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ARTICLE

Health care professionals' knowledge and attitudes towards antibiotic prescribing for the treatment of urinary tract infections: A systematic review

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Abstract

Purpose: Previous models identify knowledge and attitudes that influence prescribing behaviour. The present study focuses on antibiotic prescribing for urinary tract infections (UTIs) to describe levels of health care professionals' knowledge and attitude factors in this area and how those levels are assessed.

Methods: A systematic search was conducted to identify studies assessing the identified knowledge or attitude factors influencing health care professionals' antibiotic prescribing for urinary tract infections up to September 2022. Study quality was assessed using the Newcastle–Ottawa scale. Data were extracted about the types of factors assessed, the levels indicated and how those levels were assessed. Data were synthesized using counts, and levels were categorized as 'poor', 'moderate', 'high' or 'very high'.

Results: Seven studies were identified, six of which relied entirely on closed-ended items. Levels of knowledge factors assessed were poor, for example, their 'knowledge of condition' and 'knowledge of task environment' were poor. Levels of the attitude factors assessed varied, for example, while health care professionals expressed moderate confidence in providing optimal patient care and appropriate attitude of fear towards the problem of antibiotic resistance, they expressed a poor attitude of complacency by giving into patient pressure to prescribe an antibiotic.

Conclusions: Present evidence suggests that clinicians have poor levels of knowledge and varying levels of attitudes about antibiotic prescribing for UTIs. However, few studies were identified, and assessments were largely limited to closed-ended types of questions. Future studies that assess

more factors and employ open-ended question types could better inform future interventions to optimize antibiotic prescribing.

KEYWORDS

assessment, attitudes, health care professionals, knowledge, open-ended items, prescribing behaviour, urinary tract infections

Statement of contribution

What is already known on this subject?

- Knowledge and attitude factors have been identified as influencing prescribing behaviour, including antibiotic prescribing.
- Interventions to optimize health care professionals' prescribing behaviour are more likely to be effective where they are informed by baseline information about health care professionals' knowledge and attitudes.

What does this study add?

- Previous assessments of health care professionals' knowledge and attitudes primarily relied on closed-ended items.
- Health care professionals' knowledge towards antibiotic prescribing is not thoroughly assessed. For example, no studies assessed knowledge factors relating to procedure and patient medical factors.
- While health care professionals express confidence in their abilities to prescribe antibiotics, their indicated knowledge is poor.

INTRODUCTION

Antibiotics provided a low-cost and easy-to-implement treatment against bacterial infections, revolutionizing medicine in the 20th century. Unfortunately, the 21st century has been marked by a rise in antibiotic resistance. Antibiotic resistance is currently one of the biggest global threats to public health (World Health Organization (WHO), 2021). One factor contributing to this threat is the inappropriate prescribing of antibiotics within primary care for common conditions, such as urinary tract infections (UTIs) (Wagenlehner et al., 2022; WHO, 2018). UTIs affect over 92 million people worldwide each year (National Institute for Health and Clinical Research (NIHR), 2016). In England, UTIs account for 1%–3% of all primary care consultations (NIHR, 2016) and approximately 23% of antibiotic prescriptions (Dolk et al., 2018). While prescribing is often in accordance with national guidelines (Grigoryan et al., 2015; Kornfält Isberg et al., 2019), deviations occur that contribute to antibiotic resistance (Croker et al., 2019). Understanding the factors influencing antibiotic prescribing for UTIs across health care professionals can inform future interventions to optimize antibiotic prescribing.

Various knowledge and attitude factors influence prescribing, as described in previous empirically informed models of medical decision-making (Murshid & Mohaidin, 2017). Michie et al.'s (2005) model divides knowledge into four factors, including 'condition', 'scientific rationale', 'procedure' and 'task

environment'. Rodrigues et al.'s (2013) model divides attitudes into six factors, including 'complacency', 'fear', 'ignorance', 'indifference', 'responsibility of others' and 'confidence'. Mwape et al.'s (2022) model, which focuses on antibiotic prescribing for UTIs, merges these models into an umbrella framework that includes 'patient medical factors' and 'patient non-medical factors'. 'Patient medical factors' include knowledge directly related to the pathogenesis and pharmacological therapeutic influences, such as the patient's age or ethnicity (Jeon et al., 2014; Kumarasamy et al., 2010; Public health England (PHE), 2021; Rich et al., 2019). 'Patient non-medical factors' include attitudes that should not influence prescribing but often do. Such attitude-related patient non-medical factors include assumptions that prompt more automatic thinking processes, for example, stereotypes or stigma.

A comprehensive, reliable and valid assessment of prescribers' knowledge and attitude factors is needed to optimize future antibiotic prescribing. Based on those assessments, tailored interventions can be developed that systematically target health care professionals' needs to optimize antibiotic prescribing for UTIs (Bjorkman et al., 2013; Cooper et al., 2020).

