Taylor & Francis
Taylor & Francis Group

Scandinavian Journal of Primary Health Care

ISSN: 0281-3432 (Print) 1502-7724 (Online) Journal homepage: http://www.tandfonline.com/loi/ipri20

Antibiotic prescribing in relation to diagnoses and consultation rates in Belgium, the Netherlands and Sweden: use of European quality indicators

Mia Tyrstrup, Alike van der Velden, Sven Engstrom, Geert Goderis, Sigvard Molstad, Theo Verheij, Samuel Coenen & Niels Adriaenssens

SCANDINAVIAN JOURNAL OF PRIMARY HEALTH CARE, 2017
VOL. 35, NO. 1, 10–18
http://dx.doi.org/10.1080/02813432.2017.1288680

RESEARCH ARTICLE

OPEN ACCESS

Antibiotic prescribing in relation to diagnoses and consultation rates in Belgium, the Netherlands and Sweden: use of European quality indicators

Mia Tyrstrup[a], Alike van der Velden[b], Sven Engstrom[c], Geert Goderis[d], Sigvard Molstad[a], Theo Verheij[b], Samuel Coenen[e,f,g] and Niels Adriaenssens[e,f]

[a]Department of Clinical Sciences, General Practice, Lund University, Lund, Sweden; [b]Julius Center for Health Sciences and Primary Care, University Medical Center Utrecht, Utrecht, the Netherlands; [c]Primary Care Research and Development Unit, Jönköping, Sweden; [d]Katholieke Universiteit Leuven, Academic Center for General Practice, Leuven, Belgium; [e]Department of Primary and Interdisciplinary Care (ELIZA), Center for General Practice, University of Antwerp, Antwerp, Belgium; [f]Laboratory of Medical Microbiology, Vaccine & Infectious Disease Institute (VAXINFECTIO), University of Antwerp, Antwerp, Belgium; [g]Department of Epidemiology and Social Medicine, University of Antwerp, Antwerp, Belgium

ABSTRACT

Objective: To assess the quality of antibiotic prescribing in primary care in Belgium, the Netherlands and Sweden using European disease-specific antibiotic prescribing quality indicators (APQI) and taking into account the threshold to consult and national guidelines.
Design: A retrospective observational database study.
Setting: Routine primary health care registration networks in Belgium, the Netherlands and Sweden.
Subjects: All consultations for one of seven acute infections [upper respiratory tract infection (URTI), sinusitis, tonsillitis, otitis media, bronchitis, pneumonia and cystitis] and the antibiotic prescriptions in 2012 corresponding to these diagnoses.
Main outcome measures: Consultation incidences for these diagnoses and APQI values (a) the percentages of patients receiving an antibiotic per diagnosis, (b) the percentages prescribed first-choice antibiotics and (c) the percentages prescribed quinolones.
Results: The consultation incidence for respiratory tract infection was much higher in Belgium than in the Netherlands and Sweden. Most of the prescribing percentage indicators (a) were outside the recommended ranges, with Belgium deviating the most for URTI and bronchitis, Sweden for tonsillitis and the Netherlands for cystitis. The Netherlands and Sweden prescribed the recommended antibiotics (b) to a higher degree and the prescribing of quinolones exceeded the proposed range for most diagnoses (c) in Belgium. The interpretation of APQI was found to be dependent on the consultation incidences. High consultation incidences were associated with high antibiotic prescription rates. Taking into account the recommended treatments from national guidelines improved the results of the APQI values for sinusitis in the Netherlands and cystitis in Sweden.
Conclusion: Quality assessment using European disease-specific APQI was feasible and their inter-country comparison can identify opportunities for quality improvement. Their interpretation, however, should take consultation incidences and national guidelines into account. Differences in registration quality might limit the comparison of diagnosis-linked data between countries, especially for conditions such as cystitis where patients do not always see a clinician before treatment.

KEY POINTS

The large variation in antibiotic use between European countries points towards quality differences in prescribing in primary care.

- The European disease-specific antibiotic prescribing quality indicators (APQI) provide insight into antibiotic prescribing, but need further development, taking into account consultation incidences and country-specific guidelines.
- The incidence of consultations for respiratory tract infections was almost twice as high in Belgium compared to the Netherlands and Sweden.
- Comparison between countries of diagnosis-linked data were complicated by differences in data collection, especially for urinary tract infections.

ARTICLE HISTORY
Received 19 March 2016
Accepted 7 October 2016

KEYWORDS
General practice; drug therapy; anti-bacterial agents; quality of health care; evidence-based medicine

CONTACT Mia Tyrstrup mia.tyrstrup@med.lu.se Department of Clinical Sciences, General Practice, Lund University, Lund, Sweden

Supplemental data for this article can be accessed here.

