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Research paper

Antibiotic prescribing in primary healthcare: Dominant factors and trade-offs in decision-making

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Abstract *Background:* This study aims to establish dominant factors influencing general practitioner (GP) decision-making on antibiotic prescribing in the Australian primary healthcare sector. Two research questions were posed: What influences antibiotic prescribing from the perspective of GPs? How do GPs trade-off on factors influencing antibiotic prescribing?
Methods: An exploratory sequential mixed methods design was used, comprising semi-structured interviews followed by a discrete choice experiment (DCE). Ten GPs practising in Brisbane and Greater Brisbane, Queensland were interviewed in September/October 2015. Interview data were used to develop the DCE, which was conducted online from July–October 2016. Twenty-three GPs participated in the DCE.
Results: Three main themes influencing antibiotic prescribing emerged from the semi-structured interviews: prescribing challenges, delayed antibiotic prescriptions, and patient expectations. From the DCE, "Duration of symptoms" and "Patient expectations" exerted the most influence on antibiotic prescribing. Taken together, these results suggest that key challenges to prudent antibiotic prescribing are: patient expectations, an important barrier which is surmountable; prescribing practices of medical colleagues, cultural memes and professional etiquette; and uncertainty of diagnosis coupled with patient expectations for antibiotics exert prescribing pressure on GPs.
Conclusion: Patient expectation for antibiotics is the dominant modifiable factor influencing GP antibiotic prescribing behaviours. Key challenges to prudent antibiotic prescribing can be overcome through upskilling GPs to manage patient expectations efficaciously, and through

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two new emphases for public health campaigns—consumers have the power to reduce the use of antibiotics and the GP as a wise advocate for the patient.

Highlights

- First study using DCE to quantify factors influencing GP antibiotic prescribing.
- Patient expectations, prescribing practices of colleagues, and diagnostic uncertainty exerted prescribing pressure on GPs.
- Patient expectation is the dominant modifiable factor influencing antibiotic prescribing.
- GPs may benefit from upskilling to manage patient expectations efficaciously.

Introduction

Antibiotics are a mainstay of treatment for infection. However, every dose of antibiotic prescribed and used increases the likelihood of antimicrobial resistance (AMR). Hence, it is important to ensure that antibiotics are used appropriately. The greatest proportion of antibiotics for human use is prescribed in the primary healthcare sector [1] where use is strongly correlated to AMR rates [2,3], highlighting this sector as an important area for research and action.

Australia is contributing to the global problem of AMR with antibiotic consumption above the OECD average [4]. In the Australian primary healthcare sector, 30 million antibiotic prescriptions were dispensed in 2014 alone [1], some of which were unnecessarily prescribed. For example, 60% percent out of the 24% of people prescribed antimicrobials with an indication for the prescription documented, received antibiotics for colds and other upper respiratory tract infections [5].

Designing effective healthcare interventions to reduce the inappropriate use of antibiotics means identifying and addressing the barriers to appropriate antibiotic use pertinent to the individuals involved. Some of the barriers to prudent prescribing of antibiotics by general practitioners (GPs) are known [6—13]: patients demanding antibiotics, the perception that patients expect antibiotics, prescribing antibiotics to save time due to the perception that it takes longer to explain why antibiotics are not needed, concerns that the patient may not return for follow up, uncertainty in the diagnosis where antibiotics may be warranted, concerns about possible complications, preservation of the doctor—patient relationship, and knowledge and attitudes to AMR.

These studies have predominantly been conducted on GPs practising in Europe and the USA, with different governance, funding structures and infrastructure to that of Australia which may impact clinical practice. Research involving Australian GPs on antibiotic prescribing, previously scarce, is growing [14—18]. Further exploration of factors which are most important in influencing GP decision-making in antibiotic prescribing can inform strategies to promote more prudent use of antibiotics.

In alignment with the WHO Global Action Plan [19], Australia now has a national AMR strategy focussed on a One Health approach being implemented across human health (e.g. hospital, nursing home, primary healthcare) and animal health [20]. Thus, it is imperative to have current research pertinent to Australia's primary healthcare sector informing the ongoing implementation of its national strategy.

Our aim in this study was to establish the dominant factors influencing GP decision-making in antibiotic prescribing in the Australian primary healthcare sector using mixed methods. Two research questions (RQs) were posed: RQ1: What influences antibiotic prescribing from the perspective of GPs? RQ2: How do GPs trade-off on factors influencing antibiotic prescribing?

Methods

The research paradigm underpinning the study was pragmatism, understood as a problem-driven approach [21]. We used an exploratory sequential mixed methods study design [22,23]. A qualitative component comprising semi-structured interviews was conducted first to answer RQ1 and to inform the development of the quantitative research instrument, the discrete choice experiment (DCE). The DCE addressed RQ2. The qualitative and quantitative components were of equal importance. Recruitment for each of these components was done separately.

The mixing of methods occurred at two points: (a) findings from the semi-structured interviews were used to frame the DCE, and to develop attributes and levels; and (b) findings from both the semi-structured interviews and the DCE were examined to address the research aim.

