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## Quality indicators for the diagnosis and antibiotic treatment of acute respiratory tract infections in general practice

*a RAND Appropriateness Method*

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## Quality indicators for the diagnosis and antibiotic treatment of acute respiratory tract infections in general practice: a RAND Appropriateness Method

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### ABSTRACT

**Objective:** To develop quality indicators for the diagnosis and antibiotic treatment of acute respiratory tract infections, tailored to the Danish general practice setting.

**Design:** A RAND/UCLA Appropriateness Method was used.

**Setting:** General practice.

**Subjects:** A panel of nine experts, mainly general practitioners, was asked to rate the relevance of 64 quality indicators for the diagnosis and antibiotic treatment of acute respiratory tract infections based on guidelines. Subsequently, a face-to-face meeting was held to resolve misinterpretations and to achieve consensus.

**Main outcome measures:** The experts were asked to rate the indicators on a nine-point Likert scale. Consensus of appropriateness for a quality indicator was reached if the overall panel median rating was 7–9 with agreement.

**Results:** A total of 50 of the 64 proposed quality indicators attained consensus. Consensus was achieved for 12 indicators focusing on the diagnostic process and 19 indicators focusing on the decision about antibiotic treatment and choice of antibiotics, respectively.

**Conclusion:** These newly developed quality indicators may be used to strengthen Danish general practitioners' focus on their management of patients with acute respiratory tract infections and to identify where there is a need for future quality improvements.

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### KEYWORDS

Antibiotics; general practice; respiratory tract infections; quality indicator; quality assessment; primary care

## Background

Worldwide, the increasing rate of antimicrobial resistance (AMR) is a major health problem. AMR is closely related to the overall consumption of antibiotics [1] as well as the types of antibiotics consumed [2]. The use of antibiotics differs between countries: in Europe, antibiotic prescribing rates are lowest in the Northern countries, moderate in the Central part, and high in many Southern countries [1]. Denmark has a relatively high use of narrow-spectrum penicillins and a very low consumption of fluoroquinolones, when compared to many countries in Central and Southern Europe. However, macrolides are prescribed more often in Denmark than in other Nordic countries [3]. In the past 20 years, antibiotic consumption has increased by 40% in Denmark, and in particular, the consumption of penicillins combined with  $\beta$ -lactamase inhibitors has increased dramatically [4]. About 90% of antibiotics

are prescribed in primary care with the highest antibiotic prescribing rate observed in the Capital Region [5]. Acute respiratory tract infections (RTIs) are one of the most common indications for antibiotic prescribing in general practice [6]. However, the majority of RTIs are caused by viruses and antibiotic treatment often provides little benefit, if any [7].

In order to improve the use of antibiotics in general practice, valid instruments are necessary to identify potential quality problems of the care provided. Instruments as quality indicators (QIs) allow benchmarking by comparisons between practices or countries and are used to generate a reflection and debate about the quality of care [8,9]. Preferably, QIs should be extractable from routine care data. The use of QIs has proved to be a significant stimulus for the improvement of antibiotic prescribing [10].

Despite the large number of antibiotic prescriptions by general practitioners (GPs), only a relatively small

number of QIs currently exist for infectious diseases in general practice [11]. Existing QIs mainly focus on the choice of antibiotics; they are often drug-specific and fail to encompass the diagnostic process [11]. However, a rational decision about antibiotic prescribing is based on a proper diagnosis. It is therefore particularly important that the quality assurance should be related to a specific diagnosis and should encompass the diagnostic process.

A successful implementation of QIs requires that GPs find the indicators relevant and suitable for their daily work in practice. Nevertheless, a recent study showed that the GPs in Denmark did not find the existing European QIs suitable for measuring the quality of antibiotic treatment [12]. During the last 5 years Danish GPs have been using QIs in their daily work with different chronic diseases; however, no Danish QIs for antibiotic prescribing exist.

This study aimed to develop QIs for diagnosis and antibiotic treatment of RTIs, tailored to the Danish general practice setting.

## Method

A RAND/UCLA Appropriateness Method was used for the development of the QIs. The RAND/UCLA Appropriateness Method is a consensus method mainly used for the development of review criteria for clinical interventions in U.S.A. [13], although it has also been used for developing QIs [14]. The method combines the best available scientific evidence with the collective judgment of experts, and it has been described as one of the only thoroughly tested systematic methods combining evidence with expert opinion [15].