Introduction

Antibiotic use is recognised as the main driver of antimicrobial resistance. Consequently, the overuse of antibiotics unnecessarily induces resistance development [1–3]. The largest volumes of antibiotics are prescribed in primary care, with respiratory and urinary tract infections (RTI and UTI) being the most common indications for prescribing [4,5]. National and European surveillance of antibiotic use provides insight into the overall primary care antibiotic consumption, and into the subtypes of antibiotics used. The surveillance data are based on antibiotic sales statistics from pharmacies and are available as defined daily doses per 1000 inhabitants per day (DID) and for some countries also as number of packages per 1000 inhabitants per day (PID). Research by the European Surveillance of Antimicrobial Consumption project (ESAC), currently known as ESAC-Net, showed large variation throughout Europe with regard to these outcomes, suggesting important quality differences [6,7]. These differences urge for interventions or campaigns to improve the quality of antibiotic use. The available surveillance data, however, do not provide enough guidance to identify national focus areas for interventions, as they do not provide the indication for prescribing.

Patients' antibiotic use is in most cases the result of the following decision-making steps. First, the patient decides to present to primary care: consultation decision. Second, the primary care clinicians [general practitioners (GPs) and nurses] decide whether or not to prescribe an antibiotic: prescription decision. Third, when antibiotics are deemed necessary, the clinician decides what antibiotic to prescribe: subtype decision. Fourth, the patient decides whether or not to collect the prescription, start the treatment and whether or not to complete the treatment: intake decision. In the process of improving the quality of antibiotic use, insight into all of these steps is necessary in order to identify targets for intervention.

The ESAC project proposed a set of 21 disease-specific antibiotic prescribing quality indicators (APQIs) [8]. They are intended to assess the quality of the GPs' prescribing and subtype decision (Steps 2 and 3), i.e. for each of seven diagnoses (upper respiratory tract infection (URTI), sinusitis, tonsillitis, otitis media, bronchitis, pneumonia and cystitis): (a) the percentage of patients prescribed an antibiotic, (b) the percentage prescribed first-choice antibiotics and (c) the percentage prescribed quinolones. For each indicator ranges of acceptable APQI values were proposed based on European consensus (Table 1).

In order to evaluate the APQIs, it is necessary to consider the national guidelines as they might differ in their recommendations from the European consensus [8]. In addition, the consultation incidence may affect the antibiotic prescription rate [8] such that a low consultation incidence with a high prescribing percentage [APQI (a)] can equal a high consultation incidence with a low prescribing percentage in the total amount of prescriptions. We, therefore, present consultation incidences for each diagnosis (Step 1), diagnosis-linked prescription data and the outcomes of the APQIs (Steps 2 and 3) from primary care networks in Belgium, the Netherlands and Sweden.

The aim of this study is to evaluate the feasibility of using routine care data from electronic patient records (EPR) to analyse quality indicators for antibiotic prescribing and to investigate whether the outcomes could guide improvement strategies for antibiotic use in the respective countries.

Methods

Design

We conducted a retrospective observational study of primary care databases from three different countries. Calculation of the APQI values requires databases with information on patients' gender, age, diagnosis and the antibiotic prescribed, with diagnoses labelled according to the revised second edition of International Classification of Primary Care (ICPC-2-R) [9,10] and antibiotic prescriptions according to the Anatomical Therapeutic Chemical (ATC) classification [11]. The study period was 1 year (1 January until 31 December 2012). For each diagnosis, we determined whether or not an antibiotic was prescribed, and which one. For quality and internal validity reasons, we noted the percentage of antibiotic prescriptions not linked to a diagnosis. These were 40% for Belgium, 16% for the Netherlands and 26% for Sweden.

Primary care databases

Belgian data were retrieved from the Intego Network, providing anonymous routine healthcare data (office hours of weekdays) from digital patient records of 51 general practices (94 GPs) located all over the region of Flanders, which all use the same medical record software (Medidoc) (Table 2). More details on the Intego Network were described elsewhere [12,13]. The Intego procedures were approved by the ethical review board of the Medical School of the Catholic University of Leuven under N° ML1723 and approved

Table 1. List of proposed disease-specific APQIs in Europe.

