DOCTOR OF PHILOSOPHY

The development of a theoretically-informed intervention to improve the antibiotic prescribing behaviour of dentists in primary care in Scotland

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GLOSSARY OF ABBREVIATIONS

A&F	Audit and Feedback
AMR	Antimicrobial Resistance
BCT(s)	Behaviour Change Technique(s)
BCTTv1	Behaviour Change Technique Taxonomy (version 1)
BCW	Behaviour Change Wheel
FGDP (UK)	Faculty of General Dental Practitioners (UK)
GDC	General Dental Council
GDP(s)	General Dental Practitioner(s)
ISD	Information Services Division, NHS National Services Scotland
LM	Local Measure
NES	NHS Education for Scotland
NHS	National Health Service
QI	Quality Improvement
RCT	Randomised Control Trial
SAPG	Scottish Antimicrobial Prescribing Group
SDCEP	Scottish Dental Clinical Effectiveness Programme
SDPBRN	Scottish Dental Practice Based Network
SHARE	Scottish Health Research Register
TDF	Theoretical Domains Framework
WHO	World Health Organisation

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DECLARATION

I, Gillian MacKenzie Forbes, hereby confirm that this thesis has been written by me, and the research presented it is a record of my own work.

This thesis has not previously been submitted for any other higher degree.

ABSTRACT

Background

Despite the publication of national dental guidance recommending the minimal use of antibiotics, evidence suggests that antibiotics continue to be prescribed when there is no clinical indication.

Aim

The aim of this thesis was to apply the Theoretical Domains Framework (TDF), and the Behaviour Change Technique Taxonomy v1 (BCTTv1) guided by the Behaviour Change Wheel (BCW) to further an understanding of general dental practitioners' (GDPs) antibiotic prescribing behaviour in Scotland and to inform the development of a proposed intervention (co-produced with GDPs) to reduce the non-clinically determined prescribing of antibiotics.

Methods

Two literature reviews, 4 studies and a workshop with GDPs were completed to inform the content of the intervention. The reviews profiled factors and beliefs influencing prescribing decision making and previous antibiotic prescribing intervention studies. The studies were a semi-structured interview (qualitative) study with 16 GDPs, two independent surveys (quantitative studies) conducted with 402 GDPs and 291 patients and an experimental study of 2 recruitment methods (formal and informal) to increase participation in the patient survey. The

identified TDF domains were mapped to behaviour change techniques (BCTs), the active components of an intervention using the BCTTv1. These potential BCTs were discussed at workshop of 8 GDPs who helped to operationalise and further refine the intervention components in terms of their practicality and acceptability in primary dental care.

Results

The literature review identified no previous interventions designed to influence antibiotic prescribing were conceptualised using a theoretical framework, as recommended by the Medical Research Council, which severely limited any understanding of their success or failure. The underlying assumption in this literature appeared to be that knowledge of when to prescribe and which antibiotics to use including the correct dosage, frequency and duration is the primary issue behind inappropriate prescribing as this was the key focus of most interventions.

The GDP interview study (n = 16) identified patient expectation as the factor most likely to influence inappropriate prescribing. Nine specific beliefs, the barriers or enablers of inappropriate prescribing, were mapped on to 4 TDF domains (cognitive, affective, social and environmental factors influencing behaviour). The GDP survey (n = 402) identified the most salient of these beliefs in their decision to prescribe an antibiotic that may not be clinically determined, i.e. coping with negative consequences of the patients who may bully them or not accept dental treatment if an antibiotic was not prescribed.

The patient survey (n = 291) provided evidence that 31% of patients did believe antibiotics would help them get better if they were in pain, expected their GDP to prescribe an antibiotic and expected to get an antibiotic if they had made an emergency appointment. Any intervention will need to take this into account.

The experimental study indicated that significantly more patients participated in the survey if they received a formal style of recruitment compared to an informal style.

Sixteen potential BCTs, the active components of an intervention, may influence GDP and patient beliefs were identified guided by the Behaviour Change Wheel. The results of the workshop included several refinements that involved reception staff and patients more, to increase the importance of not succumbing to patient expectation and to provide more support to GDPs on how to manage these patients.

Based on these findings, a proposed intervention bundle was determined as the most likely approach to reduce non-clinically based antibiotic prescribing. This involved the whole dental team that included triaging instruction at the reception and poster and leaflets in the waiting room, and for the GDPs a persuasive message that included information on how to cope with expectation in the treatment room was proposed.

Conclusions

The findings from this research indicated that dentists are aware that they are prescribing when an antibiotic is not clinically indicated, and they are looking for

support to overcome the barriers of managing patient expectation appropriately. This proposed intervention is underpinned by evidence and behaviour change theory that offers evidence of how and why it works and co-designed with end-user it has the potential to be acceptable and implementable in primary dental care in Scotland. Also, it has wider relevance for intervention development as it demonstrates a staged approach design and the application of frameworks underpinned by behaviour change theories.

EXECUTIVE SUMMARY

The purpose of the research in this thesis was to develop a theoretically informed intervention aiming to improve the antibiotic prescribing behaviour in primary dental care. This executive summary is a brief outline of the research design and methods applied in this research and how theory was used to underpin this proposed behaviour change intervention.

Background

The recent use of antibiotics in dentistry continues to be too high (Cope et al. 2016; Palmer et al. 2016). Although the number of antibiotics prescribed in primary dental care is reducing, epidemiological evidence indicates continuing wide variations in prescribing rates (Health Protection Scotland (2017); Information Services Division (2014)).

In Scotland, dental data shows that in some NHS health boards twice as many antibiotics are prescribed when compared to other areas and one in thirteen of all community dispensed prescriptions are from general dental practitioners (Health Protection Scotland (2017) and Information Services Division (2014)). One explanation offered is the socio-economical difference across Scotland (Covvey et al. 2014); however, it may also be indicative of differing prescribing behaviour in response to other clinical and non-clinical factors present in primary care (Cope et al. 2014).

Previous interventions aiming to improve the use of antibiotic in dentistry have been successful (Löffler & Böhmer 2017) but indicate a need to develop intervention grounded in theory to understand how it works and to maximise its potential effectiveness.

For the purposes of this thesis, inappropriate use of antibiotics is defined as prescribing because of perceived benefits despite there being no clear clinical indications.

Design and Methods

The pragmatic approach taken in the research of this thesis was to develop an intervention underpinned by behaviour change theories which is promoted by the MRC framework for complex intervention design (Craig et al. 2008; Campbell et al. 2000). Central to the research is the Theoretical Domains Framework (TDF) (Cane at al. 2012; Michie et al. 2005) and the Behaviour Change Taxonomy (BCTTv1) (Michie et al. 2013) with the development process guided by the Behaviour Change Wheel (Michie et al. 2011a).

This phased process advocates an initial 'behaviour analysis' to understand the problems associated with performing the desired behaviour. These analyses identified the theoretically informed barriers and enablers to be overcome, then mapped this evidence to behaviour change techniques which were the potential components of the future intervention. A two-part literature review, three empirical studies (one qualitative and two quantitative studies), one experimental study and the development of a proposed intervention including a workshop

involving general dental practitioner were completed. Each of these phases are outlined in the following sections.

Literature Reviews

Review 1 - Factors and beliefs influencing prescribing decision making

One review of studies on antibiotic use in a dental setting in the UK identified the factors and beliefs likely to influence antibiotic prescribing decisions. This was completed to understand the 'problems' associated with inappropriate prescribing and to inform the focus of the anticipated qualitative and quantitative research. The key influences were found to be individual, patient and environmentally related factors. Patient expectations for antibiotics explained inappropriate antibiotic use as well as dentists' confidence in their diagnosis and clinical skills to treat successfully. In the environment of a busy practice a lack of time was likely to be resolved by prescribing to gain some time back if running behind. Importantly, this search identified that most of these past studies have been conducted over 8 years ago (Cope et al. 2016; Newlands et al. 2016; Cope et al. 2014; Dar-Odeh et al. 2010; Tulip et al. 2008; Seager et al. 2006; Chate et al. 2006; Dailey et al. 2001; Palmer et al. 2000e; Roy et al. 2000) indicating a need for more up to date evidence and also to incorporate a theoretical approach to comprehensively gather all potential barriers and enablers.

The beliefs identified in the first review that were likely to influence inappropriate use were mapped onto the TDF domains. The purpose was to use these results to identify which areas need to be explored as part of the behavioural analysis of

problems. The most frequently occurring TDF domains were social influence, beliefs about consequences, environmental resources and context, knowledge, skills and beliefs about capabilities (Cope et al. 2016; Newlands et al. 2016; Chate et al. 2006; Palmer et al. 2002e; Dailey et al. 2001). It is unclear whether the other TDF domains not identified in the review were not appropriate to prescribing behaviour or simply not covered by the interview or survey questions.

Review 2 - Interventions

A second literature search focused on past antibiotic dental-related interventions. This was conducted to determine the content and effectiveness of previous interventions. The search found that education focussed interventions predominated this literature (Elouafkaoui et al. 2016; Zahabiyon et al. 2015; Chopra et al. 2014; Chate et al. 2006; Seager et al. 2006; Palmer et al. 2001). Although many of these interventions did result in some changes in prescribing behaviour, there was no evidence provided as to why specific intervention elements were included, or what specifically influenced success or failure. They were united in an apparent underlying assumption that knowledge is the key component for changing antibiotic prescribing practice.

Empirical Studies: Study 1

A qualitative study was conducted to explore and identify the barriers and enablers of antibiotic prescribing decisions. Sixteen GDPs took part in semi-structured interviews. A theoretical framework and thematic analysis identified the continuing salience of individual, patient and environmental factors. Again, the key barriers were related to patient expectation, concerns over clinical skills and insufficient

time to treat instead using antibiotics. A new emotional influence from external monitoring was also highlighted with GDPs feeling increased pressure to justify their prescribing decisions.

Empirical Studies: Study 2

The first quantitative study was carried out to determine whether the interview findings were generalisable to the wider GDP population in Scotland. A bespoke TDF-based questionnaire was developed and distributed through the NHS Education for Scotland's online portal to all registered GDPs. The results of the survey confirmed the identified barriers did influence the appropriate management. Barriers associated with managing patient expectation were significantly more likely to determine wanting to prescribe compared to other contextual barriers such as limited time. As these were the GDPs perceived views about patients' expectations a pragmatic decision was made to further test their accuracy and to explore dental pain experiences and why are antibiotics expected from a patients' perspective.

Empirical Studies: Study 3

Furthering a deeper understanding of the GDP study, this second questionnaire also explored the characteristics and beliefs of patients with higher expectations for antibiotics. This evidence informed the development of the intervention which will address these known barriers of managing expectation by offering support on when to be aware of concerns and how to educate these patients.

Experimental Study

Study 3 included a sub-study that investigated the recruitment of the patients into research study, as anecdotal evidence suggests that this can be an issue for dental research. The study compared the potential benefits of using either a formal and informally worded invitation or information sheet. The result was that more patients were recruited if they received a formal style introduction and information sheet to the study.

Development of Intervention: Part 1

The evidence from the empirical studies was collated, before the mapping to the BCTs that could be included in the workshop. The mapping matrices guided by the BCW (Michie et al. 2011a), intervention function based on the TDF domains (Cane et al. 2015; Michie et al. 2005) were identified to narrow-down the selection of potential BCTs from the BCTTv1 (Michie et al. 2013) and the published evidence.

Development of Intervention: Part 2

The workshop aimed to engage the GDPs in a discussion about the suitability of these BCTs and to use their expertise about how best to operationalise them. Presented background information included the results of the empirical studies and views and experiences were shared at a focus group discussion.

Development of Intervention: Part 3

This part of the research refined the intervention based on the workshop findings. The findings indicated that GDPs would benefit from receiving support on how to successfully manage patient expectation. Importantly, the outcome of the workshop was that effective management of reducing patient expectation began at

the initial point of contact, so it was the responsibility of the whole dental team and patients.

Further Research

This research has reached the stage whereby further work needs to be done to determine whether these proposed elements of this intervention are likely to be effective in changing the prescribing behaviour of dentists via their management of patient expectation. This projected research includes feasibility and pilot studies before any large scale research such as a randomised control trial (RCT) could be conducted.

CHAPTER 1 - INTRODUCTION

1.1 INTRODUCTION

This thesis describes the systematic and theoretically informed approach taken to develop a behaviour change intervention aiming to improve the use of antibiotics in primary dental care. This chapter gives an overview of antibiotic use in dentistry, it highlights concerns associated with the reported level of 'inappropriate' prescribing (non-evidence based use of antibiotics) and the factors likely to influence antibiotic prescribing decisions. It explains the rationale for and the scope of this research, and the chapter concludes with the overall aims of the thesis and its key research questions.

1.2 ANTIBIOTIC PRESCRIBING IN DENTISTRY

Dentists, of whom there are appropriately 3,900 in Scotland from a total of nearly 41,000 on the General Dental Council (GDC) register across the UK, mainly prescribe antibiotics during emergency appointments within primary and secondary care, (The Dental Workforce in Scotland report, NHS Education for Scotland, 2016). Most of the dental infections managed by dentists are likely to be patients who are often in considerable discomfort and pain, (Cope et al. 2014; Dailey et al. 2001). Dental pain comes from infections in the tooth or gum resulting in either a periapical or periodontal abscess (Tulip & Palmer 2008). Other oral infections are pulpitis (inflammation of dental pulp tissue), acute necrotising gingivitis (serious infection in the gums), pericoronitis (an impacted or partly erupted wisdom tooth) and a dry

socket (lack of blood clot forming post extraction), (AAE Consensus Conference Recommended Diagnostic Terminology 2009).

Registered general dental practitioners (GDPs) can prescribe from the *British National Formulary* (BNF) and the *BNF for Children* (BNFC). GDPs prescribing within the National Health Service (NHS) are restricted to those antibiotics on the *List of Dental Preparations* in Dental Practitioners' Formulary. Fourteen antibiotics, four antifungals and one antiviral are included in the BNF 70 (British National Formulary. 70 Ed; 2015); however, NHS policies may limit the use of some broad-spectrum antibiotics for reasons of economy and reducing the development of antimicrobial resistance, (Scottish Medicines Consortium, (2016), Optimising antimicrobial prescribing in possible or suspected infections due to multi-drug resistant Gram-negative bacteria).

However, the benefits of prescribing antibiotics to manage dental infections is limited (Sweeney et al. 2004) and national guidelines recommend that antibiotics are not necessary unless there are signs of spreading infection, i.e. swelling, and/or systemic indications, (Scottish Dental Clinical Effectiveness Programme (SDCEP) (2016). *Drug Prescribing for Dentistry; the* Faculty of General Dental Practice, UK (FGDP). *'Antimicrobial Prescribing for General Dental Practitioners').* The recommended first step of care for most dental infections is to surgically treat the bacterial infection, this may involve the draining of the infection through the root canal, by an incision into the soft tissue or by extracting the tooth. Unlike, the infections more often seen in medical primary care, infections originating from within the tooth or the surrounding gum area can only be dealt with long-term by

a surgical treatment to remove the source of the infection, so they cannot be resolved by a course of antibiotics alone, (Faculty of General Dental Practice (UK), 2012).

Despite, nearly 20 years of research on dental antibiotic prescribing and the publication of national dental guidance since 2008 that recommend "the prescribing of antibiotic must be kept to a minimum and used only when there is a clear need", (*Drug Prescribing for Dentistry,* Scottish Dental Clinical Effectiveness Programme (SDCEP) 2016. p. 27), the likelihood of suboptimal prescribing decisions continues to be of concern, (Palmer et al. 2016; Cope et al. 2016). There is evidence that antibiotics are over-used for dental and periodontal diseases because of a lack of awareness of guideline recommendations, and the majority of antibiotics used in primary dental care is for therapeutic treatment of dental infections (Dar-Odeh et al. 2010). Over 80% of adult patients attend emergency dental clinics for dental infections and nearly three-quarters of them are likely to be prescribed an antibiotic (Dailey & Martin. 2001). Also, UK empirical studies have reported a range of between 37% - 71% of antibiotics are inappropriately prescribed to manage dental infections when compared to guidelines, (Cope et al. 2016; Tulip & Palmer. 2008; Chate et al. 2006).

1.3 Trends of dental antibiotic prescribing in the UK

An insight into dental antibiotic use is available from the surveillance of routinely collected data as part of the prescription processing system by the Information Services Divisions (ISD) Scotland, a division of NHS National Services Scotland. This

information is shared with the Scottish Antimicrobial Prescribing Group (SAPG) who co-ordinate and deliver a national framework for antimicrobial stewardship programme in medical care (Nathwani et al. 2011). Limited information on dental prescribing from the collection and analysis of routine data across different setting is reported by the SAPG. Since the analysis of this data began in 2006/07, SAPG's annual reports have provided evidence of a steady increase in dental prescription items until 2012/13, however, in 2013/14 there was a reduction in use of 6% and a further 9.2% in 2014/15 (ISD Scotland, SAPG, AMR annual report (2014)).

Whilst this overall reduction in prescribing rates is promising, it cannot be deduced from this data-driven evidence whether appropriate prescribing is rising or declining, or if GDPs are not using antibiotics when one should be prescribed. Also, this reduction does not reflect the consistently high proportion of dental prescriptions issued or the wide variations in prescribing rates across NHS board areas. In 2015, one in 13 (7.9%) of dispensed antibiotics were prescribed by GDPs and prescribing rates varied significantly across NHS board areas with some prescribing nearly 2.5 times more antibiotics than others. For example, the rate for NHS Greater Glasgow and Clyde was 24.56 compared to 10.10 for NHS Western Isles (figures based on item/100,000/day), Health Protection Scotland and Information Services Division (2014). *Antimicrobial Use and Resistance* in Humans in 2012. Similar proportions of dispensed antibiotics in community pharmacies and variations in prescribing rates has been reported across other parts of the UK. For example, a report published in England indicated dental antibiotic prescriptions accounts for 8.2% of primary care items dispensed in 2017 (Public Health England.

English Surveillance Programme for Antimicrobial Utilisation and Resistance (ESPAUR). And variations in prescribing activities in Welsh local health boards ranged between -10.2% to +17.2% of an average number of antibacterials was 8123 items per 100,000 resident population per year, (Review of prescribing by dentists in Wales. National Public Health Service for Wales, 2008).

The overall conclusion drawn from this epidemiological and empirical evidence is the likelihood that some of these antibiotics are un-necessarily prescribed when there is no clinical indication (Palmer et al. 2016). The result is a general view from stakeholders is that the current use of antibiotics should and could be safely reduced (Cope et al. 2017).

1.4 Inappropriate Antibiotic Prescribing

The term ‘inappropriate’ often appears in the published dental literature but it is not always clearly defined in research articles, (Cope & Chestnutt. 2014). The World Health Organisation (WHO) in 1987 stated ‘sometimes the most appropriate therapy does not include drugs’. When it does, the rational use of drugs demands that the appropriate drug be prescribed, that it be available at the right time at a price people can afford, that it be dispensed correctly, and that it be taken in the right dose at the right intervals and for the right length of time. The appropriate drug must be effective, and of acceptable quality and safety.

In 1973, Parish stated that good prescribing should be appropriate, equally safe, effective and economic. However, Barber (1995) states that good prescribing can be attained by meeting this criterion which is too simplistic as it does complex

trade-offs that affect practice. In 2003, Britten explored the feasibility of using a broader definition of appropriateness of prescribing which should include patients' and practitioners' perspectives as well as pharmacological ones.

The SDCEP guidance recommends local measures to manage dental infections, i.e. surgical treatment, unless systemic symptoms are present, any prescribing of antibiotics outside of these circumstances can be considered to then be inappropriate. Other circumstances where inappropriate prescribing may happen is where there is a high risk of an adverse allergic event, or potential drug-drug and drug-disease interactions from a specific antibiotic. Inappropriate use also includes prescribing the 'wrong' antibiotic for the presented condition, and the over-use of antibiotics at a higher frequency or for a longer duration than is recommended by guidance. Whilst, there is no available clinical evidence of prescribing for specific dental and periodontal conditions, guidance recommends limiting use but ultimately prescribing decisions are likely to be based on the clinicians' assessment and diagnosis (SDCEP, 2016).

1.4.1 Antibiotic prophylaxis

It is common for an antibiotic to be prescribed before a dental procedure is carried out to reduce the possibility of any post-operative serious complications such as with infective endocarditis or as a precaution for dental implants.

The opinion that bacteria from dental procedures is a risk factor has changed as daily oral hygiene tasks such as tooth brushing have more exposure to bacteria than dental treatment (Roberts et al. 1999). As a result, the recommendation of using prophylactic antibiotics was omitted from the 2015 version of SDECP guidance and

in their 2008 clinical guideline 64 (CG64) National Institute for Health and Care Excellence (NICE) stated ‘Antibiotic prophylaxis against infective endocarditis is not recommended for people undergoing dental procedures.’ This recommendation was based on there not being any clinical trials demonstrating the effectiveness or lack of it for antibiotic prophylaxis as summarised by Cahill et al. later in 2017. The publication of this recommendation resulted in a sudden drop in the number of antibiotics being prescribed for prophylactic reasons (Thornhill et al. 2011). However, this goes against the recommendations from the European Society for Cardiology (ESC) and American Heart Association/American College of Cardiology (AHA/ACC), who advocate restricted use of antibiotic prophylaxis.

Yet, the debate over antibiotic prophylaxis continues into 2017, when NICE changed their guideline to 'Antibiotic prophylaxis against infective endocarditis is not recommended *routinely* for people undergoing dental procedures’ in their updated guidelines in 2016. The impact of adding ‘routinely’ has raised uncertainty among dentists about when it is appropriate to use a prophylactic antibiotic (Thornhill, 2016), therefore it was not investigated as part of this thesis.

The use of antibiotics prophylactically for dental implants was examined in one study (Ireland et al. 2012). It found that 72% of dentists (n = 109) routinely used antibiotics with a wide variation in the type of antibiotic prescribed and in frequency and dosage prescribed. The necessity of using antibiotic pre- and post-operatively for dental implants is still under debate because of a lack of available evidence but as implants are not covered by the NHS, this area of practice is out-with the remit of this thesis.

1.5 Definition of Inappropriate Antibiotic Prescribing

Inappropriate use of antibiotics is often defined differently in the published literature as previously outlined. In dentistry, one definition relates to only prescribing accuracy whereas another definition is when an antibiotic is prescribed despite it not being clinically indicated (as detailed in Section 1.4, Page 17). These two different types of inappropriate antibiotic use are likely to be influenced by different factors. For example, prescribing accuracy is more likely to be determined by clinical knowledge which has been previously addressed by educational (Seager et al. 2016) and audit (Elouafkaoui et al. 2016; Chate et al. 2006) components in interventions by referring to guidance to seek the required information about the correct regimen for a specific condition.

The second type of inappropriate prescribing is when there is no clinical indication for one to be prescribed. This inappropriate prescribing behaviour is more complex as it can be in response to the dentists' own opinions or also to external factors such as patients' wishes. Existing evidence does suggest that some dentists do assess that the use of antibiotics for non-clinical reasons is acceptable if it can be justified, or that others just simply do not agree with the recommended dental treatment so instead they will prescribe an antibiotic based on their previous experience, (Newlands et al. 2016; Cope & Chestnutt. 2014).

In this thesis, inappropriate prescribing was defined as using an antibiotic when there is no clinical indication for one to be prescribed. These prescribing decisions are likely to be based on perceived benefits rather than on following recommended use of antibiotic by guidelines. Understanding these benefits is an important issue

as currently there in gap in knowledge about how these benefits are likely to influence prescribing decisions.

Use of this definition of inappropriate prescribing, opens an exploration of why and when dentists perceive there to be benefits in prescribing and to understanding how dentists weigh up the pros and cons of deciding when to prescribe when they know they should not. The identification of these influential benefits is therefore the focus of this thesis.

1.6 Consequence of inappropriate prescribing

Whilst, there is no way of confirming whether antibiotic prescribing is currently supported by clinical indications as recommended, the likelihood of inappropriate prescribing is of great concern. Therefore, the wider consequences of mis-use and over-use of all antimicrobials should also be discussed. Potential consequences include the likelihood of adverse events or delayed dental treatment and the significant issue is the growing bacterial resistance to antimicrobials.

1.6.1 Adverse events

The inappropriate selection of an antibiotic may result in an untoward medical occurrence, such as an allergic reaction. Although this is small, it is a significant risk with nearly 0.04% of the population at risk of serious life-threatening allergic reaction (Holyfield et al. 2008). Another adverse event is the co-prescribing of potentially interacting drugs such as anticoagulants or statins with some antibiotics especially in older patients who are taking multiple drugs (SDCEP, 2016; Guthrie et al. 2015).

1.6.2 Delayed dental treatment

Previous dental research suggests that antibiotics are prescribed as an alternative to carrying out surgical treatment (Dailey et al. 2001; Tulip et al. 2008). Using antibiotics to delay surgical treatment has a higher risk of a potentially life threatening severe infectious complications which require admission to hospital (Seppanen et al. 2011).

1.6.3 Antibiotic resistance

At the global level, the World Health Organisation (WHO) has flagged up concerns that if the current use of antibiotics continues, the consequence of increasing antimicrobial resistance poses a real threat to global health (Antimicrobial resistance: global report on surveillance 2014). Antibiotic resistance occurs when bacteria naturally change in response to the use of antibiotics. Infections are becoming harder to treat as antibiotics used to treat them become less effective resulting in possible longer stays in hospital, higher medical costs and increased mortality of patients. The WHO promotes the prudent use of antibiotics by reducing the overuse and misuse of antibiotics.

In response, most healthcare stakeholders in the UK have acted by developing antibiotic stewardship programmes, (NICE; the Faculty of General Dental Practice (FGDP (UK)). Antibiotic stewardship is a coordinated effort to improve and measure the appropriate use of antibiotics by promoting the optimal use of antibiotic drugs and selection of dosage and duration, (Johnston et al. 2015).

1.6.3.1 Other antimicrobials

The growing resistance by bacteria may also be affected by the over-use of antifungal and antiviral drugs. There is no empirical research on the use of antivirals in dentistry and only a single study that examined antifungal prescribing in the UK (Oliver et al. 2004). Antifungal and antiviral drugs can improve the management of fungal and viral infections, but with only three antifungal and two antiviral drugs available to GDPs, their role is limited (Lewis, 2014). For the purposes of this research, it was decided to focus only on antibiotics as they are the most prescribed antimicrobials in primary dental care.

1.7 Improvement Initiative

There is now a clear drive to reduce the use of antibiotics at a global, national and local level by stakeholders, (WHO; UK Five Year Antimicrobial Resistance Strategy 2013-2018). In dental primary care, several different approaches have been taken to encourage and support GDPs to follow evidence-based prescribing practice. This has included the publication of national guidelines (NICE; SDCEP), antimicrobial stewardship tool-kits (FGDP (UK)), Quality Improvement (QI) activity (pre-approved clinical audits) (Scottish Dental Practice Based Research Network (SDPBRN) http://www.sdpbrn.org.uk/), local health board audits (NHS Greater Glasgow & Clyde) and a systematic review of intervention studies (Löffler & Böhmer 2017).

1.7.1 Guidelines

The routine uptake of evidence-base practice in the UK has been promoted through the publication of guidance from the Scottish Dental Clinical Effectiveness

Programme (SDCEP), the Faculty of General Dental Practice (FGDP (UK) and the National Institute for Health and Care Excellence (NICE). However, the uptake of 'improved' clinical behaviour by health care professionals from passive publication has shown to be 'unpredictable' and can be a 'slow and haphazard' process, (The Improved Clinical Effectiveness through Behavioural Research, (ICEBeRG) & Francis, J. 2006; Grol & Grimshaw. 1999).

An approach to counter this has been to embed implementation research within the guidance development process. For example, Translational Research within a Dental Setting (TRiaDS), (https://www.triads.org.uk/) programme conducts a series of research studies as part of SDCEP's guidance development process to understand the barriers and enablers likely to be faced by dentists and the practice team in implementing the recommended practice (Clarkson et al. 2010). For antibiotic prescribing, findings from the TRiaDS research resulted in a QI activity (clinical audit) being developed in conjunction with the SDPBRN and NHS Education for Scotland (NES) that aimed to support dentists to reduce their antibiotic use (further details are in Section 1.7.3)

1.7.2 Dental antimicrobial stewardship toolkits

Professional dental bodies, e.g. FGDP (UK) have supported reducing the use of antibiotics by providing practitioners with resources. One resource is a toolkit for dental practices that includes educational posters and leaflets for patients and signposting to prescribing guidelines from FGDP (UK) in 2016. The aim of the toolkit was to encourage the optimal use of antibiotics by influencing the views of dentists and patients about when antibiotics are not required. This approach assumes that

educational materials will be effective at reducing the use of antibiotics without considering beforehand any other theoretically informed strategies.

1.7.3 Clinical Audits

Another strategy often used to reduce the use of antibiotics is clinical audit. This approach of evaluating antibiotic use through audits has shown to be effective at reducing and improving the prescribing practice in primary and secondary care settings, (Cope et al. 2016; Zahabiyon et al. 2015; Chopra et al. 2014; Chate et al. 2006; Palmer et al. 2001c.) However, these audits only applied an educational approach to increasing prescription accuracy indicated by issuing the right drug, duration, frequency and dosage.

An alternative strategy using action planning as a technique informed by behaviour change models was developed by the SDPBRN. The objectives of action planning are for GDPs to review their current prescribing and to consider and implement change in their use of antibiotics, if required. The aim of this quality improvement (QI) audit is to assist dentists with reflecting on the possible barriers to following the recommended used of antibiotics and to develop a suitable action plan that would help to overcome them with these identified barriers. Detailed information and all documentation which includes an action plan template were provided to support its completion.

The assessment of this strategy is on-going, so it is unclear whether this top down approach will be effective at changing prescribing practice or if it still lacks input from dentists, i.e. bottom up approach.

1.7.4 In-house practice audits

Self-developed, local NHS practice audits have been conducted but their findings are not always published or shared beyond the individual practice or health board. Knowledge of these internal audits comes from the author's involvement in projects as part of the SDPBRN. Despite, these audits being small scale and not always empirically robust, their findings did highlight the high frequency of sub-optimal use and some GDPs issuing antibiotics for non-clinical reasons such as the patient going on holiday or working off-shore. Again, these audits focussed more on improving prescribing accuracy and did not address the 'problem' of prescribing when not clinically indicated. This evidence demonstrated that inappropriate prescribing continues to occur, and it was informative for guiding the direction of this thesis by revealing these areas for further exploration.

1.7.5 Intervention Studies

A small number of interventions, particularly in the UK, have addressed the inappropriate use of antibiotics (Löffler & Böhmer 2017). These interventions used various strategies including audit and feedback, and an educational component have reported a reduction in inappropriate antibiotic prescribing of between 6% and 89%. However, Löffler & Böhmer (2017) concluded that the methodology lacked in information and the interventions were poorly described. Also, it is not clear how the interventions worked and its specific mechanism of change resulting in doubt that the intervention could be accurately replicated.

1.8 RATIONALE BEHIND THE RESEARCH

The evidence-based management of inappropriate prescribing could be viewed as a set of rules and procedures; however, as dentists do not work in isolation, this does not recognise the influence of the individual, i.e., dentist and patient, or the working environmental in the dental practice. The underlying reasons for using antibiotics are often reported to be external, in terms of appointment schedules and patients requesting antibiotics, or internal, in terms of the dentists not being motivated or unable to follow recommended practice, (Hulcher et al. 2010).

Therefore, management and treatment of dental infections is a complex system of inter-dependent influences, subsequently, consideration must be given to a decision-making process that results in the inappropriate use, (Tonkin-Crine et al. 2015). Decision-making is a cognitive process that can be automatic or reflective; a decision to either prescribe or not comes from the perceived risks and benefits to the individual or as in this example the perceived best outcome of the patient or clinician. Clinicians' views and experiences of using antibiotics are likely to influence prescribing behaviour, therefore it seems prudent to use behaviour change theories to investigate the beliefs driving decision of inappropriate prescribing behaviour. As inappropriate prescribing is likely to be influenced by perceived personal benefits versus potential risks to the patient, these barriers are potentially modifiable and can be targeted in an intervention.

Understanding the determinants of prescribing decisions can therefore be supported by using behaviour change theory to enable the identification of

influencing factors and to select behaviour change strategies more likely to optimise antibiotic use.

The focus of this thesis is therefore inappropriate prescribing decisions not only in the context of the dentist, but the relationship between dentist and patient, and which of their beliefs are likely to act either as a barrier or enabler for using antibiotics. Whilst the existence of the inappropriate use of antibiotics is well documented in published articles, they offer little understanding of the perceived benefits of prescribing antibiotics for non-clinical reasons. In an effort to improve dental antibiotic stewardship, key questions of why and when dentists are likely to prescribe when there is no clinical indication to do so still remains under explored.

The development of behaviour change interventions aiming to support healthcare professionals to routinely follow recommended best practice is acknowledged to be a major challenge, (Grimshaw et al. 2012). Therefore, this thesis draws upon the recent developments in the field of intervention design, where advances in the use of behaviour change theories to change healthcare professional have occurred (Colquhoun et al. 2017). Specifically, this research focuses on providing an evidence and empirical account of the beliefs influencing antibiotic prescribing behaviour that will ultimately inform the selection of the final intervention strategy, if one should be required. This approach to intervention research is still in its infancy, and this is the first known example of this approach that has been applied to dental prescribing behaviour.

1.9 Scope of this research

It is within the current framework of primary dental care in Scotland, that this research intends to focus on the inappropriate prescribing of antibiotics. Other factors related to the use of antibiotics (Section 1.6.1) and antimicrobial resistance are acknowledged (Section 1.4.3); however, were not included within the scope of this thesis.

1.10 Thesis aims

The overall aim of the research described in this thesis is to develop a theoretically-informed intervention to improve the antibiotic prescribing behaviour of dentists in primary care in Scotland. In order to achieve this the following objectives were set:

- Conduct a review of the published literature which has explored antibiotic prescribing in primary dental care, including both the prescription of antibiotics and the withholding of a prescription for antibiotics;
- Identify the beliefs of dentists that are associated with antibiotic prescribing (both prescribing and withholding prescription);
- Identify the association of cognitions identified from the Theoretical Domains Framework and the intention to manage patients' expectations that the dentist will prescribe antibiotics;
- Identify the perceived acceptability, format and possible content of an intervention to improve the antibiotic prescribing behaviour of dentists in primary care in Scotland.

The overarching aim of this thesis is to apply frameworks from behaviour change intervention design to investigate antibiotic prescribing behaviour. The research uses these frameworks to analyse the findings, and to underpin the development of an intervention aiming to 'improve' antibiotic prescribing behaviour of dentists in primary care. The reported variations in prescribing rates suggests that there is a 'room to improve' prescribing behaviour whereby reducing the quantity of antibiotics potentially used for non-clinical indications. Therefore, this thesis will take an improvement strategy that will be built upon the existing knowledge, if available, and further empirical studies that conduct a theoretically based analysis of beliefs likely to influence inappropriate prescribing behaviour.

It was hypothesised that GDPs are likely to prescribe antibiotics for dental and periodontal infections despite no clear clinical benefits to patients as a way of managing non-clinical factors. The specific objectives of this thesis were to first establish the existence of these non-clinical factors, to understand the determinants of prescribing decisions and to identify potential targets for change. And finally, to invite dentists to co-produce the operationalisation of behaviour change strategies in the proposed intervention.

This thesis has 3 key research questions:

(1) What clinical and non-clinical factors influence prescribing decisions including inappropriate prescribing?

(2) What salient barriers and enablers underlying these factors influence inappropriate prescribing behaviour?

(3) What behaviour change techniques and mode(s) of delivery should be applied to 'improve' prescribing behaviour?

It is anticipated that the outcome will be a theoretically informed intervention which can be recommended as one that could feasibly be delivered in primary dental care and in a format that is acceptable to GDPs.

1.11 Content of Thesis Chapters

In the next chapter, there is a detailed description of the intervention development methodology applied in the following research and the methods to be used to collect the required empirical evidence. The following chapter reports the literature reviews: (1) factors influencing prescribing and beliefs mapped to the TDF and (2) past interventions aiming to improve antibiotic prescribing behaviour (Chapter 3) and three empirical studies and one experimental study (Chapters 4, 5 and 6).

The design of the intervention and its development including the theoretically mapping of the empirical findings to determine the potential components of the intervention, the involvement of general dental practitioners to check the acceptance and feasibility of the proposed components and their mode(s) of delivery is presented in Chapter 7 and 8. The thesis concludes with the discussion and conclusions in Chapter 9.

1.12 Thesis Funding

The initial concept of this research came from Professor Jan Clarkson and Dr Debbie Bonetti (PhD Supervisors) as a proposal to the Health Foundation for an Improvement Science PhD Fellowship.

1.13 Summary of Chapter

This first chapter has introduced that despite the publication of national guidance and past interventions, some GDPs continue to inappropriately prescribe antibiotics. In conclusion, the following research needs to consider all possible antecedents of prescribing decisions and to identify what needs to change to improve antibiotic prescribing behaviour by dentists in primary care. The next chapter describes the theoretical methodology taken in this thesis to develop the proposed intervention.

CHAPTER 2 - A THEORETICAL APPROACH TO INTERVENTION DEVELOPMENT

OUTLINE OF CHAPTER

This chapter provides a background to the use of theory in designing interventions and it outlines the framework and process used to develop this intervention. It also describes the philosophical framework underpinning the research and the methodological justification for each stage of the development process.

2.1 CHANGING CLINICAL BEHAVIOUR USING THEORY

As changing behaviour is key to addressing inappropriate prescribing, it seems pragmatic that the design of an intervention, aiming to change behaviour, can be enhanced by applying theories of behaviour change (Grol et al. 2007).

There is a wide range of behaviour change theories and models available for increasing our understanding of the influences of clinical behaviour. A recent narrative review of theories, models and frameworks applied in implementation science research identified five, often overlapping categories (Nilsen, 2015). This review included the category of classic theories which came from other research disciplines such as psychology and sociology, whilst implementation theories were new or adapted from existing theories. A key proposal of social cognitive theories taken from psychology is that health care professionals' behaviour, such as that of dentists, could be explained by a cognitive approach to understand their decision-making. A systemically conducted review of 78 studies aiming to understand factors influencing healthcare professional behaviour based on social cognitive theories

found that the Theory of Planned Behaviour (TPB) was an appropriate theory to predict behaviour change (Ajzen, 1991).

The TPB proposes a model of the relationship between the constructs of beliefs, attitudes and intention to explain the intention to perform a behaviour, (Ajzen, 1991). Bonetti et al's studies explored the determinants of dental clinical behaviour identified the constructs of attitude, perceived behavioural control (PBC) and subjective norms from the TPB as likely predictors of intention to perform two clinical behaviours, i.e., take a radiograph (Bonetti et al. 2006) and place a fissure sealant (Bonetti et al. 2010). The TPB posits that any individual is more likely to engage in a clinical behaviour if they positively value it (attitude), perceive it to be easy (PBC) or if significant others endorse it (subjective norms).

Over the last 10 to 15 years, intervention studies aiming to achieve greater evidence based practice (EPB) by reducing the gap between EBP and current practice has resulted in varying terms to describe these efforts, (Grimshaw et al. 2012). Research studies designing interventions fall into the field known as knowledge-into-action (KTA). Within the KTA process, some of the common terms applied and often mis-used include 'knowledge translation, knowledge transfer, knowledge exchange, research utilization, implementation, dissemination and diffusion', (Graham et al. 2006, p. 14).

Of all these descriptions, interventions based on theory are more often described as implementation interventions within the field of implementation science research. Implementation science was defined by Eccles and Mittman (2006) as the 'scientific study of methods to promote the systematic uptake of research findings

and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services. It includes the study of influences on healthcare professional and organizational behaviour".

Behavioural science research considers the behaviour 'problem' as the starting point of the developing an intervention, for examples who needs to what differently (Bussières et al. 2014; Michie et al. 2011b). The premise underlying this type of research is that different determinants or influences may act as either barriers or enablers to performing the behaviour. This directs the research design to whether a qualitative, quantitative or mixed methods approach of data collection is required to identify the 'problem'. The nature of intervention development research suggests that mixed methods is particularly suited as it provides a practical way to understand different perspectives, different explanations for practice and multiply outcomes (Peters et al. 2013).

Indeed, a Cochrane review of 32 studies found that tailored implementation interventions were more effective, although their effects tend to be small to moderate (Baker et al. 2015). The authors of this review concluded that it is not yet clear how best to tailor interventions and what is the potential effect of an optimally tailored intervention.

Research studies that develop and apply interventions to changing professional clinical behaviour has been an area that has received more attention in recent years (French et al. 2012). Yet, this research has not always been underpinned by theory as was demonstrated in a systematic review of guideline implementation studies by Davies et al. (2010, p.1), who concluded that 'there was poor justification of

choice of intervention and the use of theory in the identified studies until at least 1998'.

The reason that some intervention developers do not use a theoretical underpinning may be that they are unaware or have difficulty choosing from among the many conceptual models available, (Lipworth et al. 2013; Davidoff et al. 2015; Grol et al. 2008).

For example, in the development of the Theoretical Domains Framework a total of 33 behaviour change conceptual models including social cognitive theory, theory of planned behaviour, and theory of reasoned behaviour, health belief model and organisation culture change models were selected as having known success at changing health professional behaviour (Francis et al. 2012; French et al. 2012; Michie et al. 2005). These theories and models often contain different, similar or overlapping 128 explanatory constructs which could add to further confusion about which is the 'best' one to select, (Michie et al. 2005). However, there is no systematic basis for determining which theory is best for underpinning an intervention. This is likely to make the task of selection very daunting for those less knowledgeable about behaviour change theories (French et al. 2012; Michie et al. 2008).

