An observational study analysing antibiotic prescribing quality for children in primary-care

Authors

1. Miss Megan Rose Williams
Medical Student
School of Medicine
Cardiff University
Cardiff
Phone: +44(0)7712204303
Email: meganwilliams576@gmail.com

2. Dr Giles Greene PHD
Lecturer
Department of Population Medicine
Cardiff University
Cardiff
Phone: +44(0)29 2068701
Email: GreeneG@cf.ac.uk

3. Dr Gurudutt Naik MBBS MS (surgery) MRCSed MRCGP MPH
GP, Honorary Research Fellow
Department of Population Medicine
Cardiff University
Cardiff
Phone: +44(0)1291636100
Email:NaikG@cf.ac.uk

4. Dr Kathryn Hughes MB BCh MRCGP DCH PHD
Clinical Research Fellow
PRIME Centre Wales
Department of Population Medicine
Cardiff University
Cardiff
Phone: +44(0)29 20687246
Email: HughesKA6@cardiff.ac.uk

6. Professor Christopher Butler BA MBChB DCH CCH MD FRCGP FFPH FMed Sci
GP, Professor of Primary Care
Nuffield Department of Primary Care Health Sciences
University of Oxford
Oxford
Phone: +44 (0)1865 289670
Email:Christopher.butler@phc.ox.ac.uk

5. Professor Alastair D Hay MD DCH MRCP FRCGP
GP, Professor of Primary Care and NIHR Research Professor
Centre for Academic Primary Care
Population Health Sciences
Bristol Medical School
University of Bristol
Phone: +44(0)117 3314554
Email:Alastair.Hay@bristol.ac.uk

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Abstract

Background: Overuse and inappropriate prescribing of antibiotics is driving antibiotic resistance. GPs often prescribe antibiotics for RTIs in young children despite their marginal beneficial effects.

Aim: To assess the quality of antibiotic prescribing for common infections in young children attending primary care and describe influencing factors.

Design and setting: An observational, descriptive analysis, including children attending primary care sites in England and Wales.

Method: The DUTY study collected data on 7163 children under five, presenting to UK primary care with an acute illness (<28 days). Data were compared to the ESAC disease specific QIs to assess prescribing for acute URTIs, tonsillitis and otitis media, against ESAC proposed standards. NP trend tests and Chi-square tests assessed trends/differences in prescribing by level of deprivation, site type and demographics.

Results: Prescribing rates fell within the recommendations for URTIs but exceeded the recommended limits for tonsillitis and otitis media. The proportion of children receiving the recommended antibiotic was below standards for URTIs and tonsillitis, but within the recommended limits for otitis media. Prescribing rates increased as the level of deprivation decreased for all infections (Ps<0.05), prescribing rates increased as the age of the child increased for URTIs and tonsillitis (Ps<0.05). There were no other significant trends or differences.

Conclusion: The quality of antibiotic prescribing in this study was mixed and highlights the scope for future improvements. There is a need to further assess the quality of disease specific antibiotic prescribing within UK primary care setting using data representative of routine clinical practice.

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Keywords

Antibiotic prescribing, children, primary health care, ESAC disease specific QIs, common infections.

How this fits in

The quality of antimicrobial prescribing, within NHS primary care, is currently assessed by using item based weighted prescribing unit rate comparisons. European Surveillance of Antimicrobial Consumption (ESAC) developed and validated disease-specific antibiotic prescribing quality indicators (QI) for primary care. The performance of UK primary care against these indicators is unknown. This study provides an overview of the quality of antibiotic prescribing using ESAC QIs for young children presenting to primary care and recruited into the DUTY observational study.