No.	Title	Acceptable range (%)
1a.	The percentage of patients aged between 18 and 75 years with acute bronchitis/bronchiolitis (ICPC-2-R: R78) prescribed antibacterials for systemic use (ATC: J01)	0–30
1b.	= 1a. receiving the recommended antibacterials (ATC: J01CA or J01AA)	80–100
1c.	= 1a. receiving quinolones (ATC: J01M)	0–5
2a.	The percentage of patients older than 1 year with acute upper respiratory infection (ICPC-2-R: R74) prescribed antibacterials for systemic use (ATC: J01)	0–20
2b.	= 2a. receiving the recommended antibacterials (ATC: J01CE)	80–100
2c.	= 2a. receiving quinolones (ATC: J01M)	0–5
3a.	The percentage of female patients older than 18 years with cystitis/other urinary infection (ICPC-2-R: U71) prescribed antibacterials for systemic use (ATC: J01)	80–100
3b.	= 3a. receiving the recommended antibacterials (ATC: J01XE or J01EA or J01XX)	80–100
3c.	= 3a. receiving quinolones (ATC: J01M)	0–5
4a.	The percentage of patients older than 1 year with acute tonsillitis (ICPC-2-R: R76) prescribed antibacterials for systemic use (ATC: J01)	0–20
4b.	= 4a. receiving the recommended antibacterials (ATC: J01CE)	80–100
4c.	= 4a. receiving quinolones (ATC: J01M)	0–5
5a.	The percentage of patients older than 18 years with acute/chronic sinusitis (ICPC-2-R: R75) prescribed antibacterials for systemic use (ATC: J01)	0–20
5b.	= 5a. receiving the recommended antibacterials (ATC: J01CA or J01CE)	80–100
5c.	= 5a. receiving quinolones (ATC: J01M)	0–5
6a.	The percentage of patients older than 2 years with acute otitis media/myringitis (ICPC-2-R: H71) prescribed antibacterials for systemic use (ATC: J01)	0–20
6b.	= 6a. receiving the recommended antibacterials (ATC: J01CA or J01CE)	80–100
6c.	= 6a. receiving quinolones (ATC: J01M)	0–5
7a.	The percentage of patients aged between 18 and 65 years with pneumonia (ICPC-2-R: R81) prescribed antibacterials for systemic use (ATC: J01)	90–100
7b.	= 7a. receiving the recommended antibacterials (ATC: J01CA or J01AA)	80–100
7c.	= 7a. receiving quinolones (ATC: J01M)	0–5

J01: antibacterials for systemic use; J01AA: tetracyclines; J01CA: penicillins with extended spectrum; J01CE: β-Lactamase sensitive penicillins; J01EA: trimethoprim and derivatives; J01M: quinolone antibacterials; J01XE: nitrofuran derivatives; J01XX: other antibacterials.

Table 2. Country specific data and characteristic of dataset.

Country	Belgium	Netherlands	Sweden
Population in whole country (2012) (source: www.statista.com)	11.1 million	16.7 million	9.6 million
DID[a] (year 2012)	29.8	11.3	14.1
PID[b] (year 2009)	2.53	1.53	1.19
No. of practices in study	46	45	52
No. of GPs in study	94	160	212
Total no. of patients registered with the practices	113 549[c]	266 417	338 149
No. of consultations (diagnosis in study with gender and age limitations)	34 044	55 529	59 534
Total no. of consultations per 1000 PY[d], (diagnoses in study with gender and age limitations)	341	329	243
Total no. of prescriptions per 1000 PY[d] (diagnoses in study with gender and age limitations)	189	170	138

[a]Defined daily dose (DDD) per 1000 inhabitants per day, Reference [6].
[b]No. of packages per 1000 inhabitants per day, Reference [6].
[c]Estimated according to Reference [15].
[d]PY refers to the number of registered patients in the participating practices per year.

compliant with the law according to the Sectorial Committee "Health" of the Belgian privacy commission (decision no. 13.026, 19 March 2013).

Dutch data were retrieved from the Julius General Practitioners Network, providing anonymous routine healthcare data (office hours of weekdays) from digital patient records of 45 general practices (160 GPs) located in the centre of the Netherlands (Table 2). The Julius General Practitioners Network, the extraction and generation of the database were described elsewhere [14]. In the Netherlands, one diagnosis might represent more than one consultation, as consultations for the same ICPC code within a pre-specified time frame combine into one episode.

Swedish anonymised data were retrieved from all 52 general practices (212 GPs and interns/residents) located in Jönköping County (office hours of weekdays), which all use a common medical record (Cosmic), with a universal database (Table 2). More than 95% of all encounters were labelled with an ICD 10 diagnostic code. The required ICD 10 codes were converted into ICPC-2-R codes (see Supplement 1).

Consultation incidence and antibiotic prescriptions per 1000 patient years

The numbers of consultations/episodes coded with the diagnosis under study (ICPC-2-R code) (within age and gender limits) were divided by the numbers of patients (within the same limits) registered at the participating general practices and multiplied by 1000.

For Belgium, the number of registered patients for the general practices was not available. Instead, we used the number of patients contacting their general practice over 1 year (90 839), according to the Intego database, and multiplied by 1.25. The factor of 1.25 has been calculated by comparing national reimbursement data with data from the Intego Network [15].

For each of the seven diagnoses we calculated the number of antibiotic prescriptions per 1000 patient years (PY) by multiplying the number of consultations per 1000 PY (consultation incidence) by the percentage of prescriptions per diagnosis.

