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Exploring determinants of antimicrobial prescribing behaviour using the Theoretical Domains Framework

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ABSTRACT

Background: Few theoretically-based, qualitative studies have explored determinants of antimicrobial prescribing behaviour in hospitals. Understanding these can promote successful development and implementation of behaviour change interventions (BCIs).

Objective: (s): To use the Theoretical Domains Framework (TDF) to explore determinants of clinicians' antimicrobial prescribing behaviour, identifying barriers (i.e., impediments) and facilitators to appropriate antimicrobial practice.

Methods: Semi-structured interviews with purposively-sampled doctors and pharmacists with a wide range of specialties and expertise in Hamad Medical Corporation hospitals in Qatar. Interviews based on previous quantitative research and the TDF were audio-recorded, transcribed and independently analysed by two researchers using the TDF as an initial coding framework.

Results: Data saturation was achieved after interviewing eight doctors and eight pharmacists. Inter-related determinants of antimicrobial prescribing behaviour linked to ten TDF domains were identified as barriers and facilitators that may contribute to inappropriate or appropriate antimicrobial prescribing. The main barriers identified were around hospital guidelines and electronic system deficiencies (environmental context and resources); knowledge gaps relating to guidelines and appropriate prescribing (knowledge); restricted roles/responsibilities of microbiologists and pharmacists (professional role and identity); challenging antimicrobial prescribing decisions (memory, attention and decision processes); and professional hierarchies and poor multidisciplinary teamworking (social influences). Key facilitators included guidelines compliance (goals and intentions), and participants' beliefs about the consequences of appropriate or inappropriate prescribing. Further education and training, and some changes to guidelines including their accessibility were also considered essential.

Conclusions: Antimicrobial prescribing behaviour in hospitals is a complex process influenced by a broad range of determinants including specific barriers and facilitators. The in-depth understanding of this complexity provided by this work may support the development of an effective BCI to promote appropriate antimicrobial stewardship.

1. Introduction

Antimicrobial resistance (AMR) is recognised by the World Health Organization and the Centers for Disease Control and Prevention as a major threat to global public health due to associated morbidity, mortality and healthcare cost.[1,2] The threat of AMR is further complicated in hospitals which may harbour multidrug-resistant (MDR) pathogens against which most antimicrobial agents are ineffective.[1,2]

There is an increased rate of AMR in the Middle Eastern countries including the State of Qatar.[3–8] A recent study by Sid Ahmed et al.[4]

demonstrated a significant prevalence of MDR pathogens, particularly MDR *Pseudomonas aeruginosa* isolates (8.1 %, 205/2533), in five Qatar hospitals. The authors reported that the majority of isolates were from patients exposed to antibiotics during 90 days prior to isolation (85.4 %, 177/205) and the infections were mostly healthcare-acquired (95.1 %, 195/205).

Several factors contribute to the emergence and spread of AMR, with inappropriate prescribing of antimicrobials one of the most significant drivers.[9,10] A systematic review of antimicrobial prescribing/use in upper respiratory tract infections in different healthcare settings in Qatar highlighted that overprescribing is common in all settings[11] which is likely to contribute to AMR as above. The authors concluded that future research should investigate the factors associated with inappropriate antimicrobial prescribing and emphasised the need for interventional strategies to combat resistance.

The need for well-designed behaviour change interventions (BCIs) to improve clinicians' antimicrobial prescribing is critical. Growing evidence supports the use of behavioural theory to identify determinants (i.e., influences) of human behaviour including the potential barriers and facilitators to changing such behaviour.[12–17] Understanding these determinants may inform the development and implementation of successful interventions in the area of antimicrobial prescribing.[18–23] Despite this, a review of 17 systematic reviews investigating antimicrobial prescribing in hospital settings has shown that behavioural determinants remain underutilised in designing and reporting BCIs.[24] The existing interventions are not contextually designed,[25] implemented with end users of diverse specialities in mind,[26] based on robust behavioural theory[27,28] or employ evidence-based behaviour change techniques (BCTs) (i.e., intervention components).[29,30] In addition, most were carried out in single hospitals, showing little evidence of external validity.[30]

This study was part of a multi-phase explanatory sequential mixed-methods programme of research on antimicrobial prescribing in Qatar, informed by theory and guided by the United Kingdom (UK) Medical Research Council (MRC) framework for complex interventions.[13] The quantitative phase comprised an online questionnaire-based survey capturing data from doctors and pharmacists across 12 hospitals in Qatar, in relation to antimicrobial prescribing behaviour.[31] Questionnaire items were based on the Theoretical Domains Framework (TDF)[32] and previous research.[27,33] Principal Component Analysis (PCA)[34] of 535 responses identified three internally-reliable components: 'Guidelines compliance' (Component 1), 'Influences on practice' (Component 2) and 'Self-efficacy' (Component 3). While component scores for 'Guidelines compliance' and 'Self-efficacy' indicated positive responses, those for 'Influences on practice' were much less positive. Issues were largely around influences on antimicrobial prescribing (e.g., other clinicians, patients) with particular focus on the TDF domains of 'Environmental context and resources', and 'Social influences' among pharmacists and early career clinicians.

Building on this, the current study aimed to explore the determinants of clinicians' antimicrobial prescribing behaviour in Qatar and identify the barriers and facilitators relating to appropriate antimicrobial practice. A qualitative approach using semi-structured interviews was selected to understand clinicians' views and experiences in greater detail and build on insights from the previous quantitative phase.[31] Creswell[35] asserts that the combination of quantitative and qualitative approaches provides a more complete understanding of a research problem than either approach alone.

2. Methods

2.1. Study design

Given the COVID-19 pandemic's national lockdowns and travel restrictions, online video interviews using a videoconferencing software programme were considered most appropriate.