2.2 Approach to developing the intervention

The next section outlines the rationale for the selection and application of the theoretical framework and process underpinning this thesis, an overview of the

philosophical and methodological design approach taken, and the research methods applied in the later studies.

2.2.1 Theoretical Domains Framework

This acknowledged issue of selecting the most appropriate theory from the multiply behaviour change theories was addressed with the development of the TDF, (Michie et al. 2005). The TDF originated from the integration of all the known constructs within behavioural change and organisational theories by a group of theorists, researchers and health psychologists. The purpose was to develop a simplified framework of all constructs in theories for use by health psychologists and other research disciplines. The TDF comprehensively supports the identification of likely barriers and enablers to target for changing behaviour.

The result was an initial 12 domain framework (Michie et al. 2005) that was later revised and validated into 14 TDF domains (Cane et al. 2012). The 12 domain TDF (v1) integrates 128 theoretical constructs from 33 theories whereas the 14 domain TDF (v2) includes 84 theoretical constructs. For 11 of the TDF domains, no changes occur across the versions, however, in the 2nd version motivation and goals domain was 'separated' into 2 domains of goals and intentions. Also, the nature of behaviour domain was omitted as it was considered to be an outcome or dependent variable rather than a determinant (or independent variable) of behaviour in TDF (v2), (Cane et al. 2012).

The TDF (v2) consists of the following 14 domains: skills, knowledge, social/professional role and identity, environmental context and resources, social influences, memory, attention and decision processes, beliefs about capabilities,

beliefs about consequences, goals, intentions, optimism, reinforcement, emotion and behaviour regulation, (Cane et al. 2012). A summary of the domain definitions and their theoretical constructs is shown in Table 2.1.

Table 2.1 Definitions and Constructs of the Theoretical Domains Framework (v2) (taken and adapted from Atkins et al. 2017; Cane et al. 2012)

Domain (definition)	**Constructs (Behaviour Change Theory)**
1. Knowledge (An awareness of the existence of something)	Knowledge (including knowledge of condition/scientific rationale); Procedural knowledge; Knowledge of task environment
2. Skills (An ability or proficiency acquired through practice)	Skills; Skills development; Competence; Ability; Interpersonal skills; Practice; Skill assessment
3. Social/professional role and identity (A coherent set of behaviours and displayed personal qualities of an individual in a social or work setting)	Professional identity; Professional role; Social identity; Identity; Professional boundaries; Professional confidence; Group identity; Leadership; Organisational commitment
4. Beliefs about capabilities (Acceptance of the truth, reality or validity about an ability, talent or facility that a person can put to constructive use)	Self-confidence; Perceived competence; Self-efficacy; Perceived behavioural control; Beliefs; Self-esteem; Empowerment; Professional confidence
5. Optimism (The confidence that things will happen for the best or that desired goals will be attained)	Optimism; Pessimism; Unrealistic optimism; Identity
6. Beliefs about consequences (Acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation)	Beliefs; Outcome expectancies; Characteristics of outcome expectancies; Anticipated regret; Consequents
7. Reinforcement (Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus)	Rewards (proximal/distal, valued/not valued, probable/improbable); Incentives; Punishment; Consequents Reinforcement; Contingencies Sanctions
8. Intentions (A conscious decision to perform a behaviour or a resolve to act in a certain way)	Stability of intentions; Stages of change model; Trans theoretical model and stages of change
9. Goals (Mental representations of outcomes or end states that an individual wants to achieve)	Goals (distal/proximal); Goal priority Goal/target setting; Goals (autonomous/controlled); Action planning Implementation intention
10. Memory, attention and decision processes	Memory; Attention; Attention control Decision making;

Domain (definition)	Constructs (Behaviour Change Theory)
(The ability to retain information, focus selectively on aspects of the environment and choose between two or more alternatives)	Cognitive overload/tiredness
11. Environmental context and resources (Any circumstance of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence and adaptive behaviour)	Environmental stressors; Resources/material resources; Organisational culture/climate; Salient events/critical incidents; Person × environment interaction; Barriers and facilitators
12. Social influences (Those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours)	Social pressure; Social norms; Group conformity; Social comparisons; Group norms; Social support; Power; Intergroup conflict; Alienation; Group identity; Modelling
13. Emotion (A complex reaction pattern, involving experiential, behavioural, and physiological elements, by which the individual attempts to deal with a personally significant matter or event)	Fear; Anxiety; Affect; Stress; Depression; Positive/negative affect Burn-out
14. Behavioural regulation (Anything aimed at managing or changing objectively observed or measured actions)	Self-monitoring; Breaking habit; Action planning;

These domains are described as the potential barriers or enablers of the targeted behaviour so become the 'mechanism of change' that underpin the potential behaviour change techniques to be used in the intervention. Since its inception in 2005, there have been an exponential growth in the use of the TDF to underpin the design of intervention design studies, (Atkins et al. 2017; Francis et al. 2012). The TDF is now a widely-used tool to comprehensively explore for beliefs associated with a clinician's decision making and it also supports a theoretical underpinning to intervention design as advocated by the UK Medical Research Council (Craig et al. 2008; Campbell et al. 2007).

The TDF has been successfully used to assess and inform intervention development which aims to improve evidence based practise in a variety of healthcare settings. The TDF has been successfully applied in dental clinical settings (Newlands et al. 2016; Gnich et al. 2015; Elouafkaoui et al. 2015; Bonetti et al. 2014) and used for a variety of clinical behaviours including drug prescribing (Sargent et al. 2017; Lawton et al. 2016; Duncan et al. 2012). Both TDFv1 and TDFv2 continue to be used to design questionnaires and, focus group and interview question schedules, (Francis et al. 2012).

2.2.2 Behaviour Change Wheel

Many different develop improvement models and procedures offer support to researchers who are developing a theory-based intervention, (Grol et al. 2008; Davies et al. 2010). One example is the Behaviour Change Wheel, (Michie et al. 2011a) which was developed from a synthesis of 19 behaviour change frameworks which the authors considered unlikely to be individually comprehensive and conceptually clearly defined. Michie, Atkins & West described the BCW as consisting of "*three layers"*, with the source of the behaviour identified in the hub of the wheel. Surrounding the hub is a *"layer of nine intervention functions"* to select from depending on the behavioural analysis. The outer rim of the wheel identifies *"seven types of policy"* that one can use to deliver these intervention functions (2014, p.17). The TDF fits into first stage of the Behaviour Change Wheel as shown in yellow in Figure 2.1. The 3-stage BCW recommends that the problems associated with the target behaviour are first defined in behaviour terms using the TDF, described as the behaviour analysis.

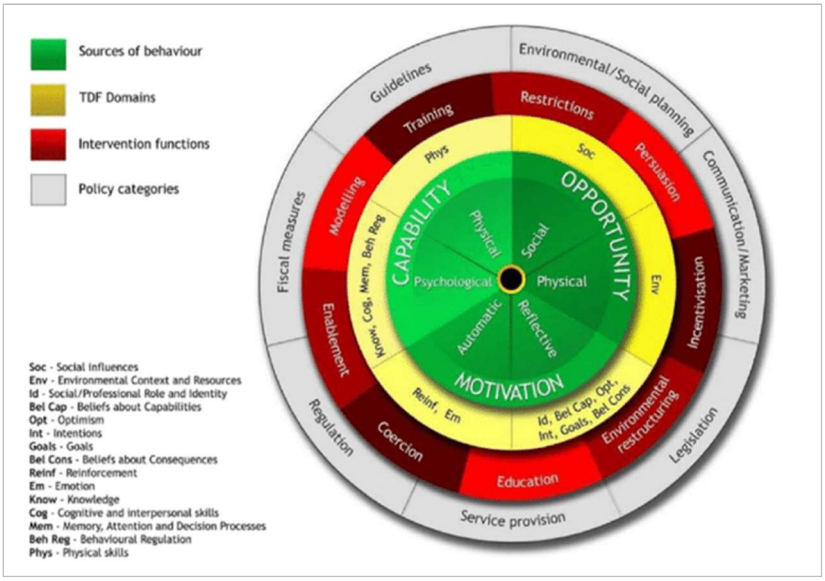

Figure 2.1 The Behaviour Change wheel (Retrieved from "Michie S, Atkins L, West R. (2014) The Behaviour Change Wheel: A Guide to Designing Interventions)

2.2.3 Behaviour Change Techniques

An 'implementation intervention' clearly distinguishes the component parts within an intervention as behaviour change techniques, (Presseau et al. 2015; Michie et al. 2011b). A behaviour change technique (BCT) is defined as "an observable, replicable, and irreducible component of an intervention designed to alter or redirect causal processes that regulate behaviour; that is, a technique is proposed to be an 'active ingredient' (Presseau et al. 2015 p. 23). The BCTs have a pivotal role in the hypothesised causal pathway of changing behaviour (Michie et al. 2008; Michie and Abraham, 2004) as it targets the behavioural determinants likely to influence an increase or reduction in the performance of the behaviour. Behaviour change theory supports the identification of the relevant behavioural determinants and offers an explanation of how the active ingredients in a BCT are likely to be effective in bringing about the desired behaviour change, (Michie et al. 2013).

Guidance on how to select the more appropriate BCTs is provided by using a behaviour change taxonomy, (Michie et al. 2013; Abraham & Michie. 2008) as part of the BCW. Within the taxonomy, 93 discrete behaviour change techniques are described, each with details on how they can be used, for example, the 'problem solving' within the category label of goals and planning.

Application of this type of process of intervention development provides a systematic and comprehensive approach to investigating and identifying the potential BCTs components of the intervention which are most likely to be effective by using theoretical evidence. The BCW supports the relationship pathway between determinants, BCTs and behavioural outcomes by first understanding the targeted behaviour, then identifying the potential intervention strategies and finally it provides an understanding or explanation of what influences behavioural outcomes. Figure 2.2 illustrates the process of behaviour change intervention design using the BCW.

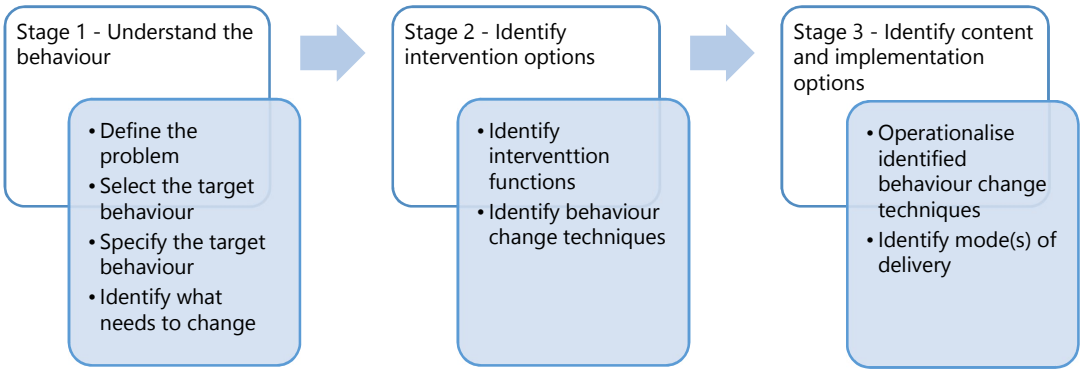

Figure 2.2. Behaviour Change intervention Design Process (Adapted from "Michie S, Atkins L, West R. (2014) The Behaviour Change Wheel: A Guide to Designing Interventions)

2.3 Research Design

Central to the original research outlined in this PhD is the TDF, (Cane et al. 2012; Michie et al. 2008) and BCTTv1 (Michie et al. 2013). This research draws upon the BCW to support the process of linking the determinants of using antibiotics with intervention components most likely to be effective in changing dentists' prescribing behaviour, (Michie et al. 2011a). It applies the TDF with 14 domains (v2) (Cane et al. 2012).

2.4 Philosophical Framework

Before commencing any research, its philosophical framework or research paradigm should be considered. Kuhn (1962) defined paradigm as "the set of common beliefs and agreements shared between scientists about how problems should be understood and addressed". Research paradigms are characterised by their ontology (What is reality?), epistemology (How do we gain knowledge?) and methodology (How do we find out about the reality and knowledge?), (Guba, 1990). The ontological and epistemological stance taken by the researcher determines whether a quantitative or/and qualitative methodology is applied in the study.

2.4.1 Methodology

This thesis adopted an epistemological stance that is best described as pragmatic using a mixed methods methodology. A mixed methods approach is defined as the "class of research where the researcher mixes or combines quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study", (Johnston and Onwuegbuzie, 2004, p. 17.) Mixed methods should not

be perceived as only a combination of qualitative and quantitative together but rather a new distinct approach, (Creswell et al. 2012). This design uses methods to collect, mix and analyse both qualitative and quantitative data in a single study, (Tashakkori et al. 2003).

The rationale for using this design is that alone neither qualitative nor quantitative data would sufficiently explore and understand the 'problem' under investigation. This pragmatic approach of understanding the 'problem' by first identifying what is likely to influence performing the behaviour is advocated by many leading intervention implementation scientists (Steinmo et al. 2016). For the purposes of developing an intervention in the 'real world' primary care setting, this pragmatic approach would seem to be appropriate.

2.4.2 Method - Qualitative

As previously described, it is likely that the empirical studies will take both qualitative and quantitative approaches to collect data as part of the behaviour analysis. As this study is investigating the prescribing decisions of GDPs an initial qualitative approach using interviews was considered to be the most appropriate as the research questions asks about 'when' antibiotic prescribing decisions are made and 'what' influences these decisions.

The value of using of a qualitative approach is to gain an insight into dental practitioners' preferences, beliefs and attitudes towards antibiotic prescribing and also to explore their prescribing behaviour in everyday practice. A qualitative approach assists in understanding the unexplained mechanism of a particular

behaviour and could help in explaining why there is a variation in the uptake of evidence-based practice (Pope et al. 2002).

There are various approaches available when conducting qualitative analysis. Broadly, all qualitative methods fundamentally adopt one of two approaches: (1) a deductive approach which is concerned with testing a hypothesis against a theory i.e. Grounded theory (Glaser, 1992) or (2) an inductive approach which is theory free i.e. thematic analysis (Braun and Clarke, 2006).

Given the explorative nature of this study and the application of the TDF, both a deductive and an inductive approach was adopted. It used a framework analysis matrix, (Gale et al. 2013; Ritchie & Lewis 2003; Ritchie & Spencer 1994) to collate and organise the responses under key factors. In the first deductive step, the responses were coded into the TDF domains and in the second inductive step used a directed content analysis (Hsieh, 2005) was used to identify their specific beliefs of the TDF domains and frequency. This approach facilitated the identification of TDF domains which are relevant in a GDPs' prescribing decisions and to elicit the salient specific beliefs of prescribing behaviour.

Qualitative research has become more popular in dental related research in recent years. In 2010, a review of the dental research literature found 43 articles had used a qualitative method (Masood et al. 2011). This review concluded that the quality of qualitative dental research was mediocre particularly for its methodological rigour and little reporting details or not appropriate method to answer the research question (Masood et al. 2011). Consequently, this study will clearly demonstrate rigour and robust processes by reporting the following criteria: validity, reliability,

transparency and reflectivity which are essential in high quality qualitative research. This thesis also clearly reports the important elements of qualitative research as advocated by the consolidated criteria for reporting qualitative research (COREQ) 32-item check list (Tong et al. 2007).

2.4.2.1 Concept of Saturation

The total number of interviews to be conducted is often determined when saturation was reached. Saturation was defined as the point when a 'mark of sampling adequacy' (O'Reilly & Parker, 2013) was obtained, thereby the collection of new data does not shed any further insight (Morse, 2000). On the basis of this definition it is not possible to state a number of interviews required in advance. Although guided by the evidence in the published literature, a number between 10 and 15 interviews is anticipated to meet the saturation criterion for this topic (Francis et al. 2010).

2.4.3 Method - Quantitative

A later quantitative based inquiry is anticipated to measure the salience of the barriers and enablers of prescribing decisions using surveys. For the purposes of this research, the format of the survey will be as a fillable pdf attachment in emails. This method facilitates targeting all primary dentists in Scotland at the lowest cost and within a reasonable time scale. Further details of the survey development is outlined later in Chapter 5, Section 5.3.2, and Page 107.

2.5 THE PROCESS OF BEHAVIOUR CHANGE INTERVENTION DEVELOPMENT

Following the counsel of taking a theoretical and systematic approach to designing an intervention, (French et al. 2012; Eccles et al. 2005; Craig et al. 2008), this research will follow a series of stages whereby the outcome of each stage will guide the next stage to eventually identify the theoretically-based components of the intervention. The development of the intervention will follow these 3 phases:

2.5.1 Literature Reviews

The generation of an evidence base from relevant and recently published literature. The objective is to identify the specific beliefs that are likely to determine antibiotic prescribing decisions. The collected evidence base will include literature reviews on the factors influencing prescribing decisions and the change strategies of past dental antibiotic prescribing behaviour intervention conducted in the UK. This will provide a basis for what further evidence is considered to be necessary to develop the intervention.

2.5.2 Empirical studies

Behaviour Analysis of the 'Problem' [BCW Stage 1].

The second phase is to understand the behaviour to be targeted in the intervention. As prescribing decisions have two behaviour outcomes: prescribing or not prescribing both require explorations as the influencing barriers and enablers may be different. This analysis will use the TDF to identify the likely barriers and enablers of antibiotic prescribing decisions.

2.5.3 Development of the intervention

2.5.3.1 Theoretical Mapping [BCW Stage 2]

In this development phase, a mapping exercise using the Behaviour Change Wheel framework (Michie et al. 2008) will support the translation of the results of the behaviour analysis (empirical studies) into behaviour change techniques (BCTs) and the mode(s) of delivery that are most likely to be effective in changing the targeted behaviour outcome.

2.5.3.2 Operationalisation of the behaviour change techniques [BCW Stage 3]

Whilst theory based intervention primarily takes a 'bottom-up' approach to conducting the behaviour analysis, (Lorencatto et al. 2018), this part of the intervention's development intends to also use a 'top down' approach in the later stages by involving GDPs in the operationalisation of the BCTs. The identified BCTs and the mode(s) of delivery will be presented in a workshop to dentists who will be asked to assist with the operationalisation of the BCTS and their preferred mode(s) of delivery.

2.5.3.3 Final content of proposed intervention

Based on the feedback from dentists, the content of the intervention will be refined and edited to produce a final recommended intervention. The phases and their associated purpose and chapter of developing the intervention is shown in Table 2.1.

Table 2.2 An overview of the thesis structure with the purpose, phases and theory of the intervention development

Structure of Thesis									
Chapter	Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5	Chapter 6	Chapter 7	Chapter 8	Chapter 9
Purpose	Introduction: Outline of Problem	Design and development of an evidence and theory informed intervention	Review of factors influencing prescribing decisions, barriers of appropriate prescribing and past interventions aiming to improve prescribing behaviour	Explore factors influencing prescribing decisions	Measure perceived patient expectations in the wider population	Measure antibiotic expectations of general population	Links barriers and enablers to BCTs	Refine and modify to finalise content of final intervention	Discussion and conclusions
Phases			[1] Evidence from the literature	[2] Empirical studies			[3] Theoretical Mapping and Co-Production of proposed intervention		
Use of Theory			Theoretical Domains Framework and Behaviour Change Technique Taxonomy guided by the Behaviour Change Wheel						

2.6 Ethical approvals

Ethical review was sought from the East of Scotland Research Ethics Service in August 2014. The Tayside Medical Science Centre (TASC) confirmed that a full ethical review was not required. TASC facilitated NHS R & D approvals from NHS Fife and NHS Tayside for GDP interviews and an amendment to include a patient survey. The University of Dundee ethics committee also approved the thesis research (UREC15030) and the School's ethics committee approved the amendment of including a patient survey (Ref 2016030). Copies of the ethical approval letters are available in Appendices 1 - 3, Pages 250 - 253.

2.7 Summary of Chapter

This chapter has provided an overview of the rationale for the intended phased methodological approach and process to be followed to develop this implementation intervention. It has considered the importance of first using existing and newly required evidence to carry out an initial behavioural analysis of the problem before deciding on the potential components of the intervention.

The next part of the thesis will be a review of the literature to identify what evidence has been already published on the subject. The literature review divided in two, the first focuses on the factors influencing antibiotic prescribing decisions and existing evidence of theoretical domains and the second profiles the past interventions aiming to improve antibiotic prescribing.

CHAPTER 3 - LITERATURE REVIEW

OUTLINE OF CHAPTER

This chapter describes the search strategy and the results from a literature review that profiled studies reporting the use of antibiotics in primary dental care in the UK. Evidence from the review articles was extracted including: (1) Factors influencing inappropriate antibiotic prescribing decisions, (2) Reported dentists' beliefs and mapping these on to TDF domains and (3) Interventions used in past studies aiming to optimise dental antibiotic prescribing. It closes with an explanation of how this evidence will be used in the development of the empirical studies of this thesis.

3.1 INTRODUCTION

This review sought to explore antibiotic prescribing in primary dental care, including both the prescription, and the withholding of a prescription for antibiotics. The overall aim of this review was to provide an evidence base platform for the studies. The objectives were:

(1) To identify factors previously identified as possibly influencing GDPs antibiotic prescribing decision making;

(2) To map identify beliefs onto the TDF and connect review results with the theoretical unpinning of the empirical research;

(3) To identify elements of previous interventions targeting antibiotic prescribing behaviour which may be useful for future intervention design;

(4) To direct the future focus of the research by improving the understanding of potential gaps in the evidence that are likely to require further exploration.

3.2 METHODS

3.2.1 Search Strategy

The following databases were searched for articles on dental antibiotic prescribing: Cochrane Library, NICE Evidence, and PubMed including Medline and OvidSP, and Google and Google Scholar for grey literature. The electronic search was first performed in January 2014 and then updated in January 2018. The search was limited to studies published since 2000 which only related to the UK. The initial searches included keywords such as 'antibiotic', 'prescribing', 'antimicrobials' and 'dentists'. Further details of keywords included are illustrated by a screenshot of the initial search in Figure 3.1.

History Download history Clear history

Search	Add to builder	Query	Items found	Time
#15	Add	Search **(((((dent*[Title/Abstract]) AND prescribing[Title/Abstract])) AND antibiotic*[Title/Abstract])) AND UK**	32	06:05:02
#10	Add	Search **(((dent*[Title/Abstract]) AND prescribing[Title/Abstract])) AND antibiotic*[Title/Abstract]**	121	06:03:54
#14	Add	Search **(((antibiotics[Title/Abstract]) AND ((dent*[Title/Abstract]) AND prescribing[Title/Abstract]))) AND UK[Title/Abstract]**	7	06:03:06
#5	Add	Search **(antibiotics[Title/Abstract]) AND ((dent*[Title/Abstract]) AND prescribing[Title/Abstract])**	105	06:02:33
#13	Add	Search **(((((dent*[Title/Abstract]) AND prescribing[Title/Abstract])) AND antibiotic*[Title/Abstract])) AND antimicrobials[Title/Abstract]**	6	06:01:27
#12	Add	Search **((antibiotic*[Title/Abstract]) AND antimicrobial*[Title/Abstract]) AND ((dent*[Title/Abstract]) AND prescribing[Title/Abstract])**	20	05:59:05
#11	Add	Search **(((((dent*[Title/Abstract]) AND prescribing[Title/Abstract])) AND antibiotic*[Title/Abstract])) AND antimicrobial*[Title/Abstract]**	20	05:57:56
#9	Add	Search **antibiotic*[Title/Abstract]**	224623	05:56:55
#8	Add	Search **(antimicrobial*[Title/Abstract]) AND ((antibiotics[Title/Abstract]) AND ((dent*[Title/Abstract]) AND prescribing[Title/Abstract]))**	18	05:55:18
#7	Add	Search **antimicrobial*[Title/Abstract]**	89232	05:54:57
#4	Add	Search **(dent*[Title/Abstract]) AND prescribing[Title/Abstract]**	426	05:52:36
#3	Add	Search **prescribing[Title/Abstract]**	25699	05:52:03
#2	Add	Search **dent*[Title/Abstract]**	243021	05:51:32
#1	Add	Search **(dent*[Title/Abstract]) AND antibiotic*[Title/Abstract]**	2859	05:49:49

Figure 3.1 Screenshot of search in PubMed database (accessed in January 2014)

3.2.2 Study selection

The articles included in the review were screened using the following process:

(1) Articles with titles that were clearly irrelevant, i.e. included animals, were omitted;

(2) Duplicate articles were removed;

(3) Abstracts were read and excluded if the topic of interest was not covered;

(4) Full article texts were then retrieved.

Endnote, a standard software tool, was used to manage and compile a library of the relevant articles. After the articles were retrieved and read, all relevant article data was collated into a matrix using Excel for examination.

Locating the relevant papers was often problematic due to the nature of the topic being searched. Papers could be found either in specialist journals for the dental profession or healthcare professional behaviour change intervention involving dentists. Because of this, the references cited in the systematically sourced articles were also hand-searched. The references in these articles were again hand-searched and cross-referenced to maximise the number of relevant papers in the reviews. Further details of full search history of the databases is provided in Appendix 4, Page 255.

3.3 Study Details

An initial thirty-two relevant articles were identified in the database searches in 2014. During the next 3-year period, using automatic email alerts of any new results from the initial searches, resulted in a further 8 articles being added and hand

searched again. Many of the studies related to secondary care dentists, but also to doctors and nurses in medical settings. A limited number of studies were found that included or solely focussed on antibiotic prescribing in primary dental care. After screening, 22 dental antibiotic prescribing articles were identified as being relevant for the proposed 3 literature reviews. A flow chart of the literature search is shown in Figure 3.2.

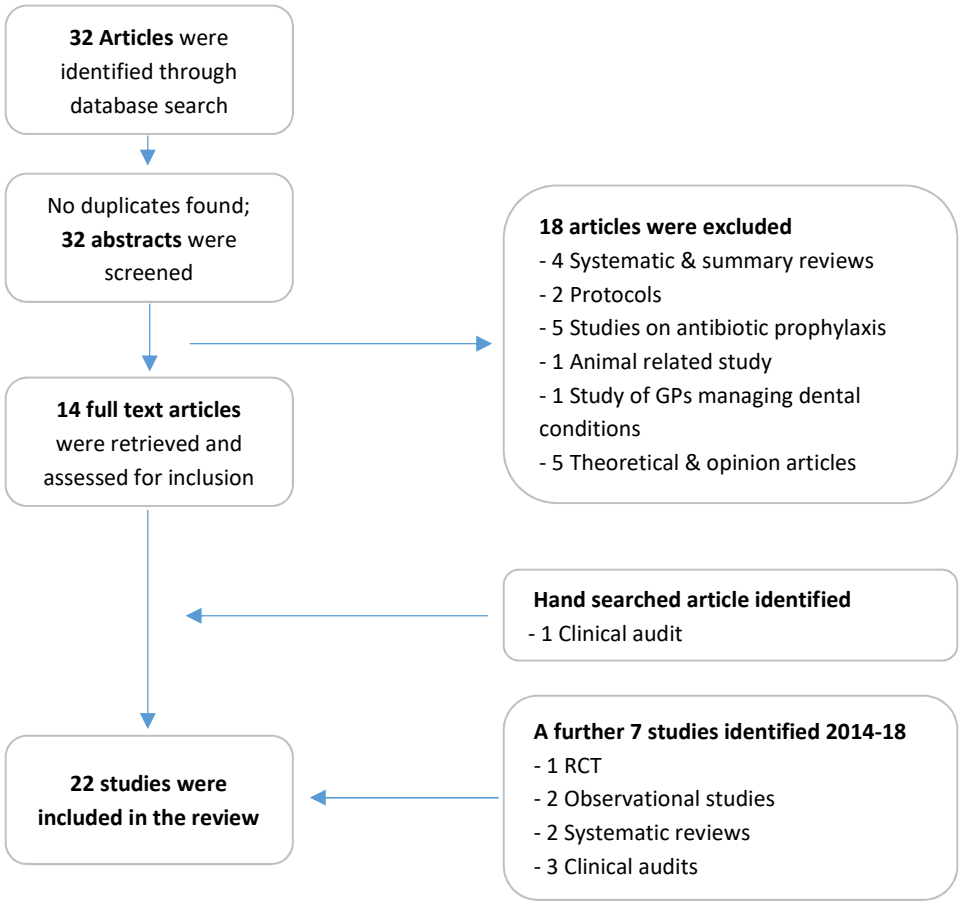

Figure 3.2 Flow chart of literature search (first conducted in January 2014, updated in 2018)

The 22 reviewed studies were:

- **2 Randomised control trial studies** - Elouafkaoui et al. 2016 (P); Seager et al. 2006 (P)

- **12 Observational studies i**ncluding:
    - 5 Prescribing database analysis studies - Karki et al. 2011 (P); Tulip et al. 2008 (S); Palmer et al. 2001d (not reported); Anderson et al. 2000 (P&S); Roy et al. 2000 (P).
    - 5 Cross-sectional study - Cope et al. 2016 (C); Harte et al. 2005 (C); Dailey et al. 2001 (P); Palmer et al. 2000b (P); Palmer et al. 2000e (P).
    - 2 Interview studies - Newlands et al. 2016 (P); Palmer et al. 2002a (P&S).
- **5 Clinical audits** - Cope et al. 2016 (P); Zahabiyon et al. 2015 (C); Chopra et al. 2014 (S); Chate et al. 2006 (P); Palmer et al. 2001c (P).
- **3 Systematic reviews** - Löffler & Böhmer 2017; Cope et al. 2014; Dar-Odeh et al. 2010.

(P denotes primary care, C is community and S is secondary care)

3.4 Review Results

The next section reports the findings of the reviews separately. Each review utilised the same or differing sources from the published research and grey literature. Within the review, it was acknowledged that inappropriate prescribing is not only a concern in dentistry but also in medicine, therefore other relevant articles from medicine were also included.

3.5 Review 1: Factors Influencing Inappropriate Prescribing Decisions

Evidence of the clinical and non-clinical factors influencing inappropriate prescribing decisions was reported in 11 studies: one interview study (Newlands et al. 2016), 3 cross-sectional survey studies (Cope et al. 2016; Dailey et al. 2006; Palmer et al. 2000e), 2 prescribing data studies (Tulip et al. 2008; Roy et al. 2000), 3 systematic reviews (Löffler & Böhmer 2017; Cope et al. 2014; Dar Odeh et al. 2010;) and in 2 clinical audits (Seager et al. 2006; Chate et al. 2006). Only 6 of these studies were conducted with GDPs in a primary care setting.

3.5.1 Clinical factors

The most likely current inappropriate use of antibiotics for specific dental infections is revealed in a recent article published in 2016 by Cope et al. This cross-sectional study in Wales found that 42 GDPs were prescribing for pulpitis (reversible (5.6%); irreversible pulpitis (19.4%), apical periodontitis (15.8%), apical abscess (acute: systemic involvement (6%) and no systemic involvement (13.7%), and chronic (12.3%)), acute periodontal conditions (13.9%), pericoronitis (12.7%) and cyst (0.5%). This study reported that only in 19% of cases was an antibiotic used as recommended by clinical guidelines.

This Welsh study also identified that GDPs were 3 times more likely to prescribe for cases of acute periodontal conditions despite no indications other than patients with irreversible pulpitis. A similar pattern of using an antibiotic more often to manage these infections is also evidenced in other studies (Tulip et al. 2008; Dailey et al. 2001).

In some cases, an antibiotic is prescribed when no definite diagnosis is documented or when there is uncertainty over the correct diagnosis (Chate et al. 2006; Dailey et al. 2001; Palmer et al. 2000e). One of these clinical audits reported 8% of inappropriate antibiotic prescriptions were due to diagnostic uncertainty and even if the dentist carries out the surgical treatment they may also prescribe despite one not being indicated in case of concerns or the patient is going on holiday. In another audit, nearly half of dentists (n = 891) reported that they were likely to prescribe if uncertain about the correct diagnosis (Palmer et al. 2000a).

A systematic review from the Cochrane Library considered prescribing for specific conditions, i.e. apical periodontitis and acute apical abscess (Cope et al. 2014). However, the authors concluded that the quality of the evidence is judged to be very low so insufficient to determine the effects of antibiotic in these conditions. Further empirical evidence comes from clinical questionnaire studies (Cope et al. 2016; Dailey et al. 2001; Palmer et al. 2000e), clinical audits (Chate et al. 2006; Roy et al. 2000) and a qualitative study (Newlands et al. 2016).

The reported level of inappropriate prescribing in primary care ranged from 37.2% to 71% (Cope et al. 2016; Chate et al. 2006). Cope et al's cross-sectional study of the management of dental infections reported 1,944/5,226 of antibiotics were prescribed in the absence of systemic involvement and spreading infection, i.e. not following clinical guidance. Whereas Palmer's earlier study concluded that there were wide variations and sub-optimal therapeutic prescribing occurring in general dental practice.

Results from the clinical audit with an educational intervention reported that within the 6-week audit period 71% of prescriptions (n = 2,090) were inappropriate, as determined by the Faculty of General Dental Practitioners, UK (FGDP) guidelines; however, 20% of appropriate prescription (n = 861) contained errors in dose, frequency and duration of use (Chate et al. 2006). After an educational component, it was concluded that 29% of prescriptions were justifiable post audit, as compared to 48% during the audit period. This study highlighted that local audit protocols did not allow assessment of whether the choice of antibiotic followed published guideline was justifiable, and the authors noted some caution in significance with a small sample size. Other studies did not quantify inappropriate prescribing but referred to its existence (Elouafkaoui et al. 2016; Cope et al. 2014; Dar-Odeh et al. 2010; Dailey & Martin 2001).

In these studies, the criteria used to determine inappropriate prescribing varied but usually included all or some of the specific antibiotic prescribed, its dose, frequency, and duration, clinical conditions, reasons for prescribing and patient's medical history. Therefore, assessing the amount of inappropriate use of antibiotics is challenging because any comparisons between studies is likely to be ineffective as its definitions vary across both guidelines and time.

In contrast, an interview studies found that GDPs viewed the use of antibiotics to have improved in the last 20 years as a result of the publication of guidelines and a greater public awareness of antimicrobial resistance (Newlands et al. 2016). However, Dar-Odeh's review in 2010 concluded that the over prescribing of antibiotics was from a lack of awareness of guidelines.

In the last nearly 20 years, evidence that dentists sometimes prescribe inappropriately when there is no clinical indication has been demonstrated or discussed in a small number of research studies and review articles. This uncertainty over the diagnosis and concerns of potential complication arising from conducting surgical treatment are often associated with inappropriate prescribing. This suggests that these clinical indications are likely to influence unnecessary prescribing decisions, although, it is unlikely that either the type of dental infection or diagnostic uncertainty are the sole factors influencing GDPs' decision to use an antibiotic.

3.5.2 Non-clinical factors

In the dental literature, it is acknowledged that many factors may influence prescribing decisions in addition to clinical indications. Understanding prescribing decisions is complex as these non-clinical factors are just as likely to influence GDPs' prescribing behaviour, including the GDPs' own views (Newlands et al. 2016). Other studies have demonstrated influence from environmental factors like pressure of time and workload, and patient-related factors such as expectations for antibiotics and refusal of surgical treatment (Cope et al. 2016; Chate et al. 2006; Dailey et al. 2001; Palmer et al. 2000e; Roy et al. 2000).

A description of these factors has often been reported with an assumption that they influence prescribing decisions in the absence of any additional assessment of how they could influence actual prescribing behaviour. Although it is not clear why GDPs prescribe inappropriately, some forwarded explanations from empirical studies

have related to clinical factors such as specific dental infections and diagnostic uncertainty as discussed earlier in this chapter.

In the absence of clinical indications, explanations for prescribing that does not follow evidence-based practice is limited. Much of the dental research investigating antibiotic prescribing has focused on reducing prescribing rates not on understanding what is influencing inappropriate prescribing decisions. The following sections address each factor separately and so demonstrate the complexity of prescribing decisions and what specific non-clinical factors could also determine GDPs inappropriate use of antibiotics.

3.5.2.1 Individual-related factors

GDPs prescribing decisions are most likely to be influenced by their own beliefs and values concerning the importance of and ease in not prescribing (Newlands et al. 2016). For example, GDPs may believe that their prescribing rates when compared to others i.e. medical, pharmacist and veterinary are so low that it has an insignificant impact on antimicrobial resistance and patient safety. Evidence suggests that some GDPs may argue that, at times, following guidance is not the best outcome for individual patients, or do not agree with guidance recommendations for treating some conditions from their own experience, or their interpretation of the evidence differs from that of the guidance developers, (Gabbay and May 2014). Also, GDPs may think that guidance undermines their autonomy to make the 'right' prescribing decisions under different circumstances (Newlands et al. 2016). Practitioners' beliefs have been identified as barriers to the uptake of evidence-based practice (Newlands et al. 2016). Beliefs likely to influence

prescribing decisions, are lack of confidence to surgically treat and to diagnose correctly, patient expectation, workload, and time restrictions as well as for clinical reasons. All or some of these beliefs could influence the uptake of the recommended use of antibiotics. However, little is known about the specific beliefs associated with each of these influences and which are likely to have the most impact on prescribing decisions.

Some characteristics of the healthcare professional, i.e., gender, country of training, years of practice and post-graduate training have been previously identified as potential influences on prescribing behaviour in general medicine (Covvey et al. 2013). However, a randomised controlled trial assessing the effect of educational outreach visits on prescribing behaviour in Wales found that gender, number of years since qualification, post-graduation qualification status and number of worked sessions were not significantly associated with influencing inappropriate prescribing in a sample of 79 GDPs (Seager et al. 2006). The authors of this RCT study did acknowledge that this small sample size reduces the power of the study to identify any difference in these secondary outcomes of dentist related characteristics.

Most GDPs are aware of SDCEP and FGDP (UK) guidance (Dar-Odeh et al. 2010) but variance in both the level of familiarity and disagreement on the effectiveness of antibiotics for some condition has been highlighted (Cope et al. 2014). Even with the publication of these guidelines and interventions to change practice being introduced, it is recognised that antibiotics are still being prescribed inappropriately (Dar-Odeh. 2010). This is despite most dentists in the UK being aware that

prescribing is ineffective for patients with specific dental infections (Newlands et al. 2016).

3.5.2.2. Patient-related factors

The results of this search further support that prescribing behaviour is likely to be influenced by patient related factors and any changes in prescribing practices need to be acceptable to patients too. Two survey studies reported that 8% GDPs (n = 929) were influenced by patient's expectation of receiving antibiotics (Palmer et al. 2000e) and 8.2% of GDPs (n = 891) indicated that relevant medical and social history influenced their decisions (Palmer et al. 2000a). Therefore, patient expectation is widely accepted as a barrier to treating an oral infection using a surgical measure. Available evidence suggests that those patients who are unwilling to accept treatment are nearly 5 times more likely to ask for antibiotics and are also 3 times more likely to receive an antibiotic when one is not indicated (Cope et al. 2014). Although the reasons why and what would support GDPs to manage without an antibiotic has not been researched to date.

GDPs are not alone in their perceptions of patients' expectations as there is also evidence from other primary care health professionals who also report it as a contributing factor of prescribing decisions (Gaarslev et al. 2016; Mustafa et al. 2014). Further exploration of whether this is supported by patients has been pursued in the medical primary care with several surveys reporting a high proportion of patients ranging from 46% to 67% expected antibiotic for the symptoms of varying minor conditions (Coenen et al. 2013; Cockburn et al. 1997). General medical practitioners who thought the patient expected medication were

10 times more likely to prescribe one (Cockburn et al. 1997), although clinicians' perception are not always accurate (Coenen et al. 2013). Also, a higher expectation of antibiotics always being helpful was likely to be associated among older patients and those with lower education and socioeconomic status (Coenen et al. 2013). Evidence from primary medical care suggests that once a patient has received, their expectation for one in the future is increased (Gaarslev et al. 2016). As far as I am aware, no research has been conducted to test whether GDPs' impression of patient expectation for antibiotics is similar in a dental primary care context.

Several patient characteristics such as age, educational level and socio economic status have accounted for managing infections with antibiotics (McNulty et al. 2007). However, it is acknowledged that any conclusion cannot be drawn regarding whether areas of overuse equate to inappropriate prescribing.

Another salient patient-related factor to all health professionals is the importance of achieving and maintaining a good clinician-patient relationship (Newlands et al. 2016). A possible consequence of pleasing the patient is that antibiotics are likely to be prescribed when not clinically necessary and so are not be consistent with good practice. For some health professionals, their decision could become a potential trade-off between the practitioner-patient relationship and adhering to evidence-based prescribing practice. Further understanding of this trade-off is therefore required as it may be a possible obstacle to improving prescribing behaviour in primary dental care.

The justification for these salient beliefs about patient expectation was unknown, therefore suggesting a further examination of the role played by patients in GDPs'

prescribing decisions was now necessary. The key questions to be asked were whether these perceived patient expectations and consequences were overestimated and whether patients expect an antibiotic or will response in the manner anticipated by GDPs.

3.5.2.3 System and policy related factors

A large proportion of NHS primary dental care takes place in the Public Dental Service in Scotland. This includes over 3,000 GDPs who are either salaried as part of the Community Dental Service (CDS) or independent 'High St' GDPs (The Dental Workforce in Scotland 2016, NHS Education for Scotland). This difference in the working environment could therefore have some impact on prescribing decisions. Only, independent GDPs must consider financial and economic pressure and potential competition from 'direct access' to dental hygienists and therapists for patients. Other parts of the UK have NHS contracts which may also have some impact on prescribing decisions, but it is beyond the remit of this thesis.