Two literature reviews conducted in the last decade synthesized evidence of health care professionals' knowledge and attitudes towards antibiotic prescribing and resistance including, one by McCullough et al. (2015) and the other by Chaw et al. (2018). Regarding knowledge, both reviews found that while health care professionals knew that antibiotic resistance was a global problem, they did not know the mechanisms of bacterial resistance to antibiotics. Regarding attitudes, both reviews found that health care professionals often attributed rises in antibiotic resistance to the prescribing decisions of other health care professionals and patients rather than their own decisions. Chaw et al. (2018) also found that health care professionals self-reported high confidence levels in prescribing antibiotics. Neither review reported findings specific to UTIs.

Assessments of health care professionals' knowledge and attitudes can include different types of items. For instance, individual items could assess different concepts, or sets of items could be about the same patient vignette. In addition, the items themselves may be closed-ended or open-ended (Rust & Golombok, 1999). Closed-ended items provide pre-populated response options, for example, multiple choice with a single correct response, multiple choice with multiple correct responses and Likert scales with a range of more suboptimal to more optimal responses. Where the optimal responses are known in advance, aggregating participants' responses can be accomplished easily, for example, by calculating the median percentage correct or the median Likert scale response. However, such closed-ended item questioning does not capture an important nuance of real-world clinical decision-making: decision-makers are rarely provided with a pre-populated short list of response options. For instance, patients rarely present with a short list of possible diagnoses of which at least one is correct (Veloski et al., 1999). A further problem arises for attitude items, as the framing of the item or response options may elicit biased responses (Sam et al., 2022).

Open-ended items more closely approximate the nature of clinical decision-making where response options and optimal answers are rarely pre-determined. In an open-ended item type of question, participants are asked to articulate their responses in their own words. Depending on the nature of the assessment the responses could be brief account (Bala et al., 2022) or a more comprehensive narrative account (McCleary et al., 2021). Because the participants can express responses in many ways, open-ended responses are often more difficult to evaluate and may require intense coding and marking (Sam et al., 2022; Veloski et al., 1999).

The current review extends a review already published by Mwape et al. (2022). In the previous review, Mwape et al. (2022) focused on the psychometric properties of existing instruments that measure the knowledge and attitudes of health care professionals towards antibiotic use for treating UTIs. The previous review neither report information about the levels of knowledge and attitudes found in the studies retrieved, nor the item types used to conduct those assessments. The current review fills this gap by (1) describing health care professionals' levels of each knowledge and attitude factor and (2) how each factor was assessed. A review specific to UTIs is needed due to the rise of antibiotic resistance partially attributed to suboptimal prescribing (Croker et al., 2019; Grigoryan et al., 2015; Philips et al., 2014).

METHODS

The current review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Figure S1; Moher et al., 2009). The review was registered on 26 April 2021 at the International Prospective Register of Systematic Reviews (Mwape et al., 2022).

Information sources

Five electronic databases (MEDLINE via Ovid, PubMed, EMBASE, Web of Science and PsycINFO) were systematically searched on 5 March 2021. An update literature search using the same search strategy (detailed below) restricted to March 2021 until 9 September 2022 was subsequently performed in the same databases.

Eligibility criteria

Key search terms were refined with a senior librarian from the University of Warwick to capture the relevant studies and to ensure the correct use of Boolean operators, truncation and subject headings. Search terms were informed by the population intervention control outcomes (PICO) framework statement, which is an acronym standing for four study characteristics: population, intervention, comparison and outcome (Huang et al., 2006; Schardt et al., 2007). In the present review, the 'I' in PICO stands for instrument rather than intervention. Specifically, we were looking for studies in which health care professionals (population) were assessed using a written survey (instrument) designed to measure factors related to knowledge and/or attitudes about antibiotic prescribing for UTIs (outcome). Studies with and without comparisons were included.

Search strategy

The full inclusion and exclusion criteria are shown in Table 1. The full search strategy for the MEDLINE database is shown in Table S1. We searched the bibliographies of retrieved articles and published reviews for additional studies.

Study selection

The search results from each database were saved in RIS text format, uploaded onto EndNote reference manager version X20 (EndNote, 2013) and then uploaded onto Rayyan software where duplicates were removed (Ouzzani et al., 2016). Two reviewers independently screened the titles and abstracts of the potentially eligible studies [AM, CB] using the Rayyan app. Consensus discussions considering the full texts resolved disagreements. The full-text review of all remaining studies was carried out by one reviewer AM and independently cross-checked by another reviewer KAS.

Data collection process

For data extraction, a table was developed to describe study characteristics and item types. This table consisted of the author name(s), publication year, number and type of respondents, sampling strategy, strategy design, therapeutic area (e.g., uncomplicated UTI and pyelonephritis), method of data collection and item format. Data were also extracted to describe the factors of knowledge and attitudes reported according to Mwape et al. (2022) model. A second table contained this information with knowledge and attitude factors represented by columns while individual studies were represented by rows.