Background

Antibiotic resistance is an important public health concern. (1, 2) The number of infections due to resistant bacteria is increasing and there are limited new, replacement classes of antibiotics. (3, 4) Overuse and inappropriate prescribing of antibiotics is driving antibiotic resistance. (1) Acute illness in young children is one of the commonest reasons for patients to seek healthcare worldwide and respiratory tract infections (RTI) are responsible for 74.4% of antibiotic prescriptions in children, (5) despite their marginal beneficial effects. (6) Good quality antibiotic prescribing for children in primary care is key to controlling antibiotic resistance. European quality indicators (QI) for antibiotic prescribing have been developed for primary care, but the extent to which these are achieved in the UK is unknown. (7)

There is a need to assess the standards of antibiotic prescribing in primary care, especially as 90% of antibiotics are prescribed by general practitioners (GP). (8) In the UK, antibiotics are still being overprescribed despite published guidelines. (9) GP prescribing in the UK increased by 40% between 1999 and 2011 and by 4.1% between 2010 and 2013. (10) Evidence shows a strong association between antibiotic exposure and antibiotic resistance. (11) Poor antibiotic prescribing exposes patients to unnecessary drug treatment and leads to increased costs to the health service and higher morbidity and mortality rates, due to infections with resistant bacteria. (1, 12)

Diagnostic complexity (13) and prognostic uncertainty (14) play important roles in decisions regarding antibiotic prescriptions and GPs are more likely to prescribe if they perceive pressure from parents. (15) Parental anxiety and pressure of time influence prescribing decisions and delayed antibiotic prescribing is used to increase parental confidence and maintain good relationships with parents. (16)

In order to improve antibiotic prescribing, we need to measure its quality. European Surveillance of Antimicrobial Consumption (ESAC) developed and validated disease-specific antibiotic prescribing QIs. This group consisted of 40 experts from 25 different countries. There was consensus that these QIs can be used to assess the quality of antibiotic prescribing and therefore, could be used to improve it. (7) Several studies have assessed the relationship between the ESAC indicators and prescribing behaviours. (5, 17-19) However, none have examined this in a large cohort of young children in the UK.

The aim of this project was to assess the disease specific quality of antibiotic prescribing for common infections in young children. We sought to examine the variations in quality of antibiotic prescribing by factors such as level of deprivation, site type and demographics. The objectives were to examine the extent to which the ESAC disease specific QIs are achieved in a population of children aged up to five years, at the point of presentation to UK primary care and to determine predictors for good or poor antibiotic prescribing. We used existing data, from 7163 children aged less than five years old, that were collected for the Diagnosis of Urinary Tract infection in Young children (DUTY) study. (20)

Methods

Data collection

The clinical data were originally collected for the DUTY study, a prospective observational, multicentre study that recruited children from primary care in both urban and rural areas across England and Wales. A total of 326 sites agreed to participate and 234 of these actively recruited at least one participant. (20)

Parents and children were invited to take part in the study via telephone when booking their appointment or on arrival at the site where they were given information sheets. If the parent agreed and the child was eligible, written consent was obtained. (20)

Children were included if they were aged between three months and five years, presenting at a participating site with an acute illness (≤28 days) as the predominant concern and with at least one ‘constitutional’ symptom identified by National Institute for Clinical Excellence (NICE) (21) as a potential marker for urinary tract infections (UTI), i.e. fever, vomiting, lethargy/malaise, irritability, poor feeding or failure to thrive. Children under five were the focus of the DUTY study as younger children are thought to be most at risk from potential complications from UTI. Children consulting with other ‘obvious’ causes for their symptoms, such as otitis media, were all included as long as the exclusion criteria did not apply. Patients presenting with trauma as a predominant concern were excluded. Full details of eligibility criteria can be found in the DUTY Protocol. (20)

Case report forms (CRF) were completed for all consented patients. This included data on eligibility, registration, presenting symptoms, medical history (including recent antibiotic use), clinical examination and management. Unique identification numbers were sequentially generated and used on consent forms and CRFs. (20) The diagnosis for the study was the working diagnosis the clinician arrived at before any other tests were undertaken. The subsequent prescription was based on the working diagnosis. Clinicians were made aware of urine dipstick results once they were available, and after they had completed the working diagnosis on the CRF.