GDPs in Scotland receive payments for NHS treatment based on the Statement of Dental Remuneration. It has already been documented that the NHS remuneration policy can stand in the way of adhering to evidence-based prescribing practice (Newlands et al. 2016). Anecdotally, GDPs will openly comment that the payment system does not financially support managing a patient with a dental infection with treatment at a first visit. It makes financial sense to initially prescribe and to surgically treat the infection at a later visit.

Since the abolition of NHS prescription charges in Scotland in 2011, it is unknown if access to free antibiotics for the patient may have some impact on use. However,

it is not clear whether an increased use of antibiotics is sufficient evidence because this may only reflect more registered dental patients, i.e. more antibiotics are issued because more patients are having dental treatment (NHS National Service Scotland, Information Service Division (2018). Dental Statistics - NHS Registration and Participation).

At practice level, time restrictions and workload are barriers to managing dental infection properly by GDPs, but it is unclear whether this is firstly a consequence of having to persuade patients about the necessity of treatment as was highlighted in the interview study (Newlands et al. 2016) or it refers only to the time taken to carry out treatment. Furthermore, appointment structure such as designated emergency appointment and length of appointments may have potential impact on prescribing decisions (Newlands et al. 2016).

3.5.3 Summary and conclusions

The impact of both clinical and non-clinical factors on the inappropriate use of antibiotics was strongly suggested in the review. However, some areas have not been fully explored from a behaviour change perspective. It still remains unclear which beliefs are more likely to result in inappropriate prescribing and whether other previously unreported beliefs still need to be identified for the purposes of developing an intervention.

3.6 Mapping of Beliefs on to the Theoretical Domains Framework

This section is a synthesis of the identified dentists' beliefs influencing inappropriate prescribing decisions collected by existing studies mapped to TDF domains.

3.6.1 Method: Mapping to theoretical domains

All articles were re-read and searched for beliefs reported to influence inappropriate prescribing decisions. The nature of the beliefs was then translated into TDF domains using a matrix format. The beliefs were reported as either 'barriers', 'problems', or 'difficulties'. The matrix included details of the study (author, title and year of publication), a description of the identified beliefs and their mapping to the TDF domain(s). A summary of the identified domains is reported in Table 3.1.

3.6.2 Results

Of these studies in the review, five studies described potential influencing beliefs within patient, individual and environmental factors. The beliefs were identified by 2 interview studies (Newlands et al. 2016; Palmer et al. 2002e), 2 clinical audits (Cope et al. 2016; Chate et al. 2006) and from comment in one survey study (Dailey et al. 2001).

The mapping exercise identified 12 of the 14 domains, only Social/Professional role and identity, and goals were not found. The most frequently found domains were social Influence (8), followed by beliefs about consequences (7) and environmental resources & context (5). Knowledge, skills and beliefs about capabilities were also reported 4 times. Some domains were only found in one of the studies, so may be

indicative of the specific study's aims, i.e. behaviour regulation, memory, attention & decision processes, reinforcement, optimism, emotion and intention. The most domains (11/14) were found in the TDF informed interview study exploring the barriers and enablers of carrying out a local measure instead of prescribing, (Newlands et al. 2016). The nature of the identified domains was as follows:

3.6.2.1 Social influences

The influence of patients on GDPs prescribing decisions was clearly evident in these studies. These influences were more often associated with the dentists' perceived patient expectation, and patients asking or demanding an antibiotic. Other reported barriers were from patients in pain who will not accept treatment or who ask for it to be delayed until a more convenient later time.

3.6.2.2 Beliefs about consequences

Beliefs about consequences was often related to the other domains of knowledge, skills, Beliefs about capabilities, and social influence. The potential negative consequences were from making the wrong diagnosis or attempting surgical treatment that could make it worse or result in problems later, for example, if the patient was about to go on holiday. Also, the potential consequences of refusing antibiotics, to patients in pain, who refused treatment required experience and skill.

3.6.2.3 Environmental resources and context

When time was limited, or many patients had to be seen quickly, this combined pressure was likely to result in an antibiotic being issued.

3.6.2.4 Knowledge, Skills and Beliefs about capabilities

For the purposes of reporting the domains of knowledge, skills, and beliefs about capabilities were combined as these domains were overlapping in content. The studies indicated that a lack of experience or ability to diagnose and treat successfully influenced inappropriate prescribing decisions.

3.6.2.5 Other domains

Other influences on prescribing decisions were deciding between patients' wishes and adhering to recommended use, lack of incentives and optimism about surgical treatment, and anxiety related concerns from not prescribing.

3.6.3 Conclusions

In summary, this mapping exercise provided an insight into the likely TDF domains that may act as a barrier of inappropriate prescribing. No enablers of prescribing appropriately were reported in any of the 5 studies.

Table 3.1 Description of studies and TDF domains identified as influencing prescribing decisions

Study	Description of Identified Beliefs	TDF Domains													
		Kn	Sk	BR	MD	EC	SI	BCa	BCo	Re	PR	Op	Go	Em	In
1. Chate et al. 2006	Clinical signs														
	Pain														
	Prophylaxis due to medical history														
	Prophylaxis following surgical procedure														
	Patient Expectation														
	Pressure of time/workload														
	Uncertainty of diagnosis														
	Treatment had to be delayed														
	Patient going on holiday/in case of problems														
	Failed local anaesthesia/un-cooperative patient														
2. Cope et al. 2016	Patient declined or was unable to accept operative treatment														
	Previous operative treatment failed														
	Reported insufficient time to complete operative treatment														
	Dentist was unable to achieve adequate local anaesthesia														
	Patient requested antibiotics														
3. Dailey 2001	Clinical diagnosis of patients' pain														
	Effect of environment i.e. no appointment system or large numbers of emergencies*														

Study	Description of Identified Beliefs	TDF Domains													
		Kn	Sk	BR	MD	EC	SI	BCa	BCo	Re	PR	Op	Go	Em	In
4. Newland et al. 2016* Identification of what needs to change when dentists manage bacterial infections	CPD programmes; update guidelines; audits of prescribing practice; arranging appropriate emergency														
	Patients demands influence prescribing behaviour														
	No incentives to conduct local measure (LM)														
	Lack of time to manage bacterial infections														
	Successful local measures involve a lot of time; occasionally make it worse														
	Difficult to apply LM with phobic patients; difficult to numb & successful conduct a LM; insufficient time to conduct a LM														
	Patient co-operation, consent influence decision; type of patient influence														
	Uncertain if LM will resolve the issue on its own														
	Anxious about letting a patient go without an antibiotic														
5. Palmer et al. 2002e	Clinical signs														
	Patient expectation of a prescription														
	Pressure of time and workload														
	Patient social history														
	Uncertainty of diagnosis														
	Where treatment has to be delayed (GDPs)														
Frequency		4	4	1	1	5	8	4	7	1	0	1	0	1	1

* Qualitative data was coded using the TDF

3.7 Review 2: Intervention Studies

This final review focused on studies that conducted intervention designed to reduce antibiotic prescribing rates by changing dentist's behaviour.

3.7.1 Method

The literature search included the following databases: Cochrane Library, NICE evidence, and PubMed including Medline and OvidSP. A search of ClinicalTrials.gov for any on-going but yet unpublished clinical trials was also conducted. The search included intervention studies designed to reduce antibiotic prescribing rate by changing dentists' behaviour. The key search terms included 'dentistry', 'antibiotic prescribing' and 'interventions'.

All identified studies were first read, then relevant information was extracted and organised into a descriptive matrix using Excel. The matrix included the following headings, author and year, design of the study, location of intervention, i.e., primary or secondary care, description of the intervention strategy and its behaviour change techniques (if available) and outcomes, for example, any change in the use of antibiotics post intervention.

3.7.2 Review results

The search yielded a total of 6 intervention studies. The aims of the interventions in all of the studies were to address inappropriate prescribing by reducing the number of antibiotics prescribed, and so increasing the dentists' adherence with the recommended use of antibiotics in guidance. All of the interventions reported a successful reduction in the use of antibiotics or an increase in appropriate prescribing or, if measured, in the accuracy prescription information (dosage,

frequency and duration). One clinical audit was excluded because it reported no before and after audit results, (Cope et al. 2016). A summary of the intervention studies is shown in Table 3.2.

Of the 6 studies, 3 interventions were conducted in primary care, (Elouafkaoui et al. 2016; Chate et al. 2006 and Palmer et al. 2001) and 3 in secondary care, (Zahabiyon et al. 2015; Chopra et al. 2014 and Seager et al. 2006). Four studies were before and after intervention designs with no control group over time periods of between 6 weeks to 12 months, (Chate et al. 2006; Zahabiyon et al. 2015; Chopra et al. 2014 and Palmer et al. 2001). The other two studies were randomised control trials that compared either 1 or 3 interventions with a usual care control group, (Elouafkaoui et al. 2016; Seager et al. 2006).

3.7.2.1 Components of the interventions

Of the 6 studies, 2 used A&F interventions (one without feedback), one used an educational package and 3 were a combination of A&F and education. The types of A&F varied across the studies from graphical prescribing rate feedback, or with feedback by others (department staff or FGDP tutors) and self-monitoring by the dentist. The educational interventions were described as tutorials or group meetings that used FGDP guidelines as a benchmark for appropriate use of antibiotics.

From a behaviour change theoretical perspective, 5 studies provided no rationale for the choice of intervention, although the clinical audits were possibly selected based on their previously reported effectiveness in the first published evidence in 2001, (Palmer et al.) Only the RCT conducted in Scotland provided a detailed

description of the BCTs used and information as to why the components of the interventions were selected, (Elouafkaoui et al. 2016).

3.7.3 Summary and conclusion

All of the interventions except one were poorly described, therefore understanding the 'active ingredients' of what has brought about the improvements in prescribing behaviour is unclear and therefore, it is unlikely to be replicated exactly.

Löffler and Böhmer published in 2017 the only systematic review on dental antibiotic prescribing interventions therefore, it was published after this thesis review was completed. The 2017 systematic review identified the same 6 intervention studies but included one study on antibiotic prophylaxis and another from outwith the UK which were beyond the scope of this thesis.

One Cochrane systemic review investigated interventions aimed at improving antibiotic prescribing practice, however, it focussed on only hospital non-dental in-patients (Davey et al. 2017), therefore none of the studies were included in this review. Yet, evidence indicated that enabling and restrictive intervention techniques were more likely to be effective in changing prescribing practice. Therefore, this knowledge needs to be taken into consideration when exploring the 'problems' associated with primary care prescribing behaviour as the underlying driving beliefs could be similar or even the same.

Table 3.2 Description of the identified intervention studies including context,

Author & Year	Study Design	Context	Description of Intervention	Intervention Components	Reported Outcome
1. Chate et al. 2006	Prospective clinical audit	Primary: General dental practice in Eastern England (N = 212 GDPs)	Audit and Feedback (A&F) (1) Informal tutorial, working through all of the Faculty of General Dental Practitioner guidelines	(1) Each dentist audited their own antibiotic prescribing (2) Informed of the improvements (3) Opportunity of further discussion and educational refinements from local expects	43.6% reduction in the number of antibiotic prescriptions issued
2. Chopra et al. 2014	Prospective clinical audit	Secondary: Oral surgery acute department of Dental hospital in England	A&F 2 cycle prospective audit (1) Education (2) Training	(1) Department staff determined appropriate use based on set standards (un-named) which was feedback at group sessions	80% of prescriptions were appropriate
3. Elouafkaoui et al. 2016	12-month partial factorial (3 level) cluster randomised control trial	Primary: NHS General Dental Practices in Scotland (N = 795 practices)	Graphical A&F (1) A&F (2) A&F + behaviour change text (3) Above at varying time intervals (0,6,9 months) + with or without HB comparator data	Two BCTs described as (1) instruction on how to perform the behaviour; (2) Provide information about the health consequences of performing the behaviour	Reduction in prescribing of -5.7% (95% CI10.2% to -1.1%; p = 0.01)
4. Palmer et al. 2001	An intervention study	Primary: General dental practitioners in the North West of England (N = 175 GDPs)	(1) A&F (2) Educational meetings based on guidelines from FGDP, Royal college of Surgeons of England (3) Individualised standard setting based on intervention (2)	(1) Each dentist audited their antibiotic prescribing pre- and post-audit for 6 weeks	Reduction in inappropriate prescribing by 42.5%

Author & Year	Study Design	Context	Description of Intervention	Intervention Components	Reported Outcome
5. Seager et al. 2006	RCT	Secondary: General dental practices in 4 health authority areas in Wales (N = 97; 27 dropped out)	Educational Package that included guidelines, summary of recommendations and patient information leaflets (1) Guideline group (2) Guideline + Intervention group (3) Control group	(1) Educational package (2) Each practitioner in the intervention group was visited by pharmacist who discussed the content of the guidelines and to encourage rationale use of antibiotics (and analgesics) when managing acute dental pain. Tailored to the attitudes of each practitioner	Intervention group prescribed significantly less antibiotics than control group (OR (95%) 0.63 (0.41, 0.95) and significantly fewer inappropriate antibiotics (OR (95%) 0.33 (0.21,0.54) There was no significant difference between guideline group and control group
6. Zahabiyon et al. 2015	Clinical Audit Before/after non-controlled trial	Secondary: Community Dental Clinics in Northeast England (N = 25)	Audit (No feedback) Respective data collected pre-audit, then prospective data post intervention	(1) Dissemination of FGDP (UK) guidelines	A statistically significant increase from 30% to 52% of prescribing satisfying FGDP (UK) guideline

3.8 Antibiotic Use Beyond the UK

Although the focus of these reviews was the UK, other published literature suggests that the inappropriate use of antibiotics for managing dental infections is of world-wide concern. European studies reported that dentists in primary care prescribe a similarly high proportion of between 6.5% and 8.5% of all antibiotics (Pipalova et al. 2014; Haroni and Skaug, 2007). A review of 33 studies consistently found similar patterns of prescribing practice to manage specific infections across 6 different countries (Dar Odeh et al. 2010).

Furthermore, although not within this thesis' definition of inappropriate use, other sub-optimal prescribing was reported for duration and dose of antibiotics (Vessal et al. 2011) and often prescribing occurred in the absence of no or delayed surgical treatment (Mainjot et al. 2009; Murti et al. 2007).

Similar to the UK, the influencing non-clinical factors were related to the expectations of and convenience for patients and their social background was found (Dar Odeh et al. 2010). Although not applicable to the UK, the direct sales of antibiotics to individuals in many parts of the world also contribute to the issue of inappropriate use (Morgan et al. 2011).

3.9 Key Conclusions from the Reviews

The searches revealed that there is somewhat of a dearth of articles on antibiotic prescribing in dental care. Often, a small number of authors drew the same conclusions from a small evidence base about the existence of inappropriate prescribing.

The studies reviewed report similar barriers and enablers of GDP prescribing behaviour. Given that the studies span 15 years suggests that little has changed, despite the publication of guidance and of the results of interventions to date. Furthermore, in the papers reporting the results of intervention designed to influence antibiotic prescribing little or no explanation was ever provided as to why the components of the intervention were selected. Even if results showed interventions were successful in reducing prescribing in the short term, they present no evidence the effects are sustainable, nor if the reduction is entirely for inappropriate prescribing.

From an intervention design viewpoint, the varying audit and feedback intervention identified in the second review could also be described as an educational intervention. Also, if A&F was considered not as a type of intervention, but as a technique used to change behaviour, then A&F could also encompass other types of interventions such as persuasion, coercion, enablement or training.

From a theoretically informed intervention development perspective, the salience of social influence and Belief about consequence domains may indicate that other types of intervention targeting this 'mechanism of actions' need to be taken into account if an intervention is to have the greatest likelihood of sustained success in supporting best practice prescribing decisions.

3.10 Contribution of the Reviews

The reviews provided evidence of the factors and beliefs that may be influencing prescribing decision making and show the limitation of previous attempts to

influence this behaviour. Past interventions do not always target any or all of these factors and most do not use theory to inform the choice of intervention components. Also, it demonstrated a need for more detailed descriptions of the intervention's components and a reason for why they were selected.

This review was limited in that it was not a systematic review. There was no analysis of the risk of bias of the studies, which might have been conducted to appraise the quality of the research findings, and there was no independent corroboration of the coding.

Given that much of the research identifying the factors is over 10 years old, the next step is to confirm the continuing relevance of these key factors and to apply a theoretical framework to comprehensively explore and identify all potential barriers and enablers of the inappropriate use of antibiotics.

CHAPTER 4 - EXPLORING ANTIBIOTIC PRESCRIBING DECISIONS IN PRIMARY CARE

OUTLINE OF CHAPTER

A qualitative interview based study was conducted This chapter describes the first qualitative study exploring the underlying beliefs of key factors likely to influence antibiotic prescribing decisions. This study has two aims, firstly to confirm that the key factors identified in the literature are still salient in influencing the use of antibiotics and secondly to apply a theoretical basis for identifying and understanding the barriers and enablers of antibiotic prescribing decisions.

4.1 SUMMARY OF STUDY 1

Introduction: Evidence suggests that different factors may influence prescribing decisions in the absence of clinical indications. These other non-clinical influences include GDP and patient-related factors as well as environmental factors such as practice policy and organisational systems. The application of psychological theories of behaviour and behaviour change to understand current antibiotic prescribing by GDPs should provide a comprehensive and theoretical foundation for the development of the intervention.

Aim: This qualitative study aimed to confirm if the same factors continue to influence or whether any newly surfaced factors are also likely to determine antibiotic prescribing decisions. Also, it used the TDF to identify the potential determinants of antibiotic prescribing decisions that do not follow recommended practice.

Methods: Semi-structured interviews were conducted with GDPs in Scotland. The data was analysed using a matrix-based approach based on framework and thematic analysis. Responses were thematically coded into factors and beliefs acting either a barrier or facilitator then mapped on to the TDF. The frequency of the salient domains indicated potential intervention targets which required further investigation.

Results: The 16 interviews revealed that most GDPs were aware that they were influenced by more than clinical indications when deciding to prescribe an antibiotic. A sub-set of 8 TDF domains were identified: knowledge; skills; beliefs about capabilities, social influence, environmental context and resources, emotion, beliefs about consequences and goals. The reported benefits of inappropriate prescribing were often based on GDPs' uncertainty and lack of confidence in effectively persuading patients who wanted an antibiotic to accept treatment.

Conclusions: This study confirms that the factors identified in previous research do continue to influence prescribing decisions. In particular, the GDPs' perception of patient expectation appears to play a dominant role in influencing inappropriate prescribing. The findings suggest that further investigation into actual patient expectations and acceptance of treatment is required. It is possible that future intervention to influence this behaviour may need to focus on patients as well as GDPs.

4.2 Introduction

The review of studies as detailed in Section 3.5 of Chapter 3 strongly suggests that GDPs may be prescribing antibiotics inappropriately, given the prevalence of non-clinical factors that appear to be influencing prescribing decisions. Previous interventions have not taken a behaviour change perspective, and so salient beliefs underlying these factors are unclear. In addition, the review revealed that most of the studies relating to antibiotic prescribing were over 10 years old, and so it is unclear whether factors identified in these studies remain influential for this behaviour.

4.2.1 Aims and objectives

This study aimed to confirm the continuing influence of the previously identified factors and by applying a theoretical approach to identify specific beliefs that may be relevant in prescribing decisions. The result is the identification of the likely barriers and enablers of prescribing decisions that could be targeted to reduce inappropriate prescribing.

The objectives of this study were to:

(1) Examine prescribing practice;

(2) Identify clinical and psychological factors influencing prescribing decisions, including inappropriate prescribing;

(3) Map potential barriers and enablers to the theoretical domains using the TDF;

(4) Inform the development of an intervention, should one be required.

4.3 METHODS

4.3.1 Design

A qualitative study of semi-structured interviews using a theoretical approach conducted with a convenience sample of GDPs from across Scotland.

4.3.2 Sampling procedure

The sampling of GDPs was coordinated using the Scottish Dental Practice Based Research Network (SDPBRN). The sample was taken from the 55 GDPs who were SDPBRN's Rapid Evaluation Practitioners (REPs), who had previously expressed an interest in participating in research projects. Although initially this is a convenience sample, there is sufficient variation within the characteristic of the REPs to have a sample of varying experience (date of qualification), and in the size and geographical location of the practice.

4.3.3 Recruitment procedure

All the 55 REPs received an email from the SDPRN which introduced them to the study and if they were interested in being interviewed were asked to return a completed consent form by using the fillable pdf or if preferred by post (Appendix 5, Page 256). Also, attached to the initial email was a more detailed invitation from the study researcher and a participant information sheet (Appendix 6, Page 257). After the consent form was received, the researcher directly contacted the GDPs to arrange an interview at a convenient date and time. After 5 days, a reminder email was sent by SDPRN to the non-responders.

A later, second round of recorded interviews was conducted to assess the reliability and consistency of the coding of the earlier first round of unrecorded interviews. It

also confirmed that saturation had been reached in the first round of interviews and it provided an opportunity to probe further after the analysis of the first round which had highlighted that some influencing factors may require more clarity. The same recruitment process as before was applied, i.e., an initial invitational email with attachments and a reminder from the SDPBRN. Only those GDPs who had not participated in the first round of interviews were contacted again.

4.3.4 Interview schedule

The interview schedule had seven open-ended questions (Appendix 7, Page 259). The purpose and content of each question is outlined below.

Current practice was examined to assess prescribing decisions by:

- When you would normally prescribe an antibiotic?
- When would you not prescribe?
- What would you do instead of prescribing?

An understanding of what is likely to determine the GDPs' decisions was sought by:

- What is relevant to you when prescribing an antibiotic?
- What is relevant to you when deciding not to prescribe?
- What are the advantages and disadvantages in prescribing to you?
- What are the advantages and disadvantages in not prescribing to you?

Planned prompts, i.e., included in the schedule when it was necessary to probe further or unscripted prompts, i.e., to check for any possible misunderstanding about intended meaning were both used. The interview schedule was piloted and refined by testing with dentists from the Dundee Dental School.

4.3.5 Analysis

A matrix-based approach taken from framework and thematic analysis was applied (Gale et al. 2013; Ritchie & Lewis 2003; Ritchie & Spencer 1994). The first stage used a deductive approach, whereby the responses were sorted and coded into themes and sub-themes. In the second stage, the responses were coded into TDF domains considered to best represent the influential beliefs statements (Pope et al. 2002). These belief statements identify the potential role that the domain could have in making appropriate or inappropriate antibiotic prescribing decisions. The importance of the domain role was assessed using frequency (Graham-Rowe et al. 2018) in the third stage.

All notes were entered into a matrix in Microsoft Excel after each interview and the analyses began after the second interview. Initially, all data belonging to each question were sorted in separate matrices. The interview notes were coded and analysed in three stages. Figure 4.1 is a visual model of the data analysis.

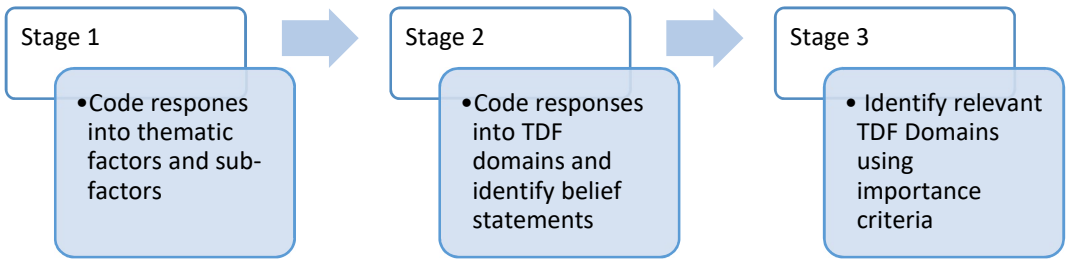

Figure 4.1 Stages of Data Analysis

As the first round of interviews were not recorded, the accuracy of the notes taken during these unrecorded interviews was checked against the data collected from the recorded interviews. This was carried out by checking that the findings, i.e. TDF

domains and beliefs statements, from the recorded responses were comparable to that in the non-recorded responses.

4.4 FINDINGS

The collection of the data in the first round of interviews took place between November and December 2015 and the second round in April and May 2016. Eleven interviews were conducted in the first round and five in the second round. As previously mentioned only the later five interviews were audio-recorded. No discrepancies in the data collected during the recorded interviews and those not recorded were identified.

4.4.1 Demographics of the participants

Overall, eighteen of the invited GDPs consented to be interviewed, giving an interview response rate 18 out of 55 (33%). The non-responding GDPs did not offer any explanations as to why they did not wish to take part in this study and no reasons were sought by the researcher. Later, two GDPs who initially gave their consent did not respond to the researcher's emails and follow up reminders to arrange an interview date and time so were not interviewed.

There was recruitment from various regions and practice types across Scotland including northern island communities, more rural area on the west coast and more densely populated areas from the central belt of the country. Of the GDPs interviewed, seven were male and nine were female. Fourteen of the GDPs qualified in the UK and the experience level ranged from a few years since

qualification to over 20 years in practice. The mean duration of the interview was 35 minutes: ranging from 25 to 50 minutes.

4.4.2 Number of interviews

Saturation point was reached by 11 interviews (round 1) as no new content was described by GDPs with most of the factors relevant to prescribing behaviours being already mentioned in the previous interviews. However, the interviews continued to follow the accepted practice of conducting at least 3 more to validate the data previously collected (Francis et al. 2010).

4.4.3 Coding matrix

A summary of the nature and frequency of the responses elicited from questions about what influences prescribing decisions are provided in Appendix 8, Page 263. An example of how the response statements were colour coded and beliefs influencing prescribing decision were manually identified using the TDF are shown on the next page in Table 4.1.

4.5 PRESCRIBING DECISIONS

From the very outset, the majority of GDPs were quick to assert that they did not prescribe an antibiotic very often or if at all. One GDP said that prescribing 'rarely' occurred and also another GDP quantified the amount of their prescribing as being about 2-3 times per month.

Table 4.1 Example of TDF coding (Interview 17)

Interview	TDF Coding
R - When would your normally prescribe an antibiotic? Dentist - OK, mm... dental abscesses probably the only time I would prescribe is …. if the patient didn't want me to do any work on that day so I would always tell them that it need opened first of all and for any reason you just get the ones that refuse but I would try to persuade them before going down the route of antibiotics for that. The only other reason I might give it is if a child comes in with a swelling or there just not in a fit state or frame of mind to have the tooth taken out but they are happy to come back another day but on the day that you tell them…..they have freaked out a little bit I would prescribe an antibiotic rather than try to get the tooth out on that day. **R – OK** Dentist – Em… if I have to do but I can't get the tooth numb, I'll be unable to do painful, in that case I would give an antibiotic. Em… at the very last measure I would only prescribe I would irrigate the tooth first and if they came back and there was still an issue I would treat on the second visit, but I would try do it on the first. **R – So would treat on the first visit and prescribe on the second. Any other times when you are likely to prescribe an antibiotic? Any specific conditions?** Dentist – I never prescribe for dry socket, for ANUG yes but I can't remember the last time I prescribed for ANUG and for pericoronitis I only prescribe if they have pain swallowing and just open their mouth. **R – Can you may tell a little more about the characteristic of a patient that might be relevant to you when deciding to prescribe?** Dentist – So when they don't want any other treatment done? That sort of thing? it could be that the patient is very nervous, so you sometimes get the ones that don't want it or mm…. they don't have time. I can't remember the last time I did give antibiotics because I didn't have time. But you do get some patients will insist that they want antibiotics and they don't want, you to do anything and they are the difficult ones because you try to explain to them that you're better to do something else and they insist that they want antibiotics. I had a patient at xxxx on the emergency rota and they came in with a facial swelling and we drained the abscess getting a lot of pus out of it then her husband phoned demanding that she needed antibiotics so I said she doesn't require them, it's been drained and he went on to such an extent that he was going to get in touch with the GDC that I didn't prescribe antibiotics.	**Memory, Attention & Decision-making** ▪ Decision to prescribe/withhold antibiotics for specific conditions Social Influence ▪ Patients not accepting treatment ▪ Demeanour of patient (i.e. nervous, anxious) ▪ Patient expect/demand antibiotics **Beliefs about Capabilities** ▪ Difficult/Easy to persuade patient to accept treatment (i.e. withhold antibiotics) ▪ Able/Unable to numb area before treatment Beliefs about Consequences ▪ Negative response to withholding antibiotics from patients **Environmental Context & Resources** ▪ Lack of appointment time ▪ Emergency clinic setting

4.6 Advantages and disadvantages in prescribing

The GDPs reported a total of nine beliefs about the advantages and disadvantages of prescribing an antibiotic. The most frequent advantage was that prescribing is 'fast and simple' (n = 6) and least mentioned was 'it's predictable and works' (n = 2). GDPs' described prescribing as being disadvantageous by saying it goes against their wishes (n = 9). The full list of the reported beliefs relating to advantages and disadvantages in prescribing are shown in Table 4.1.

Table 4.2 Identified advantages and disadvantages of prescribing by GDPs (number of GDPs)

Advantages in prescribing	Disadvantages in prescribing
Fast and simple (6);	It goes against my wishes (9);
I do not have to communicate with patients (3);	I am seen as someone who prescribes (5);
It gives me peace of mind (3)	
Gets you out of trouble (2);	
It avoids unpleasant clinical situation (2);	
No treatment so I am liked by my patients (2);	
I know it works and is predictable (2).	

4.6.1 TDF domains influencing decisions to prescribe

A further 24 barriers and enablers were identified as likely to be relevant to prescribing decisions. These mapped onto the following subset of TDF domains: knowledge, behavioural regulation, beliefs about consequences, beliefs about capabilities, social influence, environmental context and resources, emotion and goals. Of course, in some of the instances described during the interviews, an antibiotic was likely to be clinically required, therefore not inappropriate prescribing.

Direct quotes of key words often used repeatedly during the interviews by the GDPs are shown in inverted commas.

The nature of the beliefs reported and their mapping to TDF domains described below and summarised in Table 4.2.

4.6.1.1 Social Influence

Prescribing inappropriately was most frequency influenced by beliefs about patients expecting to receive an antibiotic (n = 11). Also, consequences of having the patient going away happier and also not going elsewhere was relevant to their decision to prescribe. Patients, who were anxious, upset or in considerable pain were more likely to be prescribed an antibiotic by some of the GDPs (n = 4). It was noted that patients who were not registered at the practice are more likely to have suffered in pain for longer before seeking relief and if the initial treatment is given this patient may not to come back any remaining treatment so reduce this happening an antibiotic was prescribed.

4.6.1.2 Knowledge

Despite awareness of guidance recommendation, 3 GDPs acknowledged the likelihood of inappropriate prescribing for some conditions, for example, necrotising ulcerative gingivitis (NUG), a superficial infection of the gums. The perceived benefit of prescribing was that diagnosing and treating NUG was potentially difficult and one GDPs explained by saying that ‘severe [NUG], if you can recognise it is challenging’. Another reported benefit of prescribing was a reduction in uncertainty of ‘things not settling down’ after treatment. One instance of when

an antibiotic as adjunct is used was after 'cleaning and debridement' for periodontal disease (i.e. an inflammation of the gums).

4.6.1.3 Behaviour regulation

All GDPs were hugely aware of the potential for patients to influence their decision; however, a few reported having developed some tactical ways of explaining why giving an antibiotic was not the appropriate solution to their pain as it will not get better in the long term with only antibiotics. One GDP stated that in the circumstances where there was no pus, then they would prescribe an antibiotic. Also, GDPs would routinely check the patient's medical history and allergies before deciding what to prescribe.

4.6.1.4 Beliefs about consequences

Some of the GDPs discussed that there could be potential difficulties when treating a patient with an infection. The difficulties mentioned related to whether the GDPs felt that they could successfully numb the area for the patient and then afterwards be able to achieve drainage. One GDP explained that if it was felt that drainage might not be possible, then attempting to numb the area could be a potentially uncomfortable experience for the patient and also possibly for the GDPs too (beliefs about consequences). The clinical reasons given for not attempting to drain were the location of the infection in the mouth, restricted movement especially the lower jaw, suspicions about pain level and there not being sufficient infection to release. Some GDPs stated that in the long run prescribing used up more of their time as the patient would have to come back for treatment later so this would take up another appointment slot. Under these circumstances it was the GDPs' preference to

immediately treat in the initial appointment despite the possibility of over-running into the next scheduled appointment time. Another of the GDPs said he 'hated being behind and running late' so this would result in prescribing an antibiotic if short of time to complete a more complex treatment, other GDPs preferred to prescribe and ask the patient to return for treatment in a later longer appointment. One GDP mentioned a reluctance to treat surgically on a Friday as any resulting problems would have to be dealt with over the weekend which is not ideal. Another disadvantage flagged up by one GDP was concerns that this practice of prescribing in the absence of a clinical need opened up the possibility of challenges from the General Dental Council for malpractice.

4.6.1.5 Environmental context and resources

There were mixed views on whether prescribing an antibiotic was influenced by lack of time. Environmental context including day of the week, practice policy and external monitoring were acknowledged as having some influence on a decision to prescribe. GDPs recognised that one advantage of prescribing is that it is quicker and easier than providing surgical treatment and also it avoids the likelihood of running over on appointment times. Benefits of prescribing on a Friday were also reported as it managed any potential concerns that surgical treatment might not settle properly over the weekend. Three GDPs mentioned that their practice had prescribing policies in place to address their concerns about any over or mis-use of antibiotics being identified by the external monitoring and so reducing any potential negative outcome of prescribing inappropriately for dentists.

4.6.1.6 Beliefs about capabilities

Five GDPs reported that it is harder to try and persuade a patient, who comes in saying that they want an antibiotic, that treatment is the best solution to their pain specifically when the patient is 'bullying' or 'being pushy' towards you. When it was not possible to persuade a patient to be treated and a prescription was the only option left then it was always done in conjunction with the caveat that this was not the recommended practice.

4.6.1.7 Goals

From the GDPs own perspective, it was their aim to prescribe appropriately and defensible. Other practitioners related reasons for prescribing were confidence in explaining why an antibiotic is not necessary and building a better relationship with their patients.

4.6.1.8 Emotion

Two GDPs mentioned the pressure they felt to reduce their prescribing of antibiotics because of the external monitoring of antibiotic usage in primary dental care.

Table 4.3 Self-report of beliefs perceived to be relevant for prescribing decisions mapped to TDF domains

TDF Domains	Freq	Themes	Specific Beliefs
Knowledge	27	Specific conditions Medical history Allergies Location of infection Before complex surgical treatment SDCEP guidance Areas of Deprivation	Aware of need to take medical history Aware that specific antibiotics have to be prescribed Aware of need to prescribe for systemic swelling Aware that swellings at the back of the mouth have potential breathing difficulties GDPs know when to prescribe before surgical treatment in primary care or when referring to secondary care Aware of guidance recommendations Aware that more antibiotics are prescribed in more deprived areas
Behaviour regulation	9	Medical history Allergies Severity of Swelling	Routinely ask for medical history: conditions and medications currently taken Previous allergic reactions are routinely checked It is routine to prescribe for systemic swellings GDPs routinely prescribe when referring to secondary care for complex surgical treatments
Beliefs about consequences	6	Back-up plan Expectations After surgery as an adjunct Patient characteristics Recoup time	The patient is unable to come back, for example, going on holiday, travelling distance from rural area, works off-shore after surgical treatment if things do not settle down correctly Patients will be pleased after being given an antibiotic If it does not settle after treatment, an antibiotic is prescribed Patients in pain or anxious are not likely to cope with a surgical treatment Patients who have received an antibiotic before are more likely to expect to be prescribed one again Beliefs that prescribing can recoup time when running late treatment Prevents the patient asking their GP for an antibiotic

TDF Domains	Freq	Themes	Specific Beliefs
			Prescribing means you keep up with appointment times Believe that prescribing supports a better relationship Prescribe because infections reduce the effectiveness of anaesthetics Beliefs that over prescribing will be noticed Prescribing an antibiotic must be justifiable
Social Influence	17	Expectation Patient Characteristics Dental Attendance	Patient wants an antibiotic Older patients are more likely to want an antibiotic Patients in pain or anxious want an antibiotic Patient refuses to have surgical treatment Irregular attenders are unlikely to come back for follow up care after surgical treatment Irregular attenders are unlikely to come back for follow up care after surgical Patients who live in deprived areas are more likely to receive an antibiotic
Goal	12	Individual beliefs	GDPs aim to prescribe only when it is appropriate GDPs aim to please the patient by prescribing
Beliefs about capabilities	22	Clinical skills Managing patient expectations	It is easier to prescribe than to run late It is easier prescribe than to numb effectively It is easier to prescribe than to numb at the back of the mouth GDPs prescribe when unsure of the correct diagnosis It is easier to prescribe that explain to patients why surgical treatment is necessary
Environmental context and resources	7	Practice policy Time pressure	Prescribing policies are in place within the practice Aware that antibiotic prescribing rates are monitored GDPs are more likely to prescribe towards the end of a week

TDF Domains	Freq	Themes	Specific Beliefs
		Access to emergency or secondary care	Geographical restrictions of quick access Beliefs that patients will be out of pain until treatment at secondary care for treatment prescribing
Emotion	2	External monitoring	Pressure to minimise use of antibiotics

4.7 Advantages and disadvantages in not prescribing

Eleven beliefs about the advantages and disadvantages of not prescribing were reported. These included beliefs more clinical satisfaction (n = 13) and following professional standards (n = 10) but it does come with the downside that performing a treatment takes more time (n = 13). Although, four GDPs felt that not prescribing, i.e., carrying out surgical treatment did result in freeing up more appointment times so did not necessarily negatively impact on the smooth running of the practice and one GDP stated that not prescribing could be stressful.

The full list of the reported beliefs relating to advantages and disadvantages in not prescribing are shown in Table 4.4.

Table 4.4 Identified advantages and disadvantages of not prescribing by GDPs (number of GDPs)

Advantages in not prescribing	Disadvantages in not prescribing
It gives me clinical satisfaction (13); You have done the right thing (professional standards) (10); You know you have treated the problem (4); You get paid for treatment (4); You have less appointments overall (4).	Takes time so requires managing appointment time (13); Requires you to persuade patients (6); Requires skill to numb mouth (3); I have to defend my action if I prescribe instead (2); Cost of materials i.e. suturing (1); Stressful (1).

4.7.1 TDF Domains influencing decisions to not prescribe

Responses to suggested that these GDPs were motivated to not routinely prescribe antibiotics by saying that it was their preference to carry out treatment by explicitly saying, it is something they do ‘most of the time’. For all of the GDPs a decision to not prescribe meant that a surgical treatment, i.e., a local measure would be performed.

A total of 11 barrier and enablers were identified as potentially being relevant to a decision to not prescribing an antibiotic. These mapped onto the following subset of TDF domains: social influence, beliefs about consequences, behavioural regulation, skills, knowledge, and beliefs about capabilities. (Table 4.3).

The following reports when the GDPs will normally not prescribe an antibiotic and their reasoning for making this decision. The findings are described below with the domains of the TDF to which the indicators were mapped (Table 4.5, Page 99).

4.7.1.1 Social influence

Often GDPs (n = 10) gave details about how some patients still expect antibiotics for dental pain. It was accepted that this could make the decision to treat much harder for the GDPs as they needed to explain to the patient why they were being treated instead of receiving an antibiotic. Some patient characteristics had an influence on decision of when to not prescribe. Another barrier to not prescribing was unregistered patients who were more unlikely to accept treatment or return for later treatment if required, therefore prescribing was deemed to be beneficial. Although, some GDPs who knew their regular patients well and so expressed that some patients would be very surprised if they did not get treatment.

4.7.1.2 Knowledge

The responses given by some GDPs whilst discussing not prescribing suggested an external influence from feedback given by NHS monitoring on prescribing rates. This pressure to not prescribe led some GDPs to express concerns about ‘not to be seen as the one who prescribes’ or to ‘be the outlier’ i.e. someone who prescribes more than other GDPs.

4.7.1.3 Behavioural regulation

The majority of GDPs did state that carrying out a treatment was uppermost in their thoughts when deciding to not prescribe an antibiotic. Some of the GDPs first spoke about the specific treatments they would provide to patients with an infection whilst other GDPs mentioned the condition first and then how they would be treat it. Their decision to not prescribe could involve using one of the local measures described in SDCEP's guidance document i.e. draining by extraction of the tooth or through root canals and consider incision of soft tissue to drain the infection. The local measures most often reported to be used were root treatments and extractions. A few of the GDPs talked about cleaning gums for periodontal abscess whilst one of the GDPs would refer patients who were 'regular attenders' at the practice to their dental hygiene for treatment.

4.7.1.4 Beliefs about consequences

Often the amount of pus present was judged by the level of pain reported by the patient so where the patient was not in considerable pain that suggested little pus was present to the GDP which in turn could make it 'harder to achieve clearance of infection'.

4.7.1.5 Skills

Achieving anaesthesia before treatment and having a sufficient collection of pus to drain were seen as potential problems when deciding to carry out a successful local measure. It was felt by some that a large amount of pus can reduce the effectiveness of the anaesthetic by lowering the pH value. By comparison, if there was only a small amount of pus present there might not be enough to release, and

so infection was not likely to clear (knowledge; beliefs about consequences). The specific condition of pulpitis (an inflammation in the pulp of the tooth) was mentioned by some of the GDPs as a condition that would be readily treatable.

4.7.1.6 Beliefs about capabilities

Dental abscesses were thought to be always treatable unless there was severe swelling. The cleaning out of gums could be repeated for up to 3 times before a decision was finally made to prescribe an antibiotic or in some cases having the tooth extracted was the final option for the patient. Potential key barrier of appropriate non-prescribing from GDPs (n = 8) was the acceptance of patients to have surgical treatment instead of an antibiotic. Persuading patients to have any surgical treatment was seen as the 'first hurdle' by a few of the GDPs (n = 5).