Method 1: Semi-structured interviews

An interview guide was developed based on a literature review and piloted with two practicing GPs. Data from pilot interviews were not included in the analysis. Convenience and snowball sampling were used in the recruitment of participants via e-newsletters of the two largest Primary Health Networks (PHNs) in Queensland [24] i.e. Brisbane North and Brisbane South PHNs, via recruitment emails to professional networks, and Twitter®. Eligible participants were practising GPs or Registrars (trainee GPs) within a 1-h drive of the Brisbane Central Business District. Participants

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were recruited and interviewed until no new relevant information was obtained.

Individual interviews were conducted at GP's place of practice in September and October 2015 by EL where previous experience as a clinical pharmacist, skills in educational visiting, and active listening were used. Interviews were audio recorded and transcribed verbatim using an adaptation of the Jeffersonian Transcription Notation [25]. The NVivo (Version 11.3.1.777) information management software was used for coding and analysis of interview data [26]. Transcripts were coded using a blend of deductive (codebook based on main interview questions) and inductive coding (emergent from the data) (EL). Confirmation of coding was done on one transcript (KP), randomly selected by the Microsoft Excel® random number function. Inductive codes were refined upon collaborative discussion. Following first cycle coding, three iterations of code mapping were completed to surface themes and sub-themes [27,28]. Notable main themes and sub-themes are reported in this paper.

Method 2: Discrete choice experiment

Discrete choice experiments (DCEs) have been increasingly used in health services research [29]. For example, to elicit patient preferences for health services [30–33] and health provider preferences for healthcare programs [34]. DCEs are based on an integrated behavioural theory of decision-making and choice behaviour—random utility theory—which states that utility can be described by a systematic (explainable) component and a random (unobservable) component [29,35]. DCEs also draw upon Lancaster's economic theory of value [36], which assumes that individuals derive utility not from the goods/service itself but from the characteristics (attributes) of the goods/service. When presented with choices, individuals are assumed to choose the alternative which maximises their utility [29,35,36].

DCEs are structured surveys designed for valuing different attributes that influence decision-making for a good, product or service. The questions are framed to force a choice, to enable trade-offs to be quantified in making that choice, so as to understand the relative importance of the different attributes of interest to a decision [37]. For this study, we adapted the DCE method to force a choice between the likelihood of prescribing an antibiotic given two situations with different attributes.

DCE development

The salient decision point for GPs which impacts on antibiotic consumption is whether to prescribe an antibiotic. Relevant deductive and inductive codes from the semi-structured interviews were examined in addition to what is known in the literature, to develop the DCE scenario, attributes and levels (Table 1). The final list of attributes and levels for the DCE is shown in Table 2.

We adapted a scenario of an adult with a respiratory tract infection [9] as the prescribing context for the following reasons: continuing misconception amongst Australian consumers of the utility of antibiotics for the treatment of respiratory tract infections [38,39]; and over 50% of Australian GPs surveyed reported that they would prescribe antibiotics for an upper respiratory tract infection to meet patient expectations [14].

Experimental design

Given the number of attributes and levels for the DCE, 72 choice profiles ($=3^2 \times 2^3$) were possible. A full factorial experimental design where a pair of choice profiles are presented per choice set would yield a total of 2556 choice sets ($=(72 \times 71)/2$)—too burdensome for participants to complete. Instead, a fractional factorial experimental design was used to reduce the number of choice sets to 36, divided into 2 blocks (18 choice sets per block).

The choices to be presented to participants were selected using a D-optimal orthogonal in the differences (OOD) main effects design, an orthogonal and optimally efficient design which assumes zero priors [40]; generated with NGENE® software (Version 1.1.2) [41,42]. For each block, one choice set was duplicated as an intra-participant

Table 1 Deductive and inductive codes examined for DCE development.

Codes examined for DCE development	DCE scenario development and attributes/levels
Better safe than sorry Delayed antibiotics It doesn't look like you're trying to scam them	Include delayed prescription as an option in DCE.
Clinical approach and decision-making Decision-making cognition and intuition Negotiating clinical uncertainty No definitive trigger	Incorporate into DCE scenario. Patient's presentation, including duration of symptoms Patient's life circumstances e.g. exams, deadlines, important events
Doctor–Patient relationship Trust	Familiarity with patient: Regular or new patient
Patient expectations Reassurance	Patient expectations: What the patient discloses as ascertained by GP
Permissible circumstances Prefer reassessment Respecting patient's time	Reassessment: Whether the patient can return for reassessment

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Table 2 DCE attributes, levels and a priori assumptions.

Attributes	Levels	*A priori* assumptions
Duration of symptoms	1 week 2 weeks 3 weeks	In general, a positive preference for prescribing antibiotics, the longer the patient's duration of symptoms
Life event: Patient has an important event or deadline coming up	No Yes	In general, a positive preference for prescribing antibiotics (if indicated), if patient has an important life event coming up.
Reassessment: Patient is able to return for reassessment	No Yes	In general, a negative preference for prescribing antibiotics if patient is able to return for reassessment.
Familiarity with patient (medical history, existing doctor–patient relationship/rapport)	New patient Regular patient	In general, a negative preference for prescribing antibiotics if this is a regular patient (assumption: the doctor had "trained" the patient that antibiotics are not always needed to get better. So time had already been invested to explain this previously).
Patient's expectations	Says they want antibiotics Says they don't want antibiotics Says they want reassurance	In general a negative preference for prescribing antibiotics if patient indicates they want reassurance (or that they don't want antibiotics unless necessary).

consistency check (total 19 choice sets per block). The DCE was piloted with 2 GPs to check appropriateness of the scenario, framing, attributes and levels, and clarity of instructions. Data from the pilot were not included in the analysis.