Disease-specific APQI

For seven acute infections (URTI, sinusitis, tonsillitis, otitis media, bronchitis/bronchiolitis, pneumonia and cystitis) labelled with ICPC-2-R codes R74, R75, R76, H71, R78, R81 and U71, respectively (see Supplement 1 for the corresponding IDC-10 codes) ESAC proposed three quality indicators: (a) the percentage of patients (within specified age and/or gender groups) prescribed an antibiotic; (b) the percentage of patients (within specified age and/or gender groups) prescribed the antibiotic recommended by the European consensus and (c) the percentage of patients (within-specified age and/or gender groups) prescribed quinolones [8]. For each of the 21 APQIs, a range of acceptable values was proposed (Table 1). The acceptable ranges for (a) the percentage of patients prescribed an antibiotic were 0–20% for URTI, tonsillitis, sinusitis and otitis media, 0–30% for bronchitis and 80–100% for pneumonia and cystitis. The acceptable range for (b) the percentage of recommended antibiotic was 80–100%. For (c) the percentage of patients prescribed a quinolone the acceptable range was 0–5%. The recommended first-choice antibiotic for URTIs and tonsillitis were β-lactamase sensitive penicillins, for acute bronchitis, sinusitis, media otitis and pneumonia penicillins with extended spectrum, and for cystitis, nitrofurantoin or trimetoprim. We compared the country's APQI values with these proposed ranges of acceptable values [8].

Exclusion of one indicator

In a previous study, it was found that the interpretation of Indicator 7a (the percentage of patients receiving an antibiotic for pneumonia) could be hampered due to additional diagnostic investigations and/or hospital referral before starting antibiotic treatment [13]. Therefore, we present the figures for Indicator 7a but excluded them from the overall quality assessment.

Data were analysed using Microsoft Excel 2010 and SPSS version 21 (SPSS Inc., Chicago, IL).

Results

Comparison of consultation incidences

For the seven diagnoses under study consultation incidences varied between Belgium, the Netherlands and Sweden, from 243 to 341 per 1000 registered patients per year (PY) (Table 2). Consultation incidence for the diagnoses URTI and bronchitis in Belgium were twice as high compared to the Netherlands and Sweden (Table 3). In the Netherlands, the consultation incidences of cystitis and sinusitis were higher than in the other countries, while the consultation incidence of tonsillitis in Sweden was twice of that in the Netherlands. High consultation incidences were associated with high numbers of antibiotic prescriptions per 1000 PY per diagnosis (Table 3).

Comparison of quality assessment using APQI

Table 3 shows all APQI values for Belgium, the Netherlands and Sweden. For the 20 APQIs in the analysis, 16, 10 and 9 values exceeded the respective ranges of acceptable values. Using the antibiotics recommended in the national guidelines improved the results of indicator b significantly, from 22 to 82% for sinusitis in the Netherlands and from 41 to 94% for cystitis in Sweden.

In Belgium, more than 60% of patients with bronchitis, tonsillitis, sinusitis or otitis media were prescribed an antibiotic (Indicator a) (Table 3). For none of these diagnoses was the use of recommended antibiotics within the proposed range of acceptable values (Indicator b). For bronchitis, sinusitis, pneumonia and cystitis, quinolone prescribing was higher than the acceptable level of 5% (Indicator c).

The Netherlands deviated the most from the acceptable ranges regarding the percentage of patients receiving antibiotics for cystitis and the choice of antibiotics for sinusitis.

More than 45% of patients with sinusitis, tonsillitis, otitis media or bronchitis were prescribed an antibiotic (Indicator a) (Table 3). For most of the indications, the use of the recommended antibiotics was within or close to the proposed range of acceptable values. The largest deviations from the acceptable ranges were observed for the treatment of URTI and sinusitis (Indicator b). Only for cystitis was the 5% upper limit of acceptable quinolone prescribing exceeded (Indicator c).

Table 3. Values for APQIs according to age and gender limits.

Diagnostic code[a]	R74			R75			R76			H71			R78			R81			U71		
Diagnoses in text	Upper respiratory infection acute			Sinusitis acute/chronic			Tonsillitis acute			Acute otitis media			Acute bronchitis/bronchiolitis			Pneumonia			Cystitis/urinary infection other		
Population (age group)	>1 years			>18 years			>1 years			>2 years			18–75 years			18–65 years			Female >18 years		
Country	BE	NL	SE	BE	NL	SE	BE	NL	SE	BE	NL	SE	BE	NL	SE	BE	NL	SE	BE	NL	SE
Consultation incidence[b]	190	75	66	22	35	16	20	14	28	18	22	14	43	17	22	3	10	16	45	156	81
Percentage prescribed antibiotic/Indicator a	***38***	19	8	***67***	***48***	***69***	***78***	***57***	***86***	***62***	***45***	***75***	***80***	***54***	***33***	***69***	***67***	***77***	87	***67***	84
Acceptable range (%)		0–20			0–20			0–20			0–20			0–30			90–100			80–100	
Percentage recommended antibiotic/Indicator b	***1***	***7***	***57***	***37***	***22***	***77***	***14***	***72***	87	***61***	81	91	***39***	83	***71***	***30***	***74***	***47***	***62***	83	***41***
Acceptable range (%)		80–100			80–100			80–100			80–100			80–100			80–100			80–100	
b (percentage according to national guidelines)[c]	1	77	92	34	81	70	9	72	87	61	81	84	34	83	70	–	73	42	22	73	87
Percentage quinolones/Indicator c	5	0.6	1	***11***	0.4	0	0	0.1	0	2	0.2	0	***15***	0.4	2	***19***	1.6	1	***22***	***7.4***	3
Acceptable range (%)		0–5			0–5			0–5			0–5			0–5			0–5			0–5	
Antibiotic prescription per 1000 PY[d]	72	14	5	15	17	11	16	8	24	11	10	11	34	9	7	2	7	12	39	105	68

[a]See Supplement 1 for ICPC-2-R and ICD-10 codes included in study.
[b]No. of consultations per 1000 registered patients.
[c]Percentage treated with first-choice antibiotic according to national guidelines (value not available for pneumonia in BE due to patients being sent to hospital for treatment).
[d]PY = No. of patient registered per year.
Values in italic and bold are outside the proposed acceptable range (see Table 1).