4.7.17 Environmental context and resources

One barrier was the appointment time as it was sometimes seen as not being sufficiently long enough to not prescribe especially in circumstances where the required treatment might not become straightforward i.e. problem with numbing the areas or talking to patients about the benefits of getting treatment when they are already in pain. Some GDPs (n = 3) were prepared to run over the allocated time when they thought that in the long run it would mean no more appointments for this patient if not recalled later, thereby freeing up an appointment time for another patient.

Table 4.5 Reported determinants perceived to be relevant for non-prescribing decisions mapped to TDF domains

TDF Domains	Freq	Themes	Specific Beliefs
Knowledge	12	Location of infection Risk factors	Aware of need to treat surgically Aware of need to assess swelling before treatment Aware of need to treat instead of prescribing an antibiotic Aware of risk factors of surgical treatment GDPs know how to treat Surgical treatment is only way to achieve a satisfactory outcome
Behaviour regulation	6	Medical history	Routinely ask about risk factors: allergies/alcohol consumption/other medications
Beliefs about consequences	6	Long term solution Treatment is viable Antimicrobial resistance	Surgically treatment can cause appointment times to run late Patients are not pleased if they have long waiting times Practice staff are not pleased about having to explain that the dentists is running late to patients Surgical treatment reduces the over-use of antibiotic Patient cannot comeback the next day if there are any problems Unregistered patients are unlikely to come back later
Social influence	8	Compliance of patients Treatment can be done Unregistered patient	Patients are/are not accepting of treatment Patients do not want treatment
Beliefs about capabilities	11		GDPs have/lacks confidence to treat appropriately There is enough/insufficient time to treat properly Believe that numbing at the back of the mouth is complex/straightforward Believe that patients will not be able to cope with surgical treatment

TDF Domains	Freq	Themes	Specific Beliefs
Environmental context and resources	3	Time Available Day of the week, i.e., Friday	Treatment is possible/not possible in allotted appointment time Appointment time is long/not long enough
Skills	3	Treatment is viable	GDPs have/lack the required skills GDPs are able/not able to diagnose and to treat surgically

4.8 Discussion

This study has explored the reported prescribing practices and decisions, and the likely theoretical determinants of why GDPs may or may not prescribe an antibiotic in accordance with recommended evidence based practice. While the majority of GDPs reported minimal prescribing in their daily practice, a few stated that prescribing was an easier and quicker option as it pleased their patients and it also could save them time in a busy practice. These findings are consistent with previous research that reported patient expectations and time pressures can influence a GDPs' decision making (Cope et al. 2016; Newlands et al. 2016; Chate et al. 2006; Palmer 2002e). For most, a decision to not prescribe necessitated some surgical treatment instead, so for some GDPs this required having the confidence to perform the surgical treatment and also having the communication skills to explain to patients the reasons for them needing some treatment.

In almost all cases, the main influence of prescribing was the GDPs' awareness of a clinical indications balanced against a need to reduce their prescribing rates (knowledge). Other influences were having the skills to know when an antibiotic was indicated (skills; beliefs about capabilities), and routinely prescribing for specific dental conditions as per clinical guidance (behavioural regulation). In this study, the key enablers of prescribing were beliefs about meeting patient expectations (social influence) and not having sufficient time to treat effectively (environmental resources and context). Another facilitator included prescribing as an adjunct to treatment when the GDP was uncertain that it might not be 'settling down' satisfactorily afterwards (beliefs about consequences). New barriers not

previously reported in other studies were identified in this research. These barriers included the possibilities of stress associated with being found to be an over or inappropriate prescriber from the external monitoring of routinely collected prescribing data (emotion; beliefs about consequences) and also a GDPs' desire to reduce their cases of prescribing (goal).

For decisions to not prescribe, the most reported related to clinical factors which included positive beliefs about an awareness of a need to perform treatment as a long term solution and knowing about risk factors (knowledge; beliefs about consequences). Certain views revealed some variation in the influence of the GDPs' experience and confidence in diagnosing, numbing and surgically treating dental infections (skills; beliefs about capabilities) within the allocated appointment time (environmental resources and context). A potential key barrier influencing not prescribing was the beliefs that patients do not want treatment (social influence) and that the GDP does not feel confidence in their skills to persuade them otherwise (Beliefs about capabilities).

While other research has developed interventions to reduce prescribing rates, only a few studies have examined the determinants of prescribing practice and no other qualitative study has reported taking a theoretical approach to assessing prescribing behaviour. No other studies so far, to the author's knowledge, have assessed prescribing behaviour in terms of the enablers and barriers of both prescribing and not prescribing decisions in the 'diagnostic analysis' stage of intervention development. These findings are important to inform the selection of behavioural techniques used in a future intervention.

Also, unlike previous studies investigating prescribing practice, this study has taken a different viewpoint by considering that non-prescribing behaviour and prescribing behaviour are not the opposite ends of the same continuum, but instead are two separate behaviours and therefore potentially influenced by different factors and their associated determinants and specific beliefs. Previous research investigating antibiotic prescribing has usually taken it to be single behaviour.

4.8.1 Differences between high and low prescribers

This sample was judged to be low prescribers by the author based on the explicit comments made by some of the GDPs and also by what was implied in the content of some responses from others. It may be suggested that GDPs with high prescribing rates could have different beliefs influencing their prescribing behaviour, so this was not captured in these interviews. The issue of the GDPs prescribing rates was addressed in the RAPiD trial which reported no differences in the interview content and themes of low, medium and high prescribers although no definition of these categories was reported (Newlands et al. 2016). This trial explored the barriers and enablers to carrying out a local measure but did not consider what facilitates or hinders the prescribing of antibiotics.

4.8.2 Default responses

It was challenging sometimes to obtain the appropriate replies to the questions asked especially for questions which asked about the advantages and disadvantages of prescribing or of not prescribing. Often the initial response was to answer by talking about advantages or disadvantages to the patient and not for the GDP. Frequently, further direction and clarity had to be provided by the researcher,

i.e., I am looking for the benefits or difficulties to you, as the GDP not the patient, when prescribing (or not prescribing) antibiotics. On occasion an additional prompt was also necessary, e.g., replies from earlier interviews have included 'it's fast and simple' to glean the information required. Despite these prompts being given, some of the GDPs still unwittingly drifted back to talking about the benefits to the patient again. This gave a sense to the researcher that GDPs were unaccustomed to thinking about or reflecting on their prescribing behaviour in this manner and so tended to default back to giving clinical and patient reasons and not personal reasons for prescribing antibiotics.

4.8.3 Strengths and Limitations

Potential bias in the sampling process was limited by interviewing GDPs with varying levels of experience, type and location of practice. The extent to which the GDPs reported their actual prescribing behaviour is unknown. It is not thought that the GDPs only gave socially desirable responses because most did openly discuss the advantages and disadvantages of prescribing or not prescribing to them in everyday practice. A strength of this study is the evenness of the pattern of the reported enablers and barriers identified to be relevant; however potential bias is acknowledged as it was only coded by the author. The interviews may also have benefited from the author not having any clinical training.

4.9 Conclusions and Contribution

The results strongly suggest that clinical, individual, patient and environmental factors continue to influence antibiotic prescribing decisions including the

inappropriate use of antibiotics. The perceived benefits of inappropriate prescribing could be explained by a lack of confidence in ability to persuade patients who expect an antibiotic that one is not required.

However, this study does not identify the relative importance of the identified salient TDF domains to facilitate potential targets of any future intervention. Therefore, this was explored further using a larger sample of GDPs working in primary care. This further research will support any decisions about whether the proposed intervention needs to focus on patients as well as GDPs.

CHAPTER 5 - SURVEY INVESTIGATING THE MANAGEMENT OF PATIENT EXPECTATION FOR ANTIBIOTICS BY GENERAL DENTAL PRACTITIONERS

OUTLINE OF CHAPTER

Given that the previous qualitative study has identified that dentists believed that the expectations of patients were a major influence in their decision to prescribe antibiotics, the aim of this element of the thesis was to identify the association of cognitions identified from the Theoretical Domains Framework and the intention to manage patients' expectations that the dentist will prescribe antibiotics.

This chapter describes the development, implementation and analysis of an online survey of 402 GDPs in Scotland. Its aim was to further an understanding of the salience of the TDF domains and beliefs identified in Study 1 as described in the previous chapter. The overall aim was to inform the development of the proposed behaviour change intervention.

5.1 SUMMARY OF STUDY 2

Background: Patient expectation has consistently emerged in previous studies as a factor that may influence GDPs antibiotic prescribing decisions (Chapters 1 and 3). The results of Study 1 described in Chapter 4 further supports patient expectation as being a current issue and crucial concern of GDPs in terms of following best practice. Any intervention to improve antibiotic prescribing behaviour needs to take this factor into account.

Aims: The overall aim was to inform the development of an intervention by establishing the possible targets of change and a likely mode of delivery.

Method: A cross-sectional on-line survey of GDPs working in primary care in Scotland was conducted. Data was collected using a bespoke 35-item TDF domain based questionnaire incorporating the results of the semi-structured interviews of 16 GDPs (Study 1). The specific beliefs of the TDF domains were used to further an understanding of GDPs perceptions relating to the influence of patient expectation and self-reported prescribing behaviour.

Findings: A total of 402 GDPs completed the survey. This sample was 63% female and experience ranged from less than 5 years to over 30 years (mean = 18 years). These GDPs mainly worked in general dental practice (96%), treated NHS patients (83%) and qualified in the UK (81%). The highest mean score was for beliefs about consequences (4.7) and the lowest scoring were beliefs about capabilities (2.9) and emotion (2.9). The mean scores for the proxy intentions of wanting and planning to prescribe were 2.2 and 5.7 respectively.

Nine specific beliefs associated with the TDF domains of beliefs about capabilities, beliefs about consequences, social influence and emotion were likely to influence how GDPs intend to manage patient expectations. Planning when to prescribe was positively related to beliefs about maintaining relationships, irregular attenders, changing patient views, patient expectations and disappointing patients. Wanting to prescribe was positively related to justifying the decision and the influence of professional bodies, but negatively related to patients who were irregular attenders. Prescribing to manage patient expectations occurred when GDPs were less confident in coping with upset and uncooperative patients, and found it difficult to change patients' views

Conclusion: A significant proportion of GDPs continue to prescribe antibiotics to manage patient expectations. This evidence suggests that GDPs perceive benefits in inappropriate prescribing despite knowing that these prescribing decisions are not justifiable, and it goes against best practice advocated by professional bodies. It confirms that a key barrier of evidence-base prescribing is confidence in skills to cope with patient expectations. These are the barriers perceived by GDPs, therefore it seems essential to also understand the patient perspective on expecting to receive antibiotics is required.

5.2 Introduction

In the previous chapter, it was identified that prescribing decisions can be influenced by patient expectation, i.e. inappropriate antibiotic prescribing may occur to manage expectations. This study investigated the salience of the specific beliefs of the TDF domains identified in the interview study with a larger sample of GDPs working in primary care.

5.2.1 Aims and Research Questions

The limited knowledge available about the specific beliefs underlying the 'umbrella term' of patient expectation guided the focus of this next empirical study. The aim was to identify the beliefs likely to underlie decisions associated with the management of patient expectation for antibiotics by using a new theoretically informed questionnaire. The second aim was to ask GDPs about their preferred modes of delivering interventions to inform a more pragmatic delivery of the proposed intervention. These findings would then be used to establish which

beliefs should be considered as potential targets for change and which are from a theoretical perspective more likely to be effective. The specific research questions to be addressed were:

(1) What specific beliefs influence prescribing behaviour in the context of managing patients' expectation for antibiotics?
(2) What barriers need to be changed for GDPs to better manage patients' expectation for antibiotics?
(3) Which mode(s) of delivery of future behaviour change techniques (BCTs) are likely to be acceptable to GDPs?

5.3 Methods

5.3.1 Design and Participants

The study was a cross-sectional on-line survey of GDPs working in dental primary care in Scotland. These dentists were either salaried GDPs in the NHS Community Dental Service, or independent GDPs who worked in general 'high street' practices offering NHS and private treatment to patients.

5.3.2 Questionnaire Measures

The on-line survey was developed using the TDF as its foundation. It was informed by the specific beliefs associated with TDF domains identified in Study 1. The independent variables (predictors) were the five TDF domains of beliefs about consequences, beliefs about capabilities, environmental context and resources, social influence and emotion. Individual items measured the beliefs specific associated with each of these domains.

Intention was selected as the outcome variable based on the Theory of Planned Behaviour (Ajzen, 1991) which proposes that intention is an antecedent of a behaviour, namely, people do what they intend to do or do not do what they do not intend to do. Although not a direct measurement of prescribing behaviour, proximal intention items are likely to indicate the likelihood of the behaviour of prescribing being performed or not.

Evidence from intervention modelling experiment studies has found that intention as a proxy outcome can be effectively used as a measurement of motivational strength or intention to perform the target behaviour of antibiotic prescribing (Treweek et al. 2013; Hrisos et al. 2008). Therefore, a proxy outcome of intention was measured by 2 items: wanting to prescribe (intention-w) and of planning when to prescribe (intention-p) as part of managing patient expectation. GDPs were asked to rate their level of agreement with a belief item on a 7 point Likert agreement scale (1 = strongly disagree; 7 = strongly agree).

Also, in the questionnaire were items asking about GDPs' perceptions of the available and on-going initiatives directed at patients to address the use of antibiotics, i.e. educational posters and information leaflets. Data on which mode(s) of delivery of potential future BCTs would be preferred and acceptable by GDPs were also gathered. All items were scored on a 7 point Likert scale of likelihood (1 = not at all likely; 7 = extremely likely).

Demographical details about gender, date of qualification as a proxy for experience, country of qualification, number of sessions (half days) per week, location of work, i.e. general or public dental service, and type of provision to adult patients if in

general dental service, i.e. proportion of NHS and/or private dental treatment were also collected.

The final questionnaire was organised into 3 sections with a total of 35 items, comprising of:

- 20 items measuring the 5 TDF domains;
- 9 items exploring GDPs' views on potential modes of delivery for the proposed intervention;
- 6 items asking for the GDPs demographic details.

Options to give comments for each of the 3 sections were also provided. Further details of how the TDF domain items were developed is described in the following section. The complete questionnaire is available in Appendix 9, Page 262.

5.3.3 Development of the questionnaire

The measurement of the influencing beliefs was developed by following a recognised approach for designing theoretically informed questionnaires (Atkins et al. 2017; Huijg et al. 2014) and guided by examples from other researchers who have previously published TDF informed interview topic guides (Newlands et al. 2016; Bussières et al. 2012; Duncan et al. 2012; Islam et al. 2012; Patey et al. 2012). There are standardised formats for TDF domain items available, but contextual modifications are usually needed before they could be used. This requires that the behaviour under investigation is clearly defined using the TACT principle (Fishbein, 1967) which describes the behaviour in terms of the Action being performed, its Target, and the Context and Time when it occurred.

In this study, the behaviour to be assessed was defined as 'managing patient expectation for antibiotics. The target was the 'patient', the action was the 'prescribing or not prescribing', the context was the 'expectation for antibiotics' and the time was during a 'dental appointment in primary care'. The individual items were based on the specific beliefs for each TDF domain identified in the interview study. An example of how the TACT principle underlies the construction of a belief about consequence item is shown in Table 5.1.

Table 5.1 Stages of item development using the TACT principle

TACT Principle	**I think [action] with [target population] in [context, time]**
TACT for study	When managing patient expectation for antibiotic [context], I think prescribe/not prescribing [action] for patients [target] attending a primary care practice with dental infections [time]
Example of Individual item (beliefs about consequences)	If a patient expects an antibiotic, I prescribe because I think patients are likely to be more pleased in their care.

5.3.4 TDF domain items in the survey

Based on the findings from the previous interview study (Chapter 4) the following sub-set of 5 TDF domains and their associated beliefs associated, and intention as defined above were included in the survey. An index of all TDF domain and intention items is shown in Table 5.2

Table 5.2 Index of TDF domains, intention and individual items in the questionnaire

TDF Domain	**Individual Items**
1. Beliefs about consequences	If a patient expects an antibiotic, I prescribe because I think: a) patients believe I am a caring dentist[1] b) patients believe I am a competent dentist[1] c) patients are likely to be more pleased in their care[1] d) this maintains the clinician-patient relationship[1] e) this is a quick solution for me f) this is an easier solution for me g) I can justify my decision
2. Beliefs about capabilities	When a patient expects an antibiotic, I am confident in not prescribing even if patients: a) are upset[1] b) become hostile towards me[1] c) not being co-operative[1] d) are irregular attenders[1] When a patient expects an antibiotic, it is easier to prescribe than e) explaining why an antibiotic is not required[2] f) changing patients' views on receiving an antibiotic[2]
3.Environmental context & resources	a) My dental practice does not allow me sufficient time to not prescribe[2] (i.e. to drain any abscess) b) SDR payments do not cover the time costs to deal with patient expectation
4. Social influence	a) My decision to prescribe can be influenced by patients expecting antibiotics b) Professional bodies expect me to manage patient expectation by not prescribing[2] (i.e. to drain any abscess)
5. Emotion	a) If a patient expects me to prescribe, I am concerned about disappointing them by not prescribing[2]
Proxy Outcome	**Individual Items**
6. Intention	If a patient expects an antibiotic: a) I want to prescribe as part of managing their expectation b) I have a plan about when I would prescribe

Overlap with other TDF domains[1] Social influences; [2] Beliefs about consequences

5.3.5 Pilot of Questionnaire

A group of dentists working at the Dundee Dental Hospital and some of GDPs who participated in the interviews piloted the questionnaire using an online link (n = 5). The dentists were specifically asked to assess the lucidity of the items and to indicate whether they thought these questions would be acceptable to GDPs. It was advised that their answers were not the focus of the piloting; the pilot responses of the questionnaire were excluded from the final study.

Positive feedback was received from 4 dentists; one dentist was unable to response within the required period due to holiday commitments. All dentists found the questions to be clear and understandable with none of them saying that answering them is likely to be unacceptable to GDPs. Although, one dentist did comment that some of the questions were possibly better directed at patients and not at GDPs. It was reported that it took under 10 minutes to complete the questionnaire which was less time than was anticipated. All items were answered, so consequently no items were omitted or changed. The only revision made to the final questionnaire was a reduction in the time required to complete it, i.e. from 10-15 minutes to 5-10 minutes.

5.3.6 Questionnaire Administration

In May 2017, an invitational email was sent to a sub-section of dentists who were registered as either a salaried or an independent GDP working in Scotland. This initial email included a brief introduction to the study and a link to the survey. The email was distributed to the GDPs via the NHS Education for Scotland Portal which is a national online course and management system available to healthcare

professionals including dentists. The SDPBRN hosted the survey on the portal using Questback© (https://www.questback.com/), an on-line survey tool, to collect the data on behalf of the researcher. A reminder was sent 3 weeks after the initial email. The link to the survey was accessible until the number of submitted replies met the requirements of the power calculation. The minimal number of 400 was reached after the questionnaire was on the portal for a period of 6 weeks. Data was downloaded into an Excel spreadsheet for analysis.

5.3.7 Statistical Analysis

Before any statistical analysis began, the dataset was cleaned. This included checking for missing values and outliers, and an inspection of the data distribution. The method applied to replace any missing data was individual mean imputation which substituted the omitted items values with the mean of the completed cases providing that no less than 5% of values are missing (Enders, 2011).

Checks for normal distribution of data included visual inspection of histograms and values of skewness and kurtosis. Cut-off criteria of items for the skewness and kurtosis statistics was values of greater than ±1 (Miles and Shelvin, 2009).

The internal consistency of the TDF domains was tested using a Cronbach's alpha. This is an evaluation of the unidimensionality of the belief items to measure a construct by calculating an average correlation between the items. A Cronbach's alpha of ≥ 0.70 is considered acceptable as this suggests that the items are measuring the same underlying concept (Nunnally, 1978).

Descriptives for the Likert scale measure of central tendency was the mean and standard deviation and for categorical measures the percentage of responses to

each category (agree, midpoint and disagree). Details of gender, level of experience, country of qualification, number of sessions per week, location of work and type of treatment provision were collected to assess the generalisability of the sample: t-tests and ANOVAs were conducted to examine whether group means differ from one another. The t-test was used to compare two groups and the one-way ANOVAs for more than two groups.

Multiple regression analysis was conducted to answer the research questions about relationships between independent variables and outcome variables in the study. Multiple regression analysis was used to develop a model to explore which TDF domains and individual items were likely to independently predict self-reported proxy intentions. Regression models for each of intention items: 'I want to prescribe as part of managing their expectation' (intention-w) and 'I have a plan about when I would prescribe' (intention-p) were conducted.

Prior to carrying out this analysis, the necessary assumptions of multiple regression were checked. These included tests for outliers, linearity, homoscedasticity and multi-collinearity, and a power calculation to determine the sample size.

The methods applied for detecting the non-normality of distribution of the data were graphical and numerical. Standardised z-scores were computed to determine univariate outliers in the dataset. Outlier cases with standard deviation values that were more than 3 from the mean were considered for elimination from the regression analysis, i.e. z-scores > 3.29.

Unusual combinations of the independent variables, i.e., multivariate outliers were detected using Mahalanobis' distance (MD) (Mahalanobis, 1936). MD values are

based on the Chi-Square distribution and interpreted using p values < 0.001 to indicate multivariate outliers. Identified cases were then considered for removal before the analysis. Linearity and homoscedasticity was verified by the visual inspection of the scatterplots.

The selection of variables into the regression model used was the enter method. This method enters all variables into the regression model at the beginning in a single step. It was selected because it is not known which of the independent variables will generate the best prediction model. After all variables are entered in step one, any variables with p-values of <0.05 were eliminated until a final model was produced of only significant predictors and only those necessary to account for as much of the variance as possible. The selection of a variable was guided by the objectives of the study and anecdotal intelligence gained from the interviews in study one. The regression analysis was first conducted using the TDF domains as predictors followed by the individual items to distinguish the effects of one domain and its beliefs over the others.

An *a priori* power calculation using GPower was conducted to determine the minimum sample size required to yield a meaningful result in the study. In the analysis using regression models, up to a maximum of 18 individual beliefs could be entered as predictors of managing patient expectation. Based on this number of predictors, a minimum sample size of 385 to achieve a 0.08 effect size with a 95% power based on a critical F (18,366) = 1.63 if using linear multiple regression analysis was required. Statistical analysis was performed using SPSS version 22.

5.4 RESULTS

5.4.1 Sample

In total, 402 questionnaires were returned from a potential 3,951 GDPs registered on the NHS portal in May 2017, giving a response rate of 10.2%.

5.4.2 Demographics of Sample

Most (96.2%) GDPs worked in general dental practices. On average, the GDPs worked 8 sessions ranging from one to 14 sessions per week. Just over half of the GDPs worked full-time with only 20.2% working < than 6 sessions (3 days) per week and the majority attended to all (20.5%) or mostly (62.3%) NHS patients. Nearly two-thirds (63.1%) of the GDPs who responded were female with all responders had an average of 18 years' experience, ranging from one to 47 years. Nearly 19 percent of the GDPs qualified out with the UK and over 90 percent reported working only in general dental service. A small percentage of the GDPs (10.8%) had mostly or all private patients. A breakdown of the demographics of the survey sample is shown in Table 5.3.

Table 5.3 Details of the demographics of the general dental practitioners

Characteristics	**Number (N = 399)**	**Proportion (%)**
Gender (n = 171)		
Male	62	36.2
Female	109	63.8
Level of experience (n = 395)		
Less than 5 years	42	10.6
Between 5 - 9 years	76	19.2
Between 10 - 14 years	64	16.2
Between 15 - 19 years	43	10.9
Between 20 - 24 years	36	9.1
Between 25 - 29 years	56	14.2
30 years and more	78	19.7

Characteristics	Number (N = 399)	Proportion (%)
Place of qualification (n = 395)		
In the UK	321	81.3
Outside the UK	74	18.7
Number of sessions (half days) per week (n = 386)		
4 or less sessions	26	6.7
4.5 - 6 sessions	52	13.5
6.5 - 8 sessions	100	25.9
8.5 - 10 sessions	199	51.6
More than 10 sessions	9	2.3
Location of work (n = 397)		
General dental service	382	96.2
Public dental service	10	2.5
Both GDS & PDS	0	0.0
Other	5	1.3
Adults patients- General dental service (n = 342)		
Only NHS	70	20.5
Mostly NHS	213	62.3
Equally NHS & Private	22	6.4
Mostly Private	28	8.2
Only Private	9	2.6

5.4.3 Representation of Sample

Whilst the overall response rate was low, the 402 completed questionnaires was sufficient to meet the minimal requirements of the power calculation. However, further investigations examined the representation of the sample.

Independent t-tests were conducted to compare the TDF domain responses between gender and place of qualification. No statistically significant differences between the responses from male and female GDPs was found for the TDF domains. However, there was a statistical difference, at a .01 level of significance, between GDPs trained in the UK and those trained out with the UK in environmental

context and resources but not for the other TDF domains. The results showed that non-UK trained GDPs scored higher (mean = 4.7) than GDPs trained in the UK (mean = 4.1). A one-way ANOVA to determine whether the GDPs' beliefs differed based on their work location found no significant differences between the general dental service (GDS), public dental service (PDS), a combination of GDS and PDS and an undefined 'other' location, number of sessions per week, level of experience and type of treatment provision. The results of the t-test and ANOVA analyses in shown in Table 5.4 on Page 121.

Table 5.4 Results of t-tests and ANOVAs comparing responses of the demographic variables sub-groups to TDF domains

Variable (TDF Domains)	Gender			Place of Qualification			Level of Experience			Number of Session			Location of work			Type of Treatment		
	Mean	t value	P value	Mean (Country)	t value	p value	Mean (Years)	F value	p value	Mean (per week)	F value	p value	Mean	F value	p value	Mean	F value	p value
Beliefs about consequences	**M** 4.7 **F** 4.5	1.05	0.30	**Non-UK** 4.4 **UK** 4.6	1.69	0.09	**< 5** 4.8 **5-9** 4.5 **10-14** 4.5 **15-19** 4.5 **20-24** 4.3 **25-29** 4.7 **>30** 4.8	1.38	0.22	**<4** 4.8 **4.5-6** 4.5 **6.5-8** 4.4 **8.5-10** 4.7 **>10** 5.2	2.05	0.09	**GDP** 4.6 **PDS** 4.6 **Other** 4.5	0.06	0.94	**NHS** 4.5 **>NHS** 4.5 **=NHS & Private** 4.8 **>Pr** 4.6 **All Pr** 5.3	1.49	0.21
Beliefs about capabilities	**M** 3.2 **F** 2.8	1.89	0.06	**Non-UK** 2.9 **UK** 2.9	-.003	0.99	**< 5** 2.7 **5-9** 3.1 **10-14** 3.0 **15-19** 3.1 **20-24** 2.8 **25-29** 2.7 **>30** 2.9	1.00	0.42	**<4** 2.8 **4.5-6** 2.8 **6.5-8** 3.0 **8.5-10** 3.0 **>10** 2.9	0.05	0.99	**GDP** 2.9 **PDS** 2.7 **Other** 3.1	0.58	0.56	**NHS** 2.8 **>NHS** 3.1 **=NHS & Private** 3.2 **>Pr** 3.1 **All Pr** 2.6	0.85	0.50
Environmental context & resources	**M** 4.4 **F** 4.3	0.31	0.76	**Non-UK** 4.7 **UK** 4.1	-3.13	0.002	**< 5** 4.3 **5-9** 4.6 **10-14** 4.2 **15-19** 4.4 **20-24** 4.0 **25-29** 4.2 **>30** 3.7	1.84	0.09	**<4** 4.1 **4.5-6** 4.0 **6.5-8** 4.3 **8.5-10** 4.2 **>10** 4.4	0.16	0.96	**GDP** 4.2 **PDS** 3.9 **Other** 3.2	0.34	0.71	**NHS** 3.9 **>NHS** 4.6 **=NHS & Private** 4.3 **>Pr** 4.0 **All P** 3.3	4.40	0.20

Variable (TDF Domains)	Gender			Place of Qualification			Level of Experience			Number of Session			Location of work			Type of Treatment		
	Mean	t value	P value	Mean (Country)	t value	p value	Mean (Years)	F value	p value	Mean (per week)	F value	p value	Mean	F value	p value	Mean	F value	p value
Social influence	**M** 4.5 **F** 4.4	0.80	0.43	**Non-UK** 4.6 **UK** 4.6	-.203	0.84	**< 5** 4.3 **5-9** 4.5 **10-14** 4.6 **15-19** 4.6 **20-24** 4.6 **25-29** 4.4 **>30** 4.3	1.24	0.29	**<4** 4.6 **4.5-6** 4.4 **6.5-8** 4.5 **8.5-10** 4.5 **>10** 4.2	0.42	0.79	**GDP** 4.5 **PDS** 4.6 **Other** 4.0	0.24	0.79	**NHS** 4.5 **>NHS** 4.5 **=NHS & Private** 4.8 **>Pr** 4.4 **All Pr** 4.2	0.84	0.50
Emotion	**M** 2.9 **F** 2.7	0.75	0.16	**Non-UK** 3.0 **UK** 2.8	-.046	0.84	**< 5** 3.2 **5-9** 3.1 **10-14** 2.7 **15-19** 2.7 **20-24** 2.5 **25-29** 2.9 **>30** 2.6	0.72	0.64	**<4** 2.2 **4.5-6** 2.7 **6.5-8** 2.9 **8.5-10** 2.8 **>10** 3.8	0.88	0.47	**GDP** 2.8 **PDS** 2.7 **Other** 2.0	0.09	0.92	**NHS** 3.0 **>NHS** 2.9 **=NHS & Private** 3.5 **>Pr** 3.0 **All Pr** 1.7	2.04	0.09

5.4.4 Analysis of the TDF Domains and Individual Items

Thirty-six questionnaires were incomplete, equating to 1.4% of missing values in the dataset. On the basis of this low percentage, missing values were replaced using mean imputation resulting in no cases being deleted from the dataset before analysis. It was noted that most of the missing values came from the same 14 GDPs, who did not response to most of the beliefs about consequences items.

Except for two items, all items were identified with a skewness and kurtosis values of <1. Intention-p (an outcome variable) and professional bodies expect me to manage patient expectation by not prescribing (social influence) were non-normally distributed with a skewness values of -1.6 (*SE* = 0.12) and -1.4 (*SE* = 0.12), and kurtosis values of 1.8 (*SE* = 0.24) and 2.3 (*SE* = 0.24). These values may warrant concerns in the regression analysis, however, based on the nature of the beliefs being measured the likelihood of highly positive responses were to be expected. The check for outliers found that 12 cases had z-scores greater than 3.29. Although, the 3 cases with z-scores of -4.32 were removed, the other nine cases were marginal so remained in the dataset for analysis. The final number of cases used in the analysis was 399.

The TDF domains with more than 3 items had an alpha value of greater than 0.6 (beliefs about consequences = 0.84 and beliefs about capabilities = 0.63). The correlations between the items of environmental resources and context had a Pearson's coefficient of r = 0.28 suggesting it is appropriate to combine as one domain, however, the 2 social influence items were not significantly correlated (r = 0.08), indicating that the items are tapping into different aspects of the domain. No

significant correlation was found between the two items of intention (r = -0.08), this indicated not using an aggregated score of intention as a latent outcome variable in the regression model. Whilst some caution for using a combined social influence domain score is noted based on this low correlation, these aggregated TDF domains scores were used in the multiple regression analysis.

5.4.5 TDF Domain and Intention Scores

The TDF domain with the highest summed mean was beliefs about capabilities (mean = 4.6; SD = 1.0). While, the lowest mean score was the same for beliefs about consequences (mean = 2.9; SD = 1.3) and emotion (mean = 2.9; SD = 1.8). The two predictor items of intention were scored very differently with 'plan when to prescribe' having the higher mean of 5.7 (SD = 1.5) and 'want to prescribe' the lower mean of 2.2 (SD = 1.5). All mean scores are out of a possible 7. A summary of the descriptive results is displayed in Table 5.5.

Table 5.5 Descriptive summary of TDF domains and intention outcomes, and their internal consistency (Cronbach's alpha)

Variables (TDF Domain/Outcome)	**No of items**	**Summed Mean (SD)**	**Range**	**Cronbach's Alpha**
Beliefs about consequences	7	4.6 (1.0)	1-7	0.84
Beliefs about capabilities	6	2.9 (1.2)	1-7	0.63
Environmental context & resources	2	4.2 (1.5)	1-7	n/a#
Social influence	2	4.5 (1.0)	1-7	n/a#
Emotion	1	2.9 (1.8)	1-7	n/a
Intention (Want)	1	2.2 (1.5)	1-7	n/a
Intention (Plan)	1	5.7 (1.5)	1-7	n/a

N/A < 3 items in scale

5.4.6 Score Frequency for Individual Beliefs

Ten percent of GDPs wanted to prescribe as part of managing patient expectation (n = 39) and 8% did not have a plan about when they would prescribe an antibiotic (n = 32). Prescribing was found to be easier than changing patients' views about receiving an antibiotic by 27% of GDPs (n = 106) and explaining why an antibiotic is not required by 18% of GDPs (n = 71).

In this sample, between 14% and 27% of GDPs were not confident in their capabilities to manage patient expectation when not prescribing an antibiotic. In circumstance when the patient is upset (n = 105), patient becomes hostile towards them (n = 57), patients not being co-operative (n = 69) and patient is an irregular attender (n = 54).

The results found between 13% and 25% of GDPs agreed that beliefs about consequences would influence their prescribing antibiotics to manage patient expectations. The reported consequences of prescribing were: (1) patients are more likely to be pleased with their care (n = 97); (2) prescribing maintains a good clinician-patient relationship (n = 76); (3) prescribing is a quicker solution for me (n = 70); patients believe I am a competent dentist (n = 61); this is an easier solution for me (n = 61) and patients believe I am a caring dentist (n = 51). Twenty-five percent of GDPs reported that they were could not justify their prescribing to manage patient expectation (n = 96).

The results found that 26% of GDPs felt that their practice does not give them sufficient time to not prescribe (n = 100) and 75% agreed that the SDR payment does not cover the time costs to deal with patient expectation (n = 290). Eighteen

percent of GDPs agreed that their decision to prescribe can be influenced by patient expecting antibiotics (n = 70) and 90% agreed that professional bodies expect them to manage patient expectation by not prescribing (n = 350). The results found 22% of GDPs are concerned about disappointing patients by not prescribing (n = 86). A summary of the frequency scores are detailed in Table 5.6.

Table 5.6 Frequency of scores for TDF Domain and belief items (n=389)

TDF Domain & Beliefs Items (Prescribing Decision)	Mean (SD)	Disagree (%)	Midpoint (%)	Agree (%)
Beliefs about consequences (Prescribing)				
Patients believe I am a caring dentist	2.3 (1.7)	294 (76%)	44 (11%)	51 (13%)
Patients believe I am a competent dentist	2.5 (1.7)	281 (72%)	47 (12%)	61 (16%)
Patients are more likely to be pleased with their care	2.9 (2.0)	245 (63%)	47 (12%)	97 (25%)
This maintains a good clinician -patient relationship	2.6 (1.8)	264 (68%)	49 (13%)	76 (19%)
This is an quicker solution for me	2.6 (1.9)	277 (71%)	42 (11%)	70 (18%)
This is an easier solution for me	2.4 (1.7)	294 (75%)	34 (9%)	61 (16%)
I can justify my decision	5.1 (2.2)	96 (25%)	28 (7%)	264 (68%)
Beliefs about capabilities (Not prescribing when)				
Patient is upset	5.7 (1.6)	105 (27%)	26 (7%)	258 (66%)
Patient becomes hostile towards me	5.6 (1.7)	57 (15%)	21 (5%)	311 (80%)
Patient is not being co-operative	5.4 (1.7)	69 (18%)	33 (8%)	287 (74%)
Patient is an irregular attender	5.6 (1.7)	54 (14%)	32 (8%)	303 (78%)
Beliefs about capabilities (Not prescribing)				
Easier than explaining why an antibiotic is not required	2.4 (1.8)	302 (78%)	16 (4%)	71 (18%)
Easier than changing patients' views on receiving an antibiotic	3.0 (2.0)	251 (64%)	32 (9%)	106 (27%)
Environmental context and resources (Not prescribing)				
My practice does not give me sufficient time to not prescribe	2.9 (2.0)	253 (65%)	36 (9%)	100 (26%)
SDR payment do not cover the time costs to deal with patient expectation	5.5 (1.7)	48 (12%)	51 (13%)	290 (75%)

TDF Domain & Beliefs Items (Prescribing Decision)	Mean (SD)	Disagree (%)	Midpoint (%)	Agree (%)
Social influence				
My decision to prescribe can be influenced by patients expecting antibiotics	2.7 (1.6)	270 (69%)	49 (13%)	70 (18%)
Professional bodies expect me to manage patient expectations by not prescribing	6.2 (1.2)	14 (4%)	25 (6%)	35 (90%)
Emotion: Not prescribing				
I am concerned about disappointing patients by not prescribing	2.8 (1.8)	265 (68%)	38 (10%)	86 (22%)
Intentions				
I want to prescribe as part of managing patient expectations	2.2 (1.5)	303 (78%)	47 (12%)	39 (10%)
I have a plan about when I would prescribe	5.7 (1.5)	32 (8%)	37 (10%)	320 (82%)

5.4.7 Individual Belief Item Scores

The mean scores for all items ranged from 2.2 to 6.2, indicating that these beliefs have varying salience to GDPs for managing patient expectation. The two beliefs with the highest mean scores were 'professional bodies expect me to manage expectation by not prescribing' (6.2; SD = 1.2) and 'I am confident in not prescribing despite patients being upset' (5.7; SD = 1.6). The two beliefs with the lowest mean scores were 'I prescribe because patients believe I am a caring dentist' (2.3; SD = 1.7) and 'This is an easier solution [prescribing] for me' (2.4; SD = 1.7). Wanting to prescribe had a lower mean score of 2.2 (SD = 1.7) compared to 5.7 for planning when to prescribe (SD = 1.7).

5.4.8 Predicting the Management of Patient Expectation

Multiple regression analysis was used to test if the TDF domains significantly predicted the surveyed GDPs' intentions of managing patient expectation. The two outcome variables were wanting to prescribe (intention-w) and planning when to prescribe (intention-p).

At a domain level, multicollinearity was unlikely to be an issue as the highest Pearson's correlation was r = .53 (beliefs about consequences); however moderate to larger correlations were reported among the individual items. This was to be expected as these beliefs were intended to measure a TDF domain, however none of the correlations were greater than 0.9 so they all were included in the regression analysis. No multivariate outliers were identified using the Mahalanobis distance criteria of $p > 0.001$.

The histograms of standardised residuals indicated close to normally distributed standardised residual errors, as did the normal P-P plot of standardised residuals which showed points on or around the line. The data also met the assumptions of homogeneity of variance and linearity as shown in the scatterplot of standardised residuals. The histograms and graphs for the four final regression models are displayed in Appendix 10, Page 271.

5.4.8.1 Predictors (TDF Domains) of wanting to prescribe

Two cases with standard residuals > 3.29 were identified and removed from the analysis. Using the enter method of regression, it was revealed that three TDF domains significantly explained 41% of the variance in wanting to prescribe as part of managing patient expectation (F (3,395) = 91.24), $p < 0.001$ Adj. $R^2 = 0.41$). The result indicated that beliefs about capabilities ($\beta = 0.39$, $p < 0.001$), social influence ($\beta = 0.27$, $p < 0.001$) and emotion ($\beta = 0.24$, $p < 0.001$) were significant predictors. Beliefs about consequences, environmental context and resources beliefs, and the demographical variables did not significantly predict wanting to prescribe to manage patient expectation. The results are shown in Table 5.7.

Table 5.7 Results of multiple regression analysis assessing predictor variables of intention-w

Variables	**B**	**β**	**t value**	**p value**	**B**	**β**	**t value**	**p value**
	Model 1 (All Domains)				*Model 2*			
Beliefs about capabilities	0.39	0.33	7.18	0.001	0.39	0.33	7.29	0.001
Environmental context and resources	0.02	0.02	0.03	0.68				
Beliefs about consequences	-0.00	-0.00	7.18	0.98				
Emotion	0.23	0.29	6.27	0.001	0.24	0.29	6.47	0.001
Social influence	0.26	0.18	3.89	0.001	0.27	0.19	4.15	0.001

5.4.8.2 Predictors (TDF domains) of planning when to prescribe

After 12 cases with standard residuals of > 3.29 were removed, the results of the final analysis revealed that only beliefs about consequences explained a small but significant amount of the variation (4%) in planning when to prescribe to manage patient expectation (F (1,) = 18.20), $p < 0.001$, Adj. $R^2 = 0.04$). None of the other TDF domains were significant predictors of Intention-p. Results are shown in Table 5.8.

Table 5.8 Result of multiple regression analyses assessing predictor variables of Intention-p

Variables	**B**	**β**	**t value**	**p value**	**B**	**β**	**t value**	**p value**
	Model 1 (All variables)				*Model 2*			
Beliefs about capabilities	0.01	0.01	0.19	0.85				
Environmental context and resources	0.02	0.03	0.63	0.53				
Beliefs about consequences	0.30	0.21	4.11	0.001	0.30	0.21	4.27	0.001
Emotion	-0.06	-0.07	-1.20	0.23				
Social influence	0.02	0.03	0.46	0.65				

5.4.9 Predicting the Management of Patient Expectation from Individual Beliefs

Further investigations examined whether the individual beliefs within the TDF domains were predictors of intentions. Therefore, a further two multiple linear regressions were conducted to help determine which of the 18 belief items predicted intention-w and intention-p.