TABLE 1 Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
Instrument measuring knowledge and attitudes of individual healthcare professionals including, pharmacists, nurses and doctors, towards the use of antibiotics to treat UTIs	Instruments focusing on antibiotic use or ABR (antibiotic resistance) with only one item on antibiotic use and/or ABR in the context of UTIs
Focus of the study needs to be on the prescribing of antibiotics to treat UTIs by health care professionals with a follow-up on UTI-specific knowledge and attitudes	Instruments in the context of UTI but focus on students
If the study looks at prescribing decisions, it must also look at knowledge and attitudes (could be reasons for prescribing decisions), and/or evaluate the appropriateness of those prescribing decisions and present findings on that assessment	Instruments in the context of UTI but focus on specific UTI causing bacteria
Studies assessing all non-catheterized UTIs/and or related infections that may require the use of antibiotics in the treatment pathway such as lower UTI (Cystitis), upper UTI (acute pyelonephritis), recurrent UTI and asymptomatic bacteriuria	Instruments which assess knowledge and attitudes but regarding catheter-associated UTIs
Studies that directly measure an attitude (as opposed to asking about what your attitude is) and/or knowledge	Instruments which focus on antimicrobial stewardship (AMS), use of one specific drug only and factors leading to antibiotic misuse/ABR instead of knowledge and attitudes towards the use of antibiotics to treat UTIs
Studies using qualitative methods to get a quantitative measure	Studies that assess knowledge and/or attitude in terms of prophylaxis for UTIs
The review was restricted to empirical studies published in peer-reviewed journals reporting original research	Studies that assessed the choice of antibiotic only and not about whether to give antibiotics (treatment choice)
Studies had to be published in English	Studies that assessed the need for evidence on UTI treatment than treatment decision
Any study designs	Studies that assessed general and non-specific attitude and/or knowledge items in the context of UTIs
	Instruments that assessed knowledge and attitudes using a consensus panel
	Non-English articles

Study risk of bias assessment

The Newcastle–Ottawa scale adapted for cross-sectional studies was used to assess study quality (Herzog et al., 2013). On the scale, quality indicators were arranged across two domains: group selection (4 indicators, up to 5 stars) and outcome (3 indicators, up to 3 stars). The third domain comparability was excluded because the instruments were different in each study. The study quality for included domains was assessed by awarding a star for each quality indicator. Studies with 6–8 stars were deemed high quality, 3–5 stars medium quality and 0–2 stars low quality.

Synthesis methods

The types of items used and the frequencies with which each knowledge and attitude factor were assessed are described using counts. To not overstate the precision of the current findings, synthesizing the levels for each factor involved four steps. These steps ultimately transformed the quantitative findings reported in each study into qualitative categories.

In the first step, we extracted and quantified the levels across participants responses for each item. From each study, we extracted participant responses by item and placed them into a table. Responses to closed-ended items were quantified using the percentage of optimal responses for multiple-choice responses and using the means for items with Likert scales. Responses to open-ended items were quantified using the percentage of coded optimal responses (Table 2). Some responses were reverse coded such that higher levels described in this report always relate to more optimal responses.

In the second step, we aggregated the quantified levels of each knowledge and attitude factor within each study using the means across items within each factor. In the third step, we aggregated the levels reported for each knowledge and attitude factor across all studies. The aggregate levels were calculated using the number of items for the relevant factor as weights.

Lastly, in the fourth step, the aggregated levels were converted into qualitative categories. The qualitative categories were informed by previous work, where Clemence et al. (2018) considered a percentage score of 54% a 'poor' level and Lebentrau et al. (2017) considered a score of 2 on a 4-point Likert scale a 'poor' level. We assigned these scores, 54% and 2, as the top of our 'lowest' category of 'poor' for the percentage and 4-point Likert scale items, respectively. To map the 'lowest' category cut point for the 5-point Likert scale, we standardized the values of (1,1) and (4,5) on the 4-point and 5-point scales. By doing so, we derived an equation that establishes a relationship between any given value on the two scales, wherein the 5-point scale can be obtained by multiplying any point on the 4-point scale by 4/3 and subtracting 1/3. Then we created three equal intervals above this, for the three other categories 'moderate', 'high' and 'very high'. Figure 1 summarizes this mapping process.

RESULTS

Study selection

A total of 3595 records were identified, of which 3079 were left after removing duplicates and 65 were left after reviewing titles and abstracts. Seven articles fulfilled our inclusion criteria after the full-text review (Figure 2). All included study authors were contacted for raw data regarding responses from respondents; none provided the requested information. Thus, all information that was extracted in this review came from the published studies and their Supporting Information.

