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Review

Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative studies

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ABSTRACT

Inappropriate prescription has been associated with mounting rates of antibiotic resistance worldwide, demanding more detailed studies into physicians' decision-making process. Accordingly, this study sought to explore physicians' perceptions of factors influencing antibiotic prescribing. A systematic search was performed for qualitative studies focused on understanding physicians' perceptions of the factors, attitudes and knowledge influencing antibiotic prescription. Of the total of 35 papers selected for review purposes, 18 solely included physicians and the remaining 17 also included patients and/or other healthcare providers. Data collection was based mainly on interviews, followed by questionnaires and focus groups, and the methodologies mainly used for data analysis were grounded theory and thematic analysis. Factors cited by physicians as having an impact on antibiotic prescribing were grouped into those that were intrinsic (group 1) and those that were extrinsic (group 2) to the healthcare professional. Among the former, physicians' attitudes, such as complacency or fear, were rated as being most influential on antibiotic prescribing, whilst patient-related factors (e.g. signs and symptoms) or healthcare system-related factors (e.g. time pressure and policies/guidelines implemented) were the most commonly reported extrinsic factors. These findings revealed that: (i) antibiotic prescribing is a complex process influenced by factors affecting all the actors involved, including physicians, other healthcare providers, healthcare system, patients and the general public; and (ii) such factors are mutually dependent. Hence, by shedding new light on the process, these findings will hopefully contribute to generating new and more effective strategies for improving antibiotic prescribing and allaying global concern about antibiotic resistance.

1. Introduction

Concerns raised about antibiotic resistance have highlighted this field as an important public health problem calling for prompt countermeasures. According to the World Health Organization (WHO), infections caused by microorganisms often fail to respond to conventional therapy, increasing health costs, morbidity and mortality, and threatening a return to the pre-antibiotic era [1]. In Europe, wide variations in resistance status are found depending on the pathogen type, antimicrobial substance and geographical region, with unimpeded growth rates being observed for some resistant strains [2–4].

Currently, there are few doubts about the association between the use of antibiotics and the spread of antibiotic resistance, with misprescription of antibiotics being one of the major favouring factors [5–7]. As key stakeholders in the field, physicians have been the target of numerous interventions aimed at addressing the factors underlying the misprescription of antibiotics and, ultimately, improving the quality of such prescribing [8,9]. Exploring and understanding the factors specific to each setting is the first and most important step towards designing effective interventions [10].

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Insofar as published reviews seek to evaluate the influence on antibiotic prescribing of the aspects identified, they have nevertheless not attempted to explore and identify the subjective opinions held by physicians or the type of prescriber-related attitudes and knowledge that could not be identified by researchers a priori [11]. This is the main objective of qualitative studies and could prove extremely useful in terms of improving knowledge in this field.

Qualitative methods are becoming increasingly prevalent in medical and related research [12], and several qualitative studies have investigated the factors involved in antibiotic prescribing. A review of such qualitative literature is fundamental to gaining insight into the culture of antibiotic prescribing, and this review therefore set out to explore and identify physicians' perceptions of factors, attitudes and knowledge influencing antibiotic prescribing.

2. Materials and methods

2.1. Search strategy/search methods for identification of studies

For the purpose of this systematic bibliographic review, MEDLINE PubMed scientific database was searched from January 1987 to December 2011 using the following broad-based search term strategy: (attitud* OR knowle* OR percept*) AND (physician* OR doctor* OR practitioner*) AND (antibiotic OR antimicrobial*). The selection criteria required papers to be published in English, Portuguese or Spanish, with those in other languages being excluded from the review.

2.2. Study content inclusion

Studies were deemed eligible for review if they met the following criteria: (i) they had to state expressly that their main objective was to explore and identify physicians' perceptions of factors influencing antibiotic prescribing; (ii) they had to use qualitative methodology as a method of affording additional ways of exploring real-life behaviour, by enabling participants to speak for themselves [13]; and (iii) they had to include whatever infectious disease was involved. In the case of studies including both quantitative and qualitative methodology, only qualitative data were collected. Likewise, where the study population included healthcare professionals other than physicians or other subpopulations, data were solely extracted from physicians.

All papers selected were reviewed by two of the authors (ATR and FR) who decided whether or not these met the selection criteria. In any case of disagreement, the paper in question was examined by the authors MTH and AFi, who took the final decision.

2.3. Quality inclusion criteria

To assess the quality of the papers selected for inclusion, the Critical Appraisal Skills Programme (CASP) quality assessment tool was used [14]. This tool contains two screening and eight detailed questions that deal very broadly with some of the principles or assumptions that characterise qualitative research.

2.4. Data extraction

For each study included in the review, a table was drawn up (see Table 1) with the following parameters: author; year of publication; setting; study population; workplace; sample size; method of analysis; disease/clinical condition; patient type/characteristics; and data collection method. Based on the CASP [14], Table 1 also shows the identification number of the questions correctly answered in each study.

In addition, the intrinsic and extrinsic factors reported by each study as having or not having an influence on antibiotic prescribing were extracted and respectively listed in two tables according to physicians' perceptions.