2.2. Setting

Participants were sampled from across all 12 hospital settings of Hamad Medical Corporation (HMC), the main public healthcare provider in Qatar.[36] The hospitals varied in size and services offered, but all had antimicrobial stewardship (AMS) programmes in place at the time of research.[37,38] These programmes included prospective audit with feedback, restrictions on antibiotics use (e.g. formulary restrictions) and supplemental strategies, such as clinicians' education and guidelines development.[37,38]

2.3. Eligibility criteria

Doctors (physicians and surgeons) and pharmacists (dispensing and clinical pharmacists) who completed the earlier questionnaire,[31] expressed an interest in participating in the interview phase and provided their preferred contact details were eligible.

2.4. Sampling and sample size

A broadly-based purposive sampling approach was adopted with strata of gender, profession, years of experience and area of practice. Recruitment was progressed to the likely point of data saturation, following the approach of Francis and colleagues.[39] The initial sample size was ten (five from each profession) with interviews continuing until no new themes were identified from three further consecutive interviews.

2.5. Development of interview schedule

A draft semi-structured interview schedule was developed from a comprehensive literature review, a previous systematic review[27] and the main findings (results of PCA) of the cross-sectional survey.[31] TDF domains identified as determinants in the survey were incorporated in to promote comprehensive coverage and exploration of likely determinants related to clinicians' antimicrobial prescribing behaviour. The domains 'optimism',' emotion' and 'reinforcement' were not identified as determinants in the previous study and so were not included in the interview schedule. The draft schedule was reviewed by six experienced academics, researchers and practitioners in Qatar and the UK to promote credibility,[40] then two pilot interviews were conducted (with one doctor and one pharmacist) prior to finalising the schedule. No changes were made following piloting so these data were included in the analysis. An overview of the alignment of interview questions to TDF domains and PCA components (as previously identified in the survey) is presented in Table 1.

2.6. Data generation

From December 2020 to February 2021, those clinicians sampled for interviews were contacted by the first author (HT) via e-mail which included a detailed participant information sheet and consent form. The consent form included an explicit statement consenting to interview via videoconferencing and to the video/audio recording of the conversation. Following completion and submission of this, a convenient date and time for interview was agreed.

Interviews were conducted in English by HT who has been trained in carrying out qualitative interviews (promoting dependability).[40] Different probes, such as 'Can you give me more detail about that?' were used throughout the interviews. The interviews were both video- and audio-recorded through the propriety functionality in the software used and local storage of recordings. Videoconferencing was used rather than only audio to facilitate communication and build rapport with participants. Audio transcripts generated by the videoconferencing software were checked and edited manually after each interview using a naturalistic approach in which every utterance is transcribed.[41] All

Table 1

Interview key questions aligned with the TDF domains[32] and PCA components.[31].

Area	Interview key question
DEMOGRAPHIC CHARACTERISTICS	
Introduction	Can I start by asking you to describe your current involvement in antimicrobial practice?
PCA COMPONENT 1: GUIDELINES COMPLIANCE	
Goals	I wonder if you can tell me how you feel that guidelines help you in setting your goals in relation to your routine antimicrobial practice, that is prescribing/ recommending, review/amendment, monitoring and management?
Intentions	Clinicians are encouraged to follow the guidelines in their routine antimicrobial practice. I wonder if you can comment on that in relation to your own practice?
Beliefs about consequences	What do you think the positive or negative consequences are, related to antimicrobial practice using the guidelines?
Barriers and facilitators	In relation to the guidelines, what do you feel are the barriers and facilitators to using them to help with your antimicrobial practice?
PCA COMPONENT 2: INFLUENCES ON PRACTICE	
Environmental context and resources	Which factors within the hospital environment, or resources help or hinder your antimicrobial practice?
Social influences	Can you tell me about the influences of peers and other people that are important to you in relation to your antimicrobial practice?
Behavioural regulation	Thinking about your own antimicrobial practice, can you tell me whether and how you plan to ensure the best practice?
Barriers and facilitators	In relation to the influences on antimicrobial practice, what do you feel are the barriers and facilitators to your own practice?
PCA COMPONENT 3: SELF-EFFICACY	
Knowledge/skills	Apart from your academic qualifications - what sort of knowledge and skills do you have in relation to antimicrobial practice?
Beliefs about capabilities	How well do you feel you use your knowledge and skills in your antimicrobial practice?
Optimism	How confident you feel in relation to your antimicrobial practice?
Social/professional role and identity	What you feel are your roles and responsibilities in relation to antimicrobial practice?
Barriers and facilitators	In relation to your personal qualities and attributes, what do you feel are the barriers and facilitators to your antimicrobial practice?
REFLECTIONS ON HOW TO IMPROVE AMS PRACTICE	
Conclusion	Finally, I wonder if you can let me have your thoughts around what you feel works very well and what needs to improve regarding AMS practice in HMC, in general?

Abbreviations: TDF, Theoretical Domains Framework; PCA, Principal Component Analysis; AMS, Antimicrobial stewardship; HMC, Hamad Medical Corporation.

participants were offered the opportunity to review their transcripts to promote credibility.[40]

2.7. Data analysis

Transcripts were analysed thematically using a Framework Approach,[42] and NVivo® version 11 software, a qualitative data management tool. The initial coding frame was prepared by HT using the TDF domains,[32] with identification of potential themes and subthemes under each domain. One additional theme 'Interventions needed' emerged and was added to the coding frame. Themes were then reviewed, defined and considered in relation to each other allowing grouping of related themes. Analysis was reviewed with other research team members (SC and TM) and any disagreements resolved by discussion.