Study characteristics

The study characteristics are summarized in Table 3. Respondents were predominantly physicians and nurses, with a median of 91 (mean of 179) respondents across the seven studies (range: 60–456). Most studies were conducted in high-income countries, and six of the seven studies were conducted after 2010.

TABLE 2 Types of items and statistical aggregations.

Type of item	Statistical aggregation of responses
Closed-ended	
Single optimal response, for example, yes/no or single best answer	Percentage answering correctly
Multiple optimal responses	Percentage answering correctly
Multiple optimal responses	Percentage answering yes as optimal response
Likert scale (4- or 5-point)	Mean score (1–4) or (1–5)
Open-ended	
Very short answer question	Percentage answering correctly

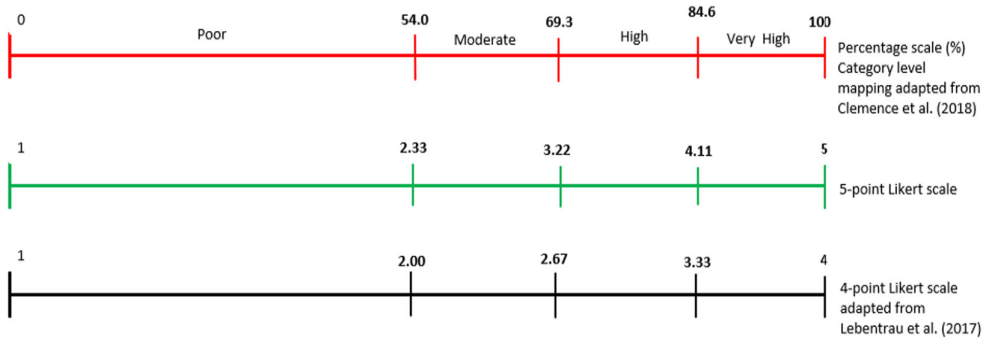

FIGURE 1 Mapping quantitative responses onto qualitative descriptors.

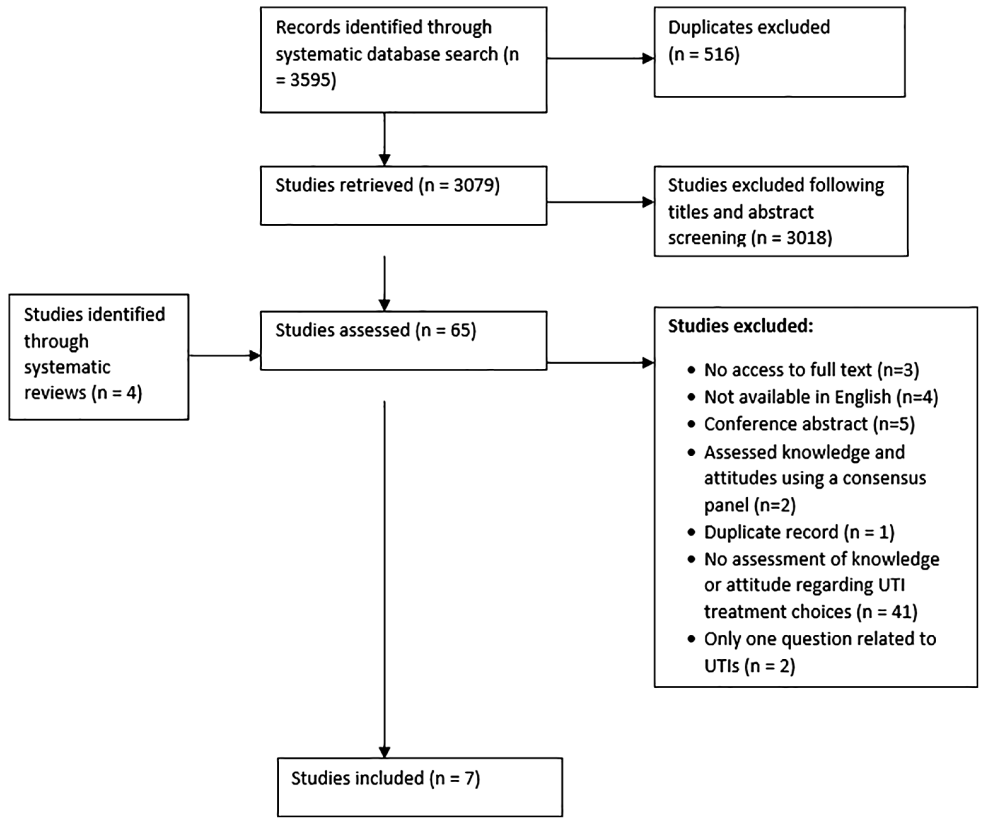

FIGURE 2 PRISMA flow diagram.