In Sweden, more than 70% of the patients consulting with sinusitis, tonsillitis or otitis media were prescribed an antibiotic (Indicator a). (Table 3) On the other hand, Sweden had the smallest proportion of antibiotic prescriptions for bronchitis (33%) and URTIs (8%). Less than half of the patients receiving antibiotics for pneumonia and cystitis were prescribed the APQI-recommended antibiotics (Indicator b). None of the indications exceeded the 5% upper limit of acceptable quinolone prescribing (Indicator c).

Comparison of number of prescriptions per 1000 PY

By combining consultation incidence and prescribing percentage, the numbers of prescriptions for the individual diagnoses can be calculated per 1000 PY, which is also presented in Table 3. Belgium had the highest number of prescriptions per 1000 PY for URTIs and bronchitis, the Netherlands for sinusitis and cystitis, and Sweden for tonsillitis and pneumonia. For otitis media this number was roughly similar for all three countries. For all RTIs including AOM, the Netherlands, Sweden and Belgium had 73, 80 and 150 prescriptions per 1000 PY, respectively. This difference is probably even larger given the higher percentage of prescriptions without a linked diagnosis in Belgium. For cystitis the number of prescriptions per 1000 PY were 105, 68 and 39, respectively.

Discussion

Main findings

We found that it was feasible to calculate the APQIs from routine data originating from EPR. For bronchitis and URTIs, the consultation incidence in Belgium was twice that of Sweden and the Netherlands. In Sweden, it was more common to consult for tonsillitis, and in the Netherlands for sinusitis and cystitis. GPs in the Netherlands and Sweden prescribed fewer antibiotics for RTIs than those in Belgium. We also noted that diagnoses with high consultation incidences resulted in high antibiotic prescribing measured per 1000 PY.

The results of the APQIs deviated from the proposed European ranges of acceptable values in 16, 10 and 9 out of the 20 indicators in Belgium, the Netherlands and Sweden respectively (Table 3).

Percentage of patients prescribed an antibiotic (Indicator a)

Results of this quality indicator showed that values deviated from the proposed acceptable ranges in all countries for sinusitis, tonsillitis, otitis media and bronchitis. Only for URTIs in the Netherlands and Sweden were they within the proposed range, and for cystitis in Belgium and Sweden. Since the consultation incidences for each of the seven studied diagnoses varied substantially between the countries, the percentage of patients treated with an antibiotic (Indicator a) is not a valid instrument to compare prescribing quality between countries. A high consultation incidence but low prescribing percentage could result in the same number of prescriptions per 1000 PY as a low consultation incidence with a high prescribing percentage. Therefore, a better appreciation of the rate of antibiotic prescribing would be the number of prescriptions per given diagnosis, per 1000 registered patient [16].

The consultation incidence is influenced by several factors such as health care organisation, physician availability, public knowledge, requirements for sick notes, patient fee to consult a GP, as well as cultural differences [17]. In Sweden and the Netherlands, all patients call the general practice where a nurse will decide whether the patient needs an appointment with a physician, or can simply be advised on self-treatment, which might explain the relatively low number of consultations in those two countries. Consultation incidences could also be influenced by consultation fees per consultation (Belgium and Sweden) and the need for sickness certification within the first week of sick-leave (Belgium). The public knowledge about correct antibiotic use and antimicrobial resistance is slightly higher in Sweden than the other countries, which might decrease patients' demands for antibiotic treatment [18]. Illness perception and disease labelling differs, so that an episode of URTI in Belgium was referred to as bronchitis by the patients and antibiotics was used more often, while in the Netherlands it was called common cold [19].

Belgium is known to be a higher prescribing country with 2.53 packages per 1000 inhabitants per day (PID) compared to the Netherlands (1.53 PID) and Sweden (1.19 PID). We present PID values from 2009 as those are the most recent figures available for comparison between the three countries [20] (Table 2). This large difference in antibiotic prescribing between the countries was not identified in our data. Notably, however, 40% of the antibiotic prescriptions were not linked to a diagnosis in the Belgian data, and hence not part of our analysis, which might explain the less pronounced differences in our study. However, we clearly found more deviance from the proposed quality targets in Belgium, except for cystitis. The cystitis incidence was very low in Belgium compared to the other countries. The highest prescribing percentages in Belgian data were seen for bronchitis and URTIs, and since the consultation incidences for these two diagnoses were high as well, significantly higher numbers of prescriptions per 1000 PY were found as compared to the other countries. Hence, bronchitis and URTIs could be areas for further attention and possible intervention in order to improve antibiotic use in Belgium.