2.8. Governance

Ethical approval was received from the Ethical Review Panel of the School of Pharmacy and Life Sciences, Robert Gordon University, UK (S181); Qatar University Institutional Review Board (QU-IRB 1171-EA/ 19); and the Medical Research Centre (MRC) at HMC, Qatar (MRC-01-19-219). Written informed consent was received from all participants via e-mail prior to interviews. The study was reported in accordance with COREQ guidelines.[43]

3. Results

3.1. Participant recruitment

Forty-five clinicians agreed to be interviewed, with data saturation achieved after interviewing 16 (eight doctors and eight pharmacists) from a range of practice areas. Interviews lasted between 23 and 45 min. Participant demographics are shown in Table 2.

3.2. Key determinants influencing antimicrobial prescribing

Key themes emerging during analysis were identified as determinants influencing antimicrobial prescribing behaviour, linked to the TDF domains[32] and PCA components,[31] as illustrated in Table 3. Classification of themes as barriers and/or facilitators to appropriate antimicrobial prescribing is also given. The TDF domain 'optimism' was not identified as an influence through interviews as it was judged that insufficient reference to this domain was made (i.e., only one reference in comparison to 199 references related to environmental context and resources). Of note also, the TDF domain 'Memory, attention and decision processes' was not represented in the PCA results of the previous survey[31] but was identified as an influence here. An additional novel theme of 'Interventions needed' was also identified.

Findings below describe how interview data align with the TDF domains[32] and PCA components.[31] Quotations have been ascribed to profession and area of practice. In general, there were no obvious differences in responses across health professions.

Table 2

Demographic characteristics of participants.

Participant[a]	Gender	Job title[b]	Area of practice[b]
Pharmacist 6	Female	Clinical pharmacist	Infectious Diseases
Pharmacist 8	Female	Clinical pharmacist	Paediatrics
Pharmacist 9	Female	Junior pharmacist	Obstetrics and Gynaecology
Pharmacist 469	Female	Clinical pharmacist	Otolaryngology
Pharmacist 470	Female	Staff pharmacist	Cardiology
Pharmacist 471	Male	Senior clinical pharmacist	Cardiology
Pharmacist 501	Male	Senior pharmacist	Obstetrics and Gynaecology
Pharmacist 511	Female	Clinical pharmacist	Ambulatory Care
Doctor 13	Male	Resident	Family Medicine
Doctor 14	Male	Associate consultant	Infectious Diseases
Doctor 17	Male	Resident	Internal Medicine
Doctor 19	Male	Resident	Emergency Medicine
Doctor 21	Female	Clinical fellow	Infectious Diseases
Doctor 23	Female	Resident	Emergency Medicine
Doctor 28	Female	Associate consultant	Internal Medicine
Doctor 514	Female	Senior consultant	Microbiology

[a] Participant's questionnaire number.[31].
[b] As stated by participants in previous questionnaire.[31].

Table 3

Summary of the TDF domains and key themes relating to clinicians' views and experiences of antimicrobial prescribing practice in Qatar, aligned to previously identified PCA components.[31].

TDF domain	Key theme		Barrier and/or facilitator
PCA COMPONENT 1: GUIDELINES COMPLIANCE			
Goals and Intentions	Following the guidelines		Barrier
			Facilitator
	Continuing education and training		Barrier
			Facilitator
Beliefs about consequences	Impacting patient outcomes and AMR		Barrier
			Facilitator
	Consequences of COVID-19 on antimicrobial practice		Barrier
PCA COMPONENT 2: INFLUENCES ON PRACTICE			
Environmental context and resources	Hospital guidelines and electronic system		Barrier
			Facilitator
	Staffing, workload and time pressure		Barrier
Social influences	Professional hierarchies		Barrier
	Multidisciplinary teamworking and relationships		Barrier
			Facilitator
Behavioural regulation	Restrictive policies on antibiotics		Barrier
			Facilitator
PCA COMPONENT 3: SELF-EFFICACY			
Knowledge	Knowledge about the guidelines and AMS		Barrier
			Facilitator
Skills	Effective communication between clinicians		Barrier
			Facilitator
Beliefs about capabilities	Confidence and self-belief		Barrier
			Facilitator
Social/professional role and identity	Professional obligation to prescribe/dispense antimicrobials appropriately		Barrier
			Facilitator
ADDITIONAL DOMAINS AND THEMES[a]			
Memory, attention and decision processes	Antimicrobial prescribing decisions		Barrier
			Facilitator
N/A	Interventions needed	Need for ongoing education and training	Facilitator
		Need for guidelines changes	Facilitator

Abbreviations: TDF, Theoretical Domains Framework; PCA, Principal Component Analysis; AMR, Antimicrobial resistance, AMS, Antimicrobial stewardship; N/A, Not applicable.

[a] Not identified in the survey results.[31].

3.2.1. PCA component 1: guidelines compliance

3.2.1.1. TDF Domain 1: goals and intentions.

a. Following the guidelines

Local antimicrobial prescribing guidelines were considered very influential and most participants stated that they tended to use them to guide their prescribing practice. Adhering to guidelines and best AMS practices were overarching goals for most participants who believed that the guidelines are tailored based on the local susceptibility data and resistance patterns.

"… following of the guidelines, actually, because it is based on our own antibiogram data. It's tailored according to our resistance patterns and to our common organisms."

(Associate consultant doctor 28, Internal Medicine)

Whereas some participants reported that they were more likely to follow the local guidelines, others indicated that in some circumstances they deviated from these and used broad-spectrum antibiotics. This was attributed to the perceived deficiencies in both the hospital guidelines and electronic system (see Domain 3: Environmental context and resources), and the antimicrobial habits of senior peers (see Domain 4: Social influences).