The technique consists of various steps [16]:

1. Development of preliminary QIs based on a systematic literature search.
2. First assessment of the preliminary QIs by experts using an e-mailed survey.
3. Face-to-face consensus meeting of a panel of experts.
4. Second assessment of QIs.

### Proposals for QIs

A list of 64 preliminary QIs was developed by the research group (the authors). The QIs were based on national and international guidelines for the management of RTIs [17–19].

The indicators were classified according to the most frequent diagnoses of infections in primary care (International Classification of Primary Care, ICPC-2)

[20]: acute tonsillitis, acute otitis media, acute rhinosinusitis, acute bronchitis, pneumonia and acute exacerbation of chronic obstructive pulmonary disease (COPD). The indicators also covered aggregated groups such as ‘acute RTIs’ and ‘acute lower RTIs’ in order to assess overall antibiotic prescribing for RTIs. The QIs were divided into three main groups and focused on (1) the diagnostic process, (2) the decision concerning antibiotic treatment and (3) the choice of antibiotics.

### Panel of experts

Experts were purposively sampled and recruited to ensure that the QIs were valid for routine clinical general practice. A nine-person panel was identified with representation of GPs ( $n=6$ ), pharmacists ( $n=1$ ), infectious disease specialists ( $n=1$ ) and clinical microbiologists ( $n=1$ ). The final panel of experts consisted of individuals with solid knowledge and experience in infectious diseases, treatment with antibiotics and quality assessment.

### Mailed survey

A list of 64 potential QIs was e-mailed to the nine experts. The experts were asked to rate each indicator using a nine-point Likert scale ranging from 1 (completely disagree) through 5 (uncertain) to 9 (completely agree). Each indicator had to be assessed for the relevance of measuring the quality of a GP’s management of patients with RTIs. The indicators either focused on the quality of (1) the diagnostic process, (2) the decision concerning antibiotic treatment and (3) the choice of antibiotics (narrow-spectrum penicillin, amoxicillin ± clavulanic acid, macrolides or quinolones). Indicators focusing on the diagnostic process aim at assessing how correct the given diagnosis is, i.e. they are assessing if specific criteria are present in patients with a specific diagnosis.

The experts were provided with evidence-based guidelines [17,18] and were encouraged to use this information in their assessment of the QIs. Each indicator was provided with a standard that embodied acceptability of the particular performance addressed by that indicator. Low quality of the care provided is indicated if a performance falls outside the standard range. The experts were asked to rate each QI with the provided standard as a complete unit. However, if the experts disagreed with the standard they were asked to comment on the disagreement and to rate the indicator separately. Furthermore, the experts were

encouraged to propose new QIs or rephrase the already existing ones.

### **Face-to-face meeting**

A total of seven experts attended the 4-h face-to-face meeting held in November 2015 in Copenhagen, Denmark, 10 days after the survey was completed. Two experts (one GP and one infectious disease specialist) were unable to attend the meeting and participated in the process through pre-meeting conversations and post-meeting rating.

At the meeting, experts were given feedback in the form of a bar chart showing the distribution of ratings from the initial round, with the expert's own rating marked in the figure.

Only QIs that did not reach consensus in the initial survey were discussed at the face-to-face meeting. Each of these indicators were discussed and experts were encouraged to propose new QIs or rephrase the already existing ones. The discussion was facilitated by a moderator from the research group (L.T.S.) and evidence-based literature was cited whenever appropriate. Finally, the experts were asked to rate these indicators again at the meeting, i.e. second assessment.

### **Analysis**

For each QI, medians of the Likert scores were calculated and the indicators were classified into three levels of appropriateness: (1) appropriate was defined as a panel median of 7–9 without disagreement, (2) uncertain was defined as a panel median of 4–6 or any median with disagreement and (3) inappropriate was defined as a panel median of 1–3 without disagreement. A classic definition for a nine-member panel, as defined by the RAND team [16], was used for the definition of agreement and disagreement. Agreement was defined as: no more than two experts rated the indicator outside the three-point region (1–3; 4–6; 7–9) containing the median. Disagreement was defined as: at least three experts rate the indicator in the 1–3 region, and at least three experts rate it in the 7–9 region. Consensus of appropriateness for an indicator was achieved if the indicator was classified as appropriate with agreement. Those indicators with consensus of appropriateness from either the first or the second round were included in the final recommended set of indicators.