Participants were randomly allocated to answer one of two blocks of 19 choice sets. They were asked to choose one of two hypothetical patient presentations where they would be more likely to prescribe antibiotics (Fig. 1). GPs were then asked whether the prescription would be for immediate treatment or issued as a delayed antibiotic prescription, to ascertain the potential use of such prescriptions. A delayed antibiotic prescription is a prescription given to a patient with instructions to use it only if their symptoms worsen or do not improve in a few days.

A "neither" option was not offered, as the intent was not to estimate or predict the demand for antibiotics, but in identifying the factors most likely to influence the decision to prescribe an antibiotic. A "neither" option may offer participants a choice which is likely to be deemed socially desirable, posing a high risk that trade-offs would not be observed.

Sample size and recruitment

A targeted sample size of 42 participants per block (total 84 participants) was calculated based on Orme's convention [43]. The DCE was conducted via an online survey platform, Key Survey® (Version 8.7.5) [44] from late July to October 2016. Participants were recruited via professional networks, professional colleges/bodies, Primary Health Networks, GP Registrar regional training organisations, GP national conferences and Twitter®. GPs and Registrars were eligible to participate if they were practising in primary healthcare clinics in Australia.

Data analysis

The following were excluded from data analysis: responses to the duplicate choice sets; incomplete surveys; and completed surveys which failed the intra-participant consistency check (i.e. unmatched duplicated choice sets), as this may indicate that the participant was not attending sufficiently to the choice sets.

Choice data were analysed using a mixed logit model (MXL) which allows for potential preference heterogeneity amongst participants [29]. Model estimation was undertaken using NLOGIT® (Version 6) software [45]. All attribute levels were effects coded which allows the independent estimation of effect size for each attribute level [46]. All coefficients of attribute levels were specified as random parameters with a normal distribution using 1000 Halton Sequence draws for estimation. A cut-off of $p < 0.05$ was used for statistical significance. The coefficients for the attribute levels which acted as reference levels were calculated from the estimated coefficients as their negative sum [47].

Results

Semi-structured interviews

Participant characteristics

Ten GPs (50% male, 3 Registrars) all trained in Australia were interviewed. The length of interviews was between 22 and 35 min (mean, 29 min). Their number of years of practice as a GP, including as a Registrar ranged from 4 to 24 years. Four were early career GPs in practice for 5 years or less; 4 were mid-career, 6–15 years; and 2 had practiced for more than 15 years. Eight GPs worked 30 or more clinical hours per week. Two GPs identified as being part-time,

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An adult patient presents with a runny nose, sneezing, a sore throat and dry cough. They have managed these symptoms in their usual way, which may include a combination of rest, home remedies, vitamin supplements, commercial immune boosters, and cold/flu/cough products. As they are still feeling unwell, they decided to consult a doctor (you).

The patient has no significant past medical history. On examination, their temperature (tympanic) is 37.8°C, throat appears slightly red and there is no exudate or cervical lymphadenopathy. Chest is clear.

Based on the scenario, in which situation (A or B) would you be **more likely to prescribe** an antibiotic for the patient?

	Situation A	Situation B
Duration: Patient has had symptoms for	2 weeks	3 weeks
Life event: Patient has an important event or a deadline coming up	No	Yes
Reassessment: Patient is able to return for reassessment	Yes	No
Familiarity with patient	New patient	Regular patient
Patient's expectations	Says they want reassurance	Says they want antibiotics
I would be more likely to prescribe an antibiotic in … (Please select one)	Situation A ☐	Situation B ☐

And this antibiotic prescription would be?

☐ For immediate use

☐ A delayed prescription

Figure 1 A choice set from the DCE.

Table 3 Characteristics of clinics in which GPs worked.

Clinic type	1 worked in a Corporate clinic; 3 in Sole-owner Multi-GP clinics; 2 in Multi-GP clinics; 4 in Government Health Service clinics.
AGPAL Accreditation	8 worked in AGPAL accredited clinics; 2 did not.
Billing	3 worked in a mixed billing clinic; 1 in a private billing clinic; 6 in bulk-billing clinics.
Location	All clinics were located in the suburbs.
Socio-economic status (SES) of community served	4 were serving lower SES communities; 4 were serving mixed SES communities; 2 were serving higher SES communities.

Note: Socio-economic status by postal area code was taken as a guide to relative disadvantage as per the Socio-Economic Indexes for Areas (SEIFA) by the Australian Bureau of Statistics. SEIFA ranking within State or Territory as deciles were used, with deciles 1 and 2 representing the most disadvantaged, deciles 9 and 10 being the least disadvantaged. For the purposes of describing the characteristics of the population which the GPs interviewed served, lower SES was represented by deciles 1 to 3, mixed SES by deciles 4 to 8, and higher SES by deciles 9 and 10.

working less than 30 clinical hours per week. GPs interviewed covered a range of clinic types and served a demographically diverse population (Table 3), which added desirable contextual heterogeneity.

Main concepts/themes

Three main themes influencing antibiotic prescribing emerged from the semi-structured interviews (Table 4). Quotations from the interviews are included where relevant to illustrate a point.

Theme 1: Prescribing challenges

This theme captured the challenges experienced by GPs regarding the prudent prescribing of antibiotics.

1A. Practical and time constraints. The need to keep consultations within the allotted appointment duration means that GPs must be efficacious with their use of time. A common challenge cited by GPs is the lack of time to properly educate patients who demand or expect antibiotics when it is not clinically warranted. Experienced GPs

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Table 4 Main themes and sub-themes influencing antibiotic prescribing.

Themes and main sub-themes	Description of theme
Theme 1. Prescribing challenges	Challenges experienced by GPs pertaining to the prudent prescribing of antibiotics.
1A Practical and time constraints	
1B Knowledge-Practice dissonance in antibiotic prescribing behaviours	
1C Prescribing practices of medical colleagues and professional etiquette	
Theme 2. Delayed antibiotic prescription	GP's views on delayed antibiotic prescriptions.
2A Integrity and responsibility	
2B Support for delayed antibiotic prescriptions	
2C Opposition to delayed antibiotic prescriptions	
Theme 3. Patient expectations	Patient's expectations regarding the GP consultation.
3A Establishing and addressing patient expectations for the consultation	
3B GP as wise advocate	

adequately address these patient expectations with well-honed consultation processes which persuade the patient that they are acting in the patient's best interest. Even so, these processes take time. For less experienced GPs, time constraints may be felt more acutely, especially those working in non-bulk-billing clinics where the cost to patients is significant for longer appointments.

The lack of suitable tests to assist in diagnosis and timely treatment, and gaps in clinical research (necessitating decision-making in an "evidence-free zone" (GP07, GP for 4 years)), were other challenges to best-practice prescribing.

1B. Knowledge-practice dissonance in antibiotic prescribing behaviours. The dissonance between knowledge and prescribing practices was apparent from the interviews. Sometimes, despite GPs discerning that the presenting infection is highly likely to be viral and the knowledge that unnecessary use of antibiotics causes antibiotic resistance, antibiotics are still prescribed. GPs are aware that in doing so, a breach of best practice has occurred. Self-acknowledgement of this dissonant behaviour resulted in a range of emotions described in the interviews—frustration or disappointment in themselves, a sense of guilt, feelings of having been manipulated, and exhaustion.

GPs spoke of "caving in" to patient expectations to prescribe antibiotics due to exhaustion. The quote below conveys a sense of futility in trying to persuade the patient otherwise, resulting in the GP taking the "path of least resistance":

> "I admit there's been times I've prescribed antibiotics that I actually don't think is appropriate. Um, but the person is so::: adamant about it or difficult to deal with or just completely insistent about it, that … sometimes it's exhausting actually trying to convince them that they don't need them [antibiotics], so the path of least resistance is just to write a script, and like—There! Get out of my room." (GP04, GP Registrar final year).

GPs are especially vulnerable to knowledge-practice dissonance, if they have not previously thought through and practiced strategies, both in terms of process and verbally, in dealing with patient expectations for antibiotics. Retrospective rationalisation may ensue, to assuage the GP's conscience, and to keep their professional role and identity as a good/caring GP intact.

A subtler form of knowledge-practice dissonance was displayed when GPs prescribed delayed antibiotics despite being aware of the weak evidence base for this practice. In these instances, GPs used caveats to delineate the circumstances under which issuing such prescriptions is permissible.

1C. Prescribing practices of medical colleagues and professional etiquette. The selection of antibiotics is influenced by senior medical colleagues e.g. other GPs or hospital specialists such as Ear, Nose and Throat specialists, Respiratory physicians and Cardiologists. GPs interviewed noted that hospital specialists sometimes recommended inappropriate antibiotics for the primary healthcare sector (e.g. medicines not funded under the national medicines subsidy scheme or in terms of the antibiotic's spectrum of activity).

Undesirable prescribing practices of other GPs present a dilemma and is a source of frustration for GPs who are conserving antibiotics. At best, the patient is confused with the mixed messages regarding the need for antibiotics from different GPs. At worst, patients are perversely encouraged to seek out GPs whom they know habitually prescribe antibiotics, even when not required.

The phenomenon of extending professional etiquette was observed when interview conversations veered into critique or comment about prescribing practices of other GPs. While there is a level of frustration that not all GPs are pulling in the same direction, GPs interviewed extended professional courtesy by suggesting or

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Table 5 GP DCE participant characteristics.

Characteristics	Number (Percent)[a] (n = 23)
Female	15 (65.2)
Male	8 (34.8)
General Practitioner	19 (82.6)
GP Registrar	4 (17.4)
Country of GP training	
Australia	18 (78.3)
Elsewhere	5 (21.7)
Years of practice as a GP (including as a GP Registrar)	
≤5 years	5 (21.7)
6–15 years	9 (39.1)
16–25 years	5 (21.7)
26–35 years	3 (13.0)
>35 years	1 (4.3)
Years of practice as a GP in Australia (including as a GP Registrar)	
≤5 years	8 (34.8)
6–15 years	6 (26.1)
16–25 years	6 (26.1)
26–35 years	2 (8.7)
>35 years	1 (4.3)
State/Territory in which currently practising	
Victoria	6 (26.1)
Queensland	13 (56.5)
Western Australia	1 (4.3)
South Australia	3 (13.0)
There were no participants from New South Wales, Tasmania, Australian Capital Territory, and Northern Territory.	
Location of practice	
Inner city/Suburban	17 (73.9)
Provincial/Regional	4 (17.4)
Rural/Remote	2 (8.7)
Professional working arrangements	
Contractor GP	13 (56.5)
Employed GP	9 (39.1)
Partner	1 (4.3)
Sole owner	0 (0.0)
Clinic structure	
Sole GP owned clinic	1 (4.3)
Multi-GP owned clinic	10 (43.5)
Corporate	4 (17.4)
Government/Health Service owned clinic	6 (26.1)
Other	2 (8.7)
Clinic billing	
Bulk-billing clinic	8 (34.8)
Bulk-billing available for selected patients (mixed billing)	14 (60.9)
Private billing	1 (4.3)
Antibiotic prescribing patterns—self declared	
Prescribe more than other GPs	0 (0.0)
About the same as other GPs	13 (56.5)
Prescribe less than other GPs	10 (43.5)

[a] Rounding to one decimal point means that some cells approach, but do not yield, a total of 100%.

speculating on reasons why other GPs could have prescribed antibiotics.

Locum GPs or those attending to another GP's regular patient extend professional etiquette by: acceding to patient demand for antibiotics as their regular GP "always prescribes" antibiotics for their presenting condition; and/or not critically evaluating previous prescribing decisions.

Theme 2: Delayed antibiotic prescription

This theme captured GP's views on delayed antibiotic prescriptions.

2A. Integrity and responsibility. The issuing of delayed antibiotic prescriptions for respiratory tract infections is contentious. While there can be reasonable grounds for such prescriptions, delayed antibiotic prescriptions may represent an abdication of responsibility on the GP's part. When there is uncertainty regarding the need for antibiotics, patients who hold delayed antibiotic prescriptions essentially make the final decision on when and whether to start the antibiotics.

Prescribing delayed antibiotics introduces the problem of professional integrity, especially if it was a result of the GP's capitulation to patient demands or expectations. Experienced GPs assert clinical autonomy by making the distinction between having consciously made a medical decision, "Does this person need antibiotics or not?", and dealing with patient expectations for antibiotics. Failure to separate the two acts can lead to using a delayed antibiotic prescription as a means of assuaging the patient, which in turn compromises the GP's professional integrity.

2B. Support for delayed antibiotic prescriptions. GPs who are open to the practice of issuing delayed antibiotic prescriptions seem to do so for the following reasons: as a way of investing in the doctor–patient relationship; and as a way of respecting and involving the patient in collaborative management of their health:

> "I think it's really hard when [GPs] say, no, no look, you know, you've got to come back and see me. … if it's right on the cusp, and you're dealing with adults, I do think that you can respect the adult and say [that], because the other thing is people have had to take time off work to come in and see you." (GP09, GP for 24 years)

These GPs may view the refusal to prescribe delayed antibiotics to be an overly paternalistic approach. In addition, GPs want to avoid being negatively evaluated by patients and being accused of harbouring questionable financial motives:

"… [by writing a delayed antibiotic prescription] it doesn't look like you're trying to scam them into another appointment if they don't get better …" (GP01, GP for 1 year).

2C. Opposition to delayed antibiotic prescriptions. GPs who do not subscribe to this practice think it unfair to delegate the decision to the patient, reflecting a view that GPs should take more responsibility for treatment decisions. Often there is no single, definitive symptom that

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would trigger the warrant for antibiotics. Thus, it is difficult for GPs to provide meaningful advice to guide patients to a course of action, apart from general statements such as "… and in 3 or 4 days if you're not any better, then you could try the antibiotics." (GP10, GP Registrar final year).

Apart from the issues of compromised professional integrity and abdication of responsibility, prescribing delayed antibiotics potentially confuses patients by giving them a mixed message. As one GP puts it: "… it sends a mixed message. I don't think you need antibiotics, but here's a script." (GP06, GP for 11 years). GPs who prefer decisive action argue that by putting off the treatment decision, the benefits of antibiotics would be lost to the patient:

> "If they [antibiotics] were going to have any benefits you should give them straightaway, rather than delaying a couple of days. … you get a 16-hour benefit on- for sore throat and otitis media, and it's within a couple of days. So if you wait a couple of days you're missing out [on the benefits of treating with antibiotics]." (GP06, GP for 11 years)

GPs who oppose or rarely prescribe delayed antibiotics prefer that patients return for a reassessment of treatment needs. In instances where there is uncertainty of diagnosis and the GP has made a judgement call that antibiotics are not needed at that point, the patient is given a range of signs and symptoms which, should they occur, would warrant a return to the clinic for reassessment. GPs conceded that they would issue a delayed prescription if the patient was unable to return for reassessment due to finances, time and/or travel constraints.

Theme 3: Patient expectations

Theme 3 encompassed patient's expectations regarding the GP consultation.

3A. Establishing and addressing patient expectations for the consultation. It is important for GPs to discern and establish the patient's agenda for the consultation, preferably at the beginning of the session, rather than assume that the patient expects antibiotics. Some patients, but not all, state their expectations clearly at the outset. GPs interpret the following statements by patients to be veiled requests for antibiotics: "I just want to nip it in the bud", "I just want something to stop it in its tracks" (GP04, GP Registrar final year). Other patients are more explicit: "… got a sore throat and runny nose, I want antibiotics before it goes to my chest" (GP05, GP Registrar final year).

GPs also reported that some patients are clear about not wanting antibiotics if not required, and are simply seeking confirmation and assurance: "I want to check up, but I'm hoping not to have antibiotics" (GP02, GP for 6 years).

3B. GP as wise advocate. When addressing patient expectations for antibiotics, experienced GPs have well-honed strategies to do so efficaciously. One GP describes it as "preparing the ground" which comprises: taking a thorough medical history; conducting a thorough clinical examination; consciously making a clinical decision for treatment and management i.e. whether antibiotics are required; and communicating the decision to the patient with confidence, empathy, and in a manner which conveys that the GP has made the decision in the patient's best interest. GPs emphasised that as part of managing patient expectations and maintaining the GP's autonomy of the prescribing decision, it is important to have explicitly/consciously decided whether antibiotics are needed, prior to communicating this decision to the patient in an appropriate manner.

Reframing the consultation and instituting "preparing the ground" processes, will help GPs demonstrate that they are an advocate for the patient and that they are not simply refusing to prescribe antibiotics due to a strongly held public health ideology. These strategies also help to establish and build trust in the doctor—patient relationship. The GP comes across as a wise advocate for the patient, standing firm in their conviction that an antibiotic is not required and doing so in a manner which validates the patient's concerns without capitulating to inappropriate patient demands. GP06 offers an example of how a wise advocate would communicate their decision not to prescribe an antibiotic:

> "So I frame it in terms of … 'I've looked at you very carefully. And it's really clear to me that this is an infection that is not going to benefit from antibiotics.' In fact I would be running pretty much all the risks and the harms of antibiotics, and none of the benefits, you know 'the harms of antibiotics being diarrhoea and vomiting and rash, I wouldn't want to give you any of those [side effects].' … and the other thing I say to them is, 'if I thought I could help you with antibiotics, I would give them to you in a second.'" (GP06, GP for 11 years)

GPs also point out how *not* to communicate i.e. minimising the patient's concerns undermines the patient advocacy message:

> "I see with student doctors and junior doctors … the biggest problem is when they say [to the patient/parent] it's <u>just</u> a cold, [signalling to the patient/parent] go away, this child is not sick enough for treatment. … [instead] you want to say, yes this child is sick and unwell … and I'm doing everything in my power to get them better; antibiotics is just not part of that." (GP07, GP for 4 years)

GPs found that patients were responsive to the wise advocate approaches outlined above as they felt heard and validated, and were appreciative of the GP's expertise. GPs reflected on the fact that "you get the patients you deserve", in that over time, patients come to understand the GP's clinical approach. The fact that the patient returns and/or considers the GP their regular doctor indicates that they appreciate the approach taken by the GP.

Discrete choice experiment

Participant characteristics

Despite the comprehensive recruitment strategy at both a state/territory and national level, and the extension of the survey closure date for an additional 4 weeks, the recruitment of GPs proved to be difficult. Forty-three GPs entered

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the online DCE survey and of these, 23 completed the survey over a 3-month period (53.5% completion rate). Participant characteristics are shown in Table 5.

Participant characteristics were generally comparable to GPs registered to practise in Australia in terms of place of practice: 73.9% practiced in metropolitan areas (vs. 67.4% of Australian GPs), and 26.1% in Provincial/Regional or Rural/Remote areas (vs. 32.6% of Australian GPs) [48]. However, the proportion of female participants (65.2%) was higher than the proportion of female GPs in Australia (44.2%) [48]. There were also more GPs who had trained in Australia amongst participants (78.3%) compared to GPs in Australia (60.3%) [48].

Influence of factors on prescribing

A total of 414 choice observations (23 participants × 18 choice sets each) were available from the completed surveys. No completed surveys were removed from analysis as all passed the intra-participant consistency check.

Results of the MXL estimates are presented in Table 6. McFadden's pseudo R-squared, which provides a relative measure of model fit, was 0.44. A value between 0.2 and 0.4 indicates a good model fit [49].

All attributes except "Familiarity with patient" significantly influenced GP prescribing preferences ($p < 0.05$). The influence was generally consistent with *a priori* assumptions. GPs were more likely to prescribe antibiotics in the DCE scenario if: the patient's duration of symptoms was 3 weeks rather than 1 week (although no significant effect was observed compared to a symptom duration of 2 weeks); the patient says they want antibiotics (rather than saying they don't want antibiotics unless necessary or saying that they want reassurance); the patient had an important life event coming up; or the patient could not return for a reassessment should their health deteriorate. However, the standard deviations indicated the presence of significant variation in the impact of these attribute levels on participant decision-making ($p < 0.05$).

Preference weights for each attribute were calculated as the difference between the highest and lowest attribute level coefficients within that attribute. An importance score (%) for each attribute was generated using its preference weight as the numerator and the total preference weight as the denominator (Table 7).

The importance scores indicate the relative importance of each attribute in influencing GP preferences. The attribute which exerted the most influence on GPs' likelihood of prescribing antibiotics was "Duration of symptoms", followed by "Patient expectations".

Of the 414 valid observations, GPs indicated in 308 observations (74.4%) that the prescription given would have been a delayed antibiotic prescription. In the final section

Table 7 GP DCE—Preference weights and importance scores for attributes.

Attribute	Preference weight	Importance score (%)
Duration of symptoms	6.02	42.5
Patient expectations	4.09	28.9
Life event	1.88	13.3
Reassessment	1.7	12.0
Familiarity with patient[a]	0.46	3.3
Total		100

[a] The estimated coefficient for this attribute was not statistically significant.

Table 6 Mixed Logit estimates for GP DCE survey with effects coding (n = 23).

Attribute	Level	Coefficient	SE	Prob. |z|>Z	SD	SE	Prob. |z|>Z
Duration of symptoms	1 week	−3.09**	0.93	0.0009	2.63**	0.85	0.0019
	2 weeks	0.16	0.21	0.4424	0.54	0.38	0.1548
	3 weeks[a]	2.93[b]					
Life event	No	−0.94**	0.32	0.0038	0.94**	0.28	0.0010
	Yes[a]	0.94[b]					
Reassessment: Patient can return for reassessment	No	0.85**	0.25	0.0006	0.86**	0.27	0.0012
	Yes[a]	−0.85[b]					
Familiarity with patient	New patient	−0.23	0.16	0.1444	0.53*	0.21	0.0123
	Regular patient[a]	0.23[b]					
Patient's expectations	Says they want antibiotics	2.35**	0.74	0.0014	2.58**	0.93	0.0057
	Says they don't want antibiotics unless necessary	−0.61*	0.29	0.0356	1.17*	0.55	0.0325
	Says they want reassurance[a]	−1.74[b]					

**$p < 0.01$ and *$p < 0.05$.
SE: Standard error.
SD: Standard deviation for estimated random coefficients.
Prob. |z|>Z: p-value for the Wald test.
Log Likelihood (LL): −161.61.
Akaike Information Criteria (AIC): 0.85.
[a] Reference level.
[b] Calculated as the negative sum of the estimated coefficients.

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of the survey, GPs were asked which attribute they considered the most important and the least important when weighing up the two alternatives (Situation A and Situation B) presented in each choice set. Most GPs reported that the "Duration of symptoms" was the most important attribute, while others chose, from most votes to least votes: "Patient expectations", "Reassessment", "Life event" and "Familiarity with patient", which closely aligned with the DCE component of the survey.

More participants found the DCE easy/very easy to complete (43.5%) or neutral (34.8%), compared to difficult/very difficult (21.7%).

Discussion

This is the first study to quantify factors that exert strong influence on GP decision-making in antibiotic prescribing, using a DCE. The perspective of Australian GPs on antibiotic prescribing is an addition to the current literature which is dominated by research from Europe and the USA.

Patient expectation for antibiotics remained one of the significant challenges for the GPs interviewed, which was underscored by the results of the DCE survey. This finding is consistent with the barriers identified in the literature and a recent study where more than 50% of Australian GPs surveyed reported that they would prescribe antibiotics for an upper respiratory tract infection to meet patient expectations [14]. Early career GPs seemed to be less successful in managing patient expectations which diverge from best practice, similar to a recent study involving GP Registrars [15]. Experienced GPs who are skilful in communicating prescribing decisions, coupled with a thorough clinical consultation, are more likely to be able to defuse what could be an emotionally and professionally awkward situation.

Elements of the successful strategies used during clinic consultations are common to shared decision-making (SDM) i.e. information sharing, intentional engagement and involvement of the patient in considering treatment options and risks, taking into account patient values [50]—which when conducted well can enhance patient satisfaction and confidence in the decision [51]. A basic framework for incorporating SDM into consultations has been provided by Hoffman et al. [52]. Given the complexity of managing patient expectations while maintaining (or even increasing) patient trust and good doctor—patient relationship, well-honed strategies and advanced communication skills which may include SDM are needed. Communication skills training have been found to significantly reduce antimicrobial prescribing without affecting patient outcomes [53].

The prescribing practices of medical colleagues were an unexpected finding, mentioned as a challenge by GPs interviewed. Although prescribing etiquette had been cited in literature as one of the reasons that shape prescribing culture [54,55], the clinical context was that of hospitals where a medical hierarchy is often imposed and social capital accrued through conforming with perceived norms and practices of specialities, peers and senior colleagues [54,56]. In contrast, GPs have relative autonomy with little or no medical hierarchy, with the exception perhaps of being a Registrar under supervision [15]. Even so, GPs' prescribing practices are somewhat affected by hospital specialists regarding selection of antibiotics and in having to deal with the aftermath of other GPs who may prescribe antibiotics more freely i.e. having to deal with: patient confusion regarding the different treatment decisions; subsequent patient demands/expectations for antibiotics; a more resistant bacterial infection non-responsive to first-line antibiotics; and/or troublesome side effects from antibiotics. In the fight against antibiotic resistance, it would be desirable to have solidarity and consistency amongst GPs in judicious use of antibiotics.

Uncertainty of diagnosis coupled with patient expectations exerts a measure of prescribing pressure on GPs. This pressure to prescribe antibiotics for a respiratory tract infection was felt more acutely by early career GPs (Registrars and newly qualified GPs) who as yet may not have well-practiced strategies and professional confidence to holistically address patient expectations for antibiotics. Some GPs interviewed acknowledged that patient expectations sometimes affected their antibiotic prescribing patterns negatively, causing knowledge-practice dissonance; and a delayed antibiotic prescription is sometimes given as a "soft option". These findings add a new angle to and complement that of Henriksen and Hansen [57] who linked GP self-perception to prescribing behaviours; and is in line with the findings of a recent literature review by Public Health England [58]. GPs who felt pressured by both extrinsic and intrinsic factors prescribed in a way that protected their personal and professional self, in terms of clinical autonomy [57].

Delayed prescribing has been recommended as a strategy for reducing inappropriate antibiotic prescribing [3,17,18]. However, recent studies including a Cochrane Review found no difference in clinical outcomes for cough and the common cold when patients were refused antibiotics [59,60]. In addition, the Cochrane Review showed that a strategy of no antibiotics for respiratory infections reduced antibiotic use by a larger percentage as compared to a strategy of delayed antibiotics [60], which suggests delayed antibiotics is of limited use as a strategy to reduce antibiotic consumption.

Implications for policy and practice

We make two recommendations which are aligned with and add to the implementation of Australia's National Antimicrobial Strategy, Objective 1 — Increase awareness and understanding of antimicrobial resistance, its implications, and actions to combat it through effective communication, education and training [20].

Recommendation 1: Upskill GPs to manage patient expectations efficaciously

To recover clinical autonomy in medical decision-making especially when there is pressure to prescribe an antibiotic, GP education and training providers could incorporate/enhance training curricula with: (a) strategies for managing patient expectations; and (b) advanced communication skills to convey prescribing decisions clearly, confidently and persuasively to patients to help patients avoid inappropriate behaviours.

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Recommendation 2: Incorporate new emphases for public health campaigns

While public health campaigns are likely to continue as a key strategy to encourage antibiotic stewardship in Australia, future campaigns could incorporate two new emphases: (a) that consumers have the power to reduce the use of antibiotics (and hence reduce antibiotic resistance) by clearly communicating to GPs their preference to avoid antibiotics for minor illnesses; and (b) reframe public perception to emphasise GPs as wise advocates.

Strengths and limitations

The use of mixed methods and the research design provided a more comprehensive investigation of the dominant factors influencing decision-making in antibiotic use in the Australian primary healthcare sector.

The use of convenience sampling meant that only GPs with interest in the topic volunteered to participate. Other GPs may have different views and made different decisions. For the DCE, a higher proportion of participants were female and trained in Australia, when compared to GPs registered to practise in Australia. Hence, the stated preferences in the DCE may not adequately represent the preferences of Australian GPs.

DCEs use hypothetical scenarios, perhaps an oversimplification of the clinical context, and rely on what participants say they would do (stated preference), not what they do (revealed preference). Hence, the findings of a DCE need to be validated by other means e.g. real-time data, when available. The small number of participants for the DCE may have contributed to the lack of observation of a significant influence for the "Familiarity with patient" attribute on prescribing. The DCE results cannot be generalised to all GPs due to the small sample; however, the findings provide important insight into choice preferences of participants, which can be cautiously used to inform policy and practice given the statistical significance of most of the estimated parameters and consistency with the qualitative findings.

Future research

Opportunities for future research include: investigating GPs' attitudes to personal use of antibiotics and the impact/influence on their prescribing practice; investigating decision-making on antibiotic prescribing for dentists, nurse practitioners, or other non-medical prescribers; and investigating DCE attribute attendance and non-attendance for clinician cohorts. Given the strength of patient expectations in driving prescribing decisions, we have also investigated patient perspectives [61].

Conclusion

Patient expectation for antibiotics is the dominant modifiable factor influencing GP antibiotic prescribing behaviours. Key challenges to prudent antibiotic prescribing can be overcome through upskilling GPs to manage patient expectations efficaciously, and through two new emphases for public health campaigns—consumers have the power to reduce the use of antibiotics and the GP as a wise advocate for the patient. Coherent action from stakeholders such as government, policy-makers, training providers and GPs, are critical in the fight against antibiotic resistance.

Declarations

Ethics approval and consent to participate

Ethical clearance for this study was provided by the Human Research Ethics Committee of the Queensland University of Technology (Approval number 1500000190). Informed written consent to participate was obtained from all participants.

Availability of data and material

Metadata for the interviews and de-identified DCE data supporting the conclusions of this article will be made available in the Queensland University of Technology research dataset e-repository https://researchdatafinder.qut.edu.au/display/n701.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

EL proposed the study design with input from KP, JW, JD, and NG. EL conducted the study and analysed the data with contributions from JW (DCE), JD, and KP. EL drafted the manuscript. All authors contributed to the revision of the manuscript, and approved the final manuscript.

Provenance and peer review

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