Study quality (Newcastle–Ottawa scale)

None of the studies had a high-quality score. Five studies were given a medium-score quality (Alrasheedy et al., 2019; Clemence et al., 2018; Hale et al., 2017; Lebentrau et al., 2017; Sinkala et al., 2018) and two were given a low-quality score (Markowitz et al., 2019; Midthun et al., 2005). Table 4 shows the scores for each study (see Table S2) for more details.

TABLE 3 Study characteristics.

Author (year)	Country	Respondents (sample size)	Study site	Therapeutic area	Method of data collection	Item format
Alrasheedy et al. (2019)	Saudi Arabia	Community pharmacists (116)	Community pharmacies	UTIs (not specified)	Closed-ended items using 3-point Likert rating scale responses	Nine items: Two knowledge items regarding knowledge and perceptions of community pharmacists towards dispensing antibiotics without a prescription and seven attitude items regarding complacency, fear, indifference and responsibility of others influencing antibiotic treatment
Clemence et al. (2018)	Australia	Doctors (60)	The Townsville Hospital Emergency Department	Uncomplicated UTI and severe pyelonephritis	Closed-ended items using vignettes with multiple choice (single response)	Three items: Three knowledge items where participants indicated what strongly influenced their prescribing decisions
Hale et al. (2017)	USA	Nurses (63)	Long-term care facilities in Topeka, Kansas	General UTI management and treatment	Closed-ended items using 5-point Likert rating scale responses	14 items: 11 knowledge items with an average of 6 sub-items each regarding UTI symptoms that necessitate antibiotics, and three attitude items regarding confidence in treating UTIs
Lebentrau et al. (2017)	Germany	Urologists, internists, surgeons, gynaecologist (456)	Six university medical centres and 12 non-academic tertiary care centres in Germany	Multi Drug Resistant Organism (MDRO) infections including UTI (general)	Closed-ended items using items multiple choice items (single response) and 4-point Likert rating scale responses and a vignette with multiple-choice (single response)	34 items: 20 knowledge items regarding influence on antibiotic prescribing and 14 attitude items regarding fear towards antibiotic resistance and treatment failure

TABLE 3 (Continued)

Author (year)	Country	Respondents (sample size)	Study site	Therapeutic area	Method of data collection	Item format
Markowitz et al. (2019)	USA	Physicians (91)	US physicians (private and public)	Uncomplicated cystitis, recurrent UTI, Immunosuppressed, no UTI, pyelonephritis, Urethritis, no UTI	Open-ended items using vignettes with short answers	Five items: Five knowledge items on patients presenting with uncomplicated cystitis, recurrent UTI, immunosuppressed (no UTI), Pyelonephritis and urethritis with three segments on patient history and physical exam and diagnostic test results using identification and quantification and antimicrobial susceptibility testing (AST)
Midthun et al. (2005)	USA	Physicians and nurses (373)	US physicians (private and public)	General UTI management and treatment	Closed-ended items using multiple-choice items (multiple responses)	21 items: 21 knowledge items with a combination of best answers for the treatment of patients with varying symptoms
Sinkala et al. (2018)	Australia	Pharmacists, Australia (91)	Community pharmacies	UTI in pregnancy and acute pyelonephritis	Closed-ended items using 5-point Likert rating scale, vignettes with multiple-choice items (single response)	18 items: one knowledge item with two vignettes using multiple choice with single response regarding treatment of different types of UTIs. 15 attitude items with Likert rating scale responses regarding complacency, confidence and influence of patient non-medical factors

Item types used to assess knowledge and attitude

Across studies, there was variation in the types of items used (Table 5). Six of the seven studies used closed-ended items: four included Likert-scaled items (Alrasheedy et al., 2019; Hale et al., 2017; Lebentrau et al., 2017; Sinkala et al., 2018), three included multiple-choice items with a single correct response (Clemence et al., 2018; Lebentrau et al., 2017; Sinkala et al., 2018) and one used multiple-choice items with multiple responses (Midthun et al., 2005). Only one study (Markowitz et al., 2019) used open-ended items with very short answer responses, which were coded as correct or incorrect.

Levels of knowledge and attitude assessed

The knowledge and attitude factors assessed varied across studies. Only three of the five knowledge factors were assessed. 'Knowledge of condition' was assessed in all studies except Alrasheedy et al. (2019). Two studies assessed 'knowledge of scientific rationale' (Lebentrau et al., 2017; Sinkala et al., 2018). Three studies assessed 'task environment' (Alrasheedy et al., 2019; Clemence et al., 2018; Lebentrau et al., 2017). None of the studies assessed 'knowledge of procedure' or 'knowledge of patient medical factors'.