### **Results**

A total of 39 QIs reached consensus after the initial assessment. The remaining 25 indicators were

discussed and reassessed at the face-to-face meeting and another 11 indicators obtained consensus after the second assessment. Consequently, a total of 50 of the proposed 64 QIs attained consensus of appropriateness (overall panel median rating of 7–9 with agreement). Two QIs were rephrased at the meeting, but no additional indicators were proposed by the panel of experts.

Consensus of appropriateness was attained for 12 (75%) of the 16 QIs focusing on the diagnostic process (Table 1). The experts agreed on the use of point-of-care tests in patients with suspected acute pharyngotonsillitis [rapid Streptococcus A antigen detection (Strep A) test] fulfilling 2–3 modified Centor criteria, and in patients with suspected pneumonia [C-reactive protein rapid (CRP) test]. They also agreed on the diagnostic value of examining eardrum mobility in patients with suspected acute otitis media, as well as taking into account the duration of symptoms in patients with suspected acute rhinosinusitis.

Consensus of appropriateness was attained for 19 (70%) of the 27 QIs focusing on the decision to prescribe antibiotics (Table 2). The experts agreed on the relevance of measuring antibiotic treatment in patients with acute pharyngotonsillitis with a positive Strep A test and for systemically unwell patients fulfilling 4–5 modified Centor criteria. The relevance of measuring prescribing for patients older than 6 onths with acute otitis media, with no signs of fluid in the middle ear and <3 days of acute ear pain, was also agreed on.

Consensus of appropriateness was attained for 19 (90%) of the 21 QIs, focusing on the choice of antibiotics (Table 3). The experts agreed on the relevance of measuring the use of penicillin V for patients with acute pharyngotonsillitis, acute otitis media, acute rhinosinusitis, acute bronchitis and pneumonia. In general, the experts agreed on the relevance of measuring the use of macrolides for patients without known penicillin allergy.

No QIs were rated inappropriate with consensus (overall panel rating of 1–3 with agreement). The 14 QIs not achieving consensus were evenly distributed between the seven diagnoses. None of the QIs focusing on the proportion of patients treated with a wait-and-see antibiotic prescription achieved consensus. Only two QIs focusing on the choice of antibiotics did not attain consensus. These two indicators measured the proportion of patients, with either acute rhinosinusitis or acute exacerbation of COPD, treated with amoxicillin ± clavulanic acid.

Thirty three of the 50 standards were commented on by some of the experts, and four standards were changed according to these proposals. For example,

**Table 1.** QIs focusing on the diagnostic process.

QIs as a ratio (nominator: denominator)	Acceptable range (%)	Median, range 1–9
Patients with acute pharyngotonsillitis		
Number of patients fulfilling 2–3 modified Centor criteria examined with a StrepA test: number of patients fulfilling 2–3 modified Centor criteria	80–100	9*
Number of patients fulfilling 0–1 modified Centor criteria examined with a StrepA test: number of patients fulfilling 0–1 modified Centor criteria	0–10	9*
Number of systemically unwell patients fulfilling 4–5 modified Centor criteria examined with a StrepA test: number of systemically unwell patients fulfilling 4–5 modified Centor criteria	0–10	3
Patients with acute otitis media		
Number of patients >6 months fulfilling one or more diagnostic criteria <sup>a</sup> and reduced mobility of the eardrum <sup>b</sup> : number of patients >6 months	70–100	8*
Number of patients >6 months with an evaluation of the eardrum mobility <sup>b</sup> : number of patients >6 months	70–100	8*
Number of patients >6 months with reduced mobility of the eardrum <sup>b</sup> : number of patients >6 months	80–100	7
Patients with acute rhinosinusitis		
Number of patients with >10 days symptom duration or increasing symptoms after 5 days: number of patients	90–100	9*
Number of patients with three or more symptoms <sup>c</sup> : number of patients	90–100	9*
Number of patients examined with a CRP test: number of patients	80–100	2
Patients with acute bronchitis		
Number of patients examined with a CRP test: number of patients	20–80	2
Patients with pneumonia		
Number of patients fulfilling less than two diagnostic criteria <sup>d</sup> : number of patients	0–20	9*
Number of patients examined with a CRP test: number of patients	80–100	9*
Number of patients with a CRP test <20 mg/l: number of patients	0–20	8*
Number of patients examined with an X-ray of thorax: number of patients	0–30	8*
Patients with acute exacerbation of COPD		
Number of patients with acute exacerbation of dyspnea, coughing and/or expectoration greater than the daily variation: number of patients	90–100	9*
Patients whom the doctor suspects have a lower RTI		
Number of patients seen on the same day: number of patients	80–100	9*