"… there are a lot of good antibiotics that we don't use just because of the usual practice of others and because most people do this in our department. I think this is something we should improve in ourselves."

(Resident doctor 23, Emergency Medicine)

b. Continuing education and training

Several participants considered that continuing education, keeping up to date with recent guidelines and raising awareness among patients/family members about optimal antimicrobial use were key goals. Some pharmacist participants, however, raised concern about the lack of continuing professional development (CPD) events and funded training courses for pharmacists on AMS (see Interventions needed theme).

"Trying to be up to date with the most recent guidelines and antimicrobials journals to provide the best care to patients and to the institution at the same time … Also attending more CPDs, conferences and independent prescribing courses which are quite expensive … Here, most AMS educational events are restricted to the institution's AMS Committee members only."

(Senior clinical pharmacist 471, Cardiology)

3.2.1.2. TDF Domain 2: beliefs about consequences.

a. Impacting patient outcomes and AMR

Participants believed that prescribing antibiotics appropriately, in agreement with the guidelines, improves patient outcomes including decreased morbidity, mortality and hospitalisation.

"For sure, the patient will be treated more effectively, more cost effectively and the resistance among our patients will be reduced … Infections can kill and using the guidelines will have some sort of positive outcomes like reduced morbidity, mortality and hospital length of stay."

(Clinical pharmacist 469, Otolaryngology)

On the other hand, some participants admitted that inappropriate prescribing practice of antimicrobials outwith the guidelines is common. They considered this a leading driver for the increase in AMR in the region, with possible consequences for healthcare-associated infections, patients and costs of treatment.

"We encounter many patients who are resistant to the strongest antimicrobial treatment. When we check the patient medication history, we notice that there was an overprescribing of broad-spectrum antibiotics by the doctor. This is a very dangerous issue. Some patients lose their lives because of AMR."

(Staff pharmacist 470, Cardiology)

b. Consequences of COVID-19 on antimicrobial practice because of time constraints and increased work overload.

This is considered in Domain 3: Environmental context and resources. Several reported that COVID-19 was also driving increased patient demand for antibiotics as a prophylaxis for COVID-19 infections, which might result in serious issues including AMR.

"I see many people come to the hospital asking doctors for antibiotics, although there's no active bacterial infection. They think that antibiotics will prevent them from getting Coronavirus. The misuse of antibiotics will create resistance among bacteria that normally exist in human body …"

(Clinical pharmacist 8, Paediatrics)

3.2.2. PCA component 2: influences on practice

3.2.2.1. TDF Domain 3: environmental context and resources.

a. Hospital guidelines and electronic system

Many participants asserted that having the hospital guidelines facilitated empirical treatment decisions based on the local resistance patterns and availability of antimicrobial agents in the facility. They also described the positive influence of the hospital electronic health system (EHS) on their antimicrobial practice. They found it helpful in providing a source of information about patients' health at the place/time needed, and suggested integrating the guidelines into the EHS to enable appropriate practice.

"With the EHS, we have access to all patients' health information … Integrating the guidelines and hospital antibiogram to the EHS is needed. That's going to make it much easier for us to tailor the empirical regimen based on the local susceptibility data …"

(Senior clinical pharmacist 471, Cardiology)

Missing details, traditional document layout, infrequent updates, difficult access and lack of education/training sessions in relation to the use of guidelines negatively influenced participants' antimicrobial prescribing practice and were cited as obstacles (see Interventions needed theme). Some pharmacists mentioned the advantages of the Sanford Guide to Antimicrobial Therapy,[43] widely used in their practice due to its perceived easier access and layout.

"It would be great if the cost is there [in the guidelines] to guide us about the available options. Also, it's not updated regularly … I think the layout of the PDF document and the classic presentation of information make us not interested to go through it. We use the Sanford Guide frequently. It's easier to access and read."

(Senior clinical pharmacist 471, Cardiology)

b. Staffing, workload and time pressure

Staff shortages, high patient load and inadequate time were also reported as challenges while maintaining appropriate antimicrobial prescribing/dispensing practices in line with the guidelines. Participants described feeling overwhelmed with the heavy workload and the number of patients, which prevented them from spending enough time in patient consultation focused on antimicrobial use. Furthermore, staff shortages were linked to more antimicrobial prescriptions.

"The time barrier is the main challenge that you can find here, especially when the doctor is calling the pharmacy for a quick recommendation … We are overloaded with a huge number of patients. It is difficult to spend enough time with every patient explaining about the antibiotic and how they should take it."

(Junior pharmacist 9, Obstetrics and Gynaecology)

3.2.2.2. TDF Domain 4: social influences.

a. Professional hierarchies

Participants reported the negative influence of senior doctors on the antimicrobial prescribing practice of junior doctors, explaining that although prescribing is performed by juniors, it is the seniors who choose what is prescribed. They also mentioned that peers' habits, personal experience and preference for a particular course of action are sometimes determinants of prescribing behaviour, despite the existence of local policies.

"Dealing with people who are higher up in the multidisciplinary team, like some consultants who are very used to an old style of prescribing broad-spectrum antibiotics … I feel that's wrong because that shouldn't be a factor that affects our prescribing. Unfortunately, sometimes it is like a fight."

(Resident doctor 17, Internal Medicine)

b. Multidisciplinary teamworking and relationships

Many participants discussed the crucial influence of multidisciplinary teamworking on their prescribing practice. They reported that this provides an opportunity for strong relationships, building trust and interprofessional learning. Juniors also reported that they would refer to their senior colleagues, such as experienced clinical pharmacists or infectious disease (ID) doctors for advice if they felt unsure about prescribing something.