With regard to intrinsic factors perceived by physicians as being important to antibiotic prescribing, a second table was drawn up (Table 2) showing 'sociodemographic factors', 'physicians' attitudes' and 'others' (the 'desire for a quick fix' expressed by the physician, and diagnostic uncertainty). Sociodemographic factors included sex, medical specialisation, previous clinical experience, years of practice, university education and continuous medical education. Six different attitudes were identified in the studies selected, and their definition, except in the case of confidence, was based on the following pre-defined description [11]:

- complacency: attitude that motivates the prescribing of antibiotics to fulfil professionals' perceptions of their patients'/parents' expectations;
- fear: attitude relating to fear of possible future complications in the patient and/or fear of losing patients;
- ignorance: lack of relationship between overprescribing and antibiotic resistance, linked to lack of knowledge;
- indifference: lack of motivation to feel positively or negatively inclined to the problem of antibiotic prescribing;
- responsibility of others: attitude underlying the belief that responsibility for generating antibiotic resistances lies with other professionals; and
- confidence: term that seeks to describe the self-reliance felt by physicians when prescribing antibiotics. This attitude may be defined as the level of confidence felt by physicians when deciding whether or not to prescribe any given therapy including antibiotics, on the basis of the maxim 'never change a winning practice'. Examples of sentences extracted directly from the papers include: (i) "Never change a winning team" was quoted by several residents and specialists (Schouten et al. [15]); and (ii) the negative attitude on the single-dose regimen therefore resulted from no confidence in its effectiveness (Liabsuetrakul et al. [16]).

Extrinsic factors reported by physicians as having an influence on antibiotic prescribing are listed in Table 3 and included patient-related factors (age, other clinical conditions, symptoms, signs, anxiety, economic and social factors, educational level and express desire for a quick fix), healthcare system-related factors (pressure of time, ownership of practice location, communication and organisational model, accreditation level of practice setting, and policies/guidelines implemented) and others (influence of pharmaceutical companies, costs saving and financial incentives).

All factors directly cited in the studies selected were examined and extracted and, owing to the qualitative nature of all papers, the transcribed interviews/consultations used to collect subjective factors not identified by the authors were also assessed. Papers were analysed and the data extracted by two researchers (ATR and FR) acting independently, with the results of their respective analyses then being compared; in cases of doubt, a third author (MTH) took the final decision.

3. Results

3.1. Search results

The search strategy identified a total of 1032 studies in the MEDLINE PubMed scientific database. Following screening, 223 papers were retrieved and assessed as eligible for perusal of the full text, resulting in a final total of 35 studies included in the review (Fig. 1) [15–49]. Of these, 26 exclusively used qualitative methodology [15,17,19–24,27–31,33,35–39,41–46,49] and 9

Table 1
Methodological characteristics of the 35 studies selected.

Author (year)	Setting[a]	SP[b]	WP[c]	SS[d]	MA[e]	P/CC[f]	TP[g]	MDC[h]	CASP	
									Screening questions	Detailed questions
Paredes et al. (1996) [17]	PE	P, PA	PC	40		Di	Pe	I	1,2	4,5,6,7,9,10
Palmer and Bauchner (1997) [18]	USA	P, PA	PC	61			Pe	Q	1,2	3,4,5,7,8,9,10
Barden et al. (1998) [19]	USA	P, PA	PC	22	TA		Pe	FGD	1,2	3,4,5,8,9,10
Butler et al. (1998) [20]	UK	P, PA	PC	21	GT	RTI	A, Pe	I	1,2	3,4,5,6,7,8,9,10
Hasty et al. (1999) [21]	USA	P, PA	HC	17			Emergencies	Q	1,2	5,7,8,9,10
Coenen et al. (2000) [22]	BE	P	PC, HC	24	Content analysis	RTI	A	FGD	1,2	3,4,5,6,8,9,10
Walker et al. (2000) [23]	USA	P, Oh	HC	22	TA and content analysis	UTI	Institutionalised EP	FGD	1,2	3,4,5,7,8,9,10
Björnsdóttir and Hansen (2001) [24]	IS	P	PC	10 + 28 C	TA			I + RC	1,2	3,4,5,8,9,10
Paluck et al. (2001) [25]	CA	P	PC	392		RTI	Pe	Q	1,2	4,5,7,8,9,10
Liabsuetrakul et al. (2002) [26]	TH	P	HC	50	Ethnography	Caesarean section	Pregnant women	I	1,2	4,5,6,7,8,9,10
Kumar et al. (2003) [27]	UK	P	PC	40	GT	RTI		I	1,2	3,4,5,6,8,9,10
Liabsuetrakul et al. (2003) [16]	TH	P	HC	50	Ethnography	Caesarean section	Pregnant women	I	1,2	3,4,5,7,8,9
Altiner et al. (2004) [28]	DE	P	PC	42 C		RTI	A, no co-morbidities	RC	1,2	3,4,5,8,9,10
Mol et al. (2004) [29]	NL	P	HC	12	GT			I	1,2	3,4,5,8,9,10
Sivagnanam et al. (2004) [30]	IN	P	PC, HC	285				Q	1,2	4,5,8,9,10
Weiss et al. (2004) [31]	UK	P, PA, Oh	PC, HC	181		RTI		Q	1,2	4,5,6,7,8,9,10
Midthun et al. (2005) [32]	USA	P, Oh	PC	181		UTI	EP	Q	1,2	3,5,8,9,10
Zaffani et al. (2005) [33]	IT	P, PA	PC	276		RTI	Pe	Q	1,2	4,5,6,8,9,10
Mangione-Smith et al. (2006) [34]	USA	P, PA	PC	522 C		RTI	Pe	RC	1,2	3,4,5,7,8,9
Tan et al. (2006) [35]	CA	P, Oh	HC	23	GT and TA	SSI	Surgical patients	I	1,2	3,4,5,6,8,9,10
Gould et al. (2007) [36]	UK	P, PA	PC	54				Q	1,2	4,5,8,9,10
Ong et al. (2007) [37]	USA	P, PA	HC	54		RTI	Emergencies	I	1,2	4,5,6,7,8,9,10
Schouten et al. (2007) [15]	NL	P, Oh	HC	17	TA	RTI		I	1,2	3,4,5,6,8,9,10
Simpson et al. (2007) [38]	UK	P	PC	40	GT			I	1,2	3,4,5,6,8,9,10
Wood et al. (2007) [39]	UK	P	PC	40	GT			I	1,2	3,4,5,6,7,8,9
Moro et al. (2009) [40]	IT	P	PC, HC	633		RTI	Pe	Q	1,2	3,4,5,7,8,9,10
Reynolds and McKee (2009) [41]	CN	P, PA, Oh, Ot	PC, HC	11	GT	RTI, Di		I	1,2	4,5,7,9,10
Bjorkman et al. (2010) [42]	SE	P	HC	20	PA			I	1,2	3,4,5,7,8,9,10
Björnsdóttir et al. (2010) [43]	IS	P	PC	8	GT			I + RC	1,2	4,5,7,8,9
Kotwani et al. (2010) [44]	IN	P	PC	36	GT			FGD	1,2	3,5,9,10
Sahoo et al. (2010) [45]	IN	P, Oh	PC	8	Content analysis			I	1,2	3,4,5,7,8,9,10
Bjorkman et al. (2011) [46]	SE	P	PC	20	PA	Infectious disease		I	1,2	3,4,5,7,8,9,10
Kuehlein et al. (2011) [47]	DE	P	PC	23	TA			FGD	1,2	3,4,5,6,8,9
Ong et al. (2011) [48]	USA	P, PA	HC	260 C		Uncomplicated lacerations	Emergencies	I	1,2	3,4,5,6,7,8,9,10
Vazquez-Lago et al. (2011) [49]	ES	P	PC	33				FGD	1,2	3,4,5,6,7,8,9,10