\*Consensus of appropriateness.

<sup>a</sup>Acute onset of ear pain, injected eardrum, bulging eardrum.

<sup>b</sup>Evaluated by tympanometry or pneumatic otoscopy.

<sup>c</sup>Nasal congestion, nasal discharge, pain in the face/teeth, reduced sense of smell, fever.

<sup>d</sup>Symptoms of lower RTI (cough ± expectoration), emerging findings on examination of the chest (tachypnea, damping and/or auscultation of murmurs), signs of systemic disease (systemically unwell and/or temperature >38 °C).

the proposed standard for patients with acute rhinosinusitis treated with antibiotics was 0–10%, but was changed to 5–10% according to the experts' recommendation (Table 2).

## Discussion

### Main findings

A panel of Danish experts agreed on a total of 50 QIs for assessing the quality of GPs' management of patients with RTIs. The experts agreed on 75% of the proposed QIs concerning the diagnostic process. Nearly three quarters of the QIs focusing on the decision to prescribe antibiotics and almost all QIs focusing on the choice of antibiotics achieved consensus of appropriateness.

### Strengths and limitations

This study adhered to one of the only systematic methods combining evidence with expert opinion for developing appropriate scenarios [15,16]. The most

frequently used method for the development of QIs is the Delphi Method [11], which consists of various postal rounds of rating. By using the Delphi technique, a large panel of experts can be included in the process, but one of the drawbacks is the risk of the experts becoming fatigued and misinterpretations of the QIs. The RAND method, exclusively, includes a face-to-face meeting with the intention to resolve misinterpretations and improve definitions of QIs [16].

The panel of experts comprised healthcare providers with solid knowledge about the management of patients with RTIs and all experts had been involved in a number of quality improvement activities or relevant professional organisations. The panel comprised mainly GPs (six out of nine) as the set of indicators is aimed at improving GPs' management of RTIs. Two experts were unable to participate in the face-to-face meeting. However, these two experts were provided with relevant information from the meeting before being asked to rate the indicators again.

It is of major importance to acknowledge that QIs only assess easily measurable aspects of care and that