5.4.9.1 Predictors of Wanting to Prescribe

Since, the TDF domains likely to predict intention-w have been identified, it seemed pragmatic to enter these domain items into the model regression first. These 9 items explained a significant variation in intention-w, Adj. $R^2 = 0.46$. The higher significant predictors were ‘My decision to prescribe can be influenced by patients

expecting antibiotics' (β = 0.33, p < 0.001), 'I am concerned about disappointing patient by not prescribing' (β = 0.21, p < 0.001) and 'changing patients' views on receiving antibiotics' (β = 0.17, p < 0.001). Three cases with z-scores > 3.29 were identified and so were excluded from the subsequent analysis.

As the other items may also be significant predictors, a second regression that included all 18 items was also conducted. These items produced an Adj. R^2 of .51 (F (9,389) = 37.34), p < 0.001) and identified that 'maintaining the clinician and patient relationship' was an also a significant predictor (β = 0.22, p < 0.05) of intention-w. All items with non-significance coefficients were removed and another regression analysis was carried out (Model 3). This regression revealed that five items significantly explained 52% of the variance in wanting to prescribe as part of managing patient expectation (F (5,390) = 85.21), p < 0.001). The model indicated that beliefs about 'Maintaining a good clinician-patient relationship' (β = 0.25, p < 0.001), 'Being influenced by patients expecting antibiotics' (β = 0.24, p < 0.001), 'Changing patients' views on receiving antibiotics' (β = 0.19, p < 0.001), 'Concerns about disappointing patients by not prescribing' (β = 0.11, p < 0.05) and 'Irregular attenders' (β = -0.11, p < 0.05), were likely to be significant predictors of wanting to prescribe. None of the other items were statistically significant predictors of intention-w. A summary of the results in displayed in Table 5.9.

Table 5.9 Result of multiple regression analyses assessing predictors (Individual items) intention-w

Variables	B	β	t value	p value	B	β	t value	P value	B	β	t value	p value
	Model 1 (Domain items)				*Model 2 (All items)*				*Model 3*			
Caring dentist					0.01	.02	0.20	0.84				
Competent dentist					0.05	.06	1.03	0.30				
Pleased with care					-0.01	-.02	-0.23	0.82				
Maintain relationship					0.17	.22	2.64	0.01*	0.21	.28	6.25	0.001***
Quick solution					-0.01	-.01	-0.17	0.87				
Easier solution					0.00	.00	0.08	0.94				
Justify decision					0.02	.03	0.84	0.40				
Upset patients	-0.05	-.05	-.65	0.51	-0.04	-.04	-0.53	0.60				
Hostile patients	-0.11	-.12	-1.62	0.11	-0.09	-.10	-1.37	0.17				
Un-cooperative	0.12	.15	2.29	0.02*	0.13	.15	2.47	0.01*				
Irregular attender	-0.09	-.10	-1.98	0.05*	-0.11	-.13	-2.49	0.01*	-0.11	-.13	-3.5	0.001**
Explain not required	0.06	.08	1.51	0.13	0.08	.10	1.79	0.05				
Change views	0.12	.17	3.22	0.001***	0.09	.12	2.29	0.02*	0.11	.195	3.39	0.001***
Insufficient time					-0.00	-.00	-0.03	0.97				
Payment for time					-0.03	-.03	-0.83	0.41				
Patient expects	0.29	.33	6.74	0.001***	0.20	.22	4.21	0.001***	0.23	.27	5.7	0.001***
Pro. bodies	-0.05	-.04	-1.09	0.28	-0.04	-.03	-0.89	0.38				
Disappoint patient	0.18	.21	4.74	0.001***	0.16	.20	4.20	0.001***	0.13	.16	3.81	0.001***

Note: Adj.R^2 = .46 for model 1; Adj. R^2 = .51 for model 2; Adj.R^2 = .49 for model 3 ($p < 0.001$); * $p < 0.05$; **$p < 0.01$; ***$p < 0.001$

5.4.9.2 Predictors of Planning when to Prescribe

Eleven cases of outliers were identified using z-scores > 3.29, so were deleted from the subsequent analysis. Initially, the items of beliefs about consequences were entered into the regression as this TDF domains was likely to be a predictor of planning when to prescribe as reported earlier. The regression model was insignificant ($F (7,391) = 1.82$), $p < .08$, Adj. $R^2 = 0.03$) and only 'I can justify my decision [to prescribe]' was a significant predictor ($\beta = -0.14$, $p < 0.05$). Repeating the same process as for the other predictor, a second regression analysed using all items was conducted.

This resulted in a significant model explaining 11% of variation in planning when to prescribe ($F (18,380) = 2.55$), $p < 0.001$, Adj. $R^2 = 0.11$). It revealed 'Irregular attenders' to be a highly significant predictor ($\beta = 0.22$, $p < 0.001$), and that other likely predictors were 'patient becoming upset' and 'professional bodies' expecting me to manage patient expectation by not prescribing'. After several permutations of removing items with non-significant coefficients were tested. A final model (3) indicated that 3 items significantly explained a small but significant variation in planning when to prescribe ($F (3,384) = 25.82$), $p < 0.001$, Adj. $R^2 = 0.17$). Model 3 revealed that beliefs about 'Irregular attenders' ($\beta = -0.24$, $p < 0.001$), 'I can justify my decision [to prescribe]' ($\beta = -0.11$, $p < .05$) and 'professional bodies' expecting me to manage patient expectation by not prescribing' ($\beta = -0.11$, $p < .05$) were likely to be significant predictors of planning when to prescribe. A summary of the results is displayed in Table 5.10.

Table 5.10 Result of multiple regression analyses assessing predictors (Individual items) of intention-p

Individual Items	**B**	**β**	**t value**	**P value**	**B**	**β**	**t value**	**p value**	**B**	**β**	**t value**	**p value**
	Model 1(TDF domains)				*Model 2 (all items)*				*Model 3*			
Caring dentist	-0.11	-.12	-1.20	0.23	-0.03	-.04	-0.38	0.71				
Competent dentist	0.04	.05	0.54	0.59	-0.00	-.00	-0.02	0.99				
Pleased with care	-0.09	-.11	-1.00	0.32	-0.07	-.09	-0.78	0.44				
Maintain relationship	0.13	.15	1.39	0.17	0.09	.11	1.03	0.30				
Quick solution	0.02	.03	0.56	0.58	0.04	.05	0.93	0.35				
Easier solution	-0.05	-.06	-0.97	0.33	-0.01	-.01	-0.22	0.83				
Justify decision	0.09	.14	2.69	0.001*	0.07	.10	2.11	0.04*	0.07	.12	2.61	0.001**
Upset patients					0.17	.17	1.76	0.08				
Hostile patients					-0.14	-.16	-1.58	0.12				
Un-cooperative					0.00	.00	0.04	0.97				
Irregular attender					0.19	.22	3.23	0.001**	0.24	.33	6.99	0.001***
Explain not required					-0.04	-.05	-0.71	0.48				
Change views					0.07	.09	1.26	0.21				
Insufficient time					0.01	.01	0.23	0.82				
Payment for time					0.06	.07	1.23-	0.22				
Patient expects					-0.02	-.02	0.29	0.78				
Pro. bodies					0.11	.08	1.62	0.11	0.12	.18	3.95	0.001***
Disappoint patient					-0.03	-.04	-0.62	0.54				

Note: Adj. R^2 = .03 for model 1; Adj. R^2 = .11 for model 2; Adj. R^2 = .17 for model 3; ($p < 0.001$). * $p < 0.05$; **$p < 0.01$; ***$p < 0.001$

5.4.10 Perception of initiatives to manage patient expectation analysis

Overall, GDPs scored low for patients paying attention to information leaflets and posters in the waiting room. Using a Likert scale of 1 'not at all likely' to 7 'extremely likely', the mean score was 3.4 for information leaflets (SD = 1.4) and for posters it was 4.0 (SD = 1.6). Whilst, a higher percentage of GDPs reported low attention of information leaflets by patient, they were more equivocal about the use of posters with 42% scoring ≤ 3 and 37% scoring ≥5. Perceptions of initiatives directed at patients are summarised in Figure 5.1.

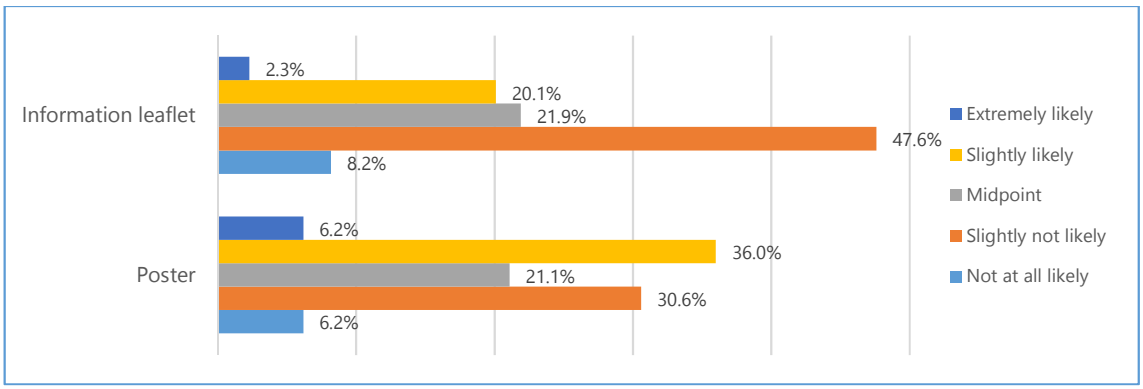

Figure 5.1 Percentages of likelihood of patients' paying attention by GDP

On average for managing patient expectation, GDPs believed that who in the dental practice handed out the information leaflet before an appointment made no difference. The mean scores and standard deviations (SD) were 3.9 for receptionists (SD = 1.8) and 3.8 for dental nurses (SD = 1.7). A higher percentage of GDPs reported that longer appointment times (mean = 5.1; SD = 1.7) than learning about communication strategies (mean = 4.4; SD = 1.8) would be the most helpful for managing patient expectation. A breakdown of the scoring percentages is shown on Figure 5.2.

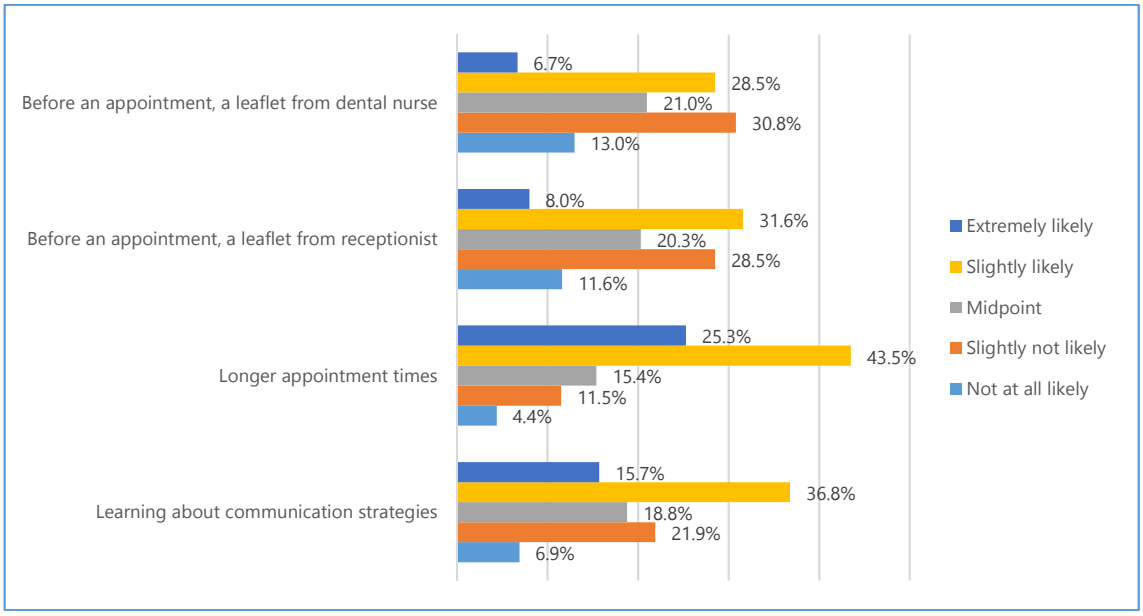

Figure 5.1 Percentages of likelihood of being helpful in managing patient expectation

A higher percentage of GDPs had positive preferences for instructor-led/PowerPoint (mean = 5.0; SD = 1.6), followed by computer training, i.e. e-Learning (mean = 5.7; SD = 1.8). The option of interactive discussion/role play whilst being the least preferred option (mean = 3.9), it also had the most variation of responses (SD = 2.1). Further details of the delivery mode preferences are summarised in Figure 5.3.

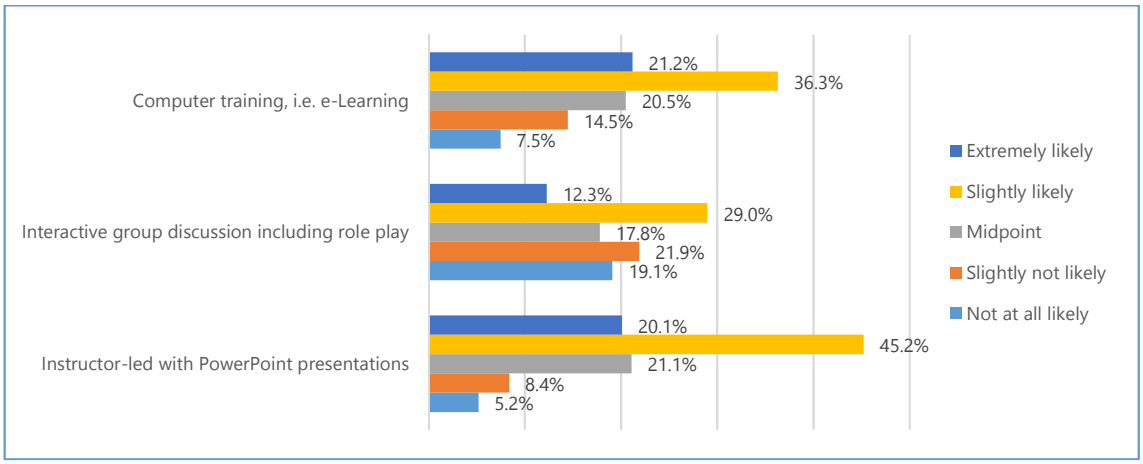

Figure 5.3 Percentages of likelihood of preferred modes of delivery

5.5 Discussion

The aims of this study were to identify the beliefs influencing prescribing decisions associated with the management of patient expectations and to inform the development of the proposed intervention.

5.5.1 Specific Beliefs associated with patient expectations for antibiotics

The first aim was to identify the specific beliefs influencing prescribing behaviour in the context of managing patients' expectation for antibiotics. The results indicated that these surveyed GDPs felt that their prescribing decisions were influenced by patient expectations. The likely benefits of prescribing were not disappointing the patient, but this came with concerns about justifying their decision to manage patient expectations by prescribing.

The important specific beliefs influencing inappropriate prescribing were often associated with confidence. Less confidence mainly occurred when patients became upset or were not being cooperative. The easiness of prescribing when faced with these difficulties and also in changing patients' views and explaining why antibiotic was not required was reported by some GDPs. Other benefits of prescribing to manage patient expectation occurred when GDPs believed it maintained the clinician-patient relationship and that patients would be more pleased with their care.

External factors reported to potentially influence prescribing were lack of appointment time and insufficient payment to cover the time costs required to manage patient expectations. The advantages of having longer appointment times to manage dental infections is commonly reported in other dental studies as a key

factor influencing appropriate prescribing (Newlands et al. 2016). The strength of this relationship between appointment time and the likelihood of the patient receiving an antibiotic despite the absence of infection was reported to be 10 times higher than when the GDPs had more time to treat surgically in 590 clinical cases with 52 GDPs (Cope et al. 2016). However, the advantage of having more time was described in interviews as less pressure with carrying out clinical treatment and not for persuading unwilling patient or those expecting an antibiotic to have treatment which is acknowledged as a key factor influencing prescribing decisions (Cope et al. 2014).

Whilst the majority of GDPs did report not wanting to prescribe to manage patient expectations, a small proportion (10%) did want to prescribe. Eighty-seven percent of GDPs planned when they would prescribe, but 8% did not have a plan.

5.5.2 Barriers predicting antibiotic prescribing intentions

The second aim of this study was to identify the potential barriers that predict intentions of managing patient expectation. Some of the TDF domains did significantly predict intention to prescribe as a way of managing patient expectation. Regression analyses explored the two aspects of intention to prescribe (wanting to prescribe (intention-w) and planning when to prescribe (intention-p)) in more depth. Of the sub-set of 5 TDF domains identified in interview study, Beliefs about capabilities, social influence and emotion accounted 51% of the variance in wanting to prescribe whilst only domain of belief about consequences predicted a less than 10% of the variance in planning of when to prescribe. Despite some agreement that the environmental context and resource related beliefs of limited

time and insufficient payment were relevant when not prescribing, it was not significantly predict wanting or planning when to prescribe.

Further explanation of prescribing intentions were explained at individual item level than by TDF domains. Five key individual items explained over half of the variation in intention-w. The key predictors of wanting to prescribe were beliefs of maintaining the clinician-patient relationship and the perceived influence of patients expecting antibiotics. Whereas for planning when to prescribe, the focal individual item was 'confidence in not prescribing to patients who were not regular attenders of the practice. None of the personal details or working environment were significantly relevant to intentions of prescribing.

In summary, the results suggest that some GDPs would agree of all the measured belief can potentially influence their prescribing decisions, the more influential beliefs of wanting to prescribe is confidence in managing negative consequence of not prescribing. On contrast when GDPs planned when to prescribe, it was often not to patients who regularly attended, but their decision could be justified and adhered to recommended practice professional bodies.

5.5.3 Potential modes of delivery

This study sought to identify whether GDPs had preferences between possible intervention design or delivery modalities. This surveyed sample perceived that current interventions such as posters and information leaflets have a marginal benefits of persuading patients that antibiotics are not required. These GDPs preferred instructor-led/PowerPoint interventions, so this should be considered

when operationalising the behaviour change techniques identified for implementation in the future intervention.

5.5.4 Limitations and Strengths

One potential limitation of this study is the use of self-reported intention as an interim endpoint of prescribing behaviour. Past research suggests that for this method to be valid, the measured intention must be predictive of behaviour outcomes in the real world (Bonetti et al. 2005). Whilst it is uncertain whether planning or wanting to prescribe are predictive of actual prescribing behaviour, it was deemed to be an acceptable measurement based on evidence from a systematic review of 10 studies developing interventions that found intention to be an effective measure of interim outcomes of 5 clinical different behaviours (Eccles et al. 2006).

A strength of this study is that the survey has provided some validation as 16 out of 19 specific beliefs identified in the interviews (Study 1) were significantly related to managing patient expectations.

5.6 Conclusions and Contribution

The findings of this study strongly suggest that increasing GDPs' confidence in managing patient expectation may be an important factor in determining intention to prescribe, and so is an area where intervention may lead to reduction in inappropriate prescribing in primary dental care. This study has identified beliefs that could provide intervention targets.

The previous studies have only focussed on GDPs' perspectives of patient expectations but given the role of patients in prescribing decisions further investigation into patients' views is required.

5.7 Next Steps

The next step in the thesis as part of the empirical studies is to understand the accuracy of these patient-related specific beliefs by GDPs. This study is presented in the next chapter.

CHAPTER 6 - ANTIBIOTICS FOR DENTAL CONDITIONS: PATIENTS' EXPECTATIONS

OUTLINE OF CHAPTER

As part of the overall aim of developing an intervention, it had emerged from both the previous qualitative and survey work with dental practitioners that patient expectations were an important belief with regard to antibiotic prescribing. In order to explore the expectations of patients, a questionnaire survey of patients was conducted to identify the association of cognitions identified from the Theoretical Domains Framework and patients' expectations that the dentist will prescribe antibiotics. This chapter describes the development, implementation and analysis of the second on-line survey of 291 patients in two NHS health boards in Scotland (Study 3). Its aim was to further an understanding of patients' expectations for antibiotics as identified in study 2 in the previous chapter. The overall aim was to inform the development of the proposed intervention.

6.1 SUMMARY OF STUDY 3

Introduction: Evidence from past research and studies 1 and 2 of this thesis suggests that inappropriate prescribing is likely to be determined by the dyadic nature of the communication between GDP and patient. Even before this conversation begins some assumptions are possibly made by GDPs which may influence their decision to prescribe inappropriately. As far as the author was aware all previous research on this topic has only focussed on the GDPs' or stakeholders' perspectives and any evidence of patients' views on expectations is missing. It seems important to have

an understanding of the patients' perspective given that it appears to play a crucial role in GDPs intentions to prescribe an antibiotic.

Aim: The aim of this study was to seek the patients' perspective of expecting to receive antibiotics for dental pain and to inform the content of the proposed intervention. Also, a sub-study tests the effectiveness of two patient recruitment approaches as part of the main study.

Methods: A cross-sectional on-line survey of a purposive sample of patients registered on Scottish Health Research Register in Scotland. A 12-item questionnaire measured the dental experience, expectations for antibiotics, patients' perceived consequences of not receiving an antibiotic and accepting surgical treatment. In addition, an experimental sub-study was performed, where patients were randomly selected to receive either a formally or informally worded invitations or information sheets to participate in the survey.

Key Results: A total of 291 patients completed the questionnaire. The surveyed sample were 39% male and the age range was 18 - 87 years (mean = 56 years). These patients mainly reported attending a dentist every 6 months (83%), experiencing dental pain (51%), received antibiotics in the last 2 years (15%) and prescribed at an emergency appointment (47%).

For dental pain, 31% patients expected to receive antibiotics and 35% did not expect antibiotics, whilst 34% were uncertain. For the patient characteristics of gender and age, and past experiences of dental attendance, dental pain, prescribed antibiotics in the last two years, and appointment location there was little difference in expectations to receive antibiotics. Patients' views associated with not

receiving antibiotics for dental pain were similar across the expectation categories. Patients' expectations are unlikely to be associated with their past experiences of and receiving antibiotics for dental pain. Influential views were beliefs about getting better, being satisfied the GDPs knows best and is doing the right thing by not prescribing.

Experimental Sub-study result: Significantly more people who received the formal recruitment invitation agreed to take part in the on-line survey.

Conclusion: A significant proportion of patients continue to expect antibiotics for dental pain. This evidence indicates the potential level of pressure from patient experienced by GDPs to prescribe inappropriately. This suggests that components of the proposed intervention should aim to encourage and support GDPs to overcome patient expectation by increasing their skills and confidence, and to address their concerns about the potential negative consequence of not prescribing antibiotics.

Careful consideration should be given to the wording of recruitment invitations and information sheets as small changes could increase how many people are likely to participate in research studies.

6.2 Introduction

The GDP survey study described in the previous chapter identified that GDPs often give expectations for antibiotics as a reason for prescribing and the potential negative consequences if they were to not prescribe to these patients. Although,

GDPs perceive that there to be some level of demand from patients for antibiotics, there is no evidence in the dental context whether it is supported by patients.

The literature search found that no studies focussed on understanding expectations for antibiotics from a patient perspective but instead only considered GDPs and stakeholders perspectives. In addition, GDPs are not alone in their perceptions of patients' expectations as there is also evidence from other primary care health professionals who also reported it is a contributing factor of prescribing decisions (Gaarslev et al. 2016; Mustafa et al. 2014).

Given its influence as reported in Studies 1 and 2 on GDPs prescribing decisions, it is therefore essential to identify the patients' views underlying their expectations for antibiotics. Therefore, the next step in this thesis was to investigate whether the assumption made by GDPs that patients expect to be prescribed antibiotics is also supported by patients. Knowledge of these views may inform which behaviour change techniques aiming to address the influence of patients' expectations on GDPs prescribing decisions should be included in the proposed intervention.

Anecdotal knowledge from the SDPBRN suggests that recruitment of patients into dental research can be challenging and published evidence has shown that it was not possible to recruit any patients from one of its case-study practices (Templeton et al. 2016). Despite these challenges, there is often little, or no details provided about the recruitment materials used to recruit. It was conceived that a less formally worded invitation style could be more appealing and perhaps help to overcome any potential uncertainty about participation. Therefore, a sub-study

was conducted that examined the effectiveness of using formally and informally worded invitations and information sheets to ask patients to complete the survey.

6.2.1 Aims and Research Questions

The aim of this study was to further understand patient expectations and to build on the knowledge from the previous studies. In addition, it will inform the design of an intervention aiming to enable GDPs to overcome patient expectations that might pressurise them into non-evidence based prescribing decisions.

The research questions were:

(1) What are patient views about being prescribed an antibiotic for dental pain by GDPs?

(2) Do any patient characteristics and previous dental experiences influence their views about receiving antibiotics for dental pain?

(3) Is the response rate improved by using a simple stylistic difference in wording using the same mode of delivery?

6.3 METHODS

6.3.1 Design

The study was a cross-sectional on-line survey of a sample of medical patients in NHS Fife and NHS Tayside on the Scottish Health Research Register.

6.3.2 Participants

Individuals were recruited from the Scottish Health Research Register (SHARE) established by NHS Research Scotland (https://www.registerforshare.org/). The register consists of over 40,000 patients who have already given consent for their

electronic health records to be used for research purposes and permission given to be approached about participating in research studies. A copy of the SHARE agreement letter is available in Appendix 11, Page 273.

Inclusion criteria: All individuals from the register in January 2017 who live in the two health board areas of NHS Fife and NHS Tayside, and over 18 years of age and under 90 were eligible to take part in the study. From this sample, a randomly selected sub-sample of 1000 was identified. This sample of 1000 was based on discussions with SHARE about their previous recruitment experiences. It was decided to achieve 400 individuals agreeing to complete the survey, this was a pragmatic sample size and also it was optimal number possible within the financial resources of the thesis.

6.3.3 Questionnaire development

The new bespoke questionnaire was developed using the information gathered in the GDP interviews (Study 1) and the results of the GDP survey (Study 2).

6.3.4 Questionnaire items

The on-line survey was divided into 5 sections covering different aspects of patient expectations and demographic information:

(1) Dental Experiences

- Attendance - *How often do you see a dentist?*
- Previous antibiotics use - *Have you been prescribed an antibiotic by a dentist in the last 2 years?*
- Context - *Was the antibiotic prescribed at an emergency appointment?*
- Dental pain - *Have you ever experienced a relentless, throbbing toothache?*

(2) Expectations

- Expectations for antibiotics - *If you have a relentless, throbbing toothache, would you expect to receive an antibiotic?*
- Outcome of receiving an antibiotic - *If you have a relentless, throbbing toothache, would you think it will get better with an antibiotic?*

The purpose of asking these last two items was to verify whether the expectations of these patients supported or not its perceived relevance by GDPs and also to assess the current levels of expectations.

Further data about what the patients might think or do, if not prescribed an antibiotic according to their expectations were also gathered. The response options provided were derived from the salient beliefs elicited in the earlier GDP interviews (Study 1). These items were as follows:

(3) Beliefs about consequences of no antibiotics

- *If you have a relentless, throbbing toothache, and did not receive an antibiotic*, would you:
    a) Feel upset?
    b) Go elsewhere?
    c) Be satisfied because the dentist knows best?
    d) Ask your dentist for one?
- *If you have a relentless, throbbing toothache, and did not receive an antibiotic*, would you think the dentist is?
    a) Doing the right thing;
    b) A caring dentist;

c) A competent dentist.

The next item asked about the individuals' response to being told that surgical treatment is required and if an antibiotic would be expected as an adjunct to treatment. The surgical procedures of a root canal treatment or an extraction of the tooth were the given options based on the SDCEP guidance, *'Drug Prescribing for Dentistry', (3rd Edition)*. The 3 options were:

(4) Acceptance of surgical treatment

If your dentist told you surgical treatment is required, are you likely to,

- Ask for an antibiotic and delay getting root treatment at that time?
- Ask for an antibiotic and delay getting the tooth extracted at the time?
- Expect to receive an antibiotic along with surgical treatment?

Details of the individual's age and gender were also collected in the questionnaire.

6.3.5 Response Options

All items were scored on a categorical response scale of 'yes', 'no', 'maybe/unsure' and 'don't know' except for age and gender. The design of the questionnaire followed the established best practice advocated by Dillman, (2000). This is that, after defining the purpose and scope of the survey, the questions should be easy to read and understand, grouped by type and follow a logical order.

The final product was a short questionnaire which had 12 items including an option to give comments at the end. The same items were asked in the formal and informal invitation versions; only the introduction and the participant information sheet were different.

A copy of the questionnaire, *'Antibiotics for Dental Conditions: Patients' Expectation'* is available in Appendix 12, Page 275.

6.4 PROCEDURES

6.4.1 Sample Recruitment

A randomly selected sub-sample of patients (n = 1000) on the SHARE register who fitted the inclusion criteria were identified by Health Informatics (HIC), University of Dundee. SHARE's protocol required initial contact by a telephone call before sending out an invitational email using the standard format that had been approved by NHS Ethics. A link to the on-line survey was provided in the recruitment email.

This sub-sample was further randomly sub-divided by SHARE so that one half received a formally worded invitation, and other half of the sample received an informally worded invitation to participate. The difference between the two approaches was in the language used in the invitation and amount of information received about what the individual was being asked to do. The formally worded invitation text used by SHARE is shown below.

> *Antibiotics are essential for treating infections, but they are becoming less effective as bacteria develop resistance to them. This increasing resistance is made worse by the over-use of antibiotics by health care professionals. This PhD project is investigating the prescribing of antibiotics by dentists who work in primary care. This part of the PhD project is exploring patients' views on receiving antibiotics for dental pain, i.e., toothache.*
>
> *Many patients have been invited to obtain a large range of views on and experiences of antibiotic prescribing for dental pain by their dentist.*

The aim is to explore patients' expectations about antibiotics for dental pain when attending a dental practice.
Participating in this study will require you to complete a short questionnaire. An online link to the questionnaire will be sent to you shortly after this call. In the questionnaire, there are 12 questions each with a list of reply options. There is also a comment box where, if you wish, you can add any further relevant details. It should take no more than 5-10 minutes to complete the questionnaire.
Your responses will be anonymous.

Copies of the formally and informally worded participant information sheets are available in Appendix 13 (Page 279) and Appendix 14 (Page 282) respectively.

Whilst telephoning potential participants, responses were logged as either no reply, interested or not interested in taking part in the survey and no longer eligible, i.e. not resident within NHS Fife or NHS Tayside as per NHS R&D approvals. Recruitment by SHARE ran for a period of 5 months from beginning of May 2017 until the end of September 2017.

6.4.2 Survey Administration

The online survey used the Questback platform hosted by the SDPBRN. The raw data from each survey was downloaded from Questback into an Excel spreadsheet, then it was combined into one dataset before importing it into SPSS 22.

6.4.3 Statistical Analysis

Item responses were collated into 3 categories (expected, not expected and uncertain (unsure/do not know). Responses to the standardised questions

(categorical data) were analysed as frequency and percentage. Responses to the open-ended questions were coded into themes.

The views from the comments section were sorted into an Excel matrix and analysed using a simple framework method. This resulted in the specific beliefs being identified and then coded under themes. The outcome was to reveal any 'new' beliefs or to add more details to those included in the questionnaire items.

6.4.4 Ethical considerations

This inclusion of patients required an amendment to the original protocol to be submitted to the Tayside Medical Science Centre (TASC) Research and Development Office for consideration. TASC liaised with the East of Scotland Research Ethics Service who confirmed that NHS REC ethical review and approval were not required. In addition, the amendment was submitted to the NHS Research Scotland Permissions Coordinating Centre (NRSPCC) and it was reviewed by the University of Dundee's School Research Committee for Dentistry/Nursing & Health Services (SREC-SDEN) to fulfil the requirement of the PhD thesis. NHS R&D approvals were received from NHS Tayside and NHS Fife. The ethics letter is shown in Appendix 15, Page 285.

6.5 RESULTS

SHARE telephoned 959 people and engaged with 467 of them, the other 492 calls were not answered, or the person no longer fitted the sample criteria. The participation rate was 49% (467/959) based on contact attempts by SHARE. A total

of 399 agreed to completing the questionnaire and 68 said that they did not wish to take part in the study.

A total of 292 questionnaires were submitted, giving a final response rate of 62% (292/467); however, one questionnaire was omitted from the analysis because it was submitted with no responses. The sample consisted of 39% males and 61% females with a mean age of 56 year (SD = 15.6), ranging from 18 to 87. Over 80% of the patients went to see a dentist every 6 month (n = 237), whilst 10% only went to see one when it was needed (n = 29). Fifty-one percent of the surveyed patients reported having had experienced a relentless, throbbing toothache (n = 149), whilst 3% reported that they were uncertain (n = 9). In the previous 2 years, 15% of the participants had been prescribed an antibiotic (n = 43), and it was equally likely to be prescribed at an emergency (50%) as a non-emergency appointment (47%). Results are shown on Table 6.1.

6.5.1 Expectations to receive an antibiotic for dental pain

The results found that 31% of this surveyed sample would have expected to receive an antibiotic for dental pain. These patients (n = 89) were mainly female (65%), aged 60-75 (42%), and regularly attended their dentist every 6 months (91%), not previously experienced dental pain (55%), not received antibiotics in the last 2 years (81%) and those who been prescribed antibiotics at an emergency appointment (57%).

Table 6.1 Frequencies of patient characteristics and dental experiences

Variables	Frequency (%)
Gender (n=288)	
Male	113 (39%)
Female	175 (61%)
Age (n=289)	
Under 30	19 (6%)
30-44	49 (17%)
45-59	71 (24%)
60-75	129 (45%)
Over 75	21 (7%)
Dental Attendance (n=287)	
Every 6 months	237 (83%)
Once a year	18 (6%)
Every 1-2 years	3 (1%)
Only when needed	29 (10%)
Experienced dental pain (n 288)	
Yes	149 (51%)
No	130 (45%)
Not sure/don't know	9 (3%)
Antibiotics in previous 2 years (n=288)	
Yes	43 (15%)
No	242 (84%)
Not sure/don't know	3 (1%)
Prescribed at an emergency appointment (n=62)*	
Yes	29 (47%)
No	31 (50%)
Not sure/don't know	2 (3%)

Note: Due to rounding up some percentage total are > 100
**N/A = 219*

Thirty-five percent of this sample reported not expecting to receive an antibiotic for dental pain. These patients (n = 102) were mainly female (67%), aged between 60-75 (39%) and regularly attended their dentist every 6 months (80%), had

experienced dental pain (59%), not received an antibiotic in the last 2 years (86%) and those who had not been prescribed at an emergency appointment (63%).

The results found that 34% of this sample were uncertain about expecting to receive an antibiotic for dental pain. These patients (n = 98) were male (49%) and female (51%), and mainly aged between 60-75 (49%) and regularly attended their dentist every 6 months (77%), had experienced dental pain (57%), not received antibiotics in the last two years (85%) and to be prescribed at an emergency appointment (50%). A summary of the results is shown in Table 6.2

Table 6.2 Response frequencies of characteristics and dental experiences of patients by expecting to receive an antibiotic

Variables	**Expectation Frequency (%)**		
	Yes	**No**	**Uncertain**
Gender (n=288)			
Male	31 (35%)	34 (33%)	48 (49%)
Female	57 (65%)	68 (67%)	50 (51%)
Age (n=290)			
Under 30	7 (8%)	7 (7%)	6 (6%)
30-44	13 (15%)	19 (18%)	16 (16%)
45-59	21 (24%)	29 (28%)	22 (22%)
60-75	37 (42%)	40 (39%)	48 (49%)
Over 75	11 (12%)	8 (8%)	6 (6%)
Dental Attendance (n=287)			
Every 6 months	79 (91%)	82 (80%)	76 (77%)
Once a year	3 (3%)	7 (7%)	8 (8%)
Every 1-2 years	-	1 (1%)	2 (2%)
Only when needed	5 (6%)	12 (12%)	12 (12%)
Experienced dental pain (n=288)			
Yes	38 (43%)	60 (59%)	51 (53%)
No	49 (55%)	38 (37%)	43 (44%)
Not sure/don’t know	2 (2%)	4 (4%)	3 (3%)

Variables	Expectation Frequency (%)		
	Yes	No	Uncertain
Antibiotics in previous 2 years (n=288)			
Yes	16 (18%)	14 (14%)	13 (13%)
No	71 (81%)	88 (86%)	83 (85%)
Not sure/don't know	1 (1%)	-	2 (2%)
Prescribed at emergency appointment (n=62)			
Yes	13 (57%)	6 (32%)	10 (50%)
No	10 (43%)	12 (63%)	9 (45%)
Not sure/don't know	-	1 (5%)	1 (5%)

Note: Due to rounding up some percentage total are > 100

6.5.2 Beliefs associated with expectations to receive antibiotics

The results found that 65% of the patients who reported expecting to receive an antibiotic for dental pain believed that they would get better with an antibiotic. These patients (n = 89) mainly thought they would not feel upset (82%), go elsewhere (93%), would be satisfied that the dentists know best (83%) and not ask for an antibiotic (77%). These patients mainly felt that dentists who did not prescribe for dental pain were doing the right thing (90%) and were caring (76%) and competent (87%). These patients would mainly not ask for an antibiotic and delay having root treatment (88%) or tooth extraction (83%) and did not expect an antibiotic as an adjunct to surgical treatment (58%). Details are summarised in Table 6.3.

Table 6.3 Response frequencies of patient beliefs if not prescribed who expected to receive antibiotics

Variables	Response Frequency		
	Yes	**No**	**Uncertain**
Individual beliefs			
Get better with antibiotics (n=89)	54 (65%)	4 (5%)	11 (35%)
Feel upset (n=68)	5 (7%)	56 (82%)	7 (11%)
Go elsewhere (n=68)	2 (3%)	63 (93%)	3 (4%)
Satisfied the dentist knows best (n=87)	72 (83%)	6 (7%)	9 (10%)
Ask for one (n=69)	6 (9%)	53 (77%)	10 (15%)
Beliefs about dentists			
Doing the right thing (n=80)	72 (90%)	2(3%)	6 (8%)
Caring dentist (n=67)	51 (76%)	2 (3%)	14 (21%)
Competent dentist (n=78)	68 (87%)	1 (1%)	9 (13%)
Beliefs about accepting treatment			
Ask for antibiotic and delay getting root treatment at the time (n=76)	1(1%)	67 (88%)	8 (11%)
Ask for antibiotic and delay tooth extraction at the time (n=76)	4 (5%)	63(83%)	9 (12%)
Expect an antibiotic along with surgical treatment (n=84)	14 (17%)	49 (58%)	21 (25%)

Note: Due to rounding up some percentage total are > 100

6.5.3 Beliefs associated with no expectation to receive antibiotics

Sixty-two percent of patients who did not expect to receive an antibiotic believed that they would not get better with antibiotics. These patients (n = 103) mainly thought they would not feel upset (81%), go elsewhere (94%), would be satisfied that the dentist knows best (77%) or not ask for an antibiotic (81%). These patients mainly felt that dentists who did not prescribe for dental pain were doing the right thing (79%) and were caring (73%) and competent (84%). These patients would mainly not ask for an antibiotic and delay having root treatment (86%) or tooth

extraction (83%) and did not expect an antibiotic as an adjunct to surgical treatment (58%). Details are summarised in Table 6.4.

Table 6.4 Response frequencies of patient beliefs if not prescribed who did not expect antibiotics

Variables	Response Frequency		
	Yes	No	Uncertain
Individual beliefs			
Get better with antibiotics (n=103)	4 (4%)	64 (62%)	35 (35%)
Feel upset (n=92)	4 (4%)	83 (81%)	5 (5%)
Go elsewhere (n=90)	2 (2%)	85 (94%)	3 (3%)
Satisfied the dentist knows best (n=102)	78 (77%)	8 (8%)	16 (16%)
Ask for one (n=91)	7 (7%)	74 (81%)	10 (11%)
Beliefs about dentists			
Doing the right thing (n=99)	78 (79%)	7 (7%)	14 (14%)
Caring dentist (n=90)	66 (73%)	7 (8%)	17 (19%)
Competent dentist (n=95)	80 (84%)	4 (4%)	11 (12%)
Beliefs about accepting treatment			
Ask for antibiotic and delay getting root treatment at the time (n=98)	4 (4%)	84 (86%)	10 (10%)
Ask for antibiotic and delay tooth extraction at the time (n=96)	7 (7%)	80 (83%)	9 (9%)
Expect an antibiotic along with surgical treatment (n=101)	15 (15%)	59 (58%)	27 (27%)

Note: Due to rounding up some percentage total are > 100

6.5.4 Beliefs associated with uncertainty about expectations to receive antibiotics

Although uncertain about receiving an antibiotic for dental pain, 78% patients believed that they would get better with an antibiotic. These patients (n = 98) mainly thought they would not feel upset (77%), go elsewhere (70%), be satisfied that the dentist knows best (82%) or not ask for an antibiotic (72%). These patients mainly felt that dentists who did not prescribe for dental pain were doing the right thing (85%) and were caring (66%) and competent (83%). These patients would mainly not ask for an antibiotic and delay having root treatment (80%) or tooth

extraction (83%), and not expect an antibiotic as an adjunct to surgical treatment (45%). Details are summarised in Table 6.5.