CASP, Critical Appraisal Skills Programme.

[a] Setting: PE, Peru; BE, Belgium; IS, Iceland; CA, Canada; TH, Thailand; DE, Germany; NL, Netherlands; IN, India; IT, Italy; CN, China; SE, Sweden; ES, Spain.

[b] Study population: P, physicians; PA, patients and/or their caregivers; Oh, other healthcare providers; Ot, others.

[c] Workplace: PC, primary care; HC, hospital care.

[d] Sample size: C, consultations.

[e] Methodology of analysis: TA, thematic analysis; GT, grounded theory; PA, phenomenographic analysis.

[f] Pathology/clinical condition: Di, diarrhoea; RTI, respiratory tract infection; UTI, urinary tract infection; SSI, surgical-site infection.

[g] Type of patient: Pe, paediatric; A, adult; EP, elderly persons.

[h] Method of data collection: I, interviews; Q, questionnaires; FGD, focus group discussions; RC, recorded consultations.

Table 2
Description of intrinsic factors identified as influencing antibiotic prescribing.

Author (year)	Sociodemographic factors	Attitudes[a]	Others
Paredes et al. (1996) [17]	Previous clinical practice; Years of practice	Ignorance; Fear; Confidence	Diagnostic uncertainty
Palmer and Bauchner (1997) [18]		Complacency; Fear	
Barden et al. (1998) [19]		Indifference; Complacency; Fear; Responsibility of others	Desire for a quick fix expressed by the physician
Butler et al. (1998) [20]		Ignorance; Indifference; Complacency; Fear; Responsibility of others; Confidence	Diagnostic uncertainty
Hasty et al. (1999) [21]			
Coenen et al. (2000) [22]		Complacency; Fear	Diagnostic uncertainty
Walker et al. (2000) [23]		Ignorance	Diagnostic uncertainty
Björnsdóttir and Hansen (2001) [24]		Complacency; Confidence	Diagnostic uncertainty
Paluck et al. (2001) [25]	Previous clinical practice; Continuous medical education	Complacency	Diagnostic uncertainty
Liabsuetrakul et al. (2002) [26]	Previous clinical practice	Indifference; Complacency; Fear; Confidence	
Kumar et al. (2003) [27]	Previous clinical practice; Continuous medical education	Ignorance; Complacency; Fear; Confidence	Desire for a quick fix expressed by the physician; Diagnostic uncertainty
Liabsuetrakul et al. (2003) [16]	Continuous medical education	Indifference; Fear; Confidence	
Altiner et al. (2004) [28]		Complacency	Desire for a quick fix expressed by the physician
Mol et al. (2004) [29]	Years of practice	Ignorance; Indifference	
Sivagnanam et al. (2004) [30]			
Weiss et al. (2004) [31]		Complacency	
Midthun et al. (2005) [32]			
Zaffani et al. (2005) [33]		Complacency	Desire for a quick fix expressed by the physician
Mangione-Smith et al. (2006) [34]		Complacency	
Tan et al. (2006) [35]		Indifference; Responsibility of others	
Gould et al. (2007) [36]	Previous clinical practice	Indifference	
Ong et al. (2007) [37]		Complacency; Fear	
Schouten et al. (2007) [15]	Previous clinical practice	Ignorance; Confidence	
Simpson et al. (2007) [38]	University education	Ignorance; Indifference, Complacency; Fear	
Wood et al. (2007) [39]	Previous clinical practice	Complacency; Fear	Desire for a quick fix expressed by the physician; Diagnostic uncertainty
Moro et al. (2009) [40]		Complacency; Fear	Diagnostic uncertainty
Reynolds and McKee (2009) [41]		Ignorance; Complacency	Diagnostic uncertainty
Bjorkman et al. (2010) [42]		Ignorance; Fear	Desire for a quick fix expressed by the physician; Diagnostic uncertainty
Björnsdóttir et al. (2010) [43]	Previous clinical practice	Ignorance; Fear	Desire for a quick fix expressed by the physician; Diagnostic uncertainty
Kotwani et al. (2010) [44]		Complacency; Fear; Responsibility of others	Diagnostic uncertainty
Sahoo et al. (2010) [45]		Responsibility of others	
Bjorkman et al. (2011) [46]		Complacency	Desire for a quick fix expressed by the physician
Kuehlein et al. (2011) [47]	Previous clinical practice; University education	Confidence	
Ong et al. (2011) [48]		Complacency	Diagnostic uncertainty
Vazquez-Lago et al. (2011) [49]		Ignorance; Indifference; Complacency; Fear; Responsibility of others	Diagnostic uncertainty