All seven attitude factors were assessed, and their levels ranged from poor to high. 'Complacency' was assessed in two studies (Alrasheedy et al., 2019; Sinkala et al., 2018), 'fear' in two studies (Alrasheedy et al., 2019; Lebentrau et al., 2017), 'ignorance' in one study (Sinkala et al., 2018), 'indifference' in one study (Alrasheedy et al., 2019), 'responsibility of others' in two studies (Alrasheedy et al., 2019; Sinkala et al., 2018) and 'confidence' in three studies (Hale et al., 2017; Lebentrau et al., 2017; Sinkala et al., 2018). Only one study assessed the attitudes towards 'patient non-medical factors' (Sinkala et al., 2018).

Table 5 provides an overview of the factors assessed (see Table S3 for more details). The colour codes indicate different levels of knowledge and attitude calculated. Dark green represents very high; lighter green represents high; pale green represents moderate; and pale red represents poor. The levels of knowledge and attitudes assessed in the studies are described further below.

TABLE 4 Newcastle–Ottawa scores for the included studies.

	Selection[a]				Outcome[a]		Total	Risk of bias score
Author(s), year	1	2	3	4	1	2	Risk of bias score/8	Quality score
Alrasheedy et al. (2019)	★	_	_	★★	★	_	4	Medium
Clemence et al. (2018)	★	_	_	★	★	_	3	Medium
Hale et al. (2017)	_	_	_	★★	★	_	3	Medium
Lebentrau et al. (2017)	★	_	_	★★	★	★	5	Medium
Markowitz et al. (2019)	_	_	_	★	★	_	2	Low
Midthun et al. (2005)	_	_	_	★	★	_	2	Low
Sinkala et al. (2018)	★	_	_	★★	★	_	3	Medium

[a]Number of stars available: Selection: ★★★★★ (5 stars maximum); Outcome: ★★★ (3 stars maximum). Selection is based on the representativeness of the sample (★), sample size (★), non-respondents (★) and ascertainment of the exposure (risk factor) (★★). Outcome is based on the assessment of the study outcome (★) and relevant statistical tests to analyse the data (★★).

TABLE 5 The types of items included in each study, the level of knowledge or attitude[a] assessed.

Study	Knowledge of condition	Rationale	Scientific procedure	knowledge of environment	Task	medical	Patient	Complacency	Fear	Ignorance	Indifference	of others	Responsibility	Confidence	medical	Patient non-	Total items
Alrasheedy et al. (N= 116)	0	0	0	1 Likert scale	0			2 Likert scale	2 Likert scale	0	1 Likert scale	3 Likert scale		0	0		9 scaled items
Clemence et al. (N= 60)	2 vignettes with multiple-choice	0	0	1 multiple choice	0			0	0	0	0	0		0	0		3 mixed item types
Hale et al. (N= 63)	11 Likert scale	0	0	0	0			0	0	0	0	0		3 Likert scale	0		14 scaled items
Lebentrau et al. (N= 456)	13 Likert scale	2 Likert scale	0	5 Likert scale	0			0	10 Likert scale	0	0	0		4 Likert scale	0		34 scaled items
Markowitz et al. (N= 91)	5 vignettes with very short answer responses	0	0	0	0			0	0	0	0	0		0	0		5 vignettes items with very short answer responses
Midthurn et al. (N= 373)	21 multiple responses	0	0	0	0			0	0	0	0	0		0	0		21 all multiple-choice items
Sinkala et al. (N= 91)	2 vignettes with multiple-choice	1 Likert scale	0	0	0			2 Likert scale	0	1 Likert scale	0	1 Likert scale		8 Likert scale	2 Likert scale		18 mixed item types
Total/ Weighted mean score	6 studies, 53 items	2 studies, 3 items	0 studies, 0 items:	3 studies, 7 items	0 studies, 0 items			2 studies, 4 items:	2 studies, 12 items:	1 study, 1 item	1 study, 1 item	2 studies, 4 items		3 studies, 15 items	1 study, 2 items		104 items

[a]Scoring levels
Poor Moderate High V.high

Knowledge

Knowledge of condition

The aggregate level of 'knowledge of condition' assessed was poor. Health care professionals were not able to recognize key diagnostic symptoms of UTIs or select an appropriate antibiotic. Recognition of key diagnostic symptoms was assessed using open-ended items with very short answer response (Markowitz et al., 2019) and closed-ended items with either Likert scale responses (Clemence et al., 2018; Hale et al., 2017; Sinkala et al., 2018) or two or more response options as per guidelines (Midthun et al., 2005). The appropriateness of antibiotic decision was assessed using vignettes with closed-ended items with a single optimal response option (Lebentrau et al., 2017).

Knowledge of scientific rationale

The aggregate level of 'knowledge of scientific rationale' was poor. Health care professionals were unable to identify guideline recommendations on when to prescribe an antibiotic without microbiological results

(Lebentrau et al., 2017), or when to prescribe an over-the-counter medication as per local guidance information (Sinkala et al., 2018). This factor was assessed using closed-ended items with Likert scale responses.