Table 6.5 Response frequencies of patient beliefs if not prescribed who were uncertain about receiving antibiotics

Variables	Response Frequency		
	Yes	No	Uncertain
Individual beliefs			
Get better with antibiotics (n=98)	11 (11%)	11 (11%)	76 (78%)
Feel upset (n=75)	-	58 (77%)	17 (23%)
Go elsewhere (n=72)	-	69 (70%)	3 (4%)
Satisfied the dentist knows best (n=96)	79 (82%)	2 (2%)	15 (16%)
Ask for one (n=74)	4 (5%)	53 (72%)	17 (23%)
Beliefs about dentists			
Doing the right thing (n=92)	78 (85%)	-	14 (15%)
Caring dentist (n=79)	52 (66%)	1 (1%)	26 (33%)
Competent dentist (n=83)	69 (83%)	-	14 (17%)
Beliefs about accepting treatment			
Ask for antibiotic and delay getting root treatment at the time (n=84)	4 (4%)	67 (80%)	13 (16%)
Ask for antibiotic and delay tooth extraction at the time (n=82)	4 (4%)	68 (83%)	10 (12%)
Expect an antibiotic along with surgical treatment (n=93)	19 (20%)	42 (45%)	32 (34%)

Note: Due to rounding up some percentage total are > 100

6.5.5 Patients' Comments

The distillation of comments given by 123 individuals resulted in the identification of further beliefs associated with expectation for antibiotics. Individuals commented on their positive and negative experiences of antibiotics, for example, *'prescribed antibiotics for dental pain, but didn't complete course as not effective',* whilst another revealed, *'Recently had root canal treatment without antibiotics and no problems'*.

Often mentioned was trust in the GDP to make the correct decision about when to prescribe and concerns about the increased risk of antimicrobial resistance from the over-use of antibiotics. Some indicated that infections do require an antibiotic and that one should be prescribed as an adjunct to surgical treatment.

6.6 Sub-Study: Effectiveness of recruitment approaches

Of the 467 people who engaged with SHARE, 217 received the formal version (46%) and 250 the informal version (54%) of the recruitment materials. The results of whether the person agreed or did not agree to complete the survey using the formal version was yes = 151 (70%); no = 66 (30%) and for the informal version, it was yes = 140 (56%); no = 110 (44%).

6.6.1 Comparison of Responses between Formal and Informal Recruitment

The Chi-square test of independence showed a significant difference in the approaches to recruit among the two response groups. The results suggest people were more likely to agree to participate when the formal approach was used, however, proportionally more people will say no to the informal approach. The contingency table of the manually calculated Chi-Square test is shown in Table 6.4.

Table 6.6 Results of a Chi-square test of response by recruitment approach

Recruitment Approach	**Agreement Response**	
	Yes	**No**
Formal	151 (135)	66 (82)
Informal	140 (156)	110 (94)

$p < .013$ Note: Expected values in brackets

6.7 Discussion

The key aim of this study was to examine patient expectations to receive antibiotics for dental pain. In the previous interview and survey studies, it was identified that a reason why GDPs can inappropriately prescribe is to manage patient expectations. However, it is not known if these GDPs' perceptions about patients were accurate or not, and whether any patient characteristics or dental experiences influence their expectations to receive antibiotics for dental pain.

Overall, the survey found that for dental pain, 31% patients expected to receive an antibiotic, 35% did not expect to receive an antibiotic and 34% were uncertain. The frequency scores across these 3 expectation categories showed little difference between male and female patients, and between the age groups.

Expectations to receive an antibiotic did not vary between dental attendance (every 6 months, once a year, every 1-2 years and only when needed), the patients' experiences of dental pain and whether an antibiotic had been received in the last two years at an emergency appointment or not. Antibiotics were equally likely to be prescribed at an emergency appointment as at a non-emergency appointment.

Evidence from Studies 1 and 2 suggested that GDPs were concerned about the potential negative consequences of not giving antibiotics to some patients. Yet, this was not endorsed by these surveyed patients who reported high acceptance (≥ 79%) that the GDP was doing the right thing by not prescribing for dental pain. Also, the patients who expected to receive an antibiotic for dental pain were just as likely to not become upset, go elsewhere, be satisfied that the dentists knows best and not ask for an antibiotic as those patients who reported not expecting to receive an

antibiotic. Similar beliefs about dentists being caring and competent were found among these patients regardless of their expectations. This study confirmed other research in a medical setting that found most patients were satisfied with prescribing decisions, despite not receiving an antibiotic (Tonkin-Crine et al. 2014). A barrier of not prescribing often identified by GDPs in Studies 1 and 2 was that patients who expected to receive an antibiotic were unlikely to accept surgical treatment. The similarities in the responses between the differing expectations suggest that expectations to receive an antibiotic is unlikely to indicate patient acceptance of having a root treatment or a tooth extraction. Asking for an antibiotic may be associated more with uncertainty about having treatment without antibiotics.

The proportion of surveyed patients who received an antibiotic in the last 2 years was nearly one in seven (43/291). Whilst it was one in five for patients (13/62) who expected to receive and one in ten for patients (6/62) who did not expect. It is unknown whether these antibiotics were prescribed for clinical reasons or it is indicative of inappropriate prescribing to manage patient expectations.

Some disparity was found between these patients' views and GDPs' views described in the previous studies of this thesis. It is noted that GDPs are much more familiar with the 'real time' reactions of patient expectations, whilst these surveyed individuals were having to anticipate how they would react or recall earlier experiences of dental pain. This difference may explain why a high proportion of this sample did not report negative views about not receiving antibiotics for dental pain.

6.7.1 Sub-Study

The successful participation of patients in dental studies is known to come with challenges, (Needleman, 2014) so this study examined the effectiveness of two recruitment approaches. The key finding was that significantly more people who received the formal version agreed to take part in the study. As the remit of SHARE was to recruit people into the study and not to conduct any research it was not possible to explore the reasons why some people did not agree to complete the survey or were happy to take part. Although, less people receiving the informal version did not agree to take part, it is unlikely that the content of the recruitment materials was the only contributing factor.

6.7.2 Strengths and weaknesses

Despite, the patients participating in this study being recruited from 2 Health Boards in Scotland, it is felt that these findings and their relevance can be generalised to the wider population. The surveyed patients appeared to be a representative sample of the overall population in Scotland which has over 72% registered and participating in dental practice in the last two years (Dental statistics NHS Registration and Participation, 2017) and it was reflective of the overall population by including a range of ages. However, the generalisability of the study could have been improved if socioeconomic status was included as low deprivation is acknowledged as an indicator of higher prescribing rate by dentists (Bird et al. 2018).

A linkage of patients' postcodes to prescribing data was considered however, gaining access to this data was beyond the scope of this thesis. No financial

reimbursement for completing the survey was given but as a group by being on the SHARE register they are more actively involved in research.

A strength of the study is the theoretical preparatory research that informed the development of the questionnaire items. Similarly, the careful consideration given as to how the best describe dental pain in the questionnaire. The selection of relentless, throbbing toothache was based on conversations with a research dentist at the University of Leeds about the results of an unpublished a Master's student's project that had engaged with the general public to find the best way of describing dental pain. It was felt that relentless, throbbing toothache best embraced the experience of dental pain by those who participated in the study.

The number of missed items was high with nearly 20% omitting to answer the beliefs about consequences section of the questionnaire, therefore some caution is needed to not over interpret the importance of these beliefs. A possible explanation is that with nearly half of the sample having had no experience of dental pain, therefore these beliefs in the survey may not be salient to them.

6.7.3 Implications

This study found that patients who expect to receive antibiotics for dental pain are unlikely to response any differently to patients who do not expect to receive one. A key result was that patients' expectations are unlikely to be associated with their past experiences of and receiving antibiotics for dental pain. Expectations of receiving antibiotic are more likely to be influenced by beliefs about getting better with one and alternatively when an antibiotic is not prescribed by satisfaction that the GDPs knows best and is doing the right thing.

These findings as part of the diagnosis of the 'problem' have shown that the areas to target to address the pressure experienced by GDPs' to prescribe appropriately. For consideration should be behaviour change techniques that encourage and support GDPs to overcome patient expectations by increasing their skills and confidence and to address their concerns about the negative consequence of not prescribing antibiotics.

6.8 Next Steps

The next step within the BCW framework is to utilise this knowledge gained from the 3 empirical studies to determine the design of the intervention. This 4th step requires the mapping of identified TDF domains to potential behaviour change techniques and if required intervention functions. The synthesis of the empirical results and the mapping process is described in the next chapter.

CHAPTER 7 - DEVELOPING THE THEORETICAL CONTENT OF THE INTERVENTION

OUTLINE OF CHAPTER

Within the MRC framework for the development and evaluation of complex interventions, the importance of determining the acceptability and feasibility of any planned intervention is discussed (MRC 2019). To this end a focus group discussion was conducted in order to identify the perceived acceptability, format and possible content of an intervention to improve the antibiotic prescribing behaviour of dentists in primary care in Scotland.

See: www.mrc.ac.uk/complexinterventionsguidance.

The last 3 chapters have reported the empirical studies of the thesis (Phase 2). These findings have identified where the 'problems' associated with inappropriate prescribing lie in behavioural terms. These theoretical beliefs will underpin the proposed components of the intervention. This next chapter presents the 3rd development phase which is the theoretical mapping of identified beliefs to potential intervention components. It describes the rationale behind the theoretical interpretation of the TDF domains and their mapping to BCTs using the BCTT (v1) (Michie et al. 2013; Abraham & Michie 2008) as part of the BCW (Michie et al. 2011a).

7.1 INTRODUCTION

A total of 10 TDF domains were identified as being relevant to antibiotic prescribing behaviour in the 3 empirical studies. TDF domains will provide a platform for

determining which behaviour change techniques can be considered for inclusion in the intervention (Cane et al. 2015; Michie et al. 2005).

7.2 Aims and objectives

The aim of this chapter is the identification of BCTs and their mode of delivery(s) that have the potential to be effective in managing of patient expectation where the behaviour is prescribing appropriately. This phase applies the next stage of the BCW framework that guides the selection of the intervention functions and policy categories, if required, and the specific content of the BCTs. Therefore, the objectives of this chapter were:

(1) To collate and select which of the identified TDF domains will be targeted in the proposed intervention;
(2) To map the selected TDF domains to BCTs;
(3) To decide which of the BCTs should be proposed for inclusion in the intervention including options of how they could be delivered in primary care.

7.3 Summary of TDF domains identified as potential Targets

In the interview study with GDPs, the key domains were (1) social influences; (2) beliefs about capabilities; (3) beliefs about consequences; (4) emotion; (5) environmental context and resources; (6) professional/social role & identity; (7) behaviour regulation; (8) goals; (9) knowledge and (10) skills. The 20 specific beliefs

identified within these domains were then further tested for salience by the surveying of more GDPs.

When the survey of GDPs focused on intention as the proxy for the behaviour of prescribing to manage patient expectation 6 TDF domain were relevant: social influences, beliefs about capabilities, beliefs about consequences, emotion, environmental context and resources and professional/social role & identity. The patients' beliefs associated with expectations for antibiotics were influenced by behaviour regulation, beliefs about capabilities, beliefs about consequences, knowledge and professional/social role & identity. A full list of the TDF domains identified in the 3 empirical studies are shown in Table 7.1.

7.4 WHAT NEEDS TO CHANGE?

For the purposes of developing this intervention, it was decided to focus on the non-clinical influences of GDP prescribing e.g. perceived benefits of prescribing antibiotics and coping with patient expectations, none of which are supported by guidance recommendations and therefore more likely to be involved in inappropriate prescribing. All of the identified 10 TDF domains were considered to be relevant, so all were included regardless of how often they were mentioned in the empirical studies.

Table 7.1 Summary of the factors and TDF domains identified and examined in the 3 empirical studies

Study 1 - GDP Interviews *Factors and TDF domains* influencing prescribing decisions*	**Study 2 - GDP Survey** *TDF domains influencing the management of patient expectation*	**Study 3 - Patient Survey** *Beliefs influencing expectation for antibiotics*
Social Influence [P]	Social influences [PEd]	Beliefs about capabilities [PE]
Beliefs about capabilities [I/C/P/E]	Beliefs about capabilities [PEd]	Beliefs about consequences [PE]
Beliefs about consequences [I/C/P/E]	Beliefs about consequences [PEd]	Knowledge [PE]
Emotion [I/E]	Emotion [PEd]	Social/ Professional role & identity [PE]
Environmental context & resources [E]	Environmental context & resources [PEd]	Behaviour regulation [PEd]
Professional/Social role & identity [C/I]	Professional/Social role & identity [PEd]	
Behaviour regulation [I/C]		
Goal [I]		
Knowledge [C]		
Skills [C/I]		

Key Factors: I=Individual; C=Clinical; P=Patient; E=Environmental; PEd =Patient Expectation (dentists) and PE= Patient Expectation

7.5 WHAT SPECIFIC BELIEFS SHOULD BE TARGETED?

Within the 10 TDF domains, all specific beliefs that could potentially be targeted from the GDPs' perspective and also from the patients were included. Understanding the nature of the specific beliefs that underlie the TDF domains is important in tailoring the content of BCTs to maximise their potential to change prescribing behaviour. These specific beliefs will inform the intervention content. This next section outlines the identification of key domain-specific beliefs for inclusion in the proposed intervention (as defined in Chapter 2, Section 2.3.1).

- Social Influence

In the interviews, prescribing decisions were influenced by patients' expectations for antibiotics and their refusal to have surgical treatment, and also if patients became hostile or anxious. In Study 2 there was further agreement that prescribing decisions are influenced by patient expectations, however in Study 3 the potential negative consequences of not receiving antibiotics for dental pains was not confirmed by patients. Therefore, BCTs that could help GDPs to manage these patients were likely to be important element of improving prescribing decisions.

- Beliefs about capabilities

Study 2 found that a key concern for GDPs was having confidence to persuade patients that an antibiotic was not the best solution and to gain their acceptance of treatment instead of receiving an antibiotic. Study 3 indicated that patients. BCTs targeting confidence to manage patient supported by the evidence that patient accept that the dentist knows best should therefore be considered.

- Beliefs about consequences

Prescribing decisions had both positive and negative consequences for both GDPs and patients. In the interviews and survey (Studies 1 and 2), maintaining the patient/clinician relationship was an important reason for wanting to prescribe and a consequence of planning to prescribe was justifying this decision. In the interviews, GDPs said they might delay surgical treatment until 'things settle down' after an antibiotic has been taken. Instances of patient influence were not always explicit with GDPs often perceiving potential challenges of coping with upset or hostile patients. Study 3 suggested that patients do not anticipate the same consequences as GDPs. Therefore, BCTs should address concerns about how to manage patient's reaction and to not affect the patient/clinical relationship by not using antibiotics but acknowledge this less importance to patients.

- Emotion

The interviewed GDPs were mindful of the potentially negative affect of their prescribing practice being monitored by external bodies. Concerns were also raised over patients becoming disappointed if an antibiotic was not prescribed. In the survey, plans to prescribe were predicted by being able to justify the decision to prescribe.

- Environmental Context and Resources

In the interviews, GDPs mentioned that prescribing helped with running to time as it was quick and easy, and that the current NHS payment system did not the time required to manage patient expectation. In the survey, these beliefs were not

statistically significant in GDPs wanting to prescribe to manage expectation. As a result, this TDF domain was not included as a BCT target.

- Professional/Social role and identity

Awareness of the role of all healthcare professional to reduce antibiotic was mentioned and their clinical responsibilities to only prescribe for clinical reasons. From patients this was seen as dentists making the right prescribing decisions. This suggests a BCT that emphasis of their role as healthcare professional to reduce antibiotic use to address increasing AMR.

- Behavioural regulation

As the focus of improving the management of the patient expectation, it seems prudent to include behaviour regulation as a target because its theoretical construct is breaking habits and action planning which maybe an appropriate way of delivering the BCTS may be through action plans.

- Goals

The important of goal setting was reflected upon during the interviews with some GDPs mentioning that they have strategies to increase patients' acceptance of having surgical treatment which involved taking initial in the knowledge that if the patient becomes through successes the patient becomes more compliant.

- Knowledge

Although as earlier mentioned knowledge in relation to GDPs was to be excluded in the proposed intervention, however, increasing the knowledge of patients appears to be an area that does need to be addressed.

- Skills

Non-clinical skills mentioned by GDPs were how to start the conservation with patients who expected to receive an antibiotic and what information should be include that will help to change the patients' mind about receiving antibiotics.

A matrix of the specific beliefs that could be targeted in the BCTs is shown in Table 7.2.

Table 7.2 Description of TDF domain targets for change in the proposed intervention

TDF Domain	Description of what needs to change based on the analysis	
	GDPs	**Patient**
Social Influences	Coping with patients who expect/ask for antibiotics (BR) Managing with irregular attenders	Reduce concerns about not being prescribed Reduce patients asking for antibiotics
Beliefs about consequences	Coping with concerns about how patients could react if decide to not prescribe Concerns about being 'caught' prescribing instead of providing surgical treatment Concerns about maintaining clinician-patient relationship	Concerns about not being prescribed an antibiotic Concerns about not receiving an antibiotic after treatment (delayed)
Beliefs about capabilities	Increase confidence in persuading that an antibiotic is not required Increase confidence in carrying out surgical treatment within appointment time (EnvCR)	Increase confidence in accepting surgical treatment without an antibiotic
Emotion	Managing the disappointing patient	n/a
Environmental context & resources	Managing the lack of time for surgical treatment (BR)	n/a
Goals	Support positive feelings about not prescribing for therapeutic reasons (BCap)	n/a
Behaviour regulation	Reduce prescribing to cope with time limitations (EnvCR), and patients' asking for antibiotics (SI)	Break the habit of asking for an antibiotic based on previous experience of being prescribed (K)
Professional/social role and identity	Concerns about negative impact on patients' views	n/a
Knowledge	n/a	Reduce expectations of receiving an antibiotic Inform that infections do not get better with antibiotics

In summary, the results of this research suggests that the frequency that GDPs perceive inappropriate prescribing to be beneficial is related to their beliefs about managing patient expectation, i.e. changing patients' views and coping with possible negative outcomes of not prescribing, justifying the use of antibiotics to external professional bodies, and whether or not it is within their capabilities to cope with possible negative clinical outcomes.

The overarching aim of this thesis was to apply frameworks from the behaviour change literature to identify the factors influencing prescribing behaviour and to design an intervention aiming to improve inappropriate antibiotic prescribing decisions. It was anticipated that the future intervention would be directed only at GDPs but the results of this research has identified the important role of patients had in influencing GDPs' decision making, therefore the proposed intervention will also include BCTs directed at patients attending the practice for dental pain.

7.6 Identification of Behaviour change techniques

Whilst, the BCW framework guides towards which intervention functions, it is the BCTs that are an intervention's active ingredients for bringing about change in the targeted behaviour. This section describes how the TDF domains were mapped to behaviour change techniques using the second BCT taxonomy v1 framework.

A behaviour change technique is a theory based method for changing one or more beliefs influencing the target behaviour. Michie, Atkins & West's guide to designing intervention, *'the defining characteristics of a behaviour change techniques are that it is observable, replicable, an irreducible component of an intervention designed to*

change behaviour and a postulated active ingredient within the intervention', (p. 145).

The BCTTv1 is a structured list of techniques describing their smallest component of behaviour change. It provides a method of "*specifying, interpretation and implementing the active ingredients* of the intervention", which can be used by researchers and health care professionals. (BCT-Taxonomy on-line training, 2018). Abraham & Michie, (2008) identified and tested the definition reliability from 195 to produce the first theory-linked taxonomy of 26 BCTs.

Given the proliferation of published intervention studies, it was used to code and to agree upon refined 40-item taxonomy in 2011. Additional synthesis and refinement has produced a 93-item BCT taxonomy organised into 16 groupings, such as 'goal setting', repetition and substitution, and regulation, (Michie et al. 2013). An extract from the latest version of the taxonomy illustrates the example action planning from the goal and planning grouping in Table 7.3.

Table 7.3 Example Taxonomy Behaviour Change Technique

Nº	Label	Definition	Example
1. Goals and planning			
1.4	Action planning	Prompt detailed planning of performance of the behaviour (must include at least one of content, frequency, duration and intensity. Context may be environmental (physical or social) or internal (physical, emotional or cognitive)	Encourage planning the performance of a particular activity at a particular time on certain days of the week

The reporting accuracy of the techniques(s) used in interventions in the published literature has come under scrutiny with many having concerns about the lack of clear description to reliably identify the BCTs, (Dombrowski et al. 2016; Michie et al. 2009) which reduces the identification of the effective 'active ingredient' within

interventions, (Michie et al. 2009a). Often studies report how the intervention was delivered, i.e. educational workshop, or when and how often it was delivered but omit to mention its content, (Michie et al. 2011b) as was highlight in the literature review in Chapter 3, Section 2.1. The benefits of improving the description of BCTs is in the scientific robustness of intervention studies in terms of their replication, implementation and evidence synthesis.

The process used to identify potential BCTs drew upon the literature that demonstrated which BCTs are likely to be more effective, (Löffler & Böhmer 2017; Newlands et al. 2016; Cane et al; 2015; Michie et al. 2008) and the empirical studies described in Chapters 4, 5 and 6. These studies have identified the benefits of inappropriate prescribing specifically in the context of managing patient expectation. It identified 10 TDF domain beliefs that could be targeted as 'potential levers of change', (Michie, Atkins & West, 2014, p.108) of prescribing behaviour. After this identification of what needs to change to 'improve' prescribing behaviour decisions, the next step is to make use of this understanding to determine a future intervention and its likely behaviour change components. This requires the mapping of the identified TDF domains to BCTs and then intervention functions as part of the BCW (Steps 2 and 3 of the framework). The BCTs were selected from BCT Taxonomy v1 (Michie et al. 2013; Abraham & Michie 2008) based on their potential to target and bring about the desired change in inappropriate prescribing of antibiotics.

For example, from the BCT Taxonomy (v1) grouping of Self-belief, barriers related to Beliefs about capabilities are likely to be addressed effectively by verbal

persuasion about capability [15.1]: Tell the person that they can successfully perform the wanted behaviour, arguing against self-doubt and asserting they can and will succeed (Michie, Atkins & West, 2014).

A detailed matrix of the identification mapping process is shown in Table 7.4 and a list of 18 potential BCTs in the proposed interview is provided in Table 7.5

Table 7.4 Overall behaviour analysis mapping of TDF domains identified in Empirical Studies using BCTT (v1)

TDF Domain	Description of what needs to change based on the analysis	Potential Intervention Components
Behaviour regulation	Reduce prescribing to cope with time limitations (EnvCR), and patients' asking for antibiotics (SI)	BCT: Action Planning [1.4]; Self-monitoring of behaviour [2.3]; Self-monitoring of outcome(s) of behaviour [2.4], & Habit reversal [8.4]
Beliefs about capabilities	Increase confidence in persuading that an antibiotic is not required Increase confidence in carrying out surgical treatment within appointment time (EnvCR)	BCT: Demonstration of the Behaviour [6.1]; Verbal persuasion about capability [15.1] & Mental rehearsal of successful performance [15.2]
Beliefs about consequences	Coping with concerns about how patients could react if not prescribing Concerns about being 'caught' prescribing instead of providing surgical treatment Concerns about maintaining clinician-patient relationship	BCT: Information about health consequences [5.1]; Salience of consequences [5.2]; Information on social consequences [5.3] & Anticipated regret [5.5]
Emotion	Managing the disappointed patient	BCT: Focus on past successes [15.3]
Environmental context/resources	Managing the lack of time for surgical treatment (BR)	BCT: Restructuring of physical environment [12.1]
Goals	Support positive feelings about not prescribing for therapeutic reasons (BCap)	BCT: Goal setting (behaviour) [1.1], Problem solving [1.2] &Social Comparison [6.2]
Professional/social role and identity	Concerns about negative impact on patients' views	BCT: Review behaviour goal(s) [1.5]
Social Influences	Coping with patients who expect/ask for antibiotics (BR) Managing with irregular attenders	BCT: Credible Source [9.1]; Information about health consequences [5.1]; Verbal persuasion about capability [15.1] & Mental rehearsal of successful performance [15.2]

Overlapping TDF Domains: EnvCR: Environmental resources & context; SI: Social influence; BR: Behaviour regulation

Table 7.5 Potential BCTs and their implementation in the intervention

Potential BCT Strategies	**Description of how BCTs is represented**
1. Action Planning [1.4] *Prompts detailed planning of behaviour as managing patient expectation*	Encourage a plan of how to raise with patients their decision to not prescribe an antibiotic if patient asks for one
2. Anticipated regret [5.5] *Induce or raise awareness of expectations of future regret about performance of the unwanted behaviour*	Ask GDPs to assess their feelings of regret based on their justification of prescribing to manage patient expectation
3. Credible Sources [9.1] *Present verbal or visual communication from a credible source in favour or against the behaviour*	Provide evidence from guidelines
4. Demonstration of the Behaviour [6.1] *Provide an observable example of the performance of the behaviour, directly in person or indirectly i.e. video for the person to aspire or to imitate*	Demonstrate to GDPs how to raise their decision to not prescribe with patients
5. Focus on past successes [15.3] *Advise to think about or list previous successes in performing the behaviour*	Ask GDPs to describe or list the instances of when they did not prescribe
6. Goal setting (behaviour) [1.1] *Set or agree a goal defined in terms of the behaviour to be achieved*	Agree to not manage expectations for antibiotics by prescribing
7. Habit reversal [8.4] *Prompt practice or rehearsal of the performance of the behaviour one or more times in context*	Ask the GDPs to not prescribe when they would have previously prescribed an antibiotic
8. Information about health consequences [5.1] *Provide information e.g. written, visual, verbal about the health consequences of performing the behaviour*	Explain that the over-use of antibiotics can increase antimicrobial resistance
9. Information on social consequences [5.3] *Provide information e.g. written, visual, verbal about the health consequences of performing the behaviour*	Explain that the over-use of antibiotics can increase antimicrobial resistance
10. Mental rehearsal of successful performance [15.2] *Advise to practice imagining performing the behaviour successfully in relevant contexts.*	Advise GDPs to imagine raising their decision to not prescribe with patients
11. Problem solving [1.2] Analyse, or prompt the person to analyse factors influencing the behaviour and generate or select strategies that include overcoming barriers and increasing enablers	Prompt identification of patient expectations to receive antibiotics

Potential BCT Strategies	Description of how BCTs is represented
12. Restructuring of physical environment [12.1] *Change, or advise to change the physical environment in order to facilitate performance of the wanted behaviour*	Ask GDPs' practice to have longer appointment times to facilitate surgical treatment, i.e. emergency appointments
13. Review behaviour goal(s) [1.5] *Review jointly with the person and consider modifying behaviour change strategy in light of achievement*	Examine how well a GDPs management of the expectation corresponds to agreed target behaviour
14. Salience of consequences [5.2] *Use methods specially designed to emphasis the consequences of performing the behaviour*	Produce evidence of antibiotic prescribing rates
15. Self-monitoring of behaviour [2.3] *Establish a method for the person to monitor and record their behaviour as part of the behaviour change strategy*	Ask the GDPs to record, in the patient's notes, why the antibiotic was prescribed, i.e. only clinical reasons
16. Self-monitoring of outcome(s) of behaviour [2.4] *Establish a method for the person to monitor and record the outcomes of their behaviour as part of the behaviour change strategy*	Ask the GDPs to record, in the patient's notes, whether expectation/asking for antibiotics was managed by not prescribing
17. Social Comparison [6.2] *Draw attention to others' performance to allow comparison with the person's own performance*	Demonstrate to GDPs the proportions and variations in prescribing rates
18. Verbal persuasion about capability [15.1] *Tell the person that they can successfully perform the wanted behaviour, arguing against self-doubt and asserting the they can and will succeed*	Advise GDPs that they can raise with patients that an antibiotic is not required

7.7 Mapping TDF domains to Intervention Functions

The next stage of the BCW framework is mapping the TDF domains to intervention functions by linking the BCTs to intervention functions and selecting their mode(s) of delivery.

The BCW framework illustrates the types of intervention functions that have the potential to 'shift' behaviour change in the desired direction. The term intervention function is used in preference to intervention in the BCW framework as '*any behaviour strategy or behaviour change technique may have more than one*

function', (Michie, Atkins & West, 2014, p. 109). An example of how a BCT can straddle 2 functions is illustrated in this prescribing context as adapted from BCW-A guide to designing intervention publication (Michie, Atkins and West, 2014). A BCT message that said, 'Ensure you surgically treat infections, just prescribing could result in having to justify your decision' could help to improve memory, attention and decision-making but could also cause emotion about prescribing. This example message includes both an education and persuasion function.

A systematic search resulted in the identification of 19 behaviour change frameworks that cover 9 intervention functions, (Michie et al. 2011a). These functions within the BCW framework with their definitions in brackets are, (1) Education (increasing knowledge or understanding); (2) Persuasion (using communication to induce positive or negative feelings or stimulate action); (3) Incentivisation (creating an expectation of reward); (4) Coercion (creating an expectation of punishment or cost); (5) Training (imparting skills); (6) Restriction (using rules to reduce the opportunity to engage in the target behaviour), (7) Environmental Restructuring (changing the physical or social context), (8) Modelling (providing an example for people to aspire or to imitate), and (9) Enablement (Increasing means/reducing barriers to increase capability or opportunity.

7.8 Selecting Intervention Function

The result of the mapping of these identified domains using the BCW framework suggested that all the intervention functions were likely to be effective in changing

prescribing decisions when managing patient expectation. The mapping of the domains is shown in Table 7.6.

Table 7.6 Linking of identified TDF domains to Intervention Functions

TDF Domain	**Intervention Function**								
	Education	Persuasion	Incentivisation	Coercion	Training	Restriction	Environmental Restructuring	Modelling	Enablement
Behaviour regulation	✓				✓			✓	✓
Beliefs about capabilities	✓	✓						✓	✓
Beliefs about consequences	✓	✓						✓	
Emotion		✓	✓	✓				✓	✓
Environmental resources & context					✓	✓	✓		✓
Goal	✓	✓	✓	✓				✓	✓
Professional role & identity	✓	✓						✓	
Social influences						✓	✓	✓	✓
Knowledge	✓				✓				
Skills	✓				✓				

It is acknowledged that when developing an intervention, it may be necessary to deviate from theoretical principles for pragmatic reasons. Example reasons for not following a 'pure' theoretical pathway of intervention selection may include limited monetary resources or time restrictions.

Therefore, judgements are required to determine which of the intervention functions should be selected. Yet, this selection does not have to be completely subjective as it can be sought by using the behaviour analysis findings and the APEASE criteria within the BCW framework, or by referring to the published

'changing clinician behaviour' literature. The next sections describe how these three determinants of intervention selection were applied in this research.

7.8.1 Behaviour Analysis

Of the domains identified in the survey study, only 4 were found to be significant predictors in the survey study. The analysis using multiple regression model found that beliefs about consequences, beliefs about capability, social influence and emotion were likely to be significant predictors of wanting or planning to manage expectation by prescribing. The interviewed GDPs indicated that environmental resource and context beliefs were not so likely to influence how patient expectation was managed, therefore training was omitted as a potential intervention function.

7.8.2 APEASE Criteria

These issues are addressed within the BCW framework by advocating the use of APEASE criteria. Although the first aim of designing any intervention is effectiveness, other factors often do have to be considered as have already mentioned. These include:

- A-affordability: Are there sufficient financial resources?
- P-practicability: Is it feasibly to deliver and available to all possible end users?
- E-effectiveness and cost-effectiveness: Do the benefits outweigh the costs?
- A-acceptability: Is it judged to be appropriate by the end user?
- S-side-effects/safety: Will it have any unintended consequences?
- E-equity: Is it fair?

The application of the APEASE criteria revealed that three intervention functions of persuasion, modelling and enablement were more likely to effective in an intervention that aims to support GDPs to manage patients' expectation by not prescribing.

7.8.2 'Changing clinician behaviour' Research

This mapping exercise suggested based on the identified intervention functions that the types of interventions most likely to be effective in supporting GDPs to say 'no' to patients who expect antibiotics is education, persuasion and enablement. Table 7.7 shows the links between which intervention functions are likely to be effective in bringing about improvements and the specific TDF domains.

Table 7.7 Identification of Intervention Functions based on APEASE Criteria

Nominee Intervention functions	**Criteria fit of APEASE: Prescribing antibiotics to manage patient expectation**
Education	No - Most GDPs understand and are aware of prescribing to meet patient expectation; it is unlikely to be acceptable and also unaffordability within the parameters of the thesis Yes - For patients
Persuasion	Yes - GDPs and patients
Incentivisation	No - Insufficient monies available at research level, but also very unlikely to be acceptable at system level
Coercion	No - Unacceptable and impractical
Restriction	No - Ultimately, prescribing is the clinician's decision so limiting their prescribing behaviour is unacceptable
Environmental restructuring	No - Longer appointment times are beyond the practicalities of the research
Modelling	Yes - GDPs and patients
Enablement	Yes - GDPs and patients

7.9 Specifying the mode of delivery of the BCTs

The third objective was the identification of the intervention's mode(s) of delivery. In anticipation of having to decide the best way to deliver the intervention, an item investigated preferences about how to deliver the intervention was included in the GDPs survey (Study 2). Despite, comparable mean scores of 5.7, 5.0 and 3.9 for each of the three options on the 7-point Likert scale, a slightly higher positive preference was reported by GDPs for instructor-led PowerPoint presentations (65.3%). The positive preference scores for the other options were 'Computer training, i.e. e-Learning' (57.5%) and 'Interactive group discussion including role play' (41.3%). Although not conclusive, it was decided for the purposes of this thesis to make the pragmatic selection of delivering a 'Researcher led PowerPoint presentations' at a workshop to determine the preferred mode(s) of delivery of the BCTs in the proposed intervention.

7.10 Expert advice on the refinement and operationalisation of the BCTs

The content and mode of delivery of an intervention can determine the extent and likelihood of its implementation and practicality, (Bowen et al. 2009). The right content and delivery could increase its effectiveness or if it was wrong, it could potentially undermine the whole intervention.

Consequently, to optimise the implementation and practicality of the proposed intervention, a group of GDPs were convened. The purpose of involving practising GDPs was to utilise their expertise and knowledge in the design of the intervention that addresses managing patient expectation appropriately. The result was the

likelihood of an intervention tool that was feasible to implement and would be more acceptable to GDPs.

7.11 Next Steps

Based on the empirical findings and the described mapping exercise, it was decided to present these 18 BCTs to GDPs at a workshop. The design of the workshop and the decision on the final components of the intervention is outlined in the next chapter.

CHAPTER 8 - THE OPERATIONALISATION AND DELIVERY OF THE BEHAVIOUR CHANGE TECHNIQUES

OUTLINE OF CHAPTER

Chapter 7 described the mapping process used to identify the BCTs most likely to be effective in changing the target behaviour, i.e. inappropriate antibiotic prescribing. The next stage was to determine whether all or some of these proposed 17 BCTs were suitable for delivery in dental primary care.

This chapter describes the final 2 phases of the research which was how best to put these identified BCTs into practice that results in an implementable and practical intervention. This was done by conducting a collaborative workshop with dentists working in primary care. The chapter concludes with a detailed description of the modifications completed post workshop and a full description of the final proposed intervention.

8.1 INTRODUCTION

Eighteen BCTs were considered to be promising in 'improving' the appropriate use of antibiotics when managing patient expectation in primary dental care. The specific TDF domains associated with these BCTs as the 'mechanisms for change' are targeted in the intervention.

For the purposes of this study, operationalisation of the BCT is defined as fully developing and giving more substance to the 'active component' of the BCT. The mode(s) of delivery is the way in which the BCT can be delivered in an intervention. Multiply modes of delivery can be used in an intervention and it can also be an

integral part of a BCT, i.e. provide visual or written information to deliver the BCT: Information about health consequences [5.1]. Presently, there is no generic definition for the mode(s) of delivery used in a behaviour change intervention, (Dombrowski et al. 2016).

The lack of adequate reporting of interventions is an issue often highlighted in the literature, (Lorencatto et al. 2013). This need for a standardised format was addressed by Hoffman et al in 2014, who advocated good reporting by following a template for intervention description and replication which is referred to as TIDieR.

8.2 Aims and objectives

This chapter provides a detailed and transparent description of the process applied to decide on the content and delivery of the BCTs. The primary purpose of the workshop was to utilise the expertise of these practising GDPs to establish the extent to which the presented content of these BCTs was valid and for them to suggest any additional information or to make modifications. For the BCTs without any specific content, it was to agree upon the information required to optimise their operationalisation and how to deliver them. By engaging GDPs in a conversation about how these techniques could be put into practice, it was hoped that the outcome would be an intervention that was more likely to be implementable and practical in primary dental care. The objectives were:

(1) To identify which BCTs should be included in the final intervention?

(2) How should the identified BCTs be operationalised and delivered in primary dental care?

8.3 METHODS

This section explains why a workshop was selected to operationalise the identified BCTs. It also describes the recruitment of participants, and how the proposed BCTs were presented to the GDPs attending the workshop.

Until now, the content of the intervention has been devised by applying a deductive approach, i.e., top-down, as its development has originated from behaviour change theories underpinning the BCW Framework, (Michie et al. 2013). In contrast, the workshop takes an inductive approach, i.e. bottom up by involving GDPs who will be the end-users in the selection and refinement of the components of the BCTs. This perspective draws upon employing a pragmatic 'what's likely to work' structure to the workshop to address the intervention objectives by using both deductive and inductive approaches, (Morgan, 2007). Therefore, the workshop discussion would also focus on how these GDPs manage their prescribing decisions particularly for those patients who expect antibiotics and to use their insight to determine the content of the proposed intervention.

8.3.1 Design

A workshop was attended by a purposive sample of GDPs based in general dental practices in Scotland. At the workshop, the GDPs' task was to reach consensus on which of the 17 BCTs should be included in the intervention, and how to put them into practice and their best method of delivery. The workshop was facilitated by the PhD researcher.

8.3.2 Recruitment

In February 2018, a sample of 55 GDPs were invited by email to participate in a two-and-a-half hour workshop held at the Dundee Dental Education Centre in March 2018. The sample was recruited from the Scottish Dental Practice Based Research Network of Rapid Evaluation Practitioners (REPs) who are dentists practicing in primary dental care. The invited GDPs also received an information sheet which outlined the aim of the workshop and what they would be asked to do (Appendix 16, Page 286).

The REPs are based in differing types of practices and geographical locations across Scotland. It was anticipated that this group would bring diverse expertise and experiences of communicating prescribing decisions to patients in different circumstances. As a group, the REPs are accustomed to voicing their experiences of practicing in primary care and in providing constructive feedback from previously attending similar events run by SDPBRN. None of the invited REPs participated in the interviews (Study 1), but it unknown if any completed the survey because no identified details were collected (Study 2).

For reasons of a limited financial resources, the number of available places was restricted to a maximum of 10 participants. Therefore, the first 10 GDPs to response to the invitation were followed up by an email that confirmed their place at the workshop. Prior to the workshop, GDPs were sent further information that included an agenda and financial claim forms. Consent was presumed from their agreement to enrol in the workshop.

Those GDPs who attended the workshop received a sessional fee payment of £285 and reimbursement of travel cost up to a maximum of £50.

8.3.3 Workshop Plan

The workshop included an introductory PowerPoint presentation by the PhD researcher, followed by a focus group style discussion with the GDPs.

The purpose of the PowerPoint presentation to provide the group with some initial information about how these BCTs could potentially be operationalised. The content of the presentation slide was embedded with one or more of the 17 BCTs. For example: highlighting the consequences of the current level of antibiotic prescribing by providing evidence from global organisations such as WHO national guidance from NICE and SDCEP, antibiotic stewardship programmes developed by professional bodies, e.g. FGDP (UK). The BCTs embedded within these areas for discussion were 'Information about health consequences', 'Salience of consequences', 'Information on social and health consequences' and 'Credible sources' and 'Anticipated regret'. For example, the BCTs of credible source [9.1] and information about social and environmental consequences [5.3] referred to antimicrobial stewardship initiatives by FGDP (UK), and the British Dental Association (BDA).

Table 8.1 gives a more in-depth summary of how the BCTs were embedded into each of the workshop slides.

Table 8.1 Summary of BCTs targeted in the Workshop

Behaviour Change Techniques	Proposed operationalisation or delivery in PowerPoint
1. Information about health consequences [5.1]	Written - Reference and quote current WHO website and newsletter Visual - Organisation logos
2. Salience of consequences [5.2]	Written evidence of the threat from antimicrobial resistance; effects of using antibiotics within specific time scales
3. Information on social and environmental consequences [5.3]	Highlights professional bodies, guidance and initiatives aimed at reducing the use of antibiotics
4. Credible Sources [9.1]	Indicate expertise that may include information or quotes from sources that indicate expertise. National Guidelines, e.g. from NICE and SDCEP Professional bodies, e.g. FGDP (UK)
5. Anticipated regret [5.5]	Evidence of empirical studies reporting the amount of inappropriate prescribing in UK dentistry
6. Social Comparison [6.2]	Evidence of previous interventions
7. Problem solving [1.2]	Acknowledge the influence of patient expectation, conflicting priorities, perceived risks and justification of prescribing decisions Engage the group for suggestions on how to manage the influence of these factors on their prescribing decisions
8. Demonstration of the Behaviour [6.1]	Identify examples of when managing patient expectation is more challenging. Use this example to ask the group how they would manage it
9. Focus on past successes [15.3]	Discuss strategies that have been successfully used
10. Self-monitoring of behaviour [2.3]	Explore how best to measure the use of the techniques e.g. audit
11. Self-monitoring of outcome [2.4]	Explore how best to deliver these BCTs
12. Action Planning [1.4]	

Behaviour Change Techniques	Proposed operationalisation or delivery in PowerPoint
13. Goal setting [1.1]	
14. Review behaviour goals [1.5]	
15. Habit Reversal [8.4]	
16. Verbal Persuasion of capabilities [15.1]	
17. Restructuring of physical environment [12.1]	
18. Mental Rehearsal of successful performance [15.2]	

8.3.4 Format of Presentation

The slide headings were (1) Antibiotic resistance at a global scale; (2) Effects of prescribing in primary care on antibiotic resistance and antibiotic use in dentistry; (3) What is already happening in dentistry to reduce the use of antibiotics; and (4) Developing the content of the behaviour change tool.