[a] Attitudes identified and their definition: Ignorance, lack of relationship between overprescribing and antibiotic resistance, linked to lack of knowledge; Fear, attitude relating to fear of possible future complications in the patient and/or fear of losing patients; Confidence, term that seeks to describe the self-reliance felt by physicians when prescribing antibiotics; Complacency, attitude that motivates the prescribing of antibiotics to fulfil professionals' perceptions of their patients'/parents' expectations; Indifference, lack of motivation to feel positively or negatively inclined to the problem of antibiotic prescribing; and Responsibility of others, attitude underlying the belief that responsibility for generating antibiotic resistances lies with other professionals.

used qualitative and quantitative methodology (mixed methods) [16,18,25,26,32,34,40,47,48].

3.2. Quality assessment

As shown in Table 1, all the studies selected fulfilled the requirements of the screening questions. However, the majority of the papers did not cover all of the detailed questions. Yet since the most important factors were generally reported, all 35 papers were included in this review.

3.3. Characteristics of selected studies

The general characteristics of the selected studies are summarised in Table 1.

The study setting was primary care in 20 cases [17–20,24,25,27,28,32–34,36,38,39,43–47,49], hospital care in 10 cases [15,16,21,23,26,29,35,37,42,48] and both primary and hospital care in 5 cases [22,30,31,40,41].

The studies were drawn from five different continents, although mainly from Europe ($n = 18$) [15,20,22,24,27–29,31,33,36,38–40,42,43,46,47,49] and North America ($n = 10$) [18,19,21,23,25,32,34,35,37,48].

Study populations included physicians, patients and/or their caregivers and other healthcare providers. Eighteen studies focused solely on physicians [16,22,24–30,38–40,42–44,46,47,49] and ten also included patients and/or their caregivers [17–21,33,34,36,37,48]. Furthermore, four papers studied physicians and other healthcare providers (nurses in two instances [23,32], perioperative staff in one [35] and pharmacists in another [15]). Sahoo et al. [45] also included physicians and other healthcare providers, i.e. veterinarians and drug dispensers. In the case of the remaining two papers, one included physicians, nurses and patients [31] and the other included physicians,

Table 3
Description of extrinsic factors identified as influencing antibiotic prescribing.