Task environment

The aggregate level of 'knowledge of task environment' was poor. Health care professionals were more influenced by environmental factors other than national guidelines, such as colleague advice (Alrasheedy et al., 2019; Clemence et al., 2018; Lebentrau et al., 2017). Health care professionals were more influenced by other environmental factors than national guidelines. This factor was assessed using closed-ended items with Likert scale responses (Alrasheedy et al., 2019; Clemence et al., 2018) and single optimal responses (Clemence et al., 2018).

Attitude

Lack of complacency

The aggregate level of 'complacency' was poor. In other words, health care professionals were complacent as they thought that by giving into patient pressure of dispensing antibiotics without a prescription, they did not contribute to the problem of antibiotic resistance (Alrasheedy et al., 2019; Sinkala et al., 2018). This factor was assessed using closed-ended items with Likert scale responses.

Fear

The aggregate level of 'fear' was moderate. Some health care professionals believed that prescribing antibiotics for UTIs was contributing to the global problem of antibiotic resistance (Alrasheedy et al., 2019). Health care professionals also expressed some fear that the overuse of broad-spectrum antibiotics in humans, poor guideline adherence, lack of training, insufficient pharmaceutical activities on new antibiotic development and overuse of catheters were contributing to antibiotic resistance (Lebentrau et al., 2017). Health care professionals were also not influenced by the fear of not making money (Alrasheedy et al., 2019). These items were assessed using closed-ended items with a single optimal response (Alrasheedy et al., 2019) and Likert scale responses (Lebentrau et al., 2017).

Lack of ignorance

The aggregate level of 'ignorance' was poor; in other words, they did demonstrate ignorance. Health care professionals' ignorance contributed to suboptimal patient care because they believed that a reduction in dispensing over-the-counter antibiotics would not reduce the reported rise in antibiotic resistance thereby being ignorant of the association between inappropriate antibiotic use and antibiotic resistance (Sinkala et al., 2018). These items were assessed using closed-ended items with Likert scale responses.

Lack of indifference

The aggregate level of 'indifference' was high. Health care professionals were concerned about the problem of antibiotic resistance and were willing to stop dispensing antibiotics without a prescription (Alrasheedy et al., 2019). This factor was assessed using closed-ended items with Likert scale responses.

Lack of responsibility of others

The aggregate level of 'responsibility of others' was poor. Health care professionals contributed to suboptimal patient care as they did not acknowledge their responsibility in contributing to antibiotic resistance if they dispensed antibiotics without a prescription and put the blame of antibiotic resistance on other health care professionals (Alrasheedy et al., 2019; Sinkala et al., 2018). This factor was assessed using closed-ended items with Likert scale responses.

Confidence

The aggregate level of 'confidence' was moderate. Health care professionals had some confidence in the diagnosis of UTIs and consulted with other colleagues to select the appropriate antibiotic (Hale et al., 2017). Health care professionals were also fairly confident in selecting appropriate antibiotics and interpreting microbiological results (Lebentrau et al., 2017; Sinkala et al., 2018). This factor was assessed using closed-ended items with Likert scale responses.

Patient non-medical factors

The aggregate level of 'patient non-medical factors' was poor. Health care professionals had a perception that by prescribing antibiotics to patients they were providing optimal care. In so doing, patients would assume that health care professionals were more knowledgeable in treating UTIs. Therefore, health care professionals believed that more patients would seek their advice for UTI treatment without requiring a patient referral (Sinkala et al., 2018). This factor was assessed using closed-ended items with Likert scale responses.

DISCUSSION

The present review is the first global systematic review to assess the levels of knowledge and attitudes of health care professionals towards prescribing antibiotics for UTIs. Previous research has highlighted a need for improvement in health care professionals' knowledge and attitudes towards treating UTIs (Bjorkman et al., 2013; Cooper et al., 2020; Croker et al., 2019), which is confirmed by this review. Across studies, knowledge levels were generally poor, for example, professionals' 'knowledge of condition' was low, and their knowledge of 'task environment' negatively influenced their choices. However, their attitudes varied, for example, while their attitude of confidence in providing optimal patient care and fear towards the problem of antibiotic resistance were moderate, they expressed a poor attitude of complacency by giving in to patient pressure to prescribe antibiotics and putting the blame of antibiotic resistance on other professionals. No study assessed knowledge factors such as 'knowledge of procedure' and 'knowledge of patient medical factors' and no study assessed all the factors.

A potentially worrying finding involves health care professionals' moderate 'confidence' levels despite their poor overall knowledge. Previous reviews of health care professionals' decision-making in general (Chaw et al., 2018; Md Rezal et al., 2015; Rodrigues et al., 2013) find that this combination is associated with more frequent diagnostic errors. Mismatches between health care professionals' confidence and knowledge have been characterized as a cognitive bias of overconfidence (Grigoryan et al., 2016; Saposnik et al., 2016).