"What works well is the availability of a clinical pharmacist in every single inpatient team who helps in taking decisions. I always prefer discussing my challenging cases with more senior clinical pharmacists who are very well educated and experienced … The availability of ID physicians is also helpful …"

(Clinical pharmacist 511, Ambulatory Care)

Conversely, some participants reported that the multidisciplinary work occasionally led to problems among healthcare professionals, especially when negotiations about the appropriateness of antibiotics arose and others made decisions that fell outside the guidelines. This is considered in further detail in Domain 10: Memory, attention and decision processes.

"I think peer pressure does play a part. If someone just comes and says, 'That's what you need to do', trying to impose things without actually having consultation and discussion. I think that would be quite off putting … Some people can become passive aggressive when things are not managed or implemented in their own way …"

(Senior consultant doctor 514, Microbiology)

3.2.2.3. TDF Domain 5: behavioural regulation.

a. Restrictive policies on antibiotics

Restrictive approaches in prescribing antimicrobial agents such as pre-authorisation of targeted antibiotics on the hospital's formulary were seen as influencing appropriate antimicrobial prescribing.

"One of the things that helped me in HMC is having a restricted antibiotics list … The primary prescribers can prescribe some strong antibiotics for two days only and then they have to consult ID physicians about either continuing or de-escalating."

(Clinical pharmacist 511, Ambulatory Care)

A few pharmacists reported that some doctors are not following these restrictive approaches in their prescribing practice, resulting in the need to alert the attending prescribers to modify the stopping date of the antibiotic. They explained that this requires dedicated pharmacist time that could potentially be devoted to other important tasks.

"Many prescribers do prescribe restricted antibiotics for more than two days … Any prescription for restricted antibiotics prescribed by non-ID doctor should be for two days only. So, we need to call the prescriber to modify the stopping date of the antibiotic until an ID doctor assesses the patient … There is a need to increase the methods of restrictions."

(Junior pharmacist 9, Obstetrics and Gynaecology)

3.2.3. PCA component 3: self-efficacy

3.2.3.1. TDF Domain 6: knowledge.

a. Knowledge about the guidelines and AMS

Influences on antimicrobial prescribing practice included knowledge of current local prescribing guidelines. Participants stated that they knew about the existence of the current local guidelines. They were also aware that inappropriate prescribing practice (i.e., outwith the guidelines) increases AMR and its negative consequences, including high healthcare cost.

"The local resistance patterns vary from year to year … If the guidelines are not used and there is an overconsumption of certain antibiotics, for sure we will see a kind of a surge in the resistance rates to those antibiotics … Um, more problems will be emerged, such as increased cost and length of treatment."

(Senior clinical pharmacist 471, Cardiology)

Some participants, however, did not know how to find the guidelines in the HMC Intranet and used other international resources or followed their peers' prescribing practices. In many instances, they reported a lack of educational/orientation sessions for clinicians, especially juniors, around the use of guidelines and AMS (see Domain 3: Environmental context and resources). This was perceived as a significant barrier to self-efficacy and optimum practice.

"To be honest, I do not know where are the HMC guidelines in the Intranet and I do not routinely use them. I usually use international guidelines such as the Sanford Guide, if I need to, or other resources … We didn't get any orientation about using the HMC guidelines …"

(Resident doctor 13, Family Medicine)

3.2.3.2. TDF Domain 7: skills.

a. Effective communication between clinicians

Participants articulated the importance of effective communication skills such as listening skills in their antimicrobial prescribing practice. Competence in these skills was viewed as essential in facilitating self-efficacy in practice.

"I think the communication and discussion with other peers in the multidisciplinary team is essential in developing the care plan for each patient's antimicrobial therapy … It is mainly through listening, discussing patient cases and negotiations to reach an agreement."

(Associate consultant doctor 28, Internal Medicine)

Others felt that poor levels of interpersonal communication and networking sometimes exist with clinicians outside the facility due to different practice settings, and viewed this as a barrier to self-efficacy and effective practice. In addition, communication issues, specifically between doctors and pharmacists in relation to prescribing decisions, were frequently reported (see Domain 9: Memory, intention and decision processes).

"Communication skills are not perfect here. The problem is that we are stretched to specific hospitals. I think if we have a better coverage of other HMC hospitals, interpersonal communication will be improved …"

(Resident doctor 13, Family Medicine)

3.2.3.3. TDF Domain 8: beliefs about capabilities.

a. Confidence and self-belief

Participants believed themselves capable and were generally confident in their own abilities to prescribe/dispense antimicrobials. This was due to experience in the clinical area and the availability of the hospital guidelines as a useful reference, including local antibiogram reports.

"We have guidelines in place. We have our local antibiogram in place and we, you know, follow a kind of a structural clinical thought process … So, we feel like we are good and feel confident at what we are doing."

(Senior clinical pharmacist 471, Cardiology)

A minority of junior doctors and pharmacists had doubts about their clinical capabilities in relation to antimicrobial prescribing practice and sought advice from their seniors. Again, this was attributed to the limited AMS training/education sessions offered by the institution (see Domain 3: Environmental context and resources).

"It is just the clinical practice that we are doing … I don't have a specific knowledge or training in relation to AMS … Sometimes I just say, 'Sorry I am not sure' and refer to my seniors. This varies according to the clinical condition, the practice setting and the team we are working with."

(Clinical fellow 21, Infectious Diseases)

3.2.3.4. TDF Domain 9: social/professional role and identity.

a. Professional obligation to prescribe/dispense antimicrobials appropriately

Participants saw themselves as professionally responsible or obligated to prescribe antimicrobial agents appropriately and described how this responsibility influenced their self-efficacy and prescribing practice. Key roles supporting appropriate practice included using the local guidelines to guide antimicrobial prescribing and educating/supporting other clinicians.