Author (year)	Patient-related factors	Healthcare system-related factors	Others
Paredes et al. (1996) [17]		Ownership of practice location	Financial incentives; Pharmaceutical companies
Palmer and Bauchner (1997) [18]		Pressure of time	
Barden et al. (1998) [19]	Signs; Desire for a quick fix expressed by the patient/caregivers	Implemented policies/guidelines; Influence of group exposures	Pharmaceutical companies
Butler et al. (1998) [20]	Signs; Anxiety	Pressure of time	
Hasty et al. (1999) [21]	Other clinical conditions		
Coenen et al. (2000) [22]	Symptoms; Signs	Pressure of time	
Walker et al. (2000) [23]	Patient age; Symptoms; Signs	Communication and organisational model	
Björnsdóttir and Hansen (2001) [24]	Other clinical conditions; Symptoms; Signs; Economic and social factors	Pressure of time	Cost saving
Paluck et al. (2001) [25]		Communication and organisational model; Implemented policies/guidelines	Cost saving
Liabsuetrakul et al. (2002) [26]	Signs; Economic and social factors	Accreditation level	Cost saving
Kumar et al. (2003) [27]	Symptoms; Signs; Educational level; Economic and social factors	Pressure of time; Implemented policies/guidelines	
Liabsuetrakul et al. (2003) [16]		Communication and organisational model; Implemented policies/guidelines	Cost saving
Altiner et al. (2004) [28]	Signs; Desire for a quick fix expressed by the patient/caregivers		
Mol et al. (2004) [29]		Implemented policies/guidelines	
Sivagnanam et al. (2004) [30]	Signs	Pressure of time; Inexistence of facilities to promote diagnostic tests	Cost saving
Weiss et al. (2004) [31]			
Midthun et al. (2005) [32]	Other clinical conditions		
Zaffani et al. (2005) [33]	Patient age; Anxiety; Educational level		
Mangione-Smith et al. (2006) [34]		Communication and organisational model	
Tan et al. (2006) [35]		Communication and organisational model; Workflow	
Gould et al. (2007) [36]			
Ong et al. (2007) [37]	Signs		
Schouten et al. (2007) [15]			
Simpson et al. (2007) [38]		Public health considerations	
Wood et al. (2007) [39]	Patient age; Other clinical conditions; Signs	Implemented policies/guidelines	Cost saving
Moro et al. (2009) [40]			Financial incentives
Reynolds and McKee (2009) [41]			Cost saving
Bjorkman et al. (2010) [42]		Pressure of time	
Björnsdóttir et al. (2010) [43]	Symptoms; Signs; Economic and social factors; Desire for a quick fix expressed by the patient/caregivers	Pressure of time	Cost saving
Kotwani et al. (2010) [44]	Desire for a quick fix expressed by the patient/caregivers	Pressure of time; Ownership of practice location; Use the same prescription several times	Cost saving; Pharmaceutical companies
Sahoo et al. (2010) [45]		Pressure of time	
Bjorkman et al. (2011) [46]		Pressure of time	
Kuehlein et al. (2011) [47]			
Ong et al. (2011) [48]	Signs	Patient health insurance	Cost saving
Vazquez-Lago et al. (2011) [49]	Signs	Implemented policies/guidelines	

patients and other key informers as the study population [41].

Medical specialties were described in 25 of the selected articles. The authors collected data exclusively from general practitioners (GPs) in 12 studies [20,24,27,28,31,36,38,39,43,46,47,49] and from paediatricians in 4 studies [18,33,34,40]. Family physicians were also studied along with geriatricians ($n = 1$) [32], paediatricians ($n = 1$) [19] or GPs ($n = 1$) [25]. Surgery physicians were studied in three papers, namely anaesthetists in one [35], internists and urologists in another [42] and medical, obstetrician/gynaecology and paediatric specialists in the third [30]. The remaining three papers included allopathic physicians ($n = 1$) [45] and obstetricians ($n = 2$) [16,26].

In terms of the methodology of analysis, eight papers applied grounded theory [20,27,29,38,39,41,43,44], four studies relied on thematic analysis [15,19,24,47] and one study used both [35]; the phenomenographic approach [42,46], ethnography [16,26] and content analysis [22,45] were used in two papers each, and Walker et al. [23] performed a thematic analysis followed by a content analysis.

With respect to the diseases/clinical conditions targeted, respiratory tract infections were the subject of 11 studies [15,20,22,25,27,28,31,33,34,37,40]. Other diseases targeted were urinary tract infection ($n = 2$) [23,32], infectious diseases ($n = 1$) [46], surgical-site infections ($n = 1$) [35], diarrhoea ($n = 1$) [17] and uncomplicated lacerations ($n = 1$) [48]. One paper addressed respiratory tract infection and diarrhoea [41] and two papers studied antibiotic use in Caesarean section [16,26]. The remaining 15 papers (43%) failed to identify the disease or specific clinical condition.

Regarding the type of patient studied, seven studies confined themselves to paediatric patients [17–19,25,33,34,40] and one also included adults [20]; six studies focused exclusively on adult [22], elderly [23,32] and emergency [21,37,48] patients; Altiner et al. [28] selected patients aged >16 years with no underlying chronic lung diseases, immunodeficiencies or recent episodes of acute cough; another two papers studied the use of antibiotics in pregnant women [16,26], and Tan et al. [35] included surgical patients; the remaining papers (49%) described no patient-specific characteristics.