**Table 2.** QIs focusing on the decision to prescribe antibiotics.

QIs as a ratio (nominator: denominator)	Acceptable range (%)	Median, range 1–9
<b>Patients with acute pharyngotonsillitis</b>		
Number of patients treated with antibiotics: number of patients	20–40	9
Number of patients with a positive StrepA test treated with antibiotics: number of patients with a positive StrepA test	90–100	9*
Number of patients fulfilling 0–1 modified Centor criterion treated with antibiotics: number of patients fulfilling 0–1 modified Centor criterion	0–10	9*
Number of generally affected patients fulfilling 4–5 modified Centor criteria treated with antibiotics: number of generally affected patients fulfilling 4–5 modified Centor criteria	90–100	9*
<b>Patients with acute otitis media</b>		
Number of patients treated with antibiotics: number of patients	10–50	5
Number of patients <6 months treated with antibiotics: number of patients <6 months	90–100	9*
Number of patients >6 months with no signs of fluid in the middle ear <sup>a</sup> treated with antibiotics: number of patients >6 months with no signs of fluid in the middle ear <sup>a</sup>	0–10	9*
Number of patients >6 months with ≤3 days of acute ear pain and no signs of fluid in the middle ear <sup>a</sup> treated with antibiotics: number of patients >6 months with ≤3 days of acute ear pain and no signs of fluid in the middle ear <sup>a</sup>	0–10	9*
Number of patients treated with a wait-and-see antibiotic prescription: number of patients treated with antibiotics	0–30	5
<b>Patients with acute rhinosinusitis</b>		
Number of patients treated with antibiotics: number of patients	5–10	9*
Number of patients with a CRP test <10 mg/l treated with antibiotics: number of patients with a CRP test <10 mg/l	0–10	8*
Number of patients fulfilling less than three diagnostic criteria <sup>b</sup> treated with antibiotics: number of patients fulfilling less than three diagnostic criteria <sup>b</sup>	0–10	9*
Number of patients fulfilling three or more diagnostic criteria <sup>b</sup> treated with antibiotics: number of patients fulfilling three or more diagnostic criteria <sup>b</sup>	80–100	9*
Number of patients with <5 days symptom duration treated with antibiotics: number of patients with <5 days symptom duration	0–10	9*
Number of patients treated with a wait-and-see antibiotic prescription: number of patients treated with antibiotics	0–30	2
<b>Patients with acute bronchitis</b>		
Number of patients treated with antibiotics: number of patients	0–10	9*
Number of patients with a CRP test <20 mg/l treated with antibiotics: number of patients with a CRP test <20 mg/l	0–10	8
Number of patients with purulent expectorate treated with antibiotics: number of patients with purulent expectorate	0–10	9*
<b>Patients with pneumonia</b>		
Number of patients treated with antibiotics: number of patients	90–100	9*
Number of patients with a CRP test <20 mg/l treated with antibiotics: number of patients with a CRP test <20 mg/l	0–20	3
Number of patients <65 years fulfilling less than diagnostic criteria <sup>c</sup> treated with antibiotics: number of patients <65 years fulfilling less than two diagnostic criteria <sup>c</sup>	0–20	9*
<b>Patients with acute exacerbation of COPD</b>		
Number of patients treated with antibiotics: number of patients	20–70	5
Number of patients fulfilling 2–3 Anthonisen criteria <sup>d</sup> treated with antibiotics: number of patients fulfilling 2–3 Anthonisen criteria <sup>d</sup>	90–100	9*
<b>Patients with acute exacerbation of severe (class C–D) COPD</b>		
Number of patients treated with antibiotics: number of patients	80–100	9*
<b>Patients with acute exacerbation of mild–moderate (class A–B) COPD</b>		
Number of patients with a CRP test <10 mg/l and/or absence of fever fulfilling less than two Anthonisen criteria <sup>d</sup> treated with antibiotics: number of patients with a CRP test <10 mg/l and/or absence of fever fulfilling less than two Anthonisen criteria <sup>d</sup>	0–10	9*
<b>Patients with acute RTI</b>		
Number of patients treated with antibiotics: number of patients	10–30	3
Number of patients prescribed antibiotics by telephone consultation: number of patients treated with antibiotics	0–10	9*

\*Consensus of appropriateness.

<sup>a</sup>Evaluated by tympanometry or pneumatic otoscopy and the absence of ear discharge.

<sup>b</sup>Discolored nasal discharge and/or purulent secretion in the nasal cavities, strong localised pain, fever (>38 °C), elevated CRP, exacerbation after remission of the disease.

<sup>c</sup>Symptoms of lower RTI (cough ± expectorate), emerging findings on examination of the chest (tachypnea, damping and/or auscultation of murmurs), signs of systemic disease (systemically unwell and/or temperature >38 °C).

<sup>d</sup>Increased dyspnea, increased expectorate, increased purulence of expectorate. If only two criteria are met, one of them is increased purulence of expectorate.

they fail to encompass the more complex aspects of general practice [8]. For example, the severity of an infection is not always taken into account and this limitation should be considered when interpreting and

comparing indicators across practices. However, QIs can be used to generate a reflection about the quality of care provided and indicate areas in need of quality improvement.