"Mainly prescribing antibiotics appropriately, using the guidelines and educating others … We have to educate other clinicians about the concept of antibiotic stewardship. This is one of the most important responsibilities of the prescribers … ensure the good practice of other clinicians."

(Associate consultant doctor 28, Internal Medicine)

In contrast, two discrete barriers emerged. First, the underutilised role of clinical microbiologists in supporting appropriate antimicrobial prescribing practice, for example by attending daily ward rounds to advise on therapy. This was attributed to limited collaborative practice and could be enhanced through better networking and multidisciplinary teamworking (see Domain 4: Social influences).

"The microbiologist role in the antimicrobial prescribing process is very limited, mostly laboratory and microbiology reports … Microbiologists can offer a lot in AMS. They can support the ID much more, go on the rounds and give sorts of clinical advice … In this setting, there are about four or five of us who got some UK training and background. We're not using our skills to the full extent because it's very much ID lead."

(Senior consultant doctor 514, Microbiology)

Second, the limited scope of pharmacists as an integral part of the AMS team and a lack of awareness of their expertise. Pharmacists were perceived as mainly being involved in reviewing prescriptions and dispensing medications, rather than offering practical prescribing advice on appropriate antimicrobial prescribing. Participants emphasised the need to recognise the unique skills and expertise that pharmacists can provide to ensure the optimal prescribing/use of antimicrobials (see Domain 9: Memory, attention and decision processes).

"Pharmacists have to be more involved in AMS and help doctors in choosing the best antimicrobial regimen. Also, raising awareness about AMR and providing education for others … This should be led by the pharmacists because they are drug experts and they have specific knowledge about the pharmacology of medications."

(Senior pharmacist 501, Obstetrics and Gynaecology)

3.2.4. Additional domains and themes

Analysis revealed additional determinants of antimicrobial prescribing which were not identified in the previous quantitative phase.[31]

3.2.4.1. TDF Domain 10: memory, attention and decision processes.

a. Antimicrobial prescribing decisions

Participants described that antimicrobial prescribing decisions are usually made based on the local guidelines, patients' clinical situations and any pre-existing morbidities.

"In every preparation, we have to see if the antibiotic is rightly prescribed, rightly indicated and rightly dosed based on the patient situation. Occasionally, we have patients who are not only cardiac. They are renal and hepatic too. So, we would dispense the antibiotic according to that … Mostly we use the guidelines to guide us …"

(Staff pharmacist 470, Cardiology)

Some reported that illness severity and the perceived risk of disease progression could result in treating more readily with antibiotics to protect patients from future deterioration. Another issue reported was diagnostic uncertainty, sometimes due to the time taken to obtain culture results, which in turn leads to the decision to prescribe antibiotics.

"Barrier is the overprescribing by some emergency department doctors who usually prefer to use broad-spectrum empiric antibiotics, just because their patients are very ill and admitted by emergency care. We are also struggling in implementing the guideline among the doctors in post-surgery."

(Clinical pharmacist 469, Otolaryngology)

"Many times, we have a delay in having the microbiology lab results … The respiratory pathogen panel may take three to five days to have the final results."

(Associate consultant doctor 14, Infectious Diseases)

Many of the pharmacists interviewed expressed concerns about interprofessional conflict between doctors and pharmacists. They felt that antimicrobial prescribing decisions are predominantly considered as a medical responsibility and controlled by doctors, with pharmacy only assisting, which deterred pharmacists' practice. The dominance of the medical profession was seen as being due to lack of pharmacists' legal authority to prescribe medications in Qatar. Some stressed the importance of legislative changes to allow qualified pharmacists to practise as independent prescribers, which in turn could enable more informed clinical decisions (see Interventions needed theme).

"I only take part in the prescribing decision-making process, but the final decision is made by doctors … We don't have a privilege to prescribe here in Qatar. We only recommend to the team during the hospital rounds. I think if the certified pharmacist prescribers are legally entitled to prescribe medications, that will address a lot of issues …"

(Clinical pharmacist 511, Ambulatory Care)

3.2.4.2. Interventions needed.

A novel theme identified, unrelated to the TDF, was the need for various interventions to support appropriate antimicrobial prescribing.

a. Need for ongoing education and training

Participants at all levels of seniority in medicine and pharmacy identified the need for more continuing educational activities for clinicians, focusing on using the local guidelines and appropriate AMS practices. There were also suggestions about the need for enhanced organisational support for pharmacists to undertake independent prescribing courses and to qualify as independent prescribers. This was seen as empowering pharmacists to contribute confidently to antimicrobial prescribing decisions, although as yet legislation in Qatar does not permit this.

"I would like to raise the point about the need of training doctors, especially juniors, on using the guidelines. It's not a matter of having guidelines and people are not aware about how to use it in the right way or where to find it."

(Resident doctor 17, Internal Medicine)

"I hope that the institution encourages pharmacists to participate in accredited independent prescribing courses …"

(Senior clinical pharmacist 471, Cardiology)

b. Need for guidelines changes

Most participants suggested changes to the current guidelines including more frequent updates, additional details, and an improved layout to encourage guideline use more widely. Participants proposed making the guidelines available as a smart phone application like the Sanford mobile app.[44] Tailored guidelines for each hospital/area of practice were also recommended to reduce inappropriate prescribing and improve compliance.

"We need a guideline that is updated frequently, enriched with more details with regard to the monitoring parameters or changing from IV to oral, and tailored from site to site."

