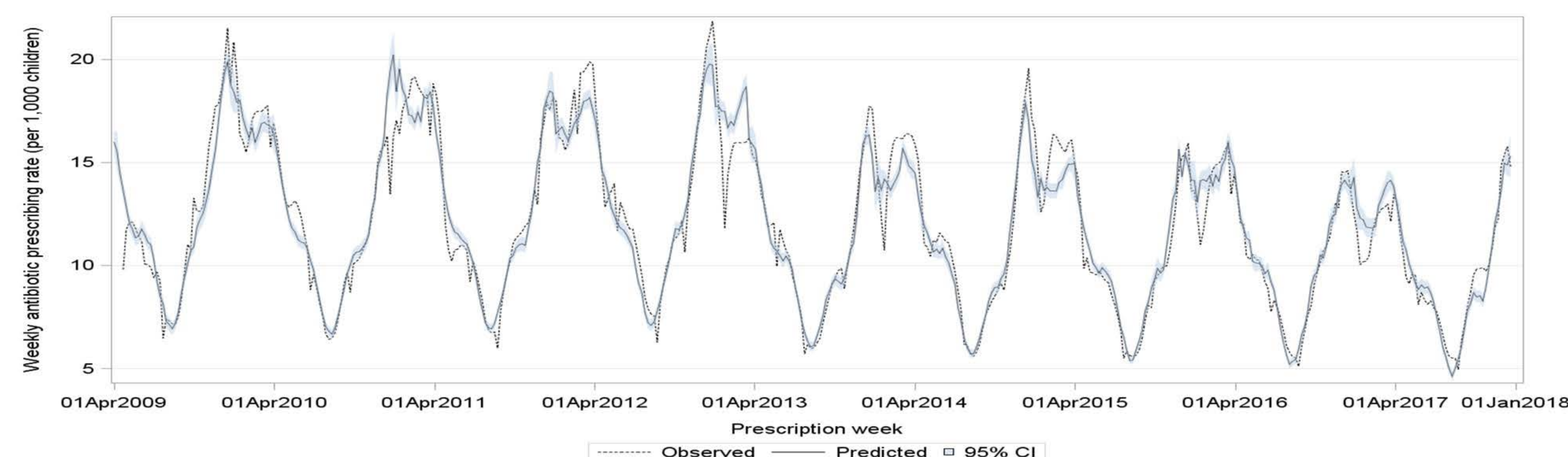
FIG 1. Observed and predicted (95% CI) rates of weekly antibiotic prescribing (smoothed four-week moving average), among Scottish children under 5 years of age

RESULTS

- We identified 6,066,492 dispensed antibiotics among 452,877 children. The antibiotic dispensing rate among all Scottish children <5 yo was 624.72 per 1000 child-years.
- Clear correlations in the patterns of antibiotic prescribing and circulating respiratory virus burden were observed, as noted by co-occurring peaks (Figure 1).
- RSV was consistently the most attributed virus, particularly among children without chronic conditions and amoxicillin and macrolide prescriptions (Table 1).
- In our sensitivity analysis, 2.43% (0, 5.02) of prescribed antibiotics were attributable to viral pneumonia and 9.75% (7.37, 12.13) to acute bronchiolitis admissions.

CONCLUSIONS

- Nearly 14% of antibiotics prescribed to Scottish children <5 yo were estimated to be attributable to common viruses for which antibiotics are not recommended.
- This study is the first to rigorously consider community-based antibiotic prescribing among children attributable to multiple respiratory viruses using representative population-based data.
- However, we could not account for children who did not seek care, for whom viral tests were not sought and for tests occurring outside of secondary care.
- These results highlight targets for reducing unnecessary antibiotic use and expected impacts of emerging vaccines.

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