**Table 3.** QIs focusing on the choice of antibiotics.

QIs as a ratio (nominator: denominator)	Acceptable range (%)	Median, range 1–9
Patients with acute pharyngotonsillitis		
Number of patients treated with penicillin V: number of patients treated with antibiotics	90–100	9*
Number of patients with known penicillin allergy treated with macrolides: number of patients treated with macrolides	90–100	9*
Number of patients without known penicillin allergy treated with macrolides: number of patients treated with macrolides	0–10	9*
Patients with acute otitis media		
Number of patients treated with penicillin V: number of patients treated with antibiotics	90–100	9*
Number of patients treated with amoxicillin ± clavulanic acid: number of patients treated with antibiotics	0–20	9*
Number of patients with known penicillin allergy treated with macrolides: number of patients treated with macrolides	90–100	9*
Number of patients without known penicillin allergy treated with macrolides: number of patients treated with macrolides	0–10	9*
Patients with acute rhinosinusitis		
Number of patients treated with penicillin V: number of patients treated with antibiotics	90–100	9*
Number of patients treated with amoxicillin ± clavulanic acid: number of patients treated with antibiotics	0–20	9
Number of patients with known penicillin allergy treated with macrolides: number of patients treated with macrolides	90–100	9*
Number of patients without known penicillin allergy treated with macrolides: number of patients treated with macrolides	0–10	9*
Patients with acute bronchitis		
Number of patients treated with penicillin V: number of patients treated with antibiotics	90–100	9*
Number of patients treated with amoxicillin ± clavulanic acid: number of patients treated with antibiotics	0–10	9*
Number of patients with known penicillin allergy treated with macrolides: number of patients treated with macrolides	90–100	9*
Number of patients without known penicillin allergy treated with macrolides: number of patients treated with macrolides	0–10	9*
Patients with pneumonia		
Number of patients treated with penicillin V: number of patients treated with antibiotics	80–100	9*
Number of patients with known penicillin allergy treated with macrolides: number of patients treated with macrolides	90–100	9*
Number of patients without known penicillin allergy treated with macrolides: number of patients treated with macrolides	0–10 <sup>a</sup>	9*
Patients with acute exacerbation of COPD		
Number of patients treated with amoxicillin ± clavulanic acid: number of patients treated with antibiotics	80–100	8
Number of patients without known penicillin allergy treated with quinolones: number of patients treated with quinolones	0–10	9*
Patients with acute RTI		
Number of patients without known penicillin allergy treated with macrolides: number of patients treated with macrolides	0–10	9*

\*Consensus of appropriateness.

<sup>a</sup>This standard cannot be used during a mycoplasma epidemic.

### Comparison with other studies

The relatively few existing QIs for infectious diseases mainly consist of drug-specific QIs; only a few other studies have developed disease-specific QIs [11]. No clear definition of disease-specific indicators for RTIs exists. It can be discussed if the criteria for a disease refer to patients presenting with symptoms and signs of an infection, or to patients with a registered diagnosis. We will argue that it depends on the data source. For example, if data is available through an electronic database or an audit it will often be based on ICPC-2 codes, hence it is patients with a registered diagnosis.

Even the disease-specific QIs often focus on the choice of antibiotics and fail to encompass the diagnostic process [21]. In order to rationalise antibiotic use, the main focus should be on ‘when to prescribe’. Hence the majority of the indicators in this study focus on the diagnostic process and the decision to prescribe antibiotics.

It is of great importance to give careful consideration to the purpose for and setting in which the indicators are planned to be used. In Denmark, there is a widespread use of point-of-care tests, such as CRP and Strep A-testing, which can help distinguish self-limiting infections from more severe ones. Point-of-care tests



are not used routinely in primary care in Eastern and Southern Europe [22]. Hence, in order to investigate and monitor the quality of antibiotic prescribing in Denmark, it is important that the QIs are tailored to the Danish primary healthcare setting. We created 50 QIs tailored to the Danish structure of primary healthcare for use mainly by GPs.

This set of QIs is provided with standards. Simply knowing the level of an indicator does not show whether or not it is acceptable. An important final step to complete the development of an indicator is to apply a standard, thereby revealing whether or not the level of the indicator is acceptable [23].

It has previously been demonstrated that clinicians involved in a specific process, for instance a clinical activity, tend to rate the quality of the process higher than those who are not directly involved in the process being assessed [24]. In the current study, we found a similar trend. Thus, the QIs were generally rated higher by the GPs than by the clinical microbiologist.

Previous literature has demonstrated that consensus is more easily achieved for QIs focusing on the choice of antibiotics than for QIs focusing on the diagnostic process [25]. Only two QIs focusing on the choice of antibiotics failed to attain consensus in our study. These two indicators measured the proportion of patients, with either acute rhinosinusitis or acute exacerbation of COPD, who were treated with amoxicillin ± clavulanic acid. In Denmark, the guideline recommendation for first-line antibiotic treatment of acute exacerbation of COPD varies between regions. As the experts represented various geographical regions it was not possible for them to agree on this indicator.