The session began with a brief presentation of how the previous empirical studies had led to conducting this particular workshop. The key results from the interviews and surveys were disseminated, the group were invited to reflect and discuss the potential implications of these findings. This was also an opportunity to verify whether the level of expectation for antibiotics found in the patient survey was typical of GDPs' experienced in practice.

The next part of the workshop required the GDPs to engage and discuss the information embedded with BCTs. The slides focussed on the potential barriers of managing patient expectations with the appropriate use of antibiotics. The content acknowledged that these barriers may include patient expectation, conflicting priorities, perceived risks and justification of prescribing decisions. The group were prompted to contemplate how best to 'solve' the problems associated with these barriers based on their experiences, i.e. 'Problem solving' and to consider what has previously worked well for them, i.e. 'Focus on past successes'.

The content of the penultimate slide aimed to operationalise the BCTs of 'Demonstration of the Behaviour' and 'Instruction on how to perform the behaviour' by asking the group to provide examples of how they communicate their prescribing decisions to patients who expect an antibiotic. This included flagging up

negative cues from patients likely to expect antibiotics or giving advice on what could be said to the patient to achieve the 'appropriate' prescribing decisions. The implementation of the remaining BCTs was addressed during the focus group discussion.

Figure 8.1 shows the suggested visual and written information that might operationalise the BCT of 'information about health consequences'.

Figure 8.1 Content of presentation slide embedded with Information about health consequences

8.3.5 Mode(s) of Delivery

The workshop finished with the group discussing how these BCTs could be delivered in primary dental care. As a guide to assist will initiating the group discussion potential modes of delivery based on the mapping of the BCW framework were provided. These were action plans, a communication skills course, providing information in flow charts of how to manage emergency patients or instructions to

members of the dental team who have reception duties. All PowerPoint slides used in the workshop presentation as provided in Appendix 17, Page 287.

A worksheet with a list of the potential BCTs and their definition was also provided to the group who were asked to record their individual thoughts and any additional comments that were not covered in the groups' discussion.

8.3.6 Data collection

The data was collected using a focus group style discussion to address the research questions. An audio record using a digital recorder and notes were also taken by the PhD researcher during the group discussion. By the end of the workshop the aim was for the group to agree upon on the content of the intervention and how it could be delivered by dental practices.

8.3.7 Analysis Plan

Discovering the salience of this information through group discussion would be considered a likely indicator of whether the BCT should be included. Although the specific BCTs were not identified in the presentation, questions and prompts facilitated the active involvement of the GDPs to explore whether it was felt that this information would be relevant to changing prescribing behaviour and managing patient expectations. The GDPs were also invited to suggest if any other relevant information should be added. Not all of the BCT were in the presentation, others were raised by the researcher during the discussion.

Agreement and suggestions for how to operationalise or delivery a technique were collated under their relevant BCTs in a matrix. Other themes that emerged were

also added to the matrix if they were thought to be relevant for increasing feasibility and the future implementation of the final intervention.

8.4 RESULTS

The results include the relevant details of the groups' conversation during the workshop and their responses to the earlier stated research questions. It reports their views on preferred BCTs and how that could be delivered in the practice.

8.4.1 Participants

Seven GDPs attended the half-day workshop in March 2018. All of the group had day- to-day experience of primary care practice in Edinburgh and Glasgow, and in smaller towns nearby to Dundee. Many of the group recalled participating in the national RAPiD (Reducing antibiotic prescribing in dentistry) RCT study in 2016 and some had also attended similar events organised by SDPBRN. None of the 7 participating GDPs recalled completing the on-line survey (Study 2).

8.4.2 Duration of the Workshop

The workshop took two and a half hours to complete. The time allocation was roughly divided into one-third for introductions and disseminating the empirical studies results, and two-thirds for group discussion. The duration of the groups' discussion was approximately 90 minutes.

8.4.3 Findings

The premise of the workshop was that patient expectation continued to be challenging for GDPs; the group unhesitatingly agreed that this was accurate. Whilst working through the information on the slides, the group readily shared their views

and many discovered similar issues when managing patient expectation. All of the group actively contributed, and they laughed many times when comparing their antibiotic prescribing stories. Overall, the groups' reaction to improving antibiotic prescribing decisions by using intervention that targeted patient expectation was positive. Some even said that they would be keen to sign up to piloting the intervention in the future. The group believed that 12 of the proposed BCTs should be included in the final intervention, but 6 were found to be less acceptable because their implementation would be more challenging. These were Demonstration of the behaviour, Goal setting (Behaviour), Habit reversal, Mental rehearsal of successful performance, Restructuring of the physical environment and Review behaviour goals. For example, the group found providing content examples of demonstrating and giving instructions on how to perform the behaviour of communicating to patients that an antibiotic was not clinically required to be more challenging. Many reflected that it was individual preference and that offering one method may not work for all. It is possible that GDPs have rarely reflected on their prescribing decisions in this manner as it has become part of their automatic routine. The matrix of the finding is reported in Table 8.2.

Table 8.2 Matrix of the themes and comment associated with the BCTs discussion

BCTs	Themes/ Comments	Quotes
Information on health; Social and environmental Consequences; salience of consequences & Social comparisons	The GDPs' thought it was prudent to initially frame the consequences of the unnecessary use of antibiotics on increasing antibiotic resistance at a global scale. They acknowledged that dentistry has a role to play in reducing the overall use of antibiotics. Yet, one GDP commented that referring to global threats and higher death rates was possibly perceived to more relevant for developing countries and not to the UK. Yet, it was felt that only 'common infections become harder to treat' and 'few new antibiotics' were the key messages from the WHO for dentists and patients. The group felt that both patients and dentists should be targeted about the consequences of using antibiotics. A GDP recalled that in the past, maybe 10 years ago, one of the NHS health board had taken swabs to detect the cause of the infection in order to determine the appropriate antibiotic treatment for the patient. More information about the current level of resistance in their area or among their patients was a very relevant message to be included in the future intervention.	"Yes, we all need to be reminded" "Dentists have become a bit blasé, when picking up your prescription you need to be more aware of the consequences of that". "Send out swabs of micro flora resistant……45% were resistant to amoxicillin"
Credible sources and Anticipated regret	All of the group agreed that mentioning professional bodies and guidance helped with underlining the importance of improving the use of antibiotics. However, it was highlighted during the conversation that some of the group were not aware that posters and information leaflets aiming to educate patients were available to them on the FGDP (UK) website. Those GDPs who had posters in their waiting rooms did perceive them to be beneficial, but they felt that they should be also be displayed not just in dental practices but more widely in GP practices and pharmacies. The message in the presented poster was not liked by the group who felt that the wording of 'dental infections antibiotics are not always the best treatment' suggested at times they were and	"I've not seen this poster before, where did you get it?" "I don't like the message on that poster, it looks like pills are being handed out"

BCTs	Themes/ Comments	Quotes
	visually, the hand of pills was ambiguous as looked as if antibiotics being handed out, (See presentation slide 10, page 289).	
Problem solving	An important point coming out of the conversation was acknowledging that not prescribing to patients who expect antibiotics is challenging and how many different competing non-clinical factors come into play when trying to manage dental infections appropriately. Some GDPs reflected how they would feel if it was a member of their own family who was asking for antibiotics. It is essential to accept that some patients will never accept anything other than an antibiotic, but others can be persuaded by information and reassurance to accept surgical treatment. Learning to pick up cues such as the patient standing by the door and not going to sit in the chair helps to identify these non-compliant patients	"Would I not prescribe, if it was one of my family who was in pain" "You learn to notice things"
Action planning; Focus on past successes & Verbal persuasion of capabilities	The suggested likely best ways of supporting GDPs and other members of the dental team in the management of patient expectation was to consider saying or doing some of the following when managing expectations: Have a prepared spiel that includes making patients aware that surgical treatment is necessary; they will get better quicker/immediate relief with treatment; notice if patient is reluctant to sit in the chair, so offer reassurance; listen to the patient Opportunities like this workshop to reflect and discuss with other GDPs why we prescribe.	"Some patients will always demand antibiotics maybe we've forgotten the reason why we prescribe".
Self-monitoring of behaviour; Self-monitoring of outcomes	The leading suggestion for the monitoring of prescribing to manage patient expectation was by conducting audits that were developed in-house or to use one of the pre-approved audit tools available on-line. Other than one GDP, none of the group has completed an audit except for the purpose of piloting one on behalf of SDPBRN.	"I've not done an audit! Have you?"

8.4.4 Modifications

It became apparent that these GDPs felt that managing patient expectation required support from the whole dental team especially those with reception duty responsibilities. The discussion indicated that with some minor changes to the content of the BCTs the proposed intervention was implementable and practical, such as more information about antimicrobial resistance and reported evidence on the inappropriate use of antibiotics. Also, this group felt that any intervention addressing patient expectation did require pro-active engagement of the whole practice team to change and improve on how it was currently managed.

It was decided to omit the 6 BCTs identified as impractical at the workshop and further clarification of descriptions from the BCTTv1.

8.4.5 Modes of Delivery

There was general agreement among the group that delivering these BCTs could be done either at training skills courses or in the dental practice. The group discussed the use of tools to support the appropriate use by having flowcharts, displaying posters and handing out information to patients. Also, a written message as a way of making dentists more mindful of their prescribing decisions.

The group agreed upon two interventions that they felt could potentially change the management of patient expectation for the better. The first and preferred was more events like this workshop where dentists can reflect on their prescribing decisions and, listen and learn from other dentists about their strategies to manage patient expectations. Although, any role-play was seen as a definite non-starter because it was uncomfortable to do as it puts you on the spot.

The alternative intervention was a set of activities that also involved the whole staff who have reception duties as well as GDPs. The activities could include the triaging of patients who phone asking for an emergency appointment, a poster in the waiting room, and information/written message that includes these BCTs directed at both patients and GDPs.

8.5 Key Elements of Intervention

The key outcome from the co-design was that the proposed intervention should involve all practice staff and patients. The intervention targeting inappropriate prescribing would include a set of procedures by staff on reception, a persuasive message for GDPs and information leaflets including posters for directed at patients. The aim was to reduce patient expectations for antibiotics during their initial contact and whilst waiting and encourage GDPs to think and reflect upon their prescribing decisions and so manage patient expectations differently from how it currently happens.

Building upon the proposed components of the intervention as outlined earlier in Table 8.2., this following section describes the full operationalisation of the BCTs intended for delivery. It describes who, when, where and how these 12 BCTs will be delivered within the practice.

The intervention will be delivered at the practice in 3 ways:

(1) Information for reception staff;

(2) Display posters and handout information leaflets for patients;

(3) Persuasive message and instructions for GDPs.

Verbal information will be delivered by the reception staff that will include collecting details about the patients' symptoms and the use of antibiotics for dental pain. This will prompt the reception staff to reduce the patients' expectations of receiving antibiotics for dental pain and to determine the length of appointment to be booked. A summary of this information will be given to the GDP well in advance of the appointment. Written information by displaying posters in the waiting room and providing information leaflets will also be delivered. This information will come from pre-existing materials developed by SDCEP and FGDP (UK). Finally, written information will be provided for the GDPs to encourage and support them to manage expectations appropriately. This will be simple key messages that prompt what to discuss with patients who expect to receive an antibiotic. The GDPs will also be given an action plan that prompts a planning the management of patient expectations. GDPs should identify as barriers to carrying out the behaviour as planned and revise the plan if required. This ensures that a tailored action plan is developed that fits the needs of the GDP. A full description of the theoretical underpinning of the intervention and how it would be applied to influence inappropriate antibiotic prescribing is dental primary care is shown in Table 8.3.

Table 8.3 Theoretical Domain Framework and Behaviour Change Techniques applied in intervention to influence inappropriate prescribing

TDF Domain (n = 7)	Behaviour Change Technique (BCT) (n = 12)	Application of BCTs in the proposed intervention
Behaviour regulation	Action Planning [1.4] Self-monitoring of behaviour [2.3] Self-monitoring of outcome(s) of behaviour [2.4] Problem solving [1.2] Credible sources [9.1]	Set a goal to not prescribe inappropriately by managing patient expectations Set goals to triage patients in dental pain Offer a method to record notes on condition and antibiotics used Encourage the monitoring on antibiotic use
Beliefs about capabilities	Verbal persuasion about capability [15.1]	Encourage reception staff to triage patients in dental pain Tell GDPs that it is possible to successfully reduce inappropriate prescribing
Beliefs about consequences	Information about social and environmental consequences [5.3] Salience of consequences [5.2] Information on health consequences [5.1] Anticipated regret [5.5]	Provide persuasive message to support managing expectations Provide information on how overuse of antibiotics can cause AMR Provide evidence that not prescribing is unlikely to impact on clinician-patient relationship Present the consequences of using antibiotic inappropriately
Emotion	Focus on past successes [15.3]	Advise to consider past successes in not prescribing antibiotics
Goals	Social Comparison [6.2]	Assess current use of antibiotics to manage patient expectations
Professional/social role and identity	Salience of consequences [5.2]	Advise that antibiotics do not cure dental pain Advise the consequence of AMR in the future
Social Influences	Information on health consequences [5.1]	Provide posters and information sheets

8.6 Intervention Development Discussion

This chapter has synthesised the evidence from the 3 empirical studies and 2 literature reviews to design a behaviour change intervention. This proposed intervention targets the functions of enablement and persuasion that delivers 12 BCTs underpinned by 7 TDF domains.

This proposed intervention is consistent with a systemic review of 67 articles examining the components of effective behaviour change of healthcare professionals, (Johnston and May, 2015). The authors of this review identified 3 main categories of interventions: (1) persuasive; (2) educational and informative; and (3) action and monitoring that were more effective at changing professional practice. However, this proposed intervention does contrast with the effective interventions described in the earlier literature review in Chapter 3, where most studies had only an educational and/or audit and feedback format. It is not known is these past intervention studies included BCTs that had a supportive or persuasive element because the content was poorly described. Only the theoretically informed intervention (Elouafkaoui et al. 2016) incorporated a persuasive message, and feedback that compared individual prescribing rate to the overall health board level antibiotic usage. In this research, the outcome of the mapping of the salient barriers to BCTs and intervention functions indicated that these three intervention categories were again likely to have a greater or lesser extent also be relevant to changing dentists' inappropriate prescribing behaviour.

This proposed intervention benefits from being clearly described, therefore making it replicable by others and for understanding the delivered BCTs and their 'active

ingredients' in the literature. A full description of the proposed intervention is presented using pre-existing TIDieR (template for intervention description and replication) guide which was developed to improve the reporting of intervention, (Hoffman et al. 2016). The guide is a 12-item checklist of the required information in a description of an intervention. The TIDieR items are: name of the intervention, rationale and goal of the intervention, description of the materials used how is accessed and who provide it; mode(s) and location(s) of the delivery, details about the number of times the intervention was delivered including duration and frequency; any modifications or tailoring and description of the fidelity assessment. Items 9-12 of the checklist are not included as this would be completed after a feasible study was conducted. A detailed description of the proposed intervention using the TIDieR template is shown in Appendix 18, Page 291.

As mentioned, this proposed intervention would need to be assessed in a future feasibly study. This would be important before conducting a randomised control trial (RCT) to establish its effectiveness to improve antibiotic prescribing behaviour in primary dental care. A framework that supports the implementation of the intervention is the Reach, Efficacy, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) that advocates the use of these factors.

Another consideration is an assessment of the adherence of the intended intervention delivery. This is important to measure the fidelity to better understand how and why this intervention worked if any variations from the originally intended delivery may affect the content of the intervention (Borelli 2011). Variation would impact on reliability and validity of the intervention, and on the understanding of

the ‘active ingredients’ effectively changing the target behaviour (French et al. 2015).

A weakness of the intervention development is that it is not fully prescriptive. Despite the applied frameworks (TDF and BCTTv1) being developed through expert consensus, the mapping of TDF domains to BCTs and the operationalisation of BCTs is largely subjective.

8.7 Summary of Chapter

This chapter has described the implementation and results of a GDP workshop, the means chosen to refine the content and format of an intervention design that was developed in the preceding chapters of this thesis. Whilst beyond the scope of this thesis, future feasibility piloting of the intervention will identify any further tailoring and necessary refinements, and also intervention fidelity issues.

CHAPTER 9 - DISCUSSION AND CONCLUSION

Outline of Chapter

In this final chapter, the phases of the research are summarised, and the key findings are outlined. It includes a discussion about the strengths and the limitations of this research, highlighting its potential contribution to improving antibiotic prescribing practice in primary dental care in Scotland and elsewhere as well as implications for future research.

9.1 OVERVIEW OF THE RESEARCH

The overall aim of this thesis was to use a theoretically informed approach to the development of an intervention to improve the use of antibiotics in primary dental care. The thesis takes a pragmatic and holistic approach whereby the perspectives of both patients and GDPs were included in this research.

During the research, two behaviour change frameworks derived from the synthesis of behaviour change theories and frameworks were applied to demonstrate the explicit use of theory throughout each phase of the design and development of the proposed intervention. It was intended that this application of a behaviour change theoretical approach was more likely to increase the effectiveness of the proposed intervention and allow an explicit understanding of why and how it works. The phases included literature reviews, empirical studies and intervention development through the application of the TDF and BCTTv1 behaviour change frameworks and the collaboration with end-users to co-produce an implementable intervention.

In the first phase, the stages of the behaviour change analysis initially utilised existing published evidence (Chapter 3) and an up-to-date qualitative re-analysis of the factors known to influence inappropriate prescribing (Chapter 4). This re-analysis also took the further step of identifying and mapping the underlying factorial beliefs to theoretical behaviour change domains using the TDF.

At this stage, a decision on what area of improvement would become the future focus and direction of the research was made. Otherwise, a potentially large number of targeted beliefs and behaviour change techniques could become unmanageable in the proposed intervention. Therefore, it was judged that the use of antibiotics as a way to manage patient expectation was a 'problem' more often associated with inappropriate prescribing. Therefore, the identified TDF domains associated with patient-related factors informed the content of two further quantitative studies that surveyed GDPs (Chapter 5) and patients (Chapter 6) about expectations for antibiotics to manage dental pain.

In chapter 7, this empirical evidence was collated, and potential mechanisms of change based on the TDF domains were identified and mapped using the BCTTv1 to potential behaviour change techniques that could improve the management of patient expectation for antibiotics. The utility of these proposed behaviour change techniques was explored, operationalised and refined during the workshop by GDPs in chapter 8.

This final chapter considers the application of this proposed intervention based on the strengths and limitations of its design and development using this behaviour change approach.

9.2 Summary of the Findings addressing the Research Questions

It was thought that a summary of the research would be helpful to the reader, therefore this section summarises the findings related to the key questions outlined in Chapter 1, Section 1.10, Page 29.

9.2.1 Research question 1

What clinical and psychological factors influence prescribing decisions including inappropriate decisions?

An initial review of the published literature revealed that clinical, individual, patient and environmental and system level related factors exist that are likely to influence antibiotic prescribing decisions (Chapter 3). The semi-structured interviews (Study 1) examining prescribing practice and inappropriate prescribing identified that these factors still continue to influence all prescribing decisions. The interviews findings indicated that patient related factors were more likely to determine non-evidence based antibiotic use. The more salient component of the patient-related factors was coping with patients who expected to receive antibiotics. Therefore, it was decided to focus on inappropriate prescribing (as defined in Chapter 1, Section 1.2, Page 20) in the context of using antibiotics to manage patient expectations.

This focus was confirmed by a larger surveyed sample of GDPs in Scotland (Study 3) which found that 10% of GDPs managed patient expectations by wanting to prescribe and 8% planned about when they would prescribe. The GDPs who participated in the workshop also confirmed that they do at times prescribe to cope with patients who expect to receive an antibiotic (Chapter 7).

9.2.2. Research question 2

What salient beliefs influence inappropriate prescribing behaviour?

The literature search found that one previous study (Newlands et al. 2016) had used the TDF to identify the beliefs underlying decisions to carry out surgical treatment instead of prescribing antibiotics. Beliefs identified in other antibiotic prescribing studies were mapped to theoretical domains using the TDF. It was found that all TDF domains except Professional/Social role and identity and Goals were influential in prescribing decisions.

These findings were updated and validated using the TDF to code the interview responses (Study 1). This resulted in 5 TDF domains being more relevant in prescribing to manage patient expectations. The specific beliefs often associated with using antibiotics as a way of managing patient expectation were as follows:

- Beliefs about consequences of prescribing to manage patient expectations (that patients believe the dentist is caring and competent; it is quicker and easier; it pleases patients more; it maintains clinician-patient relationship & justifying decisions)
- Social Influence (from irregular attenders and professional bodies)
- Beliefs about capabilities (to cope with upset, hostile and anxious patients when not prescribing, and prescribing is easier than explaining or changing patients' views)
- Emotion (from concerns about disappointing patients by not prescribing)
- Environmental context and resources (from insufficient appointment times and SDR payment policy)

The survey (Study 2) informed by the interviews findings confirmed the salience of these TDF domains and specific beliefs when GDPs decided to prescribe or to not prescribe in a larger sample. Significant predictors of intentions as a proxy measure of prescribing behaviour were explored. It found that patient expectations; disappointing patients and maintaining the clinician-patient relationship were predictive of wanting to prescribe. However, wanting to prescribe decreased when patients were more irregular attenders. These findings were agreed upon in the discussions held during the workshop.

In Study 3, one-third of patients did report expectations to receive antibiotics for dental pain, but they mainly reported little disappointment from not receiving an antibiotic despite thinking that they would get better with one.

The synthesis of the findings in Studies 1-3 resulted in targeting a sub-set of 7 TDF domains as potential mechanisms of actions that would bring about the desired change in managing patient expectations by not prescribing antibiotics. These domains were behaviour regulation, environmental context and resources, social influences, beliefs about consequences, beliefs about capabilities, professional/social role and identity and emotion.

9.2.3 Research question 3

What behaviour change technique and mode(s) of delivery should be applied to 'improve' prescribing behaviour?

The literature found that the components of previous interventions were educational using training and audits to reduce the use of antibiotics. This research took a comprehensive approach using qualitative (Study 1) and quantitative

(Studies 2 and 3) involving GDPs and patients to inform the TDF domains and specific beliefs that could be targeted in the future intervention. A mapping exercise described in Chapter 7 identified 18 BCTs that could bring about the desired change in prescribing, but how acceptable or practical it would be to implement them in primary dental care was unknown. Therefore, GDPs were involved to drawn upon their expertise to co-produce an intervention more likely to be acceptable and practical to implement in primary dental care.

Two modes of delivery preferred by PowerPoint presentations (Study 2) and more similar workshop sessions whereby issues of managing patient expectation could be compared and possible solution discussed between GDPs.

Other acceptable alternatives discussed were the provision of intervention tools that can be easily implemented in daily practice. The outcome was in-practice intervention that involved the whole dental team that triaged patients to expect surgical treatment instead of antibiotics. Based on a pragmatic decision of limited resources, an in-practice intervention was the preferred option to take forward in a future feasibility study. The result was a proposed intervention including 12 BCTs targeting the 7 TDF domains as shown in Figure 9.1.

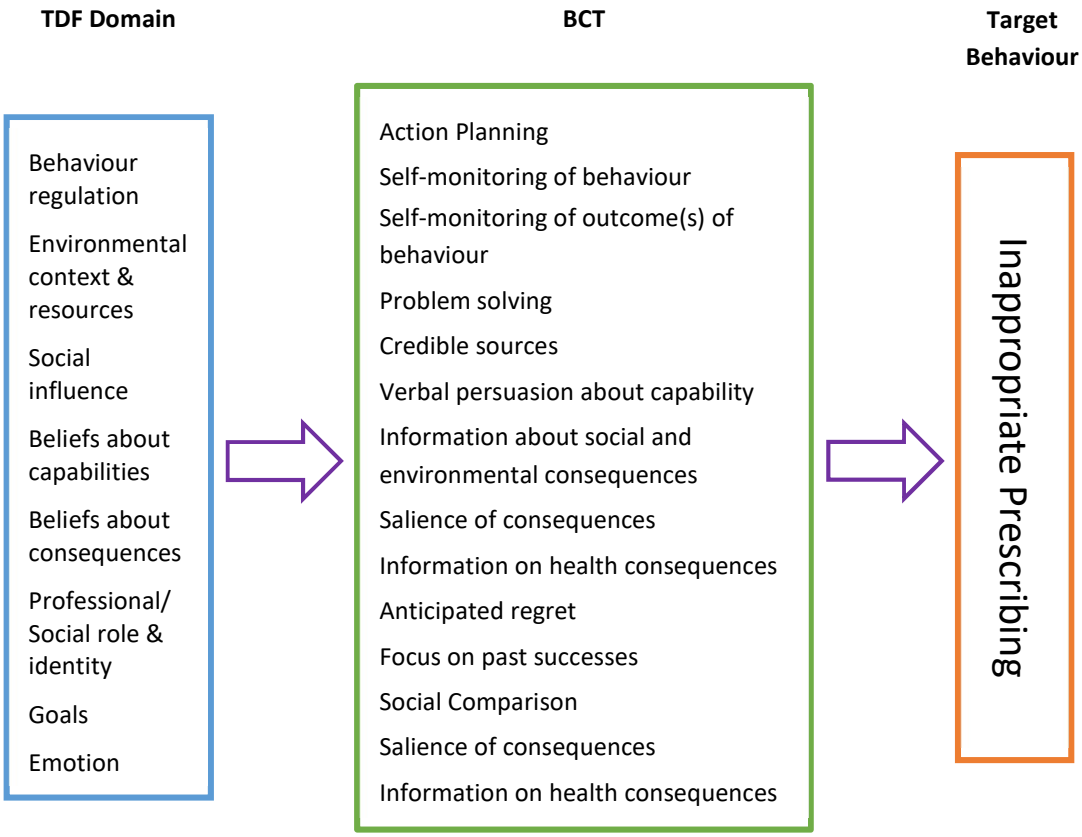

Figure 9.1 Visual model of the proposed intervention

9.3 Key Elements of the Intervention

The behaviour change techniques in this proposed intervention straddled the intervention functions of persuasion and enablement for GDPs, and education for patients. In general terms, the key elements of this proposed intervention aim to improve antibiotic prescribing by at directly persuading dental staff to follow new management practices to reduce patient expectation and to directly and indirectly educate patients to not expect antibiotics for dental pain. Together, the aim of behaviour change components were to incorporate a set of procedures that targeted the identified barriers to persuade, encourage, support, and reinforce the importance of a whole practice approach to using antibiotics appropriately and to

communicate an educational message to patients that dental pain does not get better quicker with antibiotics.

9.4 Contribution of Behaviour Change Theory to Develop Interventions

The development of interventions to change clinicians' behaviour is commonly reported in the current literature; however, how this behaviour change approach can contribute to intervention design is not always adequately considered by stakeholders and policy-makers, (Tonkin-Crine et al. 2015; Pinder et al. 2015; Lorencatto et al. 2018). Some may argue that intervention developed from anecdotal evidence can be just as effective as was shown in the previous dental intervention studies included in the review: the interventions that most effectively reduced antibiotic prescribing rates were not underpinned by theory. Whilst the theory based interventions were less effective in reducing the use of antibiotics, the benefits are that the 'mechanism of change' applied are explicitly stated, thus providing evidence of how the intervention worked and further replication is possible.

To the author's knowledge, this first time that these behaviours change frameworks have been applied to develop an intervention in a dental context. Also, the researcher is unaware of other research which takes a holistic approach of involving patients as well as dentists to understand what needs to change to improve the appropriate use of antibiotics in dentistry.

9.4.1 Strengths of the research

The main strength of the research was the use of two behaviour change frameworks to comprehensively identify the influences at play when making antibiotic prescribing decisions and the BCTs more likely to be effective in addressing the barriers and enablers of inappropriate prescribing. It became apparent during the behaviour analysis that the multi-factorial complexity of prescribing decisions was associated with many 'problems' which could result in the inappropriate use of antibiotics. This indicated a narrowing down of a target area for improving prescribing behaviour, if not, the number of identified BCTs could possibly become unmanageable and cause further issues around which ones to select in the intervention.

From the beginning, the intention of this research was to not focus on reducing prescribing but to understand why and when inappropriate prescribing decisions were made. Therefore, from the outset, the thesis defined its meaning of inappropriate prescribing which something was that was often omitted from published articles or it was implicitly taken to be understood by the authors.

A pragmatic decision that may vex the qualitative 'purists' was made to target patient-related factor of expecting antibiotics based on the higher reported issues of inappropriate prescribing of antibiotics to manage patient expectation. Justification of this decision to focus on understanding the barriers of managing patient expectation was verified by involving patients in later survey.

The use of the behaviour change theoretical frameworks helped the researcher to comprehensively identify the potential barriers and to target for change and the

mixed method approach has confirmed the perceived salience of expectations for antibiotics by involving patients in the behaviour analysis. It did identify more factors influencing prescribing decisions that are indicated by the targets of the past intervention studies described in Chapter 3.

Although this thesis was guided by the BCW (Michie et al. 2013) by applying two different frameworks, it is acknowledged that as many as over 60 other frameworks are available (Tabak et al. 2012). These applied frameworks met the purposes of this research which was to identify the determinants and applied theory throughout, and it could be operationalised using published examples (Atkins et al. 2017). Also training by a Summer School organised by the Centre of Behaviour Change, University College London and previous experience gained whilst working within the TRiaDS programme.

9.4.2 Limitations of the research

For pragmatic reasons this thesis did utilised pre-existing research networks which by their very nature may suggest even more interested and motivated participants, however, despite this a diverse range of participant characteristics was indicated in the results. Secondly, social response bias was possible whereby the participant especially the interviewed GDPS gave what was perceived to be socially acceptable replies; although, this was possibly addressed to some degree by the researcher not being a clinician. A fact that the GDPs were told before the interview started.

Another possible limitation is the subjective nature of the mapping of beliefs to TDF domains and then to behaviour change techniques by the researcher. Whilst, beyond the remit of this thesis, it is acknowledged that a detailed discussion to

check for coding consistency to TDF domains that included some double coding and verification of the mapping to BCTs is standard practice in intervention development studies. Therefore, the selection of BCTs from the taxonomy was to certain extent subjective; although their inclusion was verified at the workshop, and also from conversions with researchers from the University of Aberdeen who developed the Training in Practice Intervention to Target Antibiotic Prescribing (TiPTAP) poster, leaflet and flowchart currently available to dentists on the SDCEP website, (http://www.sdcep.org.uk/published-guidance/drug-prescribing accessed 6th August 2018).

Other methods of intervention development such as intervention mapping (IM) are also available, (Bartholomew 1998). Initially developed to bridge the gap between social and behavioural theories, it has been more often used to plan, apply and evaluate health promotion programmes, (Bartholomew 2011). Intervention mapping follows a similar staged approach whereby the TDF and Taxonomy frameworks can and has been incorporated in the assessment of determinants and selection of the behaviour change techniques. With the training and expertise of the BCW based in the UK and for IM in the Netherlands and the United States often selection of one process over the other is possibly for geographical reasons.

Use of a behaviour change approach comes not without criticism from others who believe that this systematisation of whereby clinicians become technicians is not desirable (Ogden, 2016; Greenhalgh 2013).

9.5 Future Research

Finally, this research may suggest that it has found a 'solution' to how to approach improving inappropriate antibiotic prescribing in primary dental care. Whether, these identified elements are effective or not will only be known from further research; either way it will be possible to determine why it worked or not and if successful how it can be replicated whereby future interventions can draw upon the evidence gathered by this thesis. The anticipated research would include developing the required materials, i.e. the persuasive message and triage protocols, and testing the feasibility of this proposed intervention bundle before a pilot study to measure its effectiveness ending possibly in a large-scale RCT.

9.6 Conclusions

To conclude, this thesis has reviewed the relevant literature, involved patients and end-users to co-produce a potentially acceptable intervention to improve antibiotic prescribing behaviour. Although its effectiveness will have to be determined in the future research, the thesis has offered a theory based intervention that targets the management of patient expectation to improve antibiotic prescribing in primary dental care. These identified BCTs as an intervention bundle provides a coherent approach to enhancing at practice level the everyday practice whereby patients are encouraged and supported to accept treatment, and that GDPs are offered assistance in how to cope with patients who expect to be prescribed an antibiotic.

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APPENDICES

1. University of Dundee: Letter of ethical approval
2. NHS R&D letter of access approval: NHS Tayside
3. NHS R&D letter of access approval: NHS Fife
4. Literature database search
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UNIVERSITY OF DUNDEE: LETTER OF ETHICAL APPROVAL

UNIVERSITY OF DUNDEE

School of Psychology

University of Dundee Research Ethics Committee

University of Dundee
Dundee
DD1 4HN

23rd March 2015

Dear Miss Forbes,

Application Number: UREC 15030

Title: Antimicrobial Prescribing in Primary Dental Care

I am writing to you to advise you that your ethics application has been reviewed and approved by the University of Dundee Research Ethics Committee.

Approval is valid for three years from the date of this letter. Should your study continue beyond this point, please request a renewal of the approval.

Any changes to the approved documentation (e.g., study protocol, information sheet, consent form), must be approved by UREC.

Yours sincerely,

Dr Astrid Schloerscheidt
Chair, University of Dundee Research Ethics Committee

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NHS R&D LETTER OF APPROVAL: NHS TAYSIDE

NHS Tayside

31 July 2015

Ms Gillian Forbes
University of Dundee
Dundee Dental Education Centre
Frankland Building
Small's Wynd
DUNDEE
Scotland
DD1 4HN

Dear Ms Forbes,

R & D MANAGEMENT APPROVAL - TAYSIDE

Title: Developing a theoretically informed intervention to improve the quality of antimicrobial prescribing behaviour of dentists in primary care

Chief Investigator: Ms Gillian Forbes

Principal Investigator: Ms Gillian Forbes

Tayside Ref: 2015DE07 **NRS Ref: NRS15/GH154**

REC Ref: N/A

EudraCT Ref: N/A **CTA Ref: N/A**

Sponsor(s): University of Dundee

Funder(s): The Health Foundation

Many thanks for your application to carry out the above project here in NHS Tayside. I am pleased to confirm that the project documentation (as outlined below) has been reviewed, registered and Management Approval has been granted for the study to proceed locally in Tayside.

Approval is granted on the following conditions:-

- ALL Research must be carried out in compliance with the Research Governance Framework for Health & Community Care, Health & Safety Regulations, data protection principles, statutory legislation and in accordance with Good Clinical Practice (GCP).
- All amendments to be notified to TASC R & D Office.
- All local researchers must hold either a Substantive Contract, Honorary Research Contract, Honorary Clinical Contract or Letter of Access with NHS Tayside where required (http://www.nihr.ac.uk/systems/Pages/systems_research_passports.aspx).

- TASC R & D Office to be informed of change in Principal Investigator, Chief Investigator or any additional research personnel locally.
- Notification to TASC R & D Office of any change in funding.
- As custodian of the information collated during this research project you are responsible for ensuring the security of all personal information collected in line with NHS Scotland IT Security Policies, until destruction of this data.
- All eligible studies will be added to the UKCRN Portfolio http://public.ukcrn.org.uk/. Recruitment figures for eligible studies must be recorded onto the Portfolio every month: This is the responsibility of the lead UK site. If you are the lead, or only, UK site, we can provide help or advice with this. For information, contact Sarah Auld – (01382) 383822 – sarah.auld@nhs.net or Liz Livingstone – (01382) 383872 – elivingstone@nhs.net.
- Annual reports are required to be submitted to TASC R & D Office with the first report due 12 months from date of issue of this management approval letter and at yearly intervals until completion of the study.
- Notification of early termination within 15 days or End of Trial within 90 days followed by End of Trial Report within 1 year to TASC R & D Office.
- You may be required to assist with and provide information in regard to audit and monitoring of study.

Please note you are required to adhere to the conditions, if not, NHS management approval may be withdrawn for the study.

Approved Documents

Document	Version	Date
Protocol	1.6	30/06/15
IRAS R & D Form		
SSI Form		
Topic guide	1.5	29/01/15
PIS	2	16/04/15
Consent	2	16/04/15
Invite letter	2	16/04/15
Insurance		17/06/14
University REC		23/03/15
Funder email		18/01/13
CV – Jan Clarkson		June 2015
CV – Debbie Bonetti		
CV – Gillian Forbes		

May I take this opportunity to wish you every success with your project.

Please do not hesitate to contact TASC R & D Office should you require further assistance.

Yours sincerely,

Elizabeth Coote
R&D Manager

NHS R&D LETTER OF ACCESS APPROVAL: NHS FIFE

:al Director

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ian Forbes
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30 July 2015
Our Ref *15-063 NRS15/GH154*

Enquiries to *Aileen Yell*
E-mail *aileenyell@nhs.net*
Telephone *01383 623623 Ext 20940*
Website *www.nhsfife.org*

ls Forbes

t Title: Antimicrobial prescribing in primary dental care

you for your application to carry out the above project. Your project documentation (detailed has been reviewed for resource and financial implications for NHS Fife and I am happy to you that NHS permission for the above research has been granted on the basis described in lication form, protocol and supporting documentation. The documents reviewed were:

ent	Version	Date
onnaire Topic Guide	1.5	29 January 2015
approval		23 March 2015
ol	1.6	30 June 2015
on Letter	2	16 April 2015
Information Sheet	2	16 April 2015
nt Form	2	16 October 2015
&D Form	4.0	14 July 2015
SI Form	4.0	28 July 2015
dy-Wide Governance Report		28 July 2015

ms of the approval state that you are the Principal Investigator authorised to undertake this within NHS Fife. I understand that dental practices have not yet been approached.

hat review by an NHS Research Ethics Committee has not been necessary since the study s NHS staff only.

onsors for this study are University of Dundee.

of our participation in studies will be included in annual returns we are expected to te as part of our agreement with the Chief Scientist Office. Regular reports of the study to be submitted. Your first report should be submitted to Dr A Wood, R&D Manager, R&D nent, Queen Margaret Hospital, Whitefield Rd, Dunfermline, KY12 OSU la.wood3@nhs.net) in 12 months time and subsequently at yearly intervals until the work is ted. A Lay Summary will also be required upon completion of the project.

ion, approval is granted subject to the following conditions:-

NHS
Fife

All research activity must comply with the standards detailed in the Research Governance Framework for Health & Community Care (http://www.cso.scot.nhs.uk/publications/resgov/resgov.htm), health & safety regulations, data protection principles, other appropriate statutory legislation and in accordance with Good Clinical Practice (GCP).

Any amendments which may subsequently be made to the study should also be notified to Aileen Yell, Research Governance Officer (aileenyell@nhs.net) , as well as the appropriate regulatory authorities. Notification should also be given of any new research team members post approval and/or any changes to the status of the project.

This organisation is required to monitor research to ensure compliance with the Research Governance Framework and other legal and regulatory requirements. This is achieved by random audit of research. You will be required to assist with and provide information in regard to monitoring and study outcomes (including providing recruitment figures to the R&D office as and when required). As custodian of the information collated during this research project you are responsible for ensuring the security of all personal information collected in line with NHS Scotland IT Security Policies, until the destruction of this data. Permission is only granted for the activities for which a favourable opinion has been given by the REC (and which have been authorised by the MHRA where appropriate).

The research sponsor or the Chief Investigator or local Principal Investigator at a research site may take appropriate urgent safety measures in order to protect research participants against any immediate hazard to their health or safety. The R&D office (aileenyell@nhs.net) should be notified that such measures have been taken. The notification should also include the reasons why the measures were taken and the plan for further action. The R&D office should be notified within the same time frame of notifying the REC and any other regulatory bodies.

I would like to wish you every success with your study and look forward to receiving a summary of the findings for dissemination once the project is complete.

Yours sincerely

DR FRANCES ELLIOT
Medical Director
NHS Fife

Cc : Aileen Yell, Research Governance Officer, NHS Fife, Queen Margaret Hospital, Dunfermline
NRSPCC, R&D Office, Foresterhill House Annex, Foresterhil, AberdeenAB25 2ZB

DATABASE SEARCH HISTORY

Research Question	Q: What is the profile of antibiotic prescribing in primary dental care in the UK?				
Databases	Cochrane Library; PubMed; OvidSP; Google Scholar and article citations No date limitation initially, later searches included from 1995 only. Primary and secondary care settings				
Searches	**Keywords**	**Number of Results**	**Date of Search**	**Comments**	**Updates from later searches**
As above	Dent*, prescribing, antibiotic*, UK	32	January 2014	Search found 26 relevant articles (6 excluded) Breakdown of 26 articles into setting and patient types Systematic review	April 2016; August 2018
As above	Primary AND dental AND care, prescribing, antibiotic*	17	January 2014	Search found 13 relevant articles 5 duplicates from 9/1/14 search 1 excluded (medical setting in Sweden)	April 2016; August 2018
Grey Literature from Google	Antibiotics; Antimicrobial stewardship; Prescribing guidelines; Dentists/GDPs; Primary care; NHS.	3 (UK)	February 2014	*Guidelines* SDCEP NICE Faculty of General Dental Practitioners (UK) *Reports* SAGP	April 2016; August 2018
Article citations	Roy et al. 2000 Chopra et al. 2014				

CONSENT FORM (STUDY 1)

ANTIBIOTIC PRESCRIBING DECISIONS IN PRIMARY DENTAL CARE

CONSENT FORM

The purpose of this study is to explore the decisions made by dentists when prescribing antibiotics. The research will focus on when and why dental conditions are treated with an antibiotic, what influences the decision and the advantages and disadvantages to the dentist in prescribing an antibiotic.

By completing below you are indicating that you have read and understood the Participant Information Sheet and that you agree to take part in this research study.