None of the studies assessed knowledge factors of 'procedure' and 'patient medical-factors'. Studies by Cooper et al. (2020) and Kistler et al. (2020) reported inappropriate antibiotic prescribing arising from poor knowledge of procedure among health care professionals about when to perform a

urine dipstick test or when to send urine for microbiological testing. Studies by Dylis et al. (2019) and Shallcross et al. (2017) also reported health care professionals inappropriately treating UTI patients with antibiotics due to their age and comorbidities that was inconsistent with evidence-based guidelines. The assessment of knowledge factors of 'procedure' and 'patient medical-factors' is important in identifying gaps in knowledge that may contribute to suboptimal care.

An encouraging finding was that health care professionals were concerned that antibiotics contributed to antibiotic resistance (i.e., the attitude of 'fear'). A systematic review by McCullough et al. (2015) reported similar findings where health care professionals had high levels of fear that antibiotic use was contributing to the problem of antibiotic resistance. This type of fear should encourage more prudent antibiotic prescribing. However, other types of fears could influence overprescribing. For example, a systematic review by Thompson et al. (2019) found that the fear of disease progression negatively influenced antibiotic prescribing. Similarly, studies by Krockow et al. (2019) and Zetts et al. (2020) found that health care professionals' fear of the problem of antibiotic resistance was more theoretical and not applicable to individual patient care, prompting clinicians to prescribe antibiotics inappropriately. This distinction is further exemplified in the work undertaken by McCullough et al. (2015) where health care professionals believed that antibiotic resistance is a serious problem, but thought it is caused by other health care professionals' prescribing behaviour. Similar findings were reported in this review. Health care professionals tended to prioritize their fear of antibiotic resistance over making money. However, they also displayed a complacent attitude, often yielding to patient pressure to prescribe antibiotics as a 'quick fix' or due to their easy accessibility. For example, Alrasheedy et al. (2019) found that 92% of prescribers reported yielding to patient pressure to prescribe. This behaviour effectively shifted the responsibility for antibiotic resistance onto others. Health care professionals' fear of antibiotic resistance, complacency and blaming others may lead to treatment errors (O'Sullivan & Schofield, 2018).

Only one study assessed knowledge and attitude factors using open-ended items. The other studies used closed-ended items, mainly with Likert rating scales. Two cross-sectional studies by Sam et al. (2019) and Desjardins et al. (2014) reported that clinicians in training were subject to cueing, resulting in significant biases when presented with closed-ended items compared to open-ended ones. Unlike open-ended items which provide greater authenticity, closed-ended items can give a false impression of health care professionals' competence. Furthermore, closed-ended questioning styles do not easily allow researchers to probe participants responses further to identify other critical behavioural factors that may influence prescribing (Fryling & Baires, 2016). Not identifying initially unknown factors may lead to interventions that produce poor long-term results.

Limitations

A limitation of the current review is the small number of studies included most of which were conducted in high-income countries. Further, our focus on knowledge and attitude factors meant that we may have missed other studies that did not explicitly state their study assessed knowledge or attitudes. Overall, most studies had a high risk of bias, mainly affected by the lack of sample size justification. This also influenced the comparability of knowledge and attitude between different health care professionals. No studies assessed the influence of 'knowledge of procedure' and 'patient medical factors'. Only one study used open-ended items, so we cannot compare responses to closed-ended items for all the factors.

Implications for future research

More instruments that include a mix of open and closed-ended items could be developed. Including open-ended items could increase the generalizability to real-world clinical practice and reveal additional information relevant to understanding prescribing behaviour. However, analysing open-ended items takes more

time. A consensus on the minimum levels of knowledge and attitude required to prescribe antibiotics for UTIs optimally is also required. However, until a valid and reliable measure for each factor is available, it will remain elusive what levels of knowledge and attitude factors are needed to ensure optimal care.

CONCLUSION

The current systematic review highlights two significant findings. First, despite health care professionals' moderate self-reported confidence in prescribing antibiotics for UTIs, they exhibited complacency by yielding to patient pressure and had poor knowledge regarding evidence-based guidelines for UTI treatment. Second, the instruments used to assess the knowledge and attitude of health care professionals primarily relied on closed-ended items, and their findings may not generalize to real-life clinical practice. Further work is needed to develop a comprehensive, reliable and valid measure of the knowledge and attitude factors that influence antibiotic prescribing for UTIs.

AUTHOR CONTRIBUTIONS

Angela Kabulo Mwape: Conceptualization; investigation; writing – original draft; methodology; validation; writing – review and editing; visualization; formal analysis; project administration; data curation. **Celia Brown:** Conceptualization; methodology; validation; writing – review and editing; supervision; data curation; visualization. **Kelly Ann Schmidtke:** Conceptualization; supervision; validation; methodology; visualization; data curation; writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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