In the Netherlands, the prescribing percentages were higher than recommended for bronchitis, tonsillitis, sinusitis and AOM, and lower than recommended for cystitis. However, since the consultation incidences were low for all these diagnoses except for sinusitis, the numbers of prescription per 1000 PY were low. The fact that multiple consultations (within a 2 week period) for the same ICPC code account for only one episode in the Netherlands could have affected these figures, i.e. producing lower consultation incidences, and higher prescribing percentages when measured per episode instead of by consultation. Counting in episodes, however, does not affect the number of prescriptions per 1000 PY per diagnosis. The high use of antibiotics for cystitis has been noted earlier and the authors suggest further studies regarding adequate pain medication, enhanced diagnostic procedures and delayed prescribing [21].

Swedish figures showed higher prescribing percentages for AOM, sinusitis and tonsillitis compared to the other countries. Due to low consultation incidences, however, the prescription per 1000 PY was the same as in the other countries for AOM and actually lower than the other countries for sinusitis. For tonsillitis, the prescribing per 1000 PY was three times higher than in the Netherlands. The frequent use of rapid tests for Group A streptococci for sore throat in Sweden has been questioned and might have influenced consultation behaviour, and therefore tonsillitis has been identified as a target to improve antibiotic prescribing in Sweden [22,23]. Consequently, in late 2012, the national guidelines were revised in order to improve the selection of patients given antibiotic treatment [24]. Analysis of GPs' adherences to guidelines has been made in order to understand the reasons why the prescribing rate is high for tonsillitis in Sweden [25,26].

Percentage of patients receiving the recommended antibiotic (Indicator b + c)

Sixteen of the APQI values for percentage recommended antibiotics (Indicator b values for seven diagnoses for three countries) deviated from the proposed acceptable ranges. The outcome of this quality indicator was clearly influenced by differences in recommendations between the national guidelines and the European consensus the APQI are based on. This was the case for sinusitis in the Netherlands (doxycyclin and amoxicillin are recommended) and in Sweden for cystitis (mecillinam and furantoin are recommended) and sinusitis and pneumonia (penicillin V is recommended) [27,28]. Using the antibiotics recommended by the national guidelines affected the results of indicator b significantly, which suggests that the antibiotic treatment advised by the national guidelines needs to be considered when interpreting APQI Indicator b.

The results of Indicator c were mainly of concern for Belgium, as the quinolone prescribing percentage exceeded the proposed 5% for four out of the seven diagnoses. Quinolone consumption is important to monitor, as it is a strong driver of bacterial resistance [29].

Reducing prescribing for URTIs and bronchitis in Belgium as well as decreasing the use of broad-spectrum antibiotics including quinolones would be the suggested strategy to improve antibiotic use according to the results of the APQIs.

Limitations of the study

We analysed data from routine daily primary care during office hours and out-of-hours consultations were not included, which could underestimate the antibiotic prescribing. The data used for comparison in this study were based on different databases and there may be inter-country variations in the recording of diagnoses and the efficiency and completeness of data recording. The extent of missing consultations cannot be evaluated, but the number of prescriptions not linked to a diagnosis, 40% for Belgium, 16% for the Netherlands and 26% for Sweden, shows that data are incomplete. Analysis of Swedish data showed that cystitis-related antibiotics were over-represented in the prescriptions not linked to a diagnosis, and including these would have increased the cystitis consultation incidence to approximate that of the Netherlands. Especially for cystitis, where patients do not need to see a GP, there may be differences in whether and how a prescription after a telephone consultation, or after history taking and a diagnostic test performed by the practice assistant/nurse, is registered with a diagnosis in the database. This could underestimate the consultation incidence and the prescribing for cystitis. Another explanation for the seemingly low consultation incidence and antibiotic prescribing for cystitis in Belgium is that the standard packages for nitrofurantoin contain tablets for treating three to four episodes, so the patient can self-treat new episodes without contacting the general practice. In the context of national data as well, we believe that our data have acceptable validity for evaluating prescribing quality for RTIs, but have limitations regarding cystitis.

Delayed prescribing could cause overestimation of the consumption of antibiotics if there were many prescriptions not collected by the patients. However, we believe that the strategy of delayed prescribing is used only to a limited extent, as it is not actively promoted in these countries [30]. Nevertheless, we should keep in mind that prescribing does not equal consumption, as was clearly shown for antibiotics prescribed for lower RTI by Francis et al. [31], and especially true in high prescribing settings.

Studies have shown that physicians' adherence to diagnostic coding systems is low due to the lack of clinically important diagnoses in the systems [32]. In situations where a diagnosis is better registered for treated patients than for untreated, there is a risk of overestimating the provision of treatment, which could be applicable for infectious diagnoses [33]. There could be differences between countries regarding physicians who use diagnosis to justify prescribing decisions, such as labelling bronchitis as pneumonia, which would underestimate the antibiotic prescribing for bronchitis. We must also be aware of possible case mix differences between the populations and that these can affect our data [34]. However, we believe the impact will be limited. In a recent European observational study on the management of lower RTI, controlling for case mix was not able to explain the huge variation in antibiotic prescribing [35].

Previous studies attempting to develop useful quality indicators have had difficulties in finding consensus and international validity [36–38]. For the APQI developed by ESAC and based on European consensus, we have shown that it is feasible to calculate values from primary care databases from more than one country [8,13]. Our findings, reflecting differences in practice between countries, will hopefully stimulate further national work on quality improvement. Ultimately, the concurrent validity of quality indicators should be tested against a gold standard [39,40].

Conclusion and further direction

APQIs are developed to assess the quality of antibiotic prescribing in primary care using diagnosis-linked prescription data, and to allow comparison between European countries. The APQIs could provide direction for improvement strategies such as public campaigns, physician education or organisational changes in healthcare. However, completeness of data, incorporation of consultation incidence and the nationally recommended antibiotics, knowledge of each country's specific organisation and praxis, especially for cystitis, are essential for proper interpretation of APQI values. Then APQIs could represent a useful tool to evaluate and compare prescribing quality in primary care antibiotic internationally.

References

[1] Goossens H, Ferech M, Vander Stichele R, et al. Outpatient antibiotic use in Europe and association with resistance: a cross-national database study. Lancet. 2005;365:579–587.

[2] Malhotra-Kumar S, Lammens C, Coenen S, et al. Effect of azithromycin and clarithromycin therapy on pharyngeal carriage of macrolide-resistant streptococci in healthy volunteers: a randomised, double-blind, placebo-controlled study. Lancet. 2007;369:482–490.

[3] Costelloe C, Metcalfe C, Lovering A, et al. Effect of antibiotic prescribing in primary care on antimicrobial resistance in individual patients: systematic review and meta-analysis. BMJ. 2010;340:c2096.

[4] Ashworth M, Charlton J, Ballard K, et al. Variations in antibiotic prescribing and consultation rates for acute respiratory infection in UK general practices 1995-2000. Br J Gen Pract. 2005;55:603–608.

[5] Petersen I, Hayward A on behalf of the SACAR Surveillance Subgroup. Antibacterial prescribing in primary care. J Antimicrob Chemother. 2007;60(Suppl.1): i43–i47.

[6] Adriaenssens N, Coenen S, Versporten A, et al. European Surveillance of Antimicrobial Consumption (ESAC): outpatient antibiotic use in Europe (1997-2009). J Antimicrob Chemother. 2011;66(Suppl.6): vi3–v12.

[7] Adriaenssens N, Coenen S, Versporten A, et al. European Surveillance of Antimicrobial Consumption (ESAC): quality appraisal of antibiotic use in Europe. J Antimicrob Chemother. 2011;66(Suppl.6):vi71–vi77.

[8] Adriaenssens N, Coenen S, Tonkin-Crine S, et al. European Surveillance of Antimicrobial Consumption (ESAC): disease-specific quality indicators for outpatient antibiotic prescribing. BMJ Qual Saf. 2011; 20:764–772.

[9] ICPC-2. International Classification of Primary Care. 2nd ed. Oxford: Oxford University Press; 1998.

[10] Lamberts HWood M, eds. ICPC. International Classification of Primary Care. Oxford: Oxford University Press; 1987.

[11] 2015_guidelines.pdf [Internet]. WHO Collaborating Centre for Drug Statistics Methodology. Guidelines for ATC classifications and DDD assignment 2015. Oslo, Norway: Norwegian Institute of Public Health; 2015. Available from: http://www.whocc.no/filearchive/publications/2015_guidelines.pdf

[12] Truyers C, Goderis G, Dewitte H, et al. The Intego database: background, methods and basic results of a Flemish general practice-based continuous morbidity registration project. BMC Med Inform Decis Mak. 2014;14:48.

[13] Adriaenssens N, Bartholomeeusen S, Ryckebosch P, et al. Quality of antibiotic prescription during office hours and out-of-hours in Flemish primary care, using European quality indicators. Eur J Gen Pract. 2014; 20:114–120.

[14] van den Broek d'Obrenan J, Verheij TJM, Numans ME, et al. Antibiotic use in Dutch primary care: relation between diagnosis, consultation and treatment. J Antimicrob Chemother. 2014;69:1701–1707.

[15] Bartholomeeusen S, Kim C-Y, Mertens R, et al. The denominator in general practice, a new approach from the Intego database. Fam Pract. 2005;22:442–447.

[16] Coenen S, Welschen I, Van Royen P, et al. Management of acute cough: comparisons between Belgian and Dutch GPs. Eur J Gen Pract. 2004;10: 152–156.