Please submit the form by using the 'SUBMIT' button. Alternatively, you can print this form and return by post or email as an attachment. Please return your consent form before 17th April 2015

Participant's Name..... Date.....

Telephone Contact Number.....

Signature of person obtaining consent..... Date.....

Name of the person obtaining consent.....

I agree to the use of anonymous extracts from my interview in conference papers and academic publications (please check a box) Yes ☐ No ☐

If you have any queries before giving your consent to taking part in this research study, please contact:

Gillian Forbes

Dundee Dental Education Centre, University of Dundee, Small's Wynd, Dundee DD1 4HN

Email: g.z.forbes@dundee.ac.uk Telephone: 01382 470985

UNIVERSITY OF DUNDEE

PARTICIPANT INFORMATION SHEET (STUDY 1)

ANTIBIOTIC PRESCRIBING DECISIONS IN PRIMARY DENTAL CARE

PARTICIPANT INFORMATION SHEET

My name is Gillian Forbes and I am a research student at the University of Dundee. This research is part of a PhD project supervised by Prof. Jan Clarkson and Dr Debbie Bonetti, Dental Health Services Research Unit, University of Dundee. It is funded by the Health Foundation and supported by the Scottish Dental Practice Based Network (SDPBRN) and NHS Education for Scotland (NES).

Aim of the research study

The aim is to explore the decisions made by dentists when prescribing antibiotics. The research will focus on when and why dental conditions are treated with an antibiotic, what influences this decision and the advantages and disadvantages in prescribing an antibiotic.

What am I being asked to do?

Participating in this study will require you to take part in either a face-to-face interview at your practice or a telephone interview. The interview will last between 30 to 40 minutes and will be held at a convenient time to you. Telephone interviews will be conducted from the privacy of the researcher's office. The interviews will not be audio recorded and will take place between April and July of 2015.

Do I have to participate?

Your participation in the study is voluntary. If you agree to take part, you will be asked to complete a consent form. You are free to withdraw at any time without explanation.

Can I be identified?

Please be assured that your responses during the interview will be held in confidence. Notes taken during the interview will only be seen by project supervisors and will not be made available to anyone else. All non-identifiable note files will be securely stored and kept until the end of the research project after which time they will be destroyed. Any extracts from interviews used in conference papers and academic publications will be anonymous.

Research audit credit

Participants in this study may be eligible for research audit credit under the new arrangements for clinical audit described in the CDO letter of 17 January 2014.

What is required for research audit credit?

If you wish to claim research audit credit after the interview, you will be registered with SDPBRN by the researcher. To claim the credit you will be asked to complete a short, structured reflective report and an action plan. Full details will be sent after your interview.
It is entirely up to you if you wish to claim the research audit credit. It is not a requirement to taking part in the study.

Ethics

The University Research Ethics Committee of the University of Dundee has reviewed and approved this research study.

Further information

Please do not hesitate to get in touch if you would like to discuss any part of this study in more detail, please contact:

Gillian Forbes, Dental Health Services Research Unit, University of Dundee
Email: g.z.forbes@dundee.ac.uk
Telephone: 01382 740985

UNIVERSITY OF DUNDEE

INTERVIEW TOPIC GUIDE (STUDY 1)

ANTIBIOTIC PRESCRIBING DECISIONS IN PRIMARY DENTAL CARE
SCHEDULE OF SEMI-STRUCTURED INTERVIEW

Introduction; agenda setting; check time availability (min.30 minutes); consent; etc.

The aim of the interview is to learn more about when and why conditions are treated by prescribing an antibiotic. The recommendation from SDCEP guidance is to treat and try to minimise the use of antibiotics; however, I am aware this can be challenging in everyday practice. So I'd to hear about the types of barriers and facilitators you face in attaining this gold standard.

Do you have any questions before I start?

1. When would you normally prescribe an antibiotic, for a
   a. Dental abscesses?
   b. Perio abscesses including NUG (Necrotising Ulcerative Gingivitis)?

Conditions	Patients	Practice

2. What is relevant to you when prescribing an antibiotic, for a
   a. Dental abscesses?
   b. Perio abscesses including NUG?

Prompts: Others say……., would that be relevant to you?

Conditions	Patients	Practice

3. When do you not prescribe, for a
   a. Dental abscesses?
   b. Perio abscesses including NUG?

Conditions	Patients	Practice

4. What would you do instead of prescribing, for a
    a. Dental abscesses?
    b. Perio abscesses including NUG?

Conditions	Patients	Practice

5. What is relevant to you when deciding not to prescribe, for a
    a. Dental abscesses?
    b. Perio abscesses including NUG?

Conditions	Patients	Practice

6. What are the advantages/disadvantages in prescribing for you, for a
    a. Dental abscesses?
    b. Perio abscesses including NUG?

Conditions	Patients	Practice

7. What are the advantages/disadvantages in not prescribing for you, for a
    a. Dental abscesses?
    b. Perio abscesses including NUG?

Conditions	Patients	Practice

I've asked all my questions now.

Do you wish to add anything more?

Thank you for your time.

Interviewee ID Nº..... Date of Interview.....

CODING MATRIX 1 (STUDY 1)

Coding Matrix - Nature and Frequency of reported Prescribing Practice

Factor	Sub-factor	Indicators of Prescribing Decisions	Interview N°																Freq
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Clinical	Specific Condition	Large /spreading swelling/systemic swelling/comes on quickly	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	14
Clinical	Adjunct	As an adjunct (i.e. to scale and clean for patients with periodontal disease)	✓	-	-	✓	✓	-	-	✓	-	✓	✓	-	✓	-	✓	✓	9
Patient	Demeanour of patient	Upset; anxious; sad; in pain	-	✓	✓	✓	-	✓	-	✓	-	-	✓	-	✓	-	✓	-	8
Clinical	Treatment - perceived difficulties	Numbing /Anaesthetic is difficult	-	-	-	✓	✓	✓	✓	✓	-	-	✓	-	✓	-	-	-	7
Patient	Treatment references	Patient doesn't have time or want to be treated on the day	✓	-	-	-	-	✓	✓	-	-	-	✓	-	-	-	✓	✓	6
Clinical	Adjunct	Surgery has been done, so give antibiotic to take if required (not settling)	-	-	✓	✓	-	-	✓	-	-	✓	✓	-	-	-	-	✓	6
Clinical	Specific Condition	For necrotising ulcerative gingivitis (NUG)	-	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	5
Clinical	Specific Condition	Impacted wisdom tooth	-	-	✓	-	-	✓	-	✓	✓	-	✓	-	-	-	-	-	5
Clinical	Specific Condition	Insufficient pus (pain level); no lump on gum	✓	-	-	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	4
Clinical	Treatment - perceived difficulties	Not possible to drain/unable to incise	-	✓	✓	✓	-	-	-	✓	-	-	-	-	-	-	-	-	4

Factor	Sub-factor	Indicators of Prescribing Decisions	Interview N°																Freq
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Clinical	Treatment - perceived difficulties	Restricted movement [refer]	-	✓	-	-	-	✓	-	-	-	-	✓	-	✓	-	-	-	4
Clinical	Specific Condition	For pericoronitis	-	-	-	-	✓	✓	-	-	-	-	-	✓	-	-	-	-	3
Clinical	Specific Condition	Rise in temperature	-	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-	✓	3
Extrinsic	Time	Time considerations (lack of)	-	-	-	✓	-	-	✓	✓	-	-	-	-	-	-	-	-	3
Clinical	Treatment - perceived difficulties	Location in mouth: lower jaw	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	3
Clinical	Complexity of Treatment	Abscess is under existing root treatment	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	3
Clinical	Complexity of Treatment	Complexity (requires time) of the extraction	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	2
Clinical	Complexity of Treatment	Having to refer to hospital for root treatment	-	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	2
Clinical	Specific Condition	Tooth is black and has fishy smell; rotten teeth	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	1
Clinical	Specific Condition	Dry socket	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	1
Clinical	Specific Condition	For Perio - 2 rounds of antibiotic, then extract	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	1
Clinical	Specific Condition	Cellulitis	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	1
Patient	Refusal of treatment	Patient does not want an extraction	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Patient	Attendance history	Patient is not registered	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	1

Factor	Sub-factor	Indicators of Prescribing Decisions	Interview Nº																Freq
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Patient	Delayed treatment	Patient can't come in for review appointment, i.e., work, holidays	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	1
Extrinsic	Day of the week	On a Friday	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	1
Clinical	Specific Condition	Can't resolve with local measure	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	1

CODING MATRIX 2 (STUDY 1)

Coding Matrix - Nature and Frequency of reported Non-Prescribing Practice

Factor code	Sub-Factor	Reported Non-Prescribing Practice	Interview Nº															Freq
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Clinical	Viable	Local measure, i.e., achieve clearance	✓	-	✓	-	-	✓	✓	✓	✓	✓	✓	-	✓	✓	-	✓	11
Clinical	Treatment	Location of infection (front is more assessable)	✓	✓	✓	-	-	✓	✓	-	-	-	-	-	-	-	-	✓	6
Clinical	Condition	Tooth nerve is dying (pulpitis)	✓	✓	✓	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	6
Clinical	Condition	Only localised swelling/no systemic swelling	-	-	✓	✓	-	✓	-	-	-	-	-	✓	✓	✓	-	-	6
Clinical	Treatment	Can extract the tooth/only patient pathway	✓	-	✓	✓	-	-	-	-	✓	-	-	-	✓	✓	-	-	6
Clinical	Condition	Most of the time (explicitly stated)	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	✓	✓	✓	6
Clinical	Condition	Level of pain	-	-	✓	-	✓	-	-	-	-	✓	-	-	✓	-	-	-	4
Patient	Attendance	Registered/unregistered patients/regular patients	-	✓	-	✓	-	-	-	-	-	-	✓	-	-	✓	-	-	4
Clinical	Viable	Can the patient be sufficiently numbed	-	-	✓	-	-	-	-	-	-	-	-	-	✓	-	✓	-	3
Clinical	Condition	For periodontal disease, i.e., clean out gum area	-	✓	-	✓	-	✓	-	-	-	-	-	-	-	-	-	-	3

GDP QUESTIONNAIRE (STUDY 2)

Managing Patients' Expectation for Antibiotics

It is well-documented that antibiotic prescribing varies across primary dental care and it can be influenced by non-clinical factors.

We are interested in your views about and experiences of managing patient expectation.

Please understand that there are no right or wrong answers and all your responses are anonymous. The survey should take no longer than 10-15 minutes to complete.

Your contribution is valued and greatly appreciated.

This study is funded by the Health Foundation and is kindly supported by the Dental Clinical Effectiveness Programme, NHS Education for Scotland.

1) 1. If a patient expects an antibiotic, I prescribe because I think

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
a) Patients believe I am a caring dentist	☐	☐	☐	☐	☐	☐	☐
b) Patients believe I am a competent dentist	☐	☐	☐	☐	☐	☐	☐
c) Patients are likely to be more pleased in their care	☐	☐	☐	☐	☐	☐	☐
d) This maintains a good clinician-patient relationship	☐	☐	☐	☐	☐	☐	☐
e) This is a quick solution for me	☐	☐	☐	☐	☐	☐	☐
f) This is an easier solution for me	☐	☐	☐	☐	☐	☐	☐
g) I can justify my decision	☐	☐	☐	☐	☐	☐	☐

2) 2. When a patient expects an antibiotic, I am confident in not prescribing even if the patient

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
a) Is upset	☐	☐	☐	☐	☐	☐	☐
b) Becomes hostile towards me	☐	☐	☐	☐	☐	☐	☐
c) Is not being co-operative	☐	☐	☐	☐	☐	☐	☐
d) Is an irregular attenders	☐	☐	☐	☐	☐	☐	☐

3) 3. When a patient expects to receive an antibiotic, it is easier to prescribe than

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
a) Explaining why an antibiotic is not required	☐	☐	☐	☐	☐	☐	☐
b) Changing patients' views on receiving an antibiotic	☐	☐	☐	☐	☐	☐	☐

4) 4. If a patient expects an antibiotic

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
a) I want to prescribe as part of managing their expectation	☐	☐	☐	☐	☐	☐	☐
b) I have a plan about when I would prescribe	☐	☐	☐	☐	☐	☐	☐

5) 5. For patients who expect antibiotics, my practice does not give me sufficient time to not prescribe (i.e. to drain any abscess)

☐ 1 (Strongly Disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly Agree)

6) 6. SDR payments do not cover the time costs to deal with patient expectation

☐ 1 (Strongly Disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly Agree)

7) 7. My decision to prescribe can be influenced by patients expecting antibiotics

☐ 1 (Strongly Disagree) ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 (Strongly Agree)

8) 8. Professional bodies expect me to manage patient expectation by not prescribing (i.e. to drain any abscess)

○ 1 (Strongly Disagree) ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 (Strongly Agree)

9) 9. If a patient expects me to prescribe, I am concerned about disappointing them by not prescribing

○ 1 (Strongly Disagree) ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 (Strongly Agree)

Current Initiatives

We wish to understand what you think about the approaches currently available to educate patients about receiving antibiotics for dental conditions

10) 10. Do you think, patients pay attention to the following in the waiting room?

	1 Not at all likely	2	3	4	5	6	7 Extremely likely
A poster	☐	☐	☐	☐	☐	☐	☐
An information leaflet	☐	☐	☐	☐	☐	☐	☐

11) 11. Do you think that any of the following would be helpful to you for managing with patient expectation for antibiotics?

	1 Not at all likely	2	3	4	5	6	7 Extremely likely
Learning about communication strategies	☐	☐	☐	☐	☐	☐	☐
Having longer appointment times	☐	☐	☐	☐	☐	☐	☐
Before the appointment, a leaflet is handed over by the receptionist	☐	☐	☐	☐	☐	☐	☐
Before the appointment, a leaflet is handed over by a dental nurse	☐	☐	☐	☐	☐	☐	☐

12) 12. What would be your preferred mode of delivery for any future training courses?

	1 Not at all likely	2	3	4	5	6	7 Extremely likely 7
Instructor-led with PowerPoint presentations	☐	☐	☐	☐	☐	☐	☐
Interactive group discussions including role play	☐	☐	☐	☐	☐	☐	☐
Computer training, i.e. e-learning	☐	☐	☐	☐	☐	☐	☐

About you

The following questions ask for some information about you.

13) 13. Are you?

☐ Male ☐ Female

14) 14. In which year did you qualify?

16) 16. On average, how many sessions (half days) do you work a week?

17) 17. Where do you work?

☐ General Dental Services ☐ Public Dental Services ☐ Other

18) 18. If you work in the General Dental Service, are your adult patients?

☐ Only NHS ☐ Mostly NHS ☐ Equally NHS/Private ☐ Mostly Private

☐ Only Private

Further Comments

19) Please use this box to add any comments that you think are relevant

REGRESSION MODEL GRAPHS (STUDY 2)

Regression Model 1

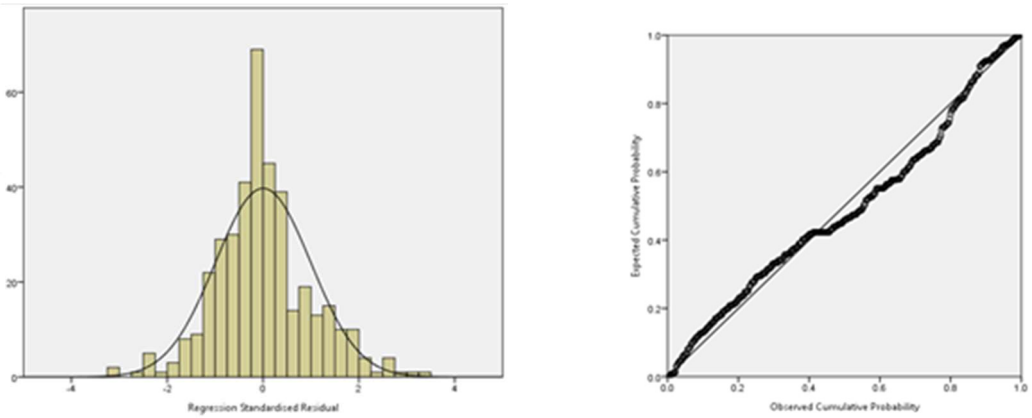

Figure 1 Histogram of Regression Standardised Residual and Graph of Observed Cumulative Probability

Regression Model 2

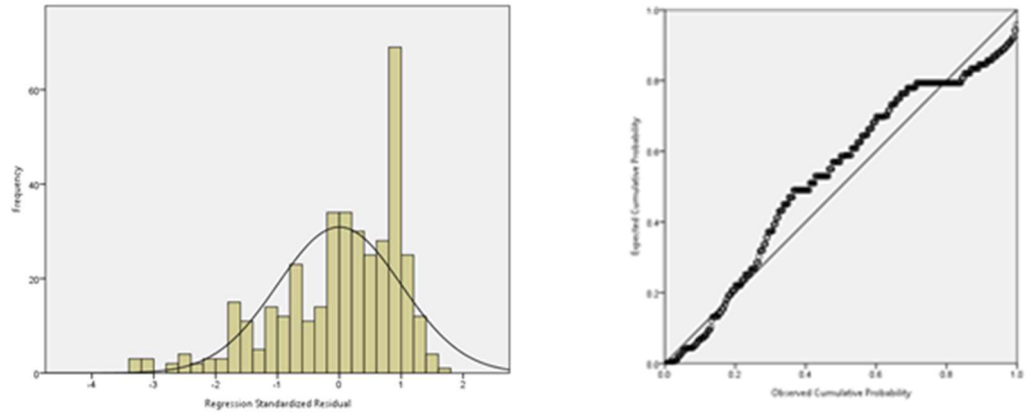

Figure 2 Histogram of Regression Standardised Residual and Graph of Observed Cumulative Probability

Regression Model 3

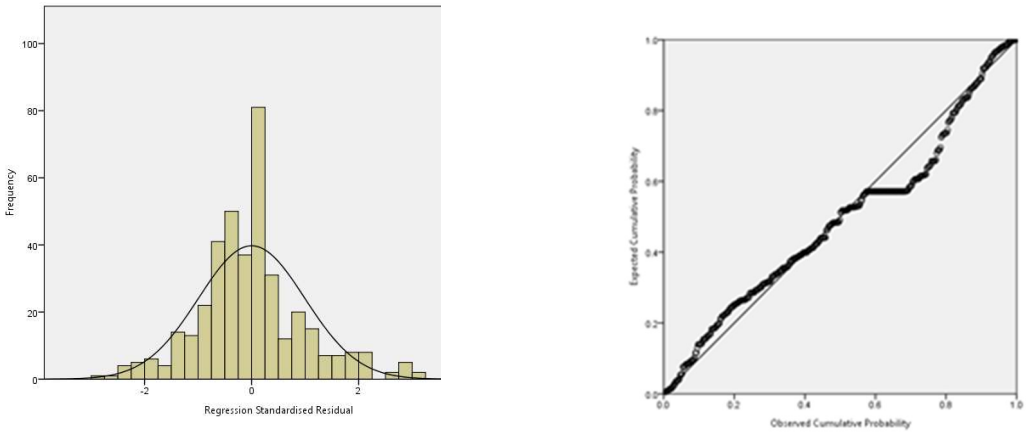

Figure 3 Histogram of Regression Standardised Residual and Graph of Observe Cumulative Probability

Regression Model 4

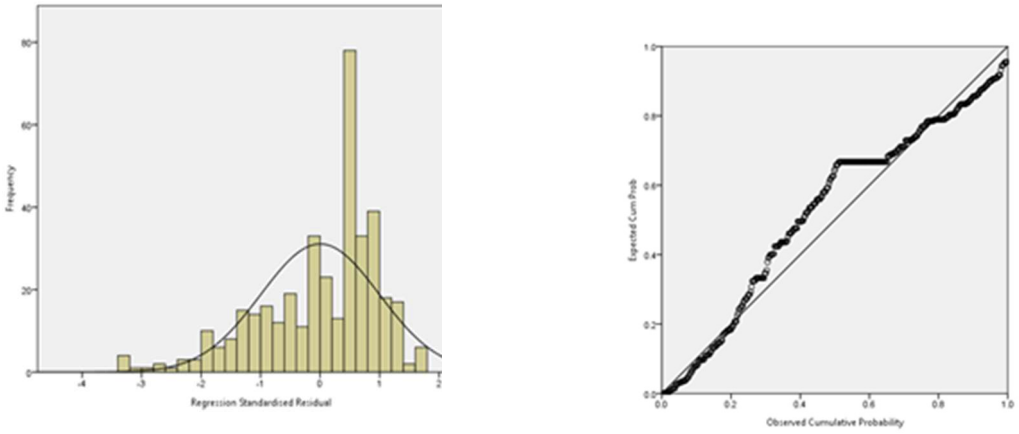

Figure 4 Histogram of Regression Standardised Residual and Graph of Observed Cumulative Probability

SHARE AGREEMENT LETTER (STUDY 3)

16/03/17
To Gillian Forbes
University of Dundee
DDEC
Frankland Building
Small's Wynd
DD1 4HN

SHARE STUDY No 054 Antibiotics for Dental conditions: Patient's Expectations

Dear Ms Forbes

Thank you for your request to the Access Committee to access data from the Scottish Health Research Register (SHARE).

I am pleased to confirm that your project has been considered by the Access Committee and your project, according to the SHARE Application Form received, has been approved.

We will be in touch soon to discuss progression of your application, and to advise you of any further paperwork which may be required.

Please note that SHARE must get acknowledgement in any publications and the standard recommended text is;

"Recruitment to this study was facilitated by SHARE – the Scottish Health Research Register.
SHARE is supported by NHS Research Scotland and the Chief Scientists Office."

We thank you for contacting SHARE, and we look forward to working with you.

Yours sincerely,

Professor Brian McKinstry Professor Colin Palmer

On behalf of the SHARE Management Team: Professor Brian McKinstry (Lothian), Professor Colin Palmer (Dundee), Dr Sam Philip (Grampian), Dr Roma Armstrong (Glasgow), Dr John Haughney (Glasgow), Dr Jacob George (Dundee), Dr Amanda Wood Fife.

Copy to: Keith Milburn (FD), Duncan Heather, James Galloway

V3 01/02/2017

PATIENT QUESTIONNAIRE (STUDY 3)

University of Dundee

Antibiotics for Dental Conditions: Patients' Expectation (F)

Introduction

Antibiotics are essential for treating infections but they are becoming less effective as bacteria develop resistance to them. This increasing resistance is made worse by the over-use of antibiotics by health care professionals. This PhD study is investigating the prescribing of antibiotics by dentists who work in primary care. This part of the PhD project is exploring patients' views on receiving antibiotics for dental pain, i.e., toothache.

Many patients have been invited to obtain a large range of views on and experiences of antibiotic prescribing for dental pain by their dentist.

Aim of the research study

The aim is to explore patients' expectations about antibiotics for dental pain when attending a dental practice.

What am I being asked to do?

Participating in this study will require you to complete a short questionnaire. In the questionnaire, there are 12 questions each with a list of reply options. This is also a comment box where, if you wish, you can add any further relevant details. It should take no more than 5-10 minutes to complete the questionnaire. The return of the completed questionnaire will imply participants' consent.

Do I have to participate?

No, it is up to you to decide. Your participation in the study is voluntary. You are free to withdraw at any time without explanation.

Can I be identified?

Please be assured that your responses will be anonymous. All the information that is collected during the course of this study will be kept strictly confidential. The confidential

handling, processing, storage and disposal of data are in accordance with the Data Protection Act 1998.

Ethics

The University of Dundee Schools of Nursing & Health Services and Dentistry Research Ethics Committee (A/N 3016030), which has the responsibility for checking all proposals for research on humans in the Dental School, University of Dundee, has examined this study and has raised no objections from the point of view of medical ethics.

If you wish more information about participating, please see the attached participant information leaflet.

Do not take too long over your replies, your immediate reactions to each question is most likely to reflect your views. There are no right or wrong answers.

1) How often do you see a dentist?

- Every 6 months
- Once a year
- Every 1-2 years
- Only when I need to go

2) Have you been prescribed an antibiotic by a dentist in the last 2 years?

- No
- Yes
- Maybe
- Don't know

3) Was the antibiotic prescribed at an emergency appointment?

- No
- Yes
- Not sure
- Don't know
- Not applicable

The following questions ask about your experiences of a relentless, throbbing toothache:

4) Have you ever experienced this?

- ○ No
- ○ Yes
- ○ Not sure
- ○ Don't know

5) Would you expect to receive an antibiotic?

- ○ No
- ○ Yes
- ○ Not sure
- ○ Don't know

6) Would you think it will get better with an antibiotic?

- ○ No
- ○ Yes
- ○ Not sure
- ○ Don't know

7) If you did not receive an antibiotic, would you

	No	Yes	Maybe	Don't know
Feel upset?	☐	☐	☐	☐
Go elsewhere?	☐	☐	☐	☐
Be satisfied because the dentist knows best?	☐	☐	☐	☐
Ask your dentist for one?	☐	☐	☐	☐

8) If you did not receive an antibiotic, would you think the dentist is

	No	Yes	Maybe	Don't know
Doing the right thing?	☐	☐	☐	☐
A caring dentist?	☐	☐	☐	☐
A competent dentist?	☐	☐	☐	☐

9) If your dentist told you surgical treatment (e.g. root canal, tooth extraction) is required, are you likely to

	No	Yes	Maybe	Don't know
Ask for an antibiotic and delay getting a root canal treatment at that time?	☐	☐	☐	☐
Ask for an antibiotic and delay getting the tooth extracted at that time?	☐	☐	☐	☐
Expect to receive an antibiotic along with surgical treatment?	☐	☐	☐	☐

The following questions ask for some information about you.

10) Please tell us your age

11) Please tell us your gender

- ○ Male
- ○ Female

12) If you have any comments, please use this box

FORMAL INFORMATION SHEET FOR PATIENT SURVEY (STUDY 3)

ANTIBIOTICS FOR DENTAL CONDITIONS: PATIENTS' EXPECTATIONS

PARTICIPANT INFORMATION SHEET

My name is Gillian Forbes and I am a researcher at the University of Dundee. This research is part of a PhD project supervised by Prof. Jan Clarkson and Dr Debbie Bonetti, Dental Health Services Research Unit, University of Dundee. It is funded by the Health Foundation and supported by the Scottish Dental Practice Based Network (SDPBRN) and NHS Education for Scotland (NES).

Introduction

Antibiotics are essential for treating infections but they are becoming less effective as bacteria develop resistance to them. This increasing resistance is made worse by the over-use and mis-use of antibiotics by health care professionals. This PhD project is investigating the prescribing of antibiotics by dentists who work in primary care.

This part of the PhD project is exploring patients' views on receiving antibiotics for dental pain, i.e., toothache.

Many patients have been invited to obtain a large range of views on and experiences of antibiotic prescribing for dental pain by their dentist.

Aim of the research study

The aim is to explore patients' expectations about antibiotics for dental pain when attending a dental practice.

What am I being asked to do?

Participating in this study will require you to complete a short questionnaire. An online link to the questionnaire is provided in the initial invitational email from SHARE. Also, if preferred, a paper version is also available on request.

In the questionnaire, there are 8 questions each with a list of reply options. There is also a comment box where, if you wish, you can add any further relevant details. It should take no more than 5-10 minutes to complete the questionnaire. The return of the anonymised completed questionnaire will imply participants' consent.

Do I have to participate?

No, it is up to you to decide. Your participation in the study is voluntary. You are free to withdraw at any time without explanation.

Can I be identified?

Please be assured that your responses will be anonymous. All the information that is collected during the course of this study will be kept strictly confidential. The confidential handling, processing, storage and disposal of data are in accordance with the Data Protection Act 1998.

What will happen to the results?

The results will be examined by the researchers who have organized the study. The results will then be published in scientific journals. Again, you will not be identified in any journal articles.

Complaints, insurance and indemnity

a. Right to raise concerns.

If you have any concerns about your participation in the study you have the right to raise your concern with a researcher involved in conducting the study or a doctor involved in your care.

b. Right to make a complaint

If you have a complaint about your participation in the study, you should first talk to a researcher involved in the study. However you have the right to raise a formal complaint. You can make a complaint to a senior member of the research team or to the NHS Complaints Officer for NHS Tayside (*or insert the site/contact details below*).

Complaints and Feedback Team
NHS Tayside
Ninewells Hospital
Dundee DD1 9SY
Freephone: 0800 027 5507
Email: feedback.tayside@nhs.net

c. Right to make a claim

In the event that you think you have suffered harm as a result of your participation in the study there are no automatic financial compensation arrangements. However, you may have the right to make a claim for

compensation. Where you wish to make a claim, you should consider seeking independent legal advice but you may have to pay for your legal costs.

d. Insurance

The University of Dundee maintains a policy of public liability insurance which provides legal liability cover in respect of damages, costs and expenses arising out of claims. Tayside Health Board is a member of the Clinical Negligence and Other Risks Insurance Scheme (CNORIS) which provides legal liability cover. The local site where you participated in the study also maintain cover via CNORIS.

You may be required to inform insurance companies with whom you intend to purchase life insurance, income protection or travel insurance, about your participation in this study. It is not anticipated that your involvement in the study will adversely affect your ability to purchase insurance but some insurers may use this information to limit the offer of cover, apply exclusions or increase any premium.

Ethics

The [details added here], which has the responsibility for checking all proposals for research on humans in the UK, has examined this study and has raised no objections from the point of view of medical ethics.

Further information

Please do not hesitate to get in touch if you would like to discuss any part of this study in more detail, please contact:

Gillian Forbes, Dental Health Services Research Unit, University of Dundee
Email: g.z.forbes@dundee.ac.uk
Telephone: 01382 740985

Thank you for reading this information sheet and considering taking part in this study.

INFORMAL PARTICIPANT INFORMATION SHEET FOR PATIENT SURVEY (STUDY 3)

ANTIBIOTICS FOR DENTAL CONDITIONS: PATIENTS' EXPECTATIONS

PARTICIPANT INFORMATION SHEET

Introduction

Antibiotics are essential for treating infections but they are becoming less effective as bacteria develop resistance to them. This increasing resistance is made worse by the over-use and mis-use of antibiotics by health care professionals. This study is exploring patients' views on receiving antibiotics for dental pain.

What we are asking you to do?

Complete a short questionnaire and return it. That is it.

An online link to 8 short questions is provided in the email from SHARE, but we are happy to send you a paper version if you prefer. Just say that in a return email.

It should take no more than 5-10 minutes to complete.

Do I have to participate?

Of course not. However, the more people who do participate and return a completed questionnaire, the more likely it is we can a get a true picture of what patients face in the prescribing and receipt of antibiotics. This means a better platform for informed training of dentists and improved patient care.

Can I be identified?

No. All responses are anonymised. This is why we are doing this survey through SHARE.

Ethics

The [Details will be added here when obtained] has checked this study and have no ethical concerns.

Complaints, insurance and indemnity

e. Right to raise concerns.

If you have any concerns about your participation in the study you have the right to raise your concern with a researcher involved in conducting the study or a doctor involved in your care.

f. Right to make a complaint

If you have a complaint about your participation in the study, you should first talk to a researcher involved in the study. However you have the right to raise a formal complaint. You can make a complaint to a senior member of the research team or to the NHS Complaints Officer for NHS Tayside (*or insert the site/contact details below*).

Complaints and Feedback Team
NHS Tayside
Ninewells Hospital
Dundee DD1 9SY
Freephone: 0800 027 5507
Email: feedback.tayside@nhs.net

g. Right to make a claim

In the event that you think you have suffered harm as a result of your participation in the study there are no automatic financial compensation arrangements. However, you may have the right to make a claim for compensation. Where you wish to make a claim, you should consider seeking independent legal advice but you may have to pay for your legal costs.

h. Insurance

The University of Dundee maintains a policy of public liability insurance which provides legal liability cover in respect of damages, costs and expenses arising out of claims. Tayside Health Board is a member of the Clinical Negligence and Other Risks Insurance Scheme (CNORIS) which provides legal liability cover. The local site where you participated in the study also maintain cover via CNORIS.

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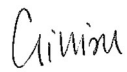
insurers may use this information to limit the offer of cover, apply exclusions or increase any premium.

Further information

This research is funded by the Health Foundation and supported by the Scottish Dental Practice Based Network (SDPBRN) and NHS Education for Scotland (NES). This study is part of a PhD supervised by Prof. Jan Clarkson and Dr Debbie Bonetti, Dental Health Services Research Unit, University of Dundee.

Please do not hesitate to get in touch with me if you would like to discuss any part of this study, my details are below.



Gillian Forbes, Dental Health Services Research Unit, University of Dundee
Email: g.z.forbes@dundee.ac.uk
Telephone: 01382 740985

UNIVERSITY OF DUNDEE

UNIVERSITY OF DUNDEE: LETTER OF ETHICAL APPROVAL AMENDMENT (STUDY 3)

University of Dundee Schools of Nursing & Health Sciences and Dentistry Research Ethics Committee (SREC)

University of Dundee
Dundee
DD1 4HJ

19 December 2016

Dear Gillian Forbes

Application Number: 2016030_Forbes
Title: Antibiotics for dental conditions: Patients' expectations

I am writing to advise you that your ethics application has been reviewed and approved independently by reviewers on behalf of the SREC.

Please include the approving ethics committee in the participant information sheet.

If your project data can be linked to an identifiable individual, you must notify the University Data Protection Officer, Mr Alan Bell a.z.bell@dundee.ac.uk.

Approval is valid for three years from the date of this letter. Should your study continue beyond this point, please request a renewal of the approval.

Any changes to the approved documentation (e.g., study protocol, information sheet, consent form) must be approved by this SREC.

Yours sincerely

R Graham Chadwick

Professor Graham Chadwick
Deputy Convenor, Schools of Nursing & Health Sciences and Dentistry
Research Ethics Committee

WORKSHOP: PARTICIPANT INFORMATION SHEET

The communication of antibiotic prescribing decisions to patients: Developing a co-produced communication skills tool to support dentists in primary care

Despite national dental guidance recommending the minimal use of antibiotics, evidence suggests that antibiotic prescribing decisions are still likely to be influenced by patient expectation. We wish to invite you to take part in a workshop aimed at developing a skills tool that can support GDPs with communicating their prescribing decisions to patients. Your participation will ensure that the content of the skills tool is both practical and implementable in primary care.
All Rapid Evaluation Practitioners have been invited to obtain a diverse range of views and experiences on communicating prescribing decisions to patients in differing types of practices and geographical locations.

What will taking part in this study involve?
You will take part in a two-and-a-half-hour workshop in the Dundee Dental Education Centre on the 7th of March 2018 from 10am until 12.30pm.
The objectives of the workshop are to discuss how practising GDPs communicate their prescribing decisions particularly to those patients who expect antibiotics and to use their knowledge and expertise to help others with their management of patient expectation.

What will I be asked to do?
You will be given an opportunity to explore possible ways of managing patient expectation using the findings from an earlier study as a starting point for the discussion. Also, you will be asked to engage in determining the content of the communication skills tool based on your knowledge and past experiences of managing patient expectation.
You are only being asked to participate in the workshop, no follow-up with your patients is required.

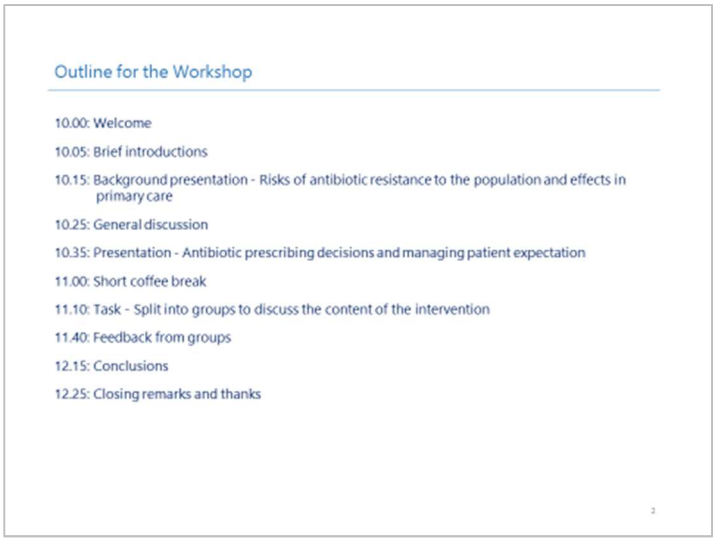
How does participating in this workshop benefit me?
GDPs working in primary care can claim £285 for taking part in the workshop, based on the British Dental Guild sessional rate for 2017/2018. Travel costs will be reimbursed up to a maximum of £50. Participation in the workshop gives you an opportunity to influence the development of a communication skills tool designed to support the better management of antibiotic prescribing decisions.

If you would like to participate in this workshop, please confirm by email as soon as possible as spaces are limited in this one-off event. Please reply by the 21st February 2018.
The workshop is funded by the Health Foundation as part of a PhD fellowship and is sponsored by the University of Dundee.

If you have any queries or require further information, please contact:
Gillian Forbes
Email: g.m.forbes@dundee.ac.uk
Telephone: 01382 740985

UNIVERSITY OF DUNDEE

WORKSHOP: POWERPOINT PRESENTATION SLIDES



Effects of prescribing in primary care on antibiotic resistance

Subsequence antibiotic resistance in individuals prescribing in primary care

- Individuals prescribed an antibiotic in primary care for respiratory or urinary infection develop bacteria resistance to that antibiotic
- Effect is greatest in the month immediately after treatment but may persist for up to 12 months
- Effect not only increases resistance to first-line antibiotics but also creates conditions for increased resistance to second-line antibiotics

[Costello et al. 2010 Effect of antibiotic prescribing in primary care on AMR in individual patients: A Systematic Review and Meta-analysis. BMJ]

✓ Find out if the patient has taken an antibiotic recently

4

What's happening in Dentistry to address antibiotic resistance?

Dental Antimicrobial Stewardship

Know when to prescribe/ Audit your management of dental infections/Educate patients

What GDPs have said is relevant to them when making antibiotic prescribing decisions

- Patient expectation
- Conflicting priorities
- Perceived risks
- Justification of prescribing decisions

✓ Focus on managing patient expectation

5

Results of Survey - Antibiotics for Dental Conditions: Patients' Expectations

292 Participants (39% Male; mean age = 56)

10% only went to see a dentist when needed

15% had been prescribed an antibiotic in the last 2 years

Key messages

24% thought antibiotics would make things better

31% expected to receive an antibiotic for a relentless, throbbing pain

16% Upset if not prescribed; 23% Would ask for an antibiotic

Ask for antibiotic: delay root treatment 16% & extraction 17% / treatment + adjunct 48%

6

Purpose of the workshop

This evidence suggests that patient expectation continues to be a challenge in primary care

What additional support is necessary? From the interviewed and surveyed dentists who said

- Capabilities/skills to change patients' view on receiving antibiotics and to manage the consequences of not prescribing

Effectively communicate antibiotic prescribing decisions to patients

But, what would be the content of these communication skills?

- What to say
- How to say it
- When to say it

Prescribing antibiotics to manage patient expectations

From interview (n=16) and survey (n= 393) studies as part of this project found that the following beliefs were likely to predict wanting to prescribe an antibiotic as a way of managing expectations

TDF Domains	Specific Beliefs
Beliefs about Consequences	Clinician-patient relationship
	Concerns of disappointing patient
Beliefs about Capabilities	Change patient views on receiving antibiotics
Social Influences	Patients expecting antibiotics
	Irregular attenders

✓ Tool that has techniques/strategies to communicate to patients that an antibiotic is not required

Tasks: Developing the content of the tool (1)

Consequences of not prescribing to patients who might expect to receive an antibiotic

- Upset/Anxious
- Angry/hostile/bullying
- High expectation from being previously prescribed an antibiotic

Using these examples, what do you say to these patients?

- What works and is unlikely to work?
- Give examples

How should it be delivered?

- Action plan – prompts for planning to not prescribe (in practice)
- Skill course
- Flow charts for emergency patients
- Information for other members of the dental team including reception staff

Tasks: Developing the content of the tool (2)

Break out into smaller discussion groups

Complete the accompanying worksheet that ask the group to:

- Discuss and reflect on how to communicate prescribing decisions to patients
- Explore possible ways of managing patient expectation
- Suggest the content of a communication skills tool based on your knowledge and past experiences of managing patient expectation
- Propose ways to deliver this communication skills tool in primary dental care

Each group will then give feedback to everyone to determine the optimal content of the proposed communication skills tool and it mode of delivery.

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Checklist

Workshop

- Please hand in all worksheets

Each group will then give feedback to everyone to determine the optimal content of the proposed communication skills tool and it mode of delivery.

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Scottish Dental Practice Based Research Network

University of Dundee

MANY THANKS FOR YOUR ASSISTANCE

If you wish to add anything that occurs afterwards, please email me:

g.m.forbes@dundee.ac.uk

The Health Foundation Inspiring Improvement

INTERVENTION DESCRIPTION (TIDIER)

Item		Details
1	Brief Name	Communicating Antibiotic Prescribing Decisions to Patients
2	Why	To reduce the perceived benefits of inappropriate prescribing to manage patient expectation
3	What materials	Information procedures for reception staff and dentists and a poster directed at patients
4	What procedures	Triage patients at initial contact (Face-to-face/telephone) Display posters Provide information to GDPs
5	Who provides	Reception staff/dental nurse/GDPs
6	How	Face-to-face and by telephone
7	Where	Reception/waiting room/treatment room
8	When and how much	Initial telephone (all contact where an infection is indicated) Poster permanently displayed in the waiting room All appointments
9	Tailoring	After the feasibility study
10	Modifications	After the feasibility study
11	How well: Planned	After the feasibility study
12	How well: Actual	After the feasibility study