Quality assessment standards

ESAC produced QIs for each of the seven main indications for antibiotic prescribing. Full details can be found in the ESAC disease-specific QI report. (7) QIs for three of these indications are applicable to children, these include: acute upper respiratory tract infections (URTI), acute tonsillitis and acute otitis media/myringitis (AOM) (Table 1). (7) The prescribing data were compared to these.

NICE recommend a ‘no antibiotic’ or ‘delayed antibiotic prescribing’ strategy to be adopted for adults and children with an acute URTI, AOM or tonsillitis. An immediate prescription (Table 2) can be considered for specific patients. (22)

Data analysis

Data were analysed using STATA software V.13.1 (StataCorp, USA).

A descriptive analysis was conducted showing the proportion of children with each disease who were prescribed antibiotics and the proportion of children who were prescribed the recommended antibiotic. These prescribing data were compared to the ESAC QIs to show how well antibiotic prescribing in the UK conforms to the ESAC proposed standards. We based the appropriateness of the antibiotic prescription based on Public Health England Guidance (22) as relevant to the clinician’s working diagnosis. All included participants had a working diagnosis.

The differences in prescribing rates were examined by level of deprivation, age, gender, ethnicity and site type. The level of deprivation was calculated using the individual patient’s postcodes, which were linked to the English and Welsh indices of multiple deprivations and aggregated from deciles into quintiles. Cuzick’s test (non-parametic trend) was used to test for trends across the ordered groups (level of deprivation and age). A chi-square test was performed on the dichotomous variables (gender and ethnicity) and the categorical site type. Trends or differences were considered significant if the p-value was <0.05.

Both immediate and delayed prescriptions were included in the analysis. Delayed antibiotic prescriptions accounted for 12.92% of all prescriptions. Acute URTIs included acute sore throat, acute pharyngitis, common cold, acute cough and acute rhinosinusitis. Doxycycline and quinolones were not included in the results tables, as they were not prescribed.

Results

A total of 7374 children aged <5 years were recruited. Of these, 211 were excluded or withdrawn, so 7163 were left with data. Full study flowchart can be found in the previous publication.(23) Baseline demographics are listed in Table 3.

Acute URTI

Of those children diagnosed with a URTI, 9.5% were prescribed antibiotics; this conforms to the ESAC standards (0-20%). However, only 65.1% of these children were prescribed the recommended, first line antibiotics (amoxicillin or penicillin V), which is below the acceptable range (Table 4). Children from more deprived areas are less likely to be prescribed antibiotics for an URTI (P=0.038). There was a significant increasing trend in prescribing rates as the child’s age increases (P=0.013). Caucasian children were more likely to be prescribed antibiotics than children from different ethnic backgrounds (0.049). Gender and site type did not influence prescribing rates and none of the factors influenced the likelihood of receiving the recommended antibiotic (Table 5).

Acute tonsillitis

The results show that 71.6% of children diagnosed with tonsillitis were prescribed antibiotics. This exceeds the ESAC QI acceptable range of 0-20%. Of these children, only

68.6% were prescribed the recommended, first line antibiotic (penicillin V), which is below the acceptable range (Table 4). Children living in more deprived areas were less likely to be prescribed antibiotics (P=0.027). There was a significant increasing trend in prescribing rates as the child's age increases (P=0.004). Ethnicity, gender and site type did not influence prescribing rates and none of the factors influenced the likelihood of receiving the recommended antibiotic (Table 5).

Acute otitis media

Children diagnosed with AOM were prescribed antibiotics 70.5% of the time. This exceeds the ESAC QI acceptable range of 0-20%. However, 92.1% received the recommended, first line antibiotic (amoxicillin), which is within the acceptable range (Table 4). Children from more deprived areas were less likely to be prescribed antibiotics (P=0.005). Age, ethnicity, gender and site type did not influence prescribing rates and none of the factors influenced the likelihood of receiving the recommended antibiotic (Table 5).

Discussion

Summary

There is mixed quality of prescribing within this data set. The prescription rates fall within the recommendations for more general diagnoses such as URTIs, but for specific diagnoses, such as tonsillitis and AOM, the rates exceed recommended limits. One of the reasons could be that children with a specific diagnosis may be more unwell than those with URTIs, where many patients would have had non-specific and milder symptoms. We included diagnoses of sore throat or pharyngitis in the 'URTI' category rather than with 'tonsillitis' and clinicians may be more likely to diagnose 'sore throat' when they are not going to prescribe antibiotics and diagnose 'tonsillitis' if they are going to prescribe antibiotics. Clinicians might be less confident in not prescribing when the diagnosis is specific and the type of antibiotic to be used is known or clear. This is also reflected in an acceptable proportion of patients receiving the recommended antibiotic for a specific diagnosis of AOM, but not for URTIs or tonsillitis where the diagnosis might not be as clear. There are some situations where children require antibiotics but cannot receive the first line antibiotic, for example, if they have a penicillin allergy. About 10% of the population believe they have a penicillin allergy and treatment with broad-spectrum, non-penicillin antibiotics can lead to antibiotic resistance. (24) However, this low percentage does not account for the low proportions of children receiving the first line antibiotic seen in this study.

In our analyses, children from more deprived areas were less likely to be prescribed an antibiotic for all infections. This is an interesting finding, as it could be argued that parents from less deprived areas may have higher health literacy levels, and higher knowledge of antibiotic use (25) so are less likely to expect a prescription for self-limiting infections. However, once a decision has been made to consult a GP many would feel that their child's infection would respond to antibiotics and may pressurise the clinician to prescribe. (16) Parents with higher literacy levels may understand the threat of antibiotic resistance, but may fail to see how this could affect their child at an individual level and would prefer to err on the safer side and use antibiotics. Parents from more deprived backgrounds may feel more confident in letting their GPs decide the best course of action. In general, antibiotic use is higher in more deprived areas probably due to higher incidences of co-morbidities and illnesses. (26) However, this is not reflected in our study, which only involved children less than 5 years of age and the use of disease specific prescribing as opposed to the use of item based prescribing rates for overall population. This may be an example of the inverse care law, with those of higher socioeconomic status being prescribed more antibiotics, in this case potentially leading to greater harm due to unnecessary antibiotics. Prescribing behaviours are complex and influenced by many factors, (27) more research is needed to assess how higher knowledge and health literacy levels affect prescribing rates. Children with URTIs or tonsillitis were more likely to be prescribed antibiotics as their age increases. This may be because it is easier to diagnose older children.

Increased confidence in the diagnosis and choice of antibiotic may increase prescribing rates.

Strengths and limitations

This is a novel study, analysing the quality of antibiotic prescribing in a large cohort of children presenting in UK primary care by comparison with the ESAC QIs and explores what factors influence prescribing decisions. However, the data used were cross-sectional, therefore, inferences of causality cannot be made. Additionally, these data were collected in a research environment, which may vary from routine practice. GPs might be more cautious when prescribing antibiotics if they are aware that data is being collected for research. Conversely, the cohort of children may be more unwell than normal practice, as they had systemic symptoms, so GPs may have been more inclined to prescribe antibiotics. A sample selection bias may limit the generalisability of the results. Acute tonsillitis and AOM are often classed as URTIs; however, they were considered as separate indicators as there is less evidence to support antibiotic prescribing for URTIs than for tonsillitis or otitis media. (7) Children up to the age of 5 were included in the analysis despite the QIs' age range being defined as >1 or >2 years old. Delayed antibiotic prescribing could also be a potential source of bias in interpreting the results, however, it is unlikely to account for the high prescription rates and influence the conclusion due to the small percentage (12.92%) of delayed prescriptions. It is also difficult to measure the number of children who actually took the antibiotics that were prescribed. The authors of the ESAC guidelines acknowledge that delayed prescriptions may be a source for potential variation which may bias the interpretation of their quality indicators.