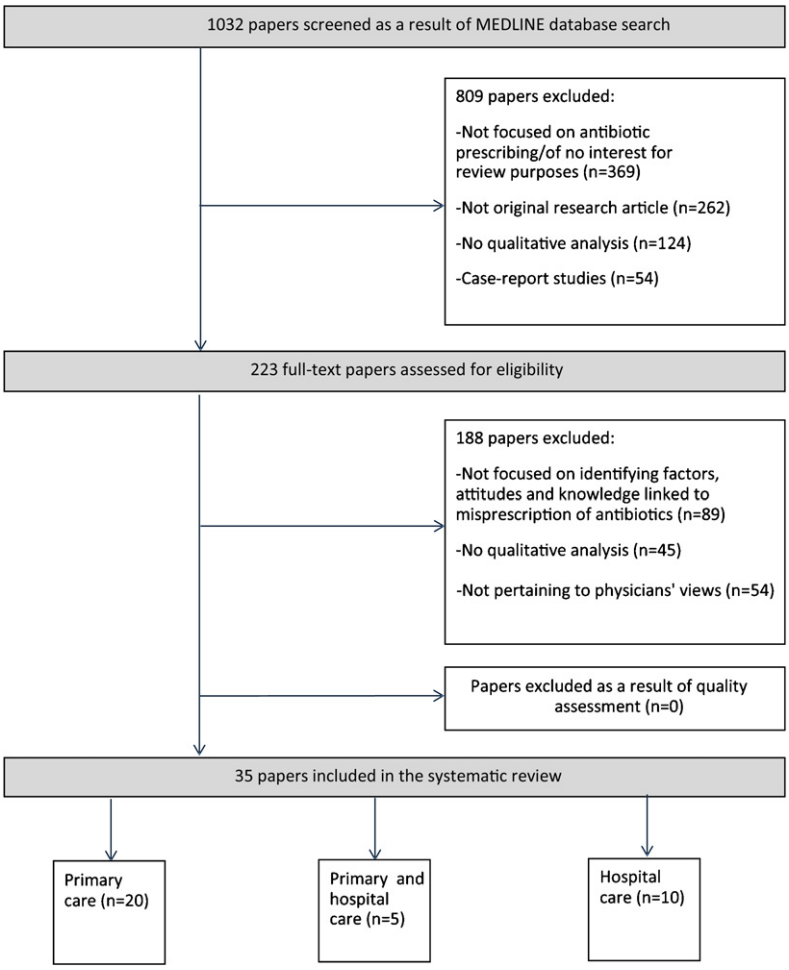

Fig. 1. Flow diagram showing study extraction and selection.

Data collection methods also varied, with most studies using semistructured and/or 'think aloud' interviews ($n = 16$) [15–17,20,26,27,29,35,37–39,41,42,45,46,48], questionnaires ($n = 9$) [18,21,25,30–33,36,40] or focus group discussions ($n = 6$) [19,22,23,44,47,49]. Recorded consultation was used in two papers [28,34] and another two papers collected data by means of interviews and recorded consultations [24,43].

3.4. Factors identified as influencing antibiotic prescription

Each study selected was assessed to identify aspects said to be related to antibiotic prescribing, i.e. factors intrinsic and extrinsic to the healthcare professional.

3.4.1. Intrinsic factors

Intrinsic factors cited by physicians as influencing antibiotic prescribing could be grouped into two broad categories, namely sociodemographic factors and physicians' attitudes (Table 2). In general, few studies described sociodemographic factors as being related to misprescription of antibiotics. Medical specialisation and sex were assessed in one paper but no direct influence was observed [25]. Previous clinical experience was considered to be a factor having an influence on antibiotic prescribing by nine studies [15,17,25–27,36,39,43,47]. The influence of years of practice was assessed in three studies, with a positive correlation being found in two [17,29] and no influence found in the third [25].

Two studies [38,47] reported that university education had a direct relationship with antibiotic prescribing; a further two papers, however, reported that this parameter had no influence on physicians' decision-making [17,25]. Continuous medical education was identified as having a direct influence on antibiotic prescribing in three papers [16,25,27].

Attitudes were identified as the major factor influencing antibiotic prescription. Eleven papers described the direct relationship between physicians' ignorance and antibiotic prescription [15,17,20,23,27,29,38,41–43,49]. A direct relationship with indifference and antibiotic misuse was assessed in nine studies [16,19,20,26,29,35,36,38,49].

Complacency was the most frequently mentioned attitude, with 24 papers [17–20,22,24–28,30,31,33,34,37–41,43,44,46,48,49] expressing diverging opinions as to its influence and 3 concluding that it had little or no influence on antibiotic prescribing [17,30,43].

Fear was also frequently described: (i) on the one hand, fear of more serious complications developing was assessed as having a direct relationship with misprescription of antibiotics by 15 studies [16,17,19,20,22,26,27,37–40,42–44,49]; and (ii) on the other hand, fear of losing patients was identified in 10 studies [16–20,22,25,26,43,44], only 1 of which failed to link it directly to antibiotic misuse [25].

Responsibility of others (i.e. other physicians, patients or other healthcare providers) was described in six papers as being a factor having an influence on antibiotic prescribing [19,20,35,44,45,49], whilst confidence was identified by eight studies as underlying the misuse of such drugs [15–17,20,24,26,27,47].

Finally, physicians' express desire for a quick fix and the problem of diagnostic uncertainty were reported as being the basis

of antibiotic misuse in 8 studies [19,27,28,33,39,42,43,46] and 15 studies [17,20,22–25,27,39–44,48,49], respectively.

3.4.2. Extrinsic factors

Factors not directly related to physicians but none the less reported as influencing the antibiotic prescription process were grouped into the following three categories: patient-related factors; healthcare system-related factors; and the impact of three other factors, namely the influence of pharmaceutical companies, cost saving (to the patient or healthcare system) and financial incentives (Table 3).

The most frequently described patient-related factors were those linked to signs and symptoms present at the date of prescription. To differentiate between these factors, the definition of the MedlinePlus medical dictionary was used [50], with signs being assessed in 14 studies [19,20,22–24,26–28,30,37,39,43,48,49] and symptoms also being included in 5 studies [22–24,27,43]. All studies identified a direct relationship between signs, symptoms and antibiotic prescribing, with the most cited factors being fever ($n = 5$) [23,24,27,30,43], 'looks unwell' ($n = 7$) [20,23,27,28,37,39,49], pain ($n = 3$) [24,27,43] and phlegm characteristics ($n = 4$) [20,28,37,49]. Patients' express desire for a quick fix was linked to antibiotic prescribing in four papers [19,28,43,44].