(Clinical pharmacist 6, Infectious Diseases)

"We need to consider getting an antibiotic guidelines app which is downloaded to clinicians' mobile phones, like the Sanford because people can't always find the guidelines …"

(Senior consultant doctor 514, Microbiology)

3.3. Interrelationships between themes

A colour-coded conceptual diagram was created as a visual representation of relationships within interview data (Figure A). This aided in comparing and relating different key themes and promoted deeper thinking on relationships between them.[45,46]

Use of the diagram helped to identify links between 'Goals and intentions'; 'Environmental context and resources'; 'Knowledge'; 'Social influences'; and 'Beliefs about consequences'. Participants considered following local antimicrobial prescribing guidelines a key goal, yet deviations were justified by perceived deficiencies in guidelines and EHS, lack of education/training on the use of the guidelines and AMS, the prescribing habits of senior peers, and COVID-19-related workload (see red text in Figure A).

The diagram also helped to identify links between 'Memory, attention and decision processes'; 'Social influences'; 'Skills'; and 'Social/professional role and identity'. For many participants, the decision whether or not to prescribe antimicrobials was attributed to multidisciplinary teamworking among healthcare professionals, interpersonal communication and networking, and sense of having a professional role in AMS (see green text in Figure A).
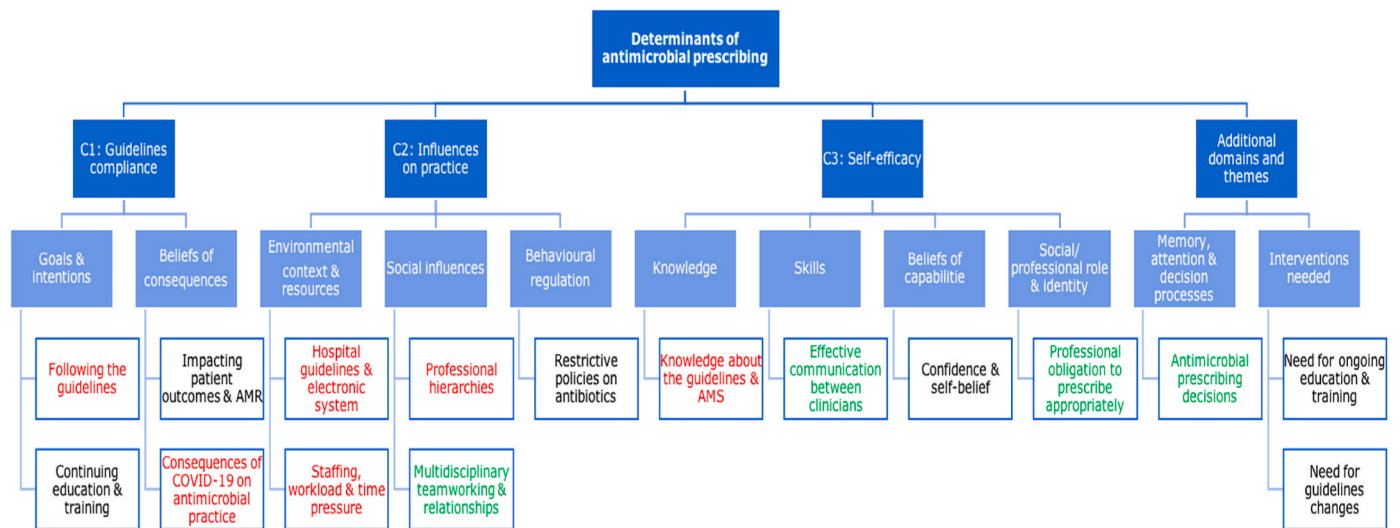
Figure A. A conceptual diagram of interview findings in relation to the PCA components[31] and TDF determinants,[32] using colours to show interrelationships between themes.

4. Discussion

4.1. Statement of key findings

Semi-structured interviews with doctors and pharmacists in 12 hospital settings in the State of Qatar showed that antimicrobial prescribing is a complex process, influenced by a broad range of interrelated behavioural determinants. Ten TDF domains were identified as key determinants of antimicrobial prescribing behaviour: 'Goals and intentions', 'Beliefs about consequences', 'Environmental context and resources', 'Social influences', 'Behavioural regulation', 'Knowledge', 'Skills', 'Beliefs about capabilities', 'Social/professional role and identity', and 'Memory, attention and decision processes'. One additional key theme unrelated to the TDF was 'Interventions needed'.

Several barriers and facilitators that may result in inappropriate or appropriate antimicrobial prescribing behaviour were identified. Main barriers were around hospital guidelines and electronic system deficiencies, clinicians' gaps in knowledge in relation to guidelines and appropriate prescribing, professional hierarchies and poor multidisciplinary teamworking, restricted roles/responsibilities of microbiologists and pharmacists in AMS, and discomfort around antimicrobial prescribing decisions. Key facilitators identified included guidelines compliance and the beliefs about consequences of appropriate or inappropriate prescribing. Further education and training, and some changes to guidelines were considered crucial.

Analysis also identified multiple interrelationships between themes illustrating the complexity of prescribing behaviour in antimicrobial practice (Figure A).

4.2. Strengths and limitations

This study has a number of strengths. As highlighted in a recent systematic review,[27] there has been little theory-informed research on determinants of antimicrobial prescribing behaviour and none has been carried out in the Middle East or targeting pharmacists. The use of the TDF[32] throughout allowed further exploration of previously-identified key behavioural determinants[31] which may be used as targets for future interventions. In addition, this study is reported according to the COREQ guidance.[43] Influences on prescribing practice were explored from the perspectives of both doctors and pharmacists in hospital practice. Interviewing these two key groups of stakeholders provided valuable insights into influences of antimicrobial prescribing in hospitals with the potential to inform the development of context-specific

interventions that are more likely to be effective.[32,47] Data saturation was achieved using a validated, evidence-based approach,[39] thereby, enhancing credibility and research trustworthiness.[40]

The main limitation of this study is that data were generated in Qatar and the findings may not be transferable to other countries. Nevertheless, the research settings, methods and participants were described in detail to allow readers to consider transferability to their organisation.[40,42] Although participants expressed their views very openly, social desirability bias is always possible. The interviews were conducted during the COVID-19 pandemic; workload or time constraints may have influenced participants' responses.