The analyses presented are descriptive and are not derived from formal hypothesis testing. Therefore, the multiple unadjusted comparisons do not require any correction or adjustment. (28) However, any association is purely descriptive and should be considered with caution.

Comparison with existing literature

A UK study, using the Clinical Practice Research Datalink (CPRD) dataset, found that GP practices were overprescribing antibiotics for RTIs, which is in line with the overall results of our study, as they included AOM and tonsillitis as RTIs. (9) Another study conducted in Belgium, using the ESAC QIs, also found that antibiotics were being overprescribed for common infections in primary care. (17) A French study using ESAC QIs found that GPs prescribed 54% more antibiotics than paediatricians. (18)

In 2012, antibiotic consumption in UK primary care was slightly lower than the European average at 20.1 defined daily dose (DDD)/1000 inhabitants, compared to 21.5 DDD/1000 for Europe. There was large variation between different countries, suggesting that there is major scope for reducing antibiotic use in the UK and in other European countries. (19)

Another study assessed predictors for antibiotic prescribing in children and found that prescribing rates increase as the age of the child increases and that children were more likely to be prescribed antibiotics if they were diagnosed with tonsillitis or AOM. (5) These results are also in line with this study.

Implications for research and practice

Despite the publication of clinical guidelines, (22) this study highlights the need to improve the quality of antibiotic prescribing for children in UK primary care. The outputs of this project provide a benchmark to allow comparison with other European countries and can be used to help target and develop future antibiotic stewardship programmes. However, the results should be viewed with caution as only univariate associations are shown.

The CPRD dataset should be used to determine the standards of antibiotic prescribing for children using the ESAC QIs, as it would be more representative of UK antibiotic prescribing than the dataset used in this study. The quality of antibiotic prescribing in Wales could be assessed, using the Secure Anonymised Information Linkage (SAIL) dataset, and then compared to other UK countries.

There is a need to explore the effects of differences in antibiotic prescribing quality on symptom recovery in children. GPs may require more evidence about the harms and benefits of prescribing antibiotics for common infections in children in order to increase their confidence in non-antibiotic prescribing strategies. Given the increasing emergence of antibiotic resistance and limited development of new, replacement antibiotics, effective professional and public measures should be examined and implemented to encourage appropriate antibiotic prescribing.

Additional information

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Ethical approval

Multicentre ethical approval was granted by the South West Southmead Research Ethics Committee (Ref #09/H0102/64). Research and Development (R&D) approval was granted for all sites recruited. (20)

Competing interests

The authors declare that there are no competing interests.

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Table 1 – ESAC disease specific QIs used in this study (7)

No.	Infection	Age range	Acceptable range (%) receiving antibiotics	Acceptable range (%) receiving recommended antibiotic	Acceptable range (%) receiving quinolones
1	Acute URTI	>1 year old	0-20	80-100	0-5
2	Acute tonsillitis	>1 year old	0-20	80-100	0-5

3	Acute otitis media	>2 years old	0-20	80-100	0-5

Table 2 – List of recommended antibiotics by NICE (22)

	Acute URTI	Acute tonsillitis	Acute otitis media
First line	Amoxicillin or penicillin V	Penicillin V	Amoxicillin
Second line or penicillin allergy	Clarithromycin	Clarithromycin	Erythromycin