Other patient-related clinical conditions identified by four studies as having an influence on the prescribing of antibiotics by physicians were as follows: allergy to antibiotics in three [21,32,39]; co-morbidity in two [32,39]; pregnancy in one [21]; and the patient's specific clinical condition in two [24,32]. The remaining factors, which included age ($n = 3$) [23,33,39], anxiety ($n = 2$) [20,33], economic and social factors ($n = 4$) [24,26,27,43] and educational level ($n = 2$) [27,33], were also described as having a direct influence on antibiotic prescribing.

Insofar as healthcare system-related factors were concerned, pressure of time—directly related to patient volume—was assessed by 12 papers [18,20,22,24,25,27,30,42–46], with a lack of correlation between this factor and antibiotic prescribing being found in only one [25]. In five studies, the communication and organisational model was identified as being influential on antibiotic prescribing [16,23,25,34,35]. Of the 12 studies that addressed implemented policies/guidelines [15,16,19,21,25,27,29,35,39,41,45,49], only 7 [16,19,25,27,29,39,49] described this factor as having an influence on decision-making, thus rendering the results inconclusive. The remaining factors, which included accreditation level of practice setting (described in one paper) [26] and ownership of practice location (described by two papers as being an important factor in antibiotic prescription [17,44]) received less mention. Other healthcare system-related factors identified were: influence of group exposures [19]; public health considerations [38]; workflow [35]; lack of diagnostic test facilities [30]; the fact that patients could use the same prescription more than once [44]; and patients' health insurance [48].

The pressure exerted by pharmaceutical companies was assessed by six studies but there was a difference of opinion as to its real influence: whereas one-half of the studies identified such pressure as being an influential factor in antibiotic prescribing [17,19,44], the other three reported it as having little or no influence whatsoever [25,39,49].

Cost saving was assessed in ten papers. On identifying whether physicians' concern was about patient costs, healthcare system expenses or both, it was reported as focusing on the healthcare system by five papers [16,30,39,41,44], on patient expenses by one study [24] and on both by two studies [26,43]. Two studies reported cost saving as being an important factor in the decision to prescribe antibiotics but did not expressly identify cost saving as the target [25,48].

Lastly, two studies highlighted the fact that financial incentives promoted the overprescription of antibiotics [17,40].

4. Discussion

This was a systematic review of qualitative studies focused on examining the subjective opinions of physicians about all the factors that influence the antibiotic prescribing process, providing a new, specific overview of each factor involved and its influence on the outcomes of antibiotic use. In the results, attitudes emerge as being the most important factor affecting antibiotic prescription, a finding that could be of great importance when it comes to designing interventions to improve rational antibiotic prescribing.

Antibiotic resistance is broadly associated with antibiotic misuse and is thus related to the behaviour of all actors involved. Physicians have a pivotal role and critical responsibility because antibiotic use is mainly associated with their counselling and prescribing practices. These findings reflect physicians' extended overview of antibiotic prescription, revealing it to be a complex process influenced by direct (i.e. player-related) factors and indirect factors that affect the decision-making process.

Despite the well-established distinction between intrinsic and extrinsic factors, this review would nevertheless suggest that they are interrelated. To improve rational antibiotic prescribing and allay global concern, an in-depth understanding of these factors and their interrelationship is fundamental. In line with the literature [51,52], we therefore propose a theoretical framework for systematising the interconnection among the factors identified (Fig. 2).

As reported elsewhere [53,54], examination of the extracted data showed physicians' attitudes to be dominant. Of the six attitudes identified, those most cited by physicians were complacency—mainly linked to patients' expectations of or demand for antibiotics—and fear. Even so, according to this analysis, all the attitudes are related to one or more of the other factors identified, as shown in Fig. 2.

With regard to sociodemographic factors, we believe that these could influence physicians' knowledge (previous clinical practice, university education, continuous medical education and years of practice), attitudes (age, sex and medical specialisation) and clinical practice. Yet not only does the literature contain few studies [11,55] that describe how physician-related sociodemographic factors influence antibiotic prescribing, but their results are inconclusive, presumably because this was not the main goal of the studies selected. In the specific case of university education, both of the studies that report this to be a factor influencing antibiotic prescribing highlight supervisors' influence during hospital training as well as knowledge acquired during university education as constituting a fundamental step in physicians' clinical practice [38,47]. These results are in agreement with the literature and confirm the difficulty of changing the behaviour of physicians who are already trained [56].

Regarding patient-related factors, these results suggest that physicians assume that these have an influence on their antibiotic prescribing, with signs and symptoms ranking among those with the highest impact. Fever of <3 days or phlegm characteristics were associated with antibiotic prescribing, even though there is no scientific evidence to show that antibiotics are necessary [57]. We also identified the link between patients' express desire for a quick fix and antibiotic misuse and recognise that this could be linked to complacency.