4.3. Comparison with other studies

To our knowledge, this study is the first to use semi-structured interviews and the TDF in the hospital setting to identify the determinants that influence clinicians' antimicrobial prescribing, and to explore barriers and facilitators to appropriate practice. However, this approach has been used in the primary care settings in Australia and UK.[48,49] Further, this study was the qualitative part of a mixed-methods research programme and, thus, extends the knowledge base beyond the quantitative findings.[31] In particular, in addition to 'Environmental context and resources', and 'Social influences',[31] this study identified three further determinants of antimicrobial prescribing which appeared to act as barriers to appropriate practice: 'Knowledge', 'Social/professional role and identity', and 'Memory, attention and decision processes'.

A number of similarities exist between the findings of this study and other qualitative studies of antimicrobial prescribing within hospitals, although a recent systematic review of the use of theory in the development and evaluation of behaviour change interventions to improve antimicrobial prescribing identified a lack of theoretical underpinning in some of the studies included in the review.[27] Previous studies identified some similar barriers which were key issues in relation to appropriate antimicrobial prescribing. For example, a systematic review of 35 studies exploring antimicrobial prescribing in both primary and hospital care reported that the prescribing process is complex, based on a host of factors that affect the decision-making process.[50] Dominant among these, according to the authors, are physicians' lack of knowledge, perceived risk of future complications and diagnostic uncertainty.[50] A further systematic review of 10 studies on antimicrobial prescribing in acute care described the dominant influence of senior clinicians on prescribing practice of juniors, including on the use of local guidelines.[28] Similarly, poor multidisciplinary collaboration and communication

were cited as barriers in previous studies.[51–53] Studies also highlighted some similar facilitators, including education and training on appropriate antimicrobial prescribing,[54–56] and guidelines changes in relation to access and content.[57–59]

Notably, none of these studies had adopted the TDF[32] or similar theoretical framework. The use of the TDF[32] in the present study identified additional barriers and facilitators which are crucial for the development of BCIs to improve antimicrobial prescribing practice. Within these barriers and facilitators, many interrelationships were also identified.

The TDF determinants identified in this study can be mapped to relevant evidence-based BCTs which can be used as part of future interventions.[60,61] The BCTs mapped to 'Environment context and resources' and 'Social influences' are as described in previous research.[31] Those relating to 'Knowledge', 'Social/professional role and identity', and 'Memory, attention and decision processes' are outlined in Table 4.

4.4. Further research

In line with the phases of the UK MRC framework,[13] further research is warranted to identify which BCTs could be utilised to target the identified TDF determinants that influence clinicians' antimicrobial prescribing, and then to test the feasibility of such theoretically-based interventions in Qatari healthcare practice. This is essential in order to develop interventions that are designed specifically for the context within Qatar and which may then be translated into practice.

5. Conclusions

This qualitative study, using a theoretically-based approach, has identified that antimicrobial prescribing in hospitals is influenced by a broad range of behavioural determinants, including specific barriers and facilitators. These determinants can be mapped to likely effective BCTs, facilitating the design and development of future BCIs to improve clinicians' antimicrobial prescribing. The issues of the environmental context and resources, social influences, knowledge, professional role and identity, and memory, attention and decision processes are significant challenges to address. It is essential that antimicrobial prescribing is optimised as part of antimicrobial stewardship to address the WHO global public health threat of antimicrobial resistance.

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CRediT authorship contribution statement

Hend Talkhan: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Derek Stewart:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Trudi McIntosh:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Hisham Ziglam:** Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization. **Palli Valappila Abdulrouf:** Writing – original draft, Resources, Methodology, Funding acquisition, Conceptualization. **Moza Al-Hail:** Writing – original draft, Software, Methodology, Funding acquisition, Conceptualization. **Mohammad Diab:** Writing – original draft, Resources, Methodology, Funding acquisition, Conceptualization. **Scott Cunningham:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision,

Table 4
Mapping the determinants of antimicrobial prescribing, identified in this study, to relevant BCTs[60,61].

TDF determinant	BCT	
	Label	Definition
Knowledge	Instruction on how to perform a behaviour	Advise or agree on how to perform the behaviour
	Feedback on behaviour	Monitor and provide informative or evaluative feedback on performance of the behaviour (e.g. form, frequency, duration or intensity)
	Information about health consequences	Provide information (e.g. written, verbal, visual) about health consequences of performing the behaviour
Social/professional role and identity	Identification of self as role model	Inform that one's own behaviour may be an example to others
	Valued self-identity	Advise the person to write or complete rating scales about a cherished value or personal strength as a means of affirming the person's identity as part of a behaviour change strategy
	Social comparison	Draw attention to others' performance to allow comparison with the person's own performance
Memory, attention and decision processes	Pros and cons	Advise the person to identify and compare reasons for wanting (pros) and not wanting to (cons) change the behaviour
	Problem solving	Analyse, or prompt the person to analyse, factors influencing the behaviour and generate or select strategies that include overcoming barriers and/or increasing facilitators
	Instruction on how to perform a behaviour	Advise or agree on how to perform the behaviour

Abbreviations: **BCTs, Behaviour change techniques; TDF, Theoretical Domains Framework.**

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Declaration of competing interest

None.

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