Høye et al. [26] have previously demonstrated that the views of the usefulness of delayed prescribing differed between GPs. This finding is in line with our findings, as none of the QIs focusing on the proportion of patients treated with a wait-and-see antibiotic prescription achieved consensus.

### **Perspectives**

A set of 50 QIs for diagnosis and antibiotic treatment of RTIs in Danish general practice was developed. These QIs may be used to strengthen Danish GPs' focus on their management of patients with RTIs and to identify where there is a need for future quality improvements.

This set of QIs is quite large and it would be very time consuming to apply all 50 indicators at the same time. However, it is worthwhile choosing just a few of

the indicators, for example all indicators related to a single diagnosis [27]. This would be valuable if an electronic administrative data source was available and all indicators could easily be applied to these data. As for now, this is not possible in Denmark and we suggest that GPs or researchers choose a number of these newly developed indicators and apply them to for example audit data.

Lack of data, especially details about the diagnostic process, such as the presence or absence of diagnostic criteria and the results of point-of-care tests, is often challenging to the development and implementation of QIs [28,29]. Although data availability is an important factor in deciding whether a QI ultimately can be implemented in general practice, we decided to focus on the initial question—the relevance of measuring the quality of care provided. The experts agreed on data availability as a challenge to the implementation of indicators, but were asked not to consider this challenge in the rating process. Our primary purpose was to develop a measure of quality, regardless of cost considerations and current opportunities for data availability.

Danish GPs use IT technology in their daily patient care, and electronic communication with the healthcare system is well established. Data Capture modules for chronic diseases are an integrated part of most computer systems in general practice; automatic data capture to assess the quality of care is mandatory for patients with chronic diseases, for example diabetes and heart failure [30].

The prerequisite for establishing a quality assurance system for infectious diseases therefore exists. Future research should focus on the evaluation and application of QIs for infectious diseases in order to investigate their relevance for Danish general practice and reliability in measuring quality of care.

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### **Disclosure statement**

No potential conflict of interest was reported by the authors.

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## References

- Van De Sande-Bruinsma N, Grundmann H, Verloo D, et al. Antimicrobial drug use and resistance in Europe. *Emerg Infect Dis*. 2008;14:1722–1730.
- Bronzwaer S, Cars O, Buchholz U, et al. A European study on the relationship between antimicrobial use and antimicrobial resistance. *Emerg Infect Dis*. 2002;8:278–282.
- European Centre for Disease Prevention and Control [Internet]. Surveillance of antimicrobial consumption in Europe 2012. 2014; [cited 2016, Sep 30]. Available from: <http://ecdc.europa.eu/en/healthtopics/antimicrobial-resistance-and-consumption/antimicrobial-consumption/publications-documents/Pages/publications.aspx>
- Pedersen K. DANMAP. 2014; [cited 2016, Sep 30]. Available from: <http://www.danmap.org/Downloads/Reports.aspx>
- Jensen JN, Bjerrum L, Boel J, et al. Parents' socio-economic factors related to high antibiotic prescribing in primary health care among children aged 0-6 years in the Capital Region of Denmark. *Scand J Prim Health Care*. 2016;34:274–281.
- Rún Sigurðardóttir N, Nielsen ABS, Munck A, et al. Appropriateness of antibiotic prescribing for upper respiratory tract infections in general practice: comparison between Denmark and Iceland. *Scand J Prim Health Care*. 2015;33:269–274.
- Arroll B, Kenealy T. Are antibiotics effective for acute purulent rhinitis? Systematic review and meta-analysis of placebo controlled randomised trials. *BMJ*. 2006; 333:2–4.
- Marshall M, Campbell S, Hacker J, Roland M. Quality indicators for general practice: a practical guide for health professionals and managers. London: Royal Society of Medicine Press Limited; 2002.
- van der Velden AW, Roukens M, van de Garde E, Lourens M, Natsch S. Usefulness of quality indicators for antibiotic use: case study for the Netherlands. *Int J Qual Heal Care*. 2016;2:1030–1037.
- 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:vi71–vi77.
- Saust LT, Monrad RN, Hansen MP, et al. Quality assessment of diagnosis and antibiotic treatment of infectious diseases in primary care: a systematic review of quality indicators. *Scand J Prim Health Care*. 2016;3432:1–9.
- Hansen MP, Bjerrum L, Gahrn-Hansen B, et al. Quality indicators for treatment of respiratory tract infections? An assessment by Danish general practitioners. *Eur J Gen Pract*. 2013;19:85–91.
- Campbell SM, Braspenning J, Hutchinson A, et al. Research methods used in developing and applying quality indicators in primary care. *Qual Saf Health Care*. 2002;11:358–364.
- Teresato Guttmann A, Loughheed MD, et al. Evidence-based performance indicators of primary care for asthma: a modified RAND Appropriateness Method. *Int J Qual Heal Care*. 2010;22:476–485.
- Naylor D. What is appropriate care? *N Engl J Med*. 1998;338:1918–1920.
- Fitch K, Bernstein SJJ, Aguilar MDD, et al. The RAND/UCLA Appropriateness Method user's manual. RAND. 2001; [cited 2016 Sep 30]. Available from: <http://www.rand.org>
- Bjerrum L, Gahrn-Hansen B, Hansen MP, et al. Luftvejsinfektioner - diagnose og behandling. Klinisk vejledning for almen praksis [Respiratory tract infections - diagnosis and treatment. Clinical guidelines for general practice]. *Dansk Selsk Almen Med*. 2014. Available from: [http://www.dsam.dk/flx/publikationer/dsams\\_kliniske\\_vejledninger/](http://www.dsam.dk/flx/publikationer/dsams_kliniske_vejledninger/)
- Sundhedsstyrelsen [Internet]. National klinisk retningslinje for behandling med trommehindedræn [National clinical guideline for treating the eardrum drain]; [cited 2016 Sep 30]. 2015. Available from: <http://www.sst.dk>
- Lund V, Fokkens W, Mullol J, et al. EPOS 2012: European position paper on rhinosinusitis and nasal polyps 2012. A summary for otorhinolaryngologists. *Rhinology*. 2012;50:1–298.
- World Health Organization (WHO) [Internet]. International Classification of Primary Care, Second edition (ICPC-2); [cited 2016 Sep 30]. Available from: <http://www.who.int/classifications/icd/adaptations/icpc2/en/>
- Adriaenssens N, Coenen S, Tonkin-Crine S, et al. European Surveillance of Antimicrobial Consumption (ESAC): disease-specific quality indicators for out-patient antibiotic prescribing. *BMJ Qual Saf*. 2011;20: 764–772.

- [22] Bjerrum L, Munck A, Gahrn-Hansen B, et al. Health Alliance for prudent antibiotic prescribing in patients with respiratory tract infections (HAPPY AUDIT) - impact of a non-randomised multifaceted intervention programme. *BMC Fam Pract.* 2011;12:1–8.
- [23] Mainz J. Developing evidence-based clinical indicators: a state of the art methods primer. *Int J Qual Health Care.* 2003;15:i5–11.
- [24] Kahan JP, Park RE, Leape LL, et al. Variations by specialty in physician ratings of the appropriateness and necessity of indications for procedures. *Med Care.* 1996;34:512–523.
- [25] 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.
- [26] Høye S, Frich JC, Lindboæk M. Delayed prescribing for upper respiratory tract infections: a qualitative study of GPs' views and experiences. *Br J Gen Pract.* 2010;60:907–912.
- [27] Hansen MP, Jarbol DE, Gahrn-hansen B, et al. Treatment of acute otitis media in general practice: quality variations across countries. *Fam Pract.* 2012;29:63–68.
- [28] Robertson J, Fryer JL, O'Connell DL, et al. Limitations of Health Insurance Commission (HIC) data for deriving prescribing indicators. *Med J Aust.* 2002;176:419–424.
- [29] Pulcini C, Lions C, Ventelou B, et al. Approaching the quality of antibiotic prescriptions in primary care using reimbursement data. *Eur J Clin Microbiol Infect Dis.* 2013;32:325–332.
- [30] Schroll H, Christensen R, dePont Thomsen JL, et al. The Danish model for improvement of diabetes care in general practice: impact of automated collection and feedback of patient data. *Int J Family Med.* 2012;2012:1–5.