Healthcare systems are related to antibiotic misprescription, both directly and indirectly: (i) directly via implemented policies/guidelines; and (ii) indirectly by, say, the influence of patient volume and pressure, which fosters antibiotic prescribing based on

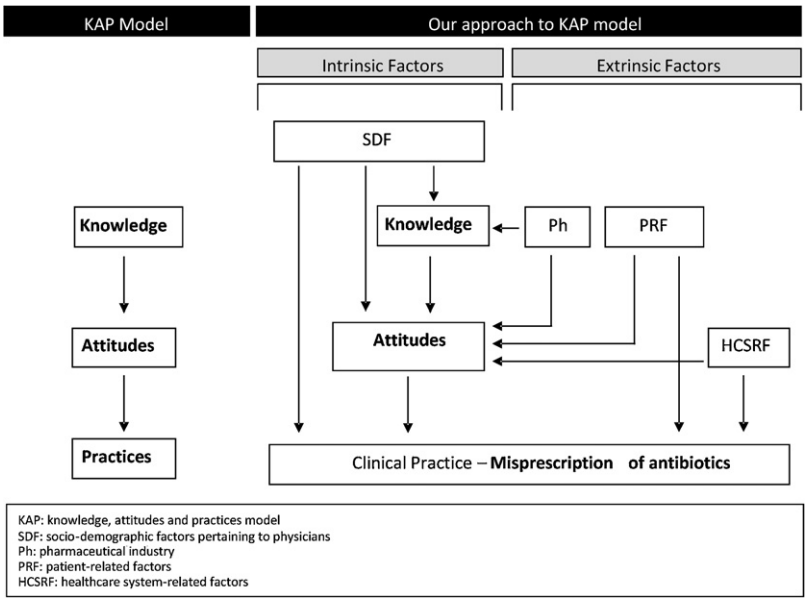

Fig. 2. Theoretical framework of the influence of and interconnection among factors that influence antibiotic prescribing.

confidence in antibiotic therapy and/or the fear of more serious complications developing or of losing patients.

There were other extrinsic factors identified in the studies selected but their poor description prevents us from drawing any general conclusions. Nevertheless, we believe that in order for antibiotic prescription patterns in any given setting to be properly understood, certain specific factors must be taken into account when implementing any intervention. There are certain factors that tend to be associated with a given context, be it a country or health system, etc. In this review, therefore, many such factors were found and not all could be analysed: these were factors specific to a group of physicians (workflow) [35] or type of patient (group exposures) [19], healthcare system (accreditation level, inexistence of diagnostic facilities, ownership of practice location) [17,26,30,44] or public health policy (public health considerations) [38].

Although this analysis of the role of the pharmaceutical industry yielded controversial results, some studies have already described the direct relationship between this factor and antibiotic prescribing [58–60].

According to this analysis, communication skills and diagnostic uncertainty rank among the principal indirect factors influencing antibiotic prescription and may provide an attractive basis for improving prescribing practices. Although physicians reported communication skills as a problem in only five of the studies selected [16,23,25,34,35], we nevertheless believe that, on the basis of complacency, this factor is an attitude related to patient expectations, in line with published papers which show that improvement in physician–patient communication can reduce patient expectations of antibiotic treatment [61,62]. In the case of diagnostic uncertainty, the current findings suggest that this may have an indirect impact by influencing physicians' attitudes, such as fear or confidence. The literature also describes the relationship between diagnostic uncertainty and antibiotic misuse, stressing the need for rapid diagnostic tests, implementation of policies/guidelines or use of delayed prescribing as ways of counteracting this problem [23,27,63–65].

Some authors have already studied the implementation of specific interventions [66–68] along with healthcare professionals' opinions about different strategies for overcoming the obstacles that could affect the success of such interventions [63,69–71]. Indeed, considering the heterogeneity of the factors identified as having an influence on antibiotic prescribing by this review, we believe that, when it comes to designing effective strategies, factors specific to each clinical practice must be taken into account. This is in line with Tonkin-Crine et al. [8] who suggest that, in order to address factors influencing antibiotic prescribing decisions, interventions should reflect GPs' own practices, reduce diagnostic uncertainty, educate health professionals about antibiotic prescribing, facilitate patient-centred care and be beneficial for GPs to implement in practice.

This review has some limitations: it only included published papers and these were very heterogeneous, rendering it susceptible to bias [72]. The main importance of such heterogeneity lies in the different settings (the studies were mainly from Europe and North America), workplaces (different realities present different factors), data collection methods, and methods of analysis used. It is also important to understand that qualitative research concerns bias and generalisation and is more valid but less reliable than quantitative research [73]. In general, the small number of physicians who participated in the qualitative studies reviewed amounts to another limitation on the generalisation of the conclusions.

We acknowledge that the conclusions could be related to our specific interpretations of the respective papers' results, and that other conclusions might be equally valid. It is also important to point out that, although the attitudes are shown as separate and distinct, we are aware that in certain situations some may well be linked (e.g. fear of losing patients and complacency).

5. Implications for practice and research

Qualitative methodology is becoming routine in medical studies, assuming the main role of exploring complex topics and defining new approaches to the field targeted [74,75]. With regard to antibiotic prescribing, this methodology has shown itself to be very useful for understanding the subjective perceptions of all the players involved, essentially physicians and policy-makers. This paper presents a fundamental understanding of the factors that physicians see as influencing antibiotic prescribing and engendering the misuse of antibiotics. This study complements previous quantitative research [11] and enhances existing knowledge of the relationship between the factors identified and physicians' perceptions and feelings.

We feel that any subsequent interventions aimed at improving rational antibiotic prescribing would do well to consider the results reported in this review. The detailed knowledge about physicians contained here could prove vital when it comes to tackling worldwide concern effectively.

6. Conclusions

In conclusion, we believe that these findings will promote a better understanding of physicians' perceptions of the factors that influence the antibiotic prescribing process, clarify how such factors influence the decision-making process, and highlight their importance in the design of strategies aimed at tackling this concern effectively.

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