Table 3 – Baseline demographics

		Acute URTI	Acute tonsillitis	Acute otitis media
Total number of children included		2,268	338	698
Gender, N (%)	Male	1,138 (50.18)	182 (53.85)	353 (50.57)
	Female	1,130 (49.82)	156 (46.15)	345 (49.43)
Mean age (S.D.)		2.07 (1.37)	3.01 (1.27)	2.52 (1.31)
Deprivation quintile, N (%)	Data available	2240	336	691
	1 - Most deprived	552 (24.64)	63 (18.75)	128 (18.52)
	2	503 (22.46)	79 (23.51)	127 (18.38)
	3	481 (21.47)	64 (19.05)	130 (18.81)
	4	358 (15.98)	46 (13.69)	128 (18.52)
	5 - Least deprived	346 (15.45)	84 (25.0)	178 (25.76)
	White	1,803 (79.50)	286 (84.62)	618 (88.54)

Ethnicity, N (%)	Non-white	465 (20.50)	52 (15.38)	80 (11.46)
Site type, N (%)	GP practice	2,195 (96.78)	307 (90.83)	675 (96.70)
	Walk in clinics	19 (0.84)	3 (0.89)	8 (1.15)
	Children's Emergency departments	54 (2.38)	28 (8.28)	15 (2.15)

Table 4 – Results compared to ESAC disease specific QIs

	URTI	Tonsillitis	Otitis media
% Receiving antibiotics (N)	9.48 (215/2268)	71.60 (242/338)	70.49 (492/698)
95% Confidence intervals	(8.3,10.7)	(66.8,76.4)	(67.1,73.9)
ESAC acceptable range (%)	0-20	0-20	0-20
% Receiving recommended antibiotic (N)	65.11 (140/215)	68.60 (166/242)	91.87 (452/492)
95% Confidence intervals	(58.7,72.0)	(62.7,74.5)	(89.7,94.5)
ESAC acceptable range (%)	80-100	80-100	80-100

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Table 5 – Potential factors influencing the quality of prescribing

	URTI		Tonsillitis		Otitis media	
Factors	**% of children with an acute URTI prescribed antibiotic**	**% receiving amoxicillin or penicillin V, of those prescribed an antibiotic**	**% of children with acute tonsillitis prescribed antibiotic**	**% receiving penicillin V, of those prescribed an antibiotic**	**% of children with otitis media prescribed antibiotic**	**% receiving amoxicillin, of those prescribed an antibiotic**
Level of deprivation						
1 (most deprived)	9.24	60.78	68.25	58.14	68.75	92.05
2	6.36	65.63	65.82	71.15	60.63	90.91
3	10.60	66.67	70.31	68.89	70.00	94.51
4	10.34	72.97	67.39	70.97	67.97	87.36

5 (least deprived)	12.14	59.52	83.33	71.43	80.34	94.41
P values[1]	0.038	0.809	0.027	0.247	0.005	0.699
Age						
0	8.26	63.64	62.50	86.67	75.00	94.87
1	8.30	68.89	59.09	69.23	65.61	91.94
2	9.44	56.41	72.41	59.52	77.10	89.11
3	10.65	70.73	74.00	68.92	67.11	93.14
4	13.36	65.71	80.00	69.44	71.31	91.95
P values[1]	0.013	0.791	0.004	0.638	0.838	0.680
Ethnic group						
Caucasian	28.22	65.38	73.08	68.90	73.08	68.90
Non-Caucasian	18.06	63.64	63.46	66.67	63.46	66.67
P values[2]	0.049	0.847	0.158	0.798	0.096	0.595
Gender						

Male	9.67	70.91	75.82	70.29	69.69	92.68
Female	9.29	59.05	66.67	66.35	71.30	91.46
P values[2]	0.761	0.069	0.063	0.514	0.640	0.617
Site type						
GP surgery	9.57	67.76	71.34	68.04	70.07	91.75
Emergency department	7.41	75.00	75.00	71.43	80.00	100.00
Walk in clinic	5.26	100.00	66.67	100.00	87.50	100.00
P values[2]	0.711	0.698	0.921	0.167	0.402	0.448

1 = NP trends, 2 = Chi-square test