[17] grace02 [Internet]. Pathways of Care for patients with LRTI in 13 European countries. Reported on GRACE 4th annual meeting, Warsaw February 2010. GRACE-Genomics to combat Resistance against antibiotics in community-aquired LRTI in Europe. [cited 2016 Feb 29]. Available from: http://www.grace-lrti.org/portal/en-gb/publications/grace-02%20patient%20pathways/grace02

[18] antimicrobial resistance_outline - eb445_amr_generalfactsheet_en.pdf [Internet]. Antimicrobial resistance. Antibiotics in the EU: use and perceptions. Brussels: European Commission; April 2016. Available from: http://ec.europa.eu/dgs/health_food-safety/amr/docs/eb445_amr_generalfactsheet_en.pdf

[19] Deschepper R, Vander Stichele RH, Haaijer-Ruskamp FM. Cross-cultural differences in lay attitudes and utilisation of antibiotics in a Belgian and a Dutch city. Patient Educ Couns. 2002;48:161–169.

[20] Publications - antimicrobial-consumption-europe-esac-net-2012.pdf. Surveillance of antimicrobial consumption in Europe 2012. European Centre for Disease Prevention and Control. [Internet]. [2014 Sept 29]. Available from: http://ecdc.europa.eu/en/publications/

[21] Willems CSJ, D'Obrenan J, van den B, et al. Cystitis: antibiotic prescribing, consultation, attitudes and opinions. Fam Pract. 2014;31:149–155.

[22] Johansson L, Månsson N-O. Rapid test, throat culture and clinical assessment in the diagnosis of tonsillitis. Fam Pract. 2003;20:108–111.

[23] Neumark T, Brudin L, Mölstad S. Use of rapid diagnostic tests and choice of antibiotics in respiratory tract infections in primary healthcare-a 6-y follow-up study. Scand J Infect Dis. 2010;42:90–96.

[24] Medical Product Agency. Management of pharyngotonsillitis – new recommendations; 2012.

[25] Gröndal H, Hedin K, Strandberg EL, et al. Near-patient tests and the clinical gaze in decision-making of Swedish GPs not following current guidelines for sore throat - a qualitative interview study. BMC Fam Pract. 2015;16:81.

[26] Hedin K, Strandberg EL, Gröndal H, et al. Management of patients with sore throats in relation to guidelines: an interview study in Sweden. Scand J Prim Health Care. 2014;32:193–199.

[27] NHG-Standaarden | NHG [Internet]. [cited 2015 Nov 30]. Available from: https://www.nhg.org/nhg-standaarden
[28] Recommendations for management of infections in primary care. Guidelines are produced by Strama and the Swedish Medical Product Agency; 2016. Available from: http://strama.se/behandlingsrekommendationer/
[29] Venezia RA, Domaracki BE, Evans AM, et al. Selection of high-level oxacillin resistance in heteroresistant Staphylococcus aureus by fluoroquinolone exposure. J Antimicrob Chemother. 2001;48:375–381.
[30] Francis NA, Gillespie D, Nuttall J, et al. Delayed antibiotic prescribing and associated antibiotic consumption in adults with acute cough. Br J Gen Pract. 2012;62:e639–e646.
[31] Francis NA, Gillespie D, Nuttall J, et al. Antibiotics for acute cough: an international observational study of patient adherence in primary care. Br J Gen Pract. 2012;62:e429–e437.
[32] Botsis T, Bassøe C-F, Hartvigsen G. Sixteen years of ICPC use in Norwegian primary care: looking through the facts. BMC Med Inform Decis Mak. 2010;10:11.
[33] Martirosyan L, Arah OA, Haaijer-Ruskamp FM, et al. Methods to identify the target population: implications for prescribing quality indicators. BMC Health Serv Res. 2010;10:137.
[34] Powell AE, Davies HTO, Thomson RG. Using routine comparative data to assess the quality of health care: understanding and avoiding common pitfalls. Qual Saf Health Care. 2003;12:122–128.
[35] Butler CC, Hood K, Verheij T, et al. Variation in antibiotic prescribing and its impact on recovery in patients with acute cough in primary care: prospective study in 13 countries. BMJ. 2009;338:b2242.
[36] Hansen MP, Bjerrum L, Gahrn-Hansen B, de-Pont CR, et al. Quality indicators for treatment of respiratory tract infections? An assessment by Danish general practitioners. Eur J Gen Pract. 2013;19:85–91.
[37] Hansen MP, Bjerrum L, Gahrn-Hansen B, et al. Quality indicators for diagnosis and treatment of respiratory tract infections in general practice: a modified Delphi study. Scand J Prim Health Care. 2010;28:4–11.
[38] Coenen S, Ferech M, Haaijer, et al. European Surveillance of Antimicrobial Consumption (ESAC): quality indicators for outpatient antibiotic use in Europe. Qual Saf Health Care. 2007;16:440–445.
[39] Andersen M. Is it possible to measure prescribing quality using only prescription data? Basic Clin Pharmacol Toxicol. 2006;98:314–319.
[40] Campbell SM, Braspenning J, Hutchinson A, et al. Research methods used in developing and applying quality indicators in primary care. BMJ. 2003;326:816–819.