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UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL AND HUMAN SCIENCES

School of Psychology

**Changing the behaviour of Healthcare Professionals using Theory Based,
Computer-delivered Interventions**

by

Lisa McDermott

Thesis for the degree of Doctor of Philosophy in Health Psychology Research
and Professional Practice

February 2013

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

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CHANGING THE BEHAVIOUR OF HEALTHCARE PROFESSIONALS USING THEORY BASED, COMPUTER-DELIVERED INTERVENTIONS

Lisa Marie McDermott

Non-adherence to clinical guidelines has been identified as a consistent finding in general practice. The purpose of this research was to develop and evaluate theory-informed, computer-delivered interventions to promote the implementation of guidelines in general practice, which GPs viewed as feasible and acceptable. The intervention aimed to promote guideline adherence for antibiotic prescribing in respiratory tract infections, and adherence to recommendations for secondary stroke prevention.

An intervention development study involved the creation of computer-delivered prompts using aspects of social cognitive theory, and drawing on nationally recommended standards for clinical content. Prompts were presented to GPs during interviews, and iteratively refined based on feedback. GPs reported being more likely to use prompts if they were perceived as offering support and choice, as opposed to being an enforcement method. The prompts were then entered into a trial (not reported) and two process evaluation studies were conducted with GPs who had taken part in the trial. A qualitative evaluation study involving interviews with GPs, revealed that the prompts were perceived as useful and acceptable in practice, but GPs who had not been informed of the prompts appearance reported being less likely to engage with them. A quantitative evaluation study involved a questionnaire consisting of theory based measures and an intervention evaluation measure. GPs were satisfied with the usability of the prompts, and intervention group GPs reported higher levels of self-efficacy in managing patients according to guidelines compared to control group GPs. Overall the intervention was viewed as feasible and acceptable. A key characteristic of an acceptable computer-delivered intervention appears to be that it should be perceived as a useful tool supporting GP practice. However, conclusions of the evaluation were limited by a small and potentially non-representative sample of trial GPs.

Contents

ABSTRACT.....	i
Contents	i
List of tables	iii
List of figures	v
DECLARATION OF AUTHORSHIP.....	vii
Acknowledgements.....	ix
Definitions and Abbreviations	xi
1. Chapter one: Guideline implementation in primary care.....	1
1.1 Chapter overview.....	1
1.2 Non-adherence to guidelines in primary care	1
1.2.1 Guidelines for antibiotic prescribing in RTI	2
1.2.2 Guidelines for the prevention of secondary stroke	4
1.3 Guideline implementation.....	7
1.3.1 The use of guideline implementation techniques to encourage adherence	7
1.3.2 Computer-delivered interventions.....	7
1.4 Behaviour change theory and healthcare professionals	9
1.5 Research rationale	10
1.6 Methodological issues	11
1.6.1 Methods for developing computer-delivered interventions.....	11

1.6.1.1	The role of qualitative research	12
1.6.1.2	Challenges of qualitative research.....	12
1.6.1.3	Quantitative methods of intervention development	13
1.6.2	Methods for evaluating computer-delivered interventions.....	15
1.6.2.1	The use of mixed methods designs.....	16
1.6.3	Use of mixed methods within this thesis	18
1.7	Thesis aims and overview	18
1.7.1	Key Aims	18
1.7.2	Thesis structure	19
1.8	Research context.....	20

2. Chapter two: A systematic literature review of computer-delivered interventions to promote the implementation of guidelines in primary care23

2.1	Chapter overview.....	23
2.2	The effectiveness of computer-delivered interventions for healthcare professionals.....	24
2.3	Moderators of the effectiveness of implementation techniques	26
2.3.1	Behaviour change theory	26
2.3.2	Self-efficacy.....	27
2.3.3	Environment.....	27
2.3.4	Outcome expectancies- risk presentation	28
2.3.5	Complex interventions	29
2.3.6	Tailoring	30
2.4	Summary and aims	31
2.5	Method.....	32
2.5.1	Design	32
2.5.2	Search strategy	32
2.5.2.1	Initial search	32
2.5.2.2	Selection of papers	33
2.5.2.3	Data extraction	33
2.5.3	Inclusion criteria	36
2.5.3.1	Eligibility criteria.....	36
2.5.4	Risk of bias	38
2.6	Results	41
2.6.1	Summary.....	41

2.6.2	Excluded studies	41
2.6.3	Study characteristics	42
2.6.4	Risk of bias	44
2.6.5	Effects of intervention	47
2.6.6	Factors identified as possible influences of intervention effectiveness:	54
2.6.7	Psychological factors: risks of non-adherence vs. no risks presented.....	55
2.6.8	Style: Simple vs. Complex interventions.....	57
2.6.9	Tailoring: Patient tailored vs. Patient group specific.....	59
2.6.10	Study design: Control group vs. Follow-up data	61
2.7	Discussion.....	63
2.7.1	Psychological theory- the role of risk presentation.....	63
2.7.2	Complex interventions	65
2.7.3	Tailoring	67
2.7.4	Control group comparisons.....	68
2.7.5	Limitations	70
2.7.6	Conclusions	72

3. Chapter three: The use of behaviour change theory in relation to healthcare professionals' adherence to guidelines 73

3.1	Chapter overview.....	73
3.2	Introduction	73
3.3	Social cognitive theory.....	75
3.3.1	Self-efficacy.....	75
3.3.2	Outcome expectancies	78
3.3.3	Environment.....	82
3.4	Alternative theories	86
3.4.1	Theory of planned behaviour.....	86
3.4.2	Operant learning theory	92
3.4.3	Implementation Intention theory	95
3.4.4	Self-regulation model	96
3.4.5	Additional theoretical constructs	98
3.5	Self-determination theory	100
3.6	Conclusion	103

4. Chapter four: Developing a computer-delivered, theory based intervention for guideline implementation in general practice..... 105

4.1	Chapter Overview	105
4.2	Method.....	107
4.2.1	Design of study.....	107
4.2.2	Participants	107
4.2.3	Procedure.....	108
4.2.4	Materials	112
4.2.4.1	Aim of prompts.....	112
4.2.4.2	Inclusion of theory	112
4.2.4.3	Development process.....	113
4.2.4.4	Content of prompts	116
4.2.5	Analysis	116
4.3	Results	117
4.3.1	Description of themes	118
4.3.2	Development of prompts.....	124
4.3.3	Final content: Application of themes to prompts	127
4.4	Discussion.....	129
4.4.1	Main findings	129
4.4.2	Limitations	132
4.4.3	Reflexivity	132
4.4.4	Conclusions	133

5. Chapter five: A qualitative process evaluation of a computer-delivered intervention trial to implement guidelines for antibiotic prescribing in respiratory tract infection..... 135

5.1	Chapter overview.....	135
5.2	Method.....	135
5.2.1	Design of study.....	135
5.2.2	Participants	136
5.2.3	Procedure.....	137
5.2.4	Materials	138
5.2.4.1	Semi-structured interview guide for GPs	138
5.2.5	Analysis	141
5.3	Results	142

5.3.1	Description of themes	143
5.3.2	Additional analysis: description of themes from implementation staff interviews	151
5.4	Discussion	156
5.4.1	Awareness of implementation	157
5.4.2	Self-determination theory	159
5.4.3	Outcome expectancies	160
5.4.4	Implementation staff interviews.....	161
5.4.5	Limitations	162
5.4.6	Conclusions	164

6. Chapter six: A quantitative process evaluation of a computer-delivered intervention trial to implement guidelines for antibiotic prescribing..... 167

6.1	Chapter overview.....	167
6.2	Method.....	167
6.2.1	Design of study.....	167
6.2.2	Participants	168
6.2.3	Procedure.....	168
6.2.4	Materials	169
6.2.4.1	Outcome expectancies questionnaire.....	170
6.2.4.2	Self-efficacy questionnaire	172
6.2.4.3	Intervention evaluation questionnaire	174
6.2.5	Analysis	181
6.3	Results	181
6.3.1	Response rates.....	181
6.3.2	Item analysis	182
6.3.3	Responses to theory questionnaires	182
6.3.4	Group differences across measures	187
6.3.5	Intervention evaluation questionnaire.....	190
6.4	Discussion.....	195
6.4.1	Self-efficacy.....	196
6.4.2	Outcome expectancies	197
6.4.3	Intervention evaluation.....	199
6.4.4	Limitations	202
6.4.5	Summary.....	205

7. Chapter seven: Discussion.....	207
7.1 Chapter overview.....	207
7.2 Research aims	207
7.3 Main Findings.....	208
7.3.1 Systematic review of computer-delivered interventions.....	208
7.3.2 Behaviour change theory and healthcare professionals.....	209
7.3.3 Development of computer-delivered intervention	209
7.3.4 Qualitative process evaluation of intervention	210
7.3.5 Quantitative process evaluation of intervention	210
7.4 Implications of the research.....	211
7.4.1 Theoretical implications	211
7.4.1.1 Self-determination theory.....	211
7.4.1.2 Outcome expectancies.....	213
7.4.1.3 Self-efficacy	216
7.4.1.4 Summary of theoretical implications	219
7.4.2 Practical implications.....	219
7.4.2.1 Awareness of intervention.....	219
7.5 Limitations of the research	222
7.6 Improving the development process- key lessons for the future.....	225
7.7 Future research	229
7.8 Conclusions.....	232
Appendices	235
Appendix 1: Development study information sheet.....	237
Appendix 2: Development study GP consent form	241
Appendix 3: RTI prompts menu page example	243
Appendix 4: RTI prompts content page example	245
Appendix 5: Stroke prompts menu page.....	247
Appendix 6: Stroke prompts content page example.....	249
Appendix 7: Development study coding manual	251
Appendix 8: GP interview invitation letter	263
Appendix 9: Implementation staff interview invitation	265
Appendix 10: GP interview invitation reminder 1	267
Appendix 11: GP interview invitation reminder 2	269
Appendix 12: Process evaluation coding manual	271
Appendix 13: Intervention group questionnaire invitation	285
Appendix 14: Control group questionnaire invitation	287
Appendix 15: Intervention group questionnaire reminder 1	289
Appendix 16: Control group questionnaire reminder 1	291

Appendix 17: Intervention group questionnaire reminder 2.....	293
Appendix 18: Control group questionnaire reminder 2.....	295
Appendix 19: Complete questionnaire as presented.....	297
Appendix 20: Intervention trial information sheet.....	301
Appendix 21: Intervention trial consent form	305
List of References	307

List of tables

Table 1 Risk of bias assessment in papers selected for review.....	45
Table 2 Studies which reported a significant effect.....	48
Table 3 Studies with no significant effect	52
Table 4 Interventions which presented information about risks of non-adherence.....	56
Table 5 Interventions which did not present information about risks of non-adherence.....	57
Table 6 Studies which used complex interventions	58
Table 7 Studies which used simple interventions	59
Table 8 Studies which used patient tailored advice	60
Table 9 Studies which used patient group specific advice	61
Table 10 Studies which used control group comparison data.....	62
Table 11 Studies which included follow-up data comparison	63
Table 12 Themes and sub-themes identified in GP interviews	118
Table 13 Themes used to inform key changes in prompts	126
Table 14 Themes and sub-themes identified in interviews	143
Table 15 Themes and sub-themes from implementation staff interviews	152
Table 16 Process evaluation components and method used	174
Table 17 Evaluation components used in intervention questionnaire	175
Table 18 Percentage of responses to each item of the Outcome expectancies questionnaire.....	185
Table 19 Percentage of responses to each item of the Self-efficacy questionnaire (*0=Cannot do, 10= Highly certain can do).....	186

Table 20 Results of Kruskal-Wallis group comparisons for theory measures.	188
Table 21 Results of Kruskal-Wallis group comparisons for Outcome expectancies questionnaire.....	189
Table 22 Results of Kruskal-Wallis group comparisons for Self-efficacy questionnaire.....	190
Table 23 Responses in percentage to Sections 1-3 of intervention evaluation questionnaire.....	193
Table 24 Responses in percentage to Section 4.1 of intervention evaluation questionnaire (part 1)	194
Table 25 Responses in percentage to Section 4.1 of intervention evaluation questionnaire (part 2)	194

List of figures

Figure 1 Research program in relation to thesis.....	21
Figure 2 PRISMA diagram showing the identification of studies for review	42
Figure 3 Semi structured interview schedule.....	110
Figure 4 Think aloud interview schedule.....	111
Figure 5 Prompts development process	115
Figure 6 Semi-structured interview schedule for GPs.....	139
Figure 7 Interview schedule for implementation staff.....	141
Figure 8 Outcome expectancies questionnaire.....	171
Figure 9 Self-efficacy questionnaire	173
Figure 10 Items presented in section 1 of the intervention evaluation questionnaire.....	176
Figure 11 Items presented in section 2 of the intervention evaluation questionnaire.....	177
Figure 12 Items presented in section 3 of the intervention evaluation questionnaire.....	178
Figure 13 Items presented in section 4 of the intervention evaluation questionnaire.....	180

DECLARATION OF AUTHORSHIP

I, Lisa McDermott

declare that the thesis entitled

Changing the behaviour of Healthcare professionals using Theory Based,
Computer-delivered Interventions

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
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Definitions and Abbreviations

GP	General Practitioner
GPRD	General practice research database
ICSWP	Intercollegiate stroke working party
NICE	National Institute for Health and clinical excellence
NHS	National Health Service
PCRN	Primary care research network
RTI	Respiratory tract infection
SCT	Social cognitive theory
SDT	Self-determination theory
TPB	Theory of planned behaviour

1. Chapter one: Guideline implementation in primary care

1.1 Chapter overview

This chapter will first examine the problem of non-adherence to guidelines by healthcare professionals, highlighting some of the key areas where this issue occurs and the potential difficulties which can result from non-adherence. Non-adherence to guidelines in two specific areas of primary care which are the main focus of this thesis will then be discussed in more detail. These guidelines relate to antibiotic prescribing in RTI (respiratory tract infection) and the prevention of secondary stroke. The chapter will then consider the use of techniques which can increase adherence to guidelines in healthcare professionals, with a particular emphasis on computer-delivered interventions, which are the focus of this thesis. The application of behaviour change theory is then examined in relation to interventions specifically for healthcare professionals. As this thesis will focus on the development and evaluation of an intervention, methodological issues and considerations relevant to this process are then presented and discussed. Finally, this chapter outlines the aims of the research and content of the thesis.

1.2 Non-adherence to guidelines in primary care

Clinical guidelines are constantly changing as decisions about best clinical practice change in line with evolving medical science (Hoomans, Severens, Evers, & Ament, 2009). However, lack of adherence to clinical guidelines across a range of conditions has frequently been reported in healthcare professionals (Grimshaw, Eccles, Walker, & Thomas, 2002). In particular, non-adherence to guidelines has consistently been reported in primary care (Eccles et al., 2002; MacLean, Gagnon, Callas, & Littenberg, 2009). Failing to adhere

to guidelines in primary care can lead to a number of problems such as worsening of a patient's medical condition or an increase in the risk of a patient developing further conditions. For example, non-adherence to guidelines has been identified in relation to the management of adults with high cholesterol. National guidelines recommend regular lipid screening and pharmacological management of the condition in order to reduce blood lipid levels and the potential risk of cardiovascular disease (Bertoni et al., 2009). However, non-adherence to these guidelines has been consistently reported, and patients are often not prescribed medication to aid in lowering blood lipid levels (Bertoni et al., 2009; Fordis et al., 2005). In addition, non-adherence has also been reported in relation to reducing the risk of future cardiovascular events in patients with hypertension. Guidelines for the management of hypertension suggest a number of treatment and lifestyle recommendations to assist in controlling and reducing blood pressure levels and overall reduce the risk of cardiovascular problems (Svetkey et al., 2009). However, despite this, practitioner non-adherence to the recommendations has been widely reported, often with little improvement in patients' long-term blood pressure control (Svetkey et al., 2009; Montgomery, Fahey, Peters, MacIntosh, & Sharp, 2000). Furthermore, non-adherence to primary care guidelines for the management of chronic conditions has also been identified. The national asthma guidelines provide recommendations for the optimum long-term care of patients with asthma; however, these are often not followed by healthcare professionals (Bell et al., 2010). Non-adherence to these guidelines can result in patients experiencing a poor quality of life and further adverse health outcomes relating to the condition (Eccles et al., 2002). Overall, a lack of healthcare professionals' adherence to guidelines in primary care has been identified across a wide range of recommendations (e.g. prescribing, preventative, management of conditions) which can lead to a number of serious consequences.

1.2.1 Guidelines for antibiotic prescribing in RTI

Non-adherence to the NICE (National Institute for Clinical Excellence) guidelines for antibiotic prescribing in RTI has been consistently reported. RTIs are usually brief and self-limiting conditions which rarely result in serious

consequences (Little et al., 1997a). Antibiotics do not provide clinical benefit in most patients (Little et al., 2002; Macfarlane et al., 2002). For example, patients with a cough who are prescribed antibiotics experience a reduction in symptom duration of less than one day, compared to patients who are not prescribed antibiotics or offered a delayed prescription (Dowell, Pitkethly, Bain, & Martin, 2001; Little et al., 2005). In addition, patients who are not given an immediate antibiotic prescription are significantly less likely to re-consult (Little et al., 1997b) and do not suffer from associated antibiotic side effects such as nausea, rash and diarrhoea (Glasziou, Del Mar, Sanders, & Hayem, 2004). The risk of further medical complications developing from RTIs is rare, even without an antibiotic prescription (Little et al., 1997a; National Institute for Health and Clinical Excellence, 2008). For example, in acute otitis media, antibiotics show no beneficial effect in reducing complications such as contralateral otitis (Glasziou et al., 2004). Evidence has also suggested that antibiotics are only likely to be beneficial in treating patients with significant co-morbidity and will be of little assistance in most patients who consult (National Institute for Health and Clinical Excellence, 2008; Smith, Fahey, Smucny, & Becker Lorne, 2004). The NICE guidelines (National Institute for Health and Clinical Excellence, 2008) recommend that antibiotics should not be prescribed to most patients with a RTI, and that a prescription of antibiotics should only be issued to patients with specific additional underlying medical conditions and high risk groups.

However, despite the evidence against using antibiotics GPs (General practitioners) often do not adhere to the guidelines and frequently prescribe antibiotics for RTI. For example, despite RTIs only being a relatively minor and self-limiting condition, they account for up to 60% of all antibiotic prescriptions in general practice (National Institute for Health and Clinical Excellence, 2008). Although the prescribing of antibiotics for RTIs in primary care declined between the years of 1995 and 2000 (Ashworth et al., 2004), the prescribing rates have stabilised since 2000 and remain high (Gulliford et al., 2009). Furthermore, GPs' decision to prescribe antibiotics for RTIs has also been reported as being influenced by their perceptions of a patient's expectation for a prescription, as opposed to only medical need, which can account for unnecessary prescribing in some cases (Little et al., 2004).

In addition to limited symptom benefit and wasted resources, the unnecessary prescribing of antibiotics for RTI could also lead to potentially fatal consequences. The overuse of antibiotics can contribute to the spread of resistant bacteria and result in antibiotics which are ineffective (Dagan et al., 1998; Costelloe, Metcalfe, Lovering, Mant, & Hay, 2010). The problem of resistant bacteria is currently on the increase and has been identified by the World Health Organisation as a serious issue which must be addressed with urgency (Zumla, Blasi, & Raviglione, 2012).

Therefore, prescribing antibiotics for RTIs provides limited symptom benefit, is unlikely to significantly reduce the risk of clinical complications in the majority of patients, and can contribute to the promotion of antibiotic resistant infections. The impact of such problems could be reduced if NICE guidelines (National Institute for Health and Clinical Excellence, 2008) which encourage a non-immediate prescribing policy were adhered to by general practitioners.

1.2.2 Guidelines for the prevention of secondary stroke

In contrast to the common, brief and self-limiting nature of respiratory tract infections, patients who have suffered from a stroke experience a less frequent, potentially life-threatening, long-term condition. Reports suggest that up to 43% of all patients who suffer from a stroke will experience a secondary stroke within five years of their first (Stevens, 2004). Patients who suffer from a secondary stroke are likely to experience more disabling or even fatal consequences than with their first (Bonita, 1992). Furthermore, the chance of experiencing a secondary stroke is not related to the features of the first stroke, so risk can be difficult to predict across any patient who has had a stroke (Mohan et al., 2009). Therefore, due to the high risk, likely severity and unpredictable nature of secondary stroke, there is significant need to address any factors which can aid its prevention in patients who have experienced their first stroke.

Various influences have been implicated as factors which may influence stroke recurrence, including social demographic factors and co morbidities (Mohan et al., 2009). Zhang et al., (Zhang, Thijs, & Staessen, 2006) identified non-modifiable and modifiable risk factors for stroke recurrence. The non-modifiable risk factors include ethnicity, gender, age and family history, and the modifiable risk factors include smoking, excessive alcohol intake, obesity, heart disease, dyslipidemia and blood pressure.

Various primary care guidelines for the prevention of secondary stroke aim to target these modifiable risk factors through a series of recommendations. Specifically, the Intercollegiate Stroke Working Party (ICSWP) have produced the National Clinical Guidelines for Stroke (Intercollegiate Stroke Working Party, 2008), which provide a set of wide, rigorous, and strongly evidence based guidelines for the prevention of secondary stroke. The guidelines advise treatment options, targets for blood pressure level (<130/80 mm Hg), cholesterol level (>3.5 mmol/l), and recommendations for diet, exercise, salt and alcohol intake. In particular, three specific guidelines proposed by the ICSWP, can greatly reduce the risk of secondary stroke if followed by GPs.

The ICSWP guidelines (Intercollegiate Stroke Working Party, 2008) recommend that an optimal target blood pressure for stroke patients is 130/80 mmHg. Reduction of blood pressure to this level can reduce the risk of recurrent stroke and additional cardiovascular events by up to 28% (Staessen & Jiguang, 2001). The guidelines also recommend that Aspirin prescribed together with Dipyridamole should be standard treatment following non-haemorrhagic stroke. This is supported by evidence which has suggested that patients prescribed both Aspirin and Dipyridamole have a 20% lower risk of repeat cardiovascular events than those prescribed Aspirin alone (Halkes, van, Kappelle, Koudstaal, & Algra, 2006). Finally a third guideline from the group recommends that all stroke patients with total cholesterol >3.5 mmol/l should be treated with a statin. The use of a statin to lower cholesterol can reduce the risk of stroke recurrence by up to 16% (The Stroke Prevention by Aggressive Reduction in Cholesterol Levels 'SPARCL' Investigators, 2006). In addition, reduction of cholesterol to a level of <3 mmol/l can reduce the risk of a further

stroke or vascular event by up to 25% (Heart Protection Society Collaborative group, 2002).

Other recommendations such as the remuneration plan known as the Quality and Outcomes Framework (QOF) of the general practice contract (Doran et al., 2006) also provide suggestions for the prevention of secondary stroke. However the ICSWP guidelines are considered the most stringent, evidence based, and thorough recommendations which are inclusive of most at risk patients (Intercollegiate Stroke Working Party, 2008; Rudd, Lowe, Hoffman, Irwin, & Pearson, 2004).

In summary, patients who have suffered a primary stroke are currently at a high risk of experiencing a secondary stroke (Stevens, 2004). The secondary stroke is likely to have more serious and life threatening consequences than the first (Bonita, 1992). A number of modifiable risk factors following a patient's first stroke can play a significant role in reducing stroke recurrence (Mohan et al., 2009). The ICSWP (Intercollegiate Stroke Working Party, 2008) have provided a variety of stringent, evidence based recommendations for the prevention of secondary stroke. Evidence suggests that at present GPs do not regularly implement preventative guideline advice, resulting in increasing high rates of secondary stroke in the UK (Intercollegiate Stroke Working Party, 2008; Rudd, Lowe, Hoffman, Irwin, & Pearson, 2004). If GPs adhered to three of the guidelines proposed (blood pressure target, aspirin and dipyridamole, and cholesterol level) the risk of a patient suffering a secondary stroke could be significantly reduced.

1.3 Guideline implementation

1.3.1 The use of guideline implementation techniques to encourage adherence

As practitioner non-adherence to clinical recommendations can lead to potentially serious health outcomes for patients, a number of implementation techniques to encourage adherence to guidelines have been used. These techniques have widely varied in their success and have included: practitioner education (programmes and materials), patient materials (e.g. leaflets), reminders, and computer-delivered systems (Hoomans et al., 2009; Hrisos et al., 2008; Simpson et al., 2009). Specifically, 'prompts' (referring to brief messages containing guideline information) which act as reminders of recommended standards of clinical practice have been found to significantly improve the delivery of preventive health care services (Rosser, McDowell, & Newell, 1991). In particular, strategies such as reminders which occur during a consultation or at the point of decision making are more likely to be effective (Shiffman, Liaw, Brandt, & Corb, 1999; Grimshaw et al., 2001). In general, evidence relating to the optimum presentation of simple reminder style messages or interventions has not directly involved or referenced behaviour change theory and has instead focused on the intervention in terms of the benefit of various 'modes of delivery'. Evidence has demonstrated that embedding such reminders into the flow of care and providing easy access to information can improve patient care and change healthcare professionals' behaviour (Durieux, Nizard, Ravaud, Mounier, & Lepage, 2000; Schriger, Baraff, Rogers, & Cretin, 1997).

1.3.2 Computer-delivered interventions

Increasingly, the implementation of guideline reminder interventions is through the use of computer-delivered systems (Heselmans, Van de Velde, Donceel, Aertgeerts, & Ramaekers, 2009). Chapter two provides a full systematic review of the use of computer-delivered interventions for healthcare professionals in primary care. Computer-delivered interventions to encourage adherence to guidelines can include reminders, full guideline documentation,

educational programmes and tools, patient resources, patient risk information, and prompts to conduct a specific action. The systems can use a simple design and include just one factor (e.g. reminders), or a complex technique which uses a variety of tools (e.g. reminders, education and patient tools). Computer-delivered interventions have been reported to significantly increase healthcare professionals' adherence to guidelines and improve health related outcomes across a variety of conditions, including RTI, croup, urticaria, urinary tract infection, post-operative nausea and diabetes (Davis et al., 2007; Flottorp, Oxman, Havelrud, Treweek, & Herrin, 2002; Kooij, Klok, Hollmann, & Kal, 2008). Overall, the use of computer based interventions has been demonstrated as effective for both prescribing behaviour (Davis et al., 2007) and preventive medical care (Grol & Grimshaw, 2003). In particular, computer interventions which use reminders and automatic prompts have been found to be most successful (Garg et al., 2005). However, success rates of computer-delivered interventions have varied considerably, with prescribing improvements reported from 3% (Flottorp et al., 2002) to 42% (Davis et al., 2007). A large scale review, involving 100 trials, concluded that computer based decision support systems can improve practitioner performance (Garg et al., 2005). The review used the term 'decision support systems' rather than computer delivered interventions or programmes. Traditionally this term has related to systems which lead the practitioner through a series of questions and provide an exact procedure as a solution which must be followed. However, in assessing the trials included in the review it is clear that the studies referred to a wide range of techniques which could also be referred to as 'computer delivered interventions'. In addition to establishing the potential benefit of computer delivered interventions, the review also concluded that to date the effects of such interventions remain both understudied and inconsistent (Garg et al., 2005).

1.4 Behaviour change theory and healthcare professionals

The key benefits of computer-delivered interventions for use in increasing healthcare professionals adherence to guidelines may lie in their ability to appear at a specific point in time, within an environment highly relevant to the target behaviour (e.g. a screen being used in a patient consultation), thus providing targeted information at a critical point of an individual's decision making process. Inconsistent findings in the success rate of computer-delivered interventions for healthcare professionals has often been attributed to the wide range of content involved in such computer-delivered messages, which have varied from detailed decision support (Kooij et al., 2008) to simple presentation of the clinical evidence (Richens, Rycroft-Malone, & Morrell, 2004). However, new evidence is emerging to suggest that intervention development must focus on the specific behaviour change methods and theory which may be relevant to a particular area, in order to achieve optimal results (Eccles et al., 2007). The implementation of evidence-based guidelines may sometimes be unsuccessful due to a lack of consideration of the theoretical behaviour change processes which may be involved (Michie et al., 2005). The explicit use of behaviour change theory may therefore provide an important tool on which to base the development of any intervention (Michie, Fixsen, Grimshaw, & Eccles, 2009). Application of theory may benefit the intervention development process by providing a consistent and generalizable framework and promoting understanding of components which may facilitate change for a specific behaviour (Michie et al., 2005).

Chapter three of this thesis provides a detailed discussion of behaviour change theory in relation to healthcare professionals; the following section provides a summary of key evidence. Research has identified theoretical components relating directly to the effective implementation of clinical guidelines in healthcare settings (Eccles et al., 2007). Social cognitive theory proposes that the environment plays a key role in influencing an individual's behaviour (Bandura, 1977), and that one of the most important mechanisms involved in successful behaviour change is an individual's belief in their ability to exercise control over their environment (Bandura, 2001). The more controllable an

individual perceives their environment to be, the more likely they are to succeed in performing the desired behaviour (Bandura, 1991), although the environment must also offer opportunities for support (Glanz, Rimer, & Lewis, 2002). The importance of environment has also been supported in guideline implementation research, which has demonstrated that interventions which are embedded in a relevant environment and occur during the flow of care are more likely to succeed (Grimshaw & Russell, 1993; Shiffman et al., 1999). Social cognitive theory (Bandura, 1977) proposes that self-efficacy beliefs function as key determinants of motivation for a specific behaviour. Self-efficacy refers to an individual's belief in their ability to conduct a specific behaviour. Individuals with high self-efficacy for a task are more likely to perform the behaviour. GPs' self-efficacy has been implicated as a predictor of intended adherence to recommendations for prescribing (Hrisos et al., 2008; Eccles et al., 2007). Social cognitive theory also suggests that anticipated outcomes ('outcome expectancies') of a behaviour influence the likelihood that it will be performed, and outcome expectancies are significantly associated with intended prescribing behaviour (Hrisos et al., 2008; Eccles et al., 2007). Outcome expectancies that may be relevant to prescribing decisions include anticipated patient pressure (Little et al., 2004), beliefs about the risks and benefits associated with characteristics of the disease and credibility of the guideline source and content (Rashidian, Eccles, & Russell, 2008).

Therefore, an intervention which creates a controllable and supportive environment, increases self-efficacy, promotes positive outcome expectancies and reduces negative outcome expectancies may be beneficial in improving GP adherence to guidelines. In addition, the inclusion of these factors in a computer-delivered reminder intervention may be an optimal mode of delivery.

1.5 Research rationale

In summary, non-adherence to clinical guidelines has been identified as a consistent finding in general practice. A lack of adherence and need for

guideline implementation has been reported in relation to both antibiotic prescribing for RTI and recommendations for the prevention of secondary stroke (Simpson et al., 2009; National Institute for Health and Clinical Excellence, 2008; Rudd et al., 2004). These provide two contrasting conditions for which to target an intervention, as RTIs are usually brief and self-limiting (Little et al., 1997a) in comparison to stroke, in which patients experience a less frequent, potentially life threatening long-term condition (involving both functional impairment and increased risk of subsequent cardiovascular events) (Kumar, Little, & Britten, 2003). Emerging evidence suggests that computer-delivered interventions which are informed by behaviour change theory may provide an effective method with which to implement guidelines in primary care (e.g. Eccles et al., 2007) .

The purpose of this research was to develop and evaluate theory-informed, computer-delivered interventions to promote the implementation of guidelines in general practice. The aim was to create an intervention which GPs would view as both feasible and acceptable in practice. Specifically, the aim was to develop and evaluate computer-delivered prompts to promote guideline adherence for antibiotic prescribing in respiratory tract infections (RTIs), and adherence to recommendations for secondary stroke prevention. A number of methodological issues were taken into consideration in the design of this research.

1.6 Methodological issues

1.6.1 Methods for developing computer-delivered interventions

There are a number of methods available which have been used in past research on the development of computer-delivered interventions. These include quantitative techniques such as small pilot trials, the piloting of different versions of an intervention, and questionnaire analysis of factors which may influence intervention success (Bosworth et al., 2009; Eccles et al., 2007). In contrast, some studies have focused on qualitative methodologies such as interviews relating to intervention content, qualitative investigations of

issues which may influence an intervention use, and qualitative research relating to views surrounding a prototype intervention (Bekkers et al., 2010).

1.6.1.1 The role of qualitative research

Qualitative research is an overarching category which can refer to a wide range of approaches and methods (Snape & Spencer, 2003). However, the distinct aim common across most qualitative research is to provide an in-depth, naturalistic and interpretive view of a particular area (Denzin & Lincoln, 2000). These aims are achieved by studying a topic within a small and select sample, using data which is detailed and extensive, involving close contact with individual participants and producing outputs which focus on interpretation in relation to a natural context or setting (Ritchie & Lewis, 2003).

Qualitative research can provide particular benefit in areas which involve: the generation or development of a new policy or intervention (Snape & Spencer, 2003), in the study of phenomena in natural contexts (Mays & Pope, 2007), and for the exploration of processes which are not amenable to experimental manipulation (Green & Thorogood, 2004). These qualities lend themselves particularly well to the development of computer-delivered interventions for healthcare professionals, as the generation of an entirely new product is being created, its use within a naturalistic setting (such as a consultation) is critical to the development and often complex issues which may not be visible within an experimental setting (such as a pilot study) may be vital to the success of the intervention. For example, a qualitative study conducted early within the development of an intervention can reveal which aspects of the design are valued by practitioners, how the intervention design can best fit within the setting of a consultation and reveal issues which may influence usage.

1.6.1.2 Challenges of qualitative research

Despite the benefits of investigating a topic using an in-depth and naturalistic technique, qualitative research has often been heavily criticised for its lack of rigour and scientific qualities compared to quantitative methods, with some

researchers suggesting that findings from qualitative research cannot produce credible outputs (Pope, Ziebland, & Mays, 2000). In addition, some authors have argued that the invasive role of the researcher strongly influences and alters findings within qualitative studies (Silverman, 2011). This perspective would suggest that any findings revealed in a qualitative study involving the development of an intervention could not be applied across other practitioners and may result in the adoption of features or pages which would not benefit the study. However, criteria can be applied to qualitative research in order to enhance credibility and improve the rigour of findings. Yardley (Yardley, 2000) proposed a series of criteria and techniques which can be used to improve the quality of qualitative research. These consist of: sensitivity to context (e.g. literature, settings, perspectives), commitment and rigour (e.g. methodological competence and appropriateness of analysis), transparency and coherence (e.g. methods and data collection), and impact and importance (theoretical/practical etc). Transparency has been argued as an essential element of producing credible qualitative research, and has been described as the “benchmark for the presentation and dissemination of findings” (Hiles & Cermak, 2007). Hiles et al (2007) propose that transparency in qualitative research must be achieved across a range of areas, including, paradigm, method, analysis, reflexivity, critical evaluation and dissemination, in order to enhance the quality of findings. Malterud (Malterud, 2001) argues that credible qualitative findings can only be achieved through the attitude of attending systematically to the construction of knowledge and effect of the researcher at every step of the research process. Therefore qualitative methods which adhere to such criteria can produce credible findings with the ability to inform research areas such as the development of an intervention. In relation to computer-delivered interventions, this could involve issues such as transparency as to the way in which pages were generated, literature consulted, and the way in which findings inform future prototypes of an intervention.

1.6.1.3 Quantitative methods of intervention development

Intervention development can also be informed by quantitative research methods. These usually take one of two forms, and can involve a pilot trial of

an intervention or a quantitative analysis of factors which may be important to an intervention. These procedures have been used in relation to the development of computer-delivered interventions for healthcare professionals. For example, Bosworth et al., (Bosworth et al., 2009) developed a computer-delivered intervention which aimed to increase practitioner use of guidelines for patients with hypertension. The intervention was created based on previous literature and was implemented in one primary care clinic. The intervention consisted of patient specific recommendations for treatment which appeared directly on GP screens during a consultation. However, the study found no significant reduction in patient blood pressure. One benefit of this technique was the ability of researchers to monitor the outcomes and use of the intervention within clinical practice. However, a key limitation with this technique was the lack of insight as to why the intervention was not successful. In this instance, the intervention did not specifically report the use of any behaviour change technique used to inform development or encourage guideline adherence which may have reduced its effectiveness. However, the use of qualitative methods in a study such as this could have provided input into the development stage, which may have revealed a critical issue surrounding intervention use within this group of participants which a pilot trial could not detect.

Quantitative methods can also be used prior to a pilot trial of an intervention. For example, an intervention aimed at increasing GP adherence to guidelines for antibiotics prescribing (Hrisos et al, 2008) based its development on the quantitative analysis of behaviour change questionnaires which had been correlated with GP prescribing rates (Eccles et al, 2007) in order to determine factors which may influence GPs prescribing. This technique benefits from the use of data relating to GPs' behaviour in practice, however the data does not relate to the intervention materials and the way in which the intervention itself may be received or used. For example, it is possible that GPs may hold negative views towards a particular aspect of the intervention which could be crucial in its success. The use of qualitative research in this example could add depth to the understanding of factors which may influence the intervention use in practice.

Overall, quantitative methods can be used to develop computer-delivered interventions for healthcare professionals and can provide useful data relating to use in practice or factors which are likely to influence behaviour. However in the early development of initial intervention content, qualitative research can provide a greater depth of understanding towards a broad range of issues which are likely to influence intervention use. Therefore, in the first phase of intervention development of this nature, qualitative research may provide a beneficial investigative approach. However, if research budgets and timescales allow, the two methods could be combined to produce maximum benefits.

1.6.2 Methods for evaluating computer-delivered interventions

As with the development of computer-delivered interventions, a number of both qualitative and quantitative techniques can be used to evaluate interventions. These techniques can range from post study interviews to questionnaires and usage data (Hrisos et al, 2008). In addition, these techniques are often combined to provide a detailed picture of the implementation and trial of an intervention (Campbell et al., 2007). When investigating the use of qualitative and quantitative techniques, an understanding of the theoretical perspective which underpins each method is essential in selecting an appropriate method (Brannen, 2005).

Quantitative research is traditionally based on a positivist paradigm which holds a scientific approach, aiming to use measures which are unbiased, consistent across different contexts and produce findings which can be generalised to a wider population (Yardley & Bishop, 2007; Ritchie & Lewis, 2003). Overall this 'realist' perspective is defined by the classic rules of scientific research and assumes there is a single and fixed reality (Bailey, 2008). In contrast, qualitative research has arisen and been defined by interpretive or constructionist paradigms, which suggest that the researcher inevitably influences the research, and that the aim of research is to

understand the world from the perspective of the participant rather than to seek or generate universal laws (Green and Thorogood, 2009).

Due to the differing theoretical perspectives of qualitative and quantitative research methods, it has been often been argued that the two methods are incompatible and cannot be mixed within one design (Mays & Pope, 2007; Pope et al., 2000; Pope & Mays, 1995). However, increasingly the benefit of using both techniques, particularly in areas such as intervention development and evaluation, has been more widely accepted (Denzin & Lincoln, 2000; Yardley & Bishop, 2007; Fielding & Fielding, 1986).

1.6.2.1 The use of mixed methods designs

Running a qualitative study alongside a quantitative technique can be useful in order to examine in detail specific isolated components and also explore complex influences which may be occurring (Ritchie & Lewis, 2003). One benefit of this technique is the ability to apply 'triangulation', which involves comparing data from different sources (such as qualitative and quantitative methods) in an attempt to validate findings by examining the degree to which data converges across methods (Denzin & Lincoln, 2000). Therefore if both qualitative and quantitative data appear to present a level of agreement, the findings can be viewed with greater credibility. However, some authors argue that although obtaining data from mixed methods can add depth to any analysis, as the data is derived from such different epistemological origins, it may be unlikely to generate concordant evidence and that individual factors which may influence this should always be considered (Fielding & Fielding, 1986).

However, using a mixed method design, particularly in relation to the evaluation of an intervention, can be advantageous, as the study can benefit from the advantages of each technique and produce a broad set of findings with which to evaluate its success. For example, quantitative methods can provide a robust assessment of the effects of individual variables or

components of an intervention. In the case of theory based interventions, measures relating to each theoretical component can be assessed statistically to make direct inferences about their effect. Quantitative methods can also provide strong internal validity with which to support any conclusions which an evaluation may have drawn in relation to the success of an intervention (Ritchie & Lewis, 2003). However, a quantitative method cannot assist in understanding more complex issues which may have influenced the success of an intervention. The inclusion of a qualitative study in the evaluation of an intervention can provide a strong technique for exploring a range of issues, such as factors which may not have been considered by researchers but which may be highlighted by this more in depth methodology (Pope & Mays, 1995). Qualitative research can provide an understanding of perceptions, explore issues which may have influenced intervention use, and critically provide an understanding of the ways in which an intervention can integrate within a naturalistic setting (such as a GP practice). Therefore, the use of research designs which incorporate methods from both qualitative and quantitative research can yield differing types of data and perspective in order to optimally assess and further develop an intervention (Campbell et al 2007).

Despite the benefits in using a mixed methods approach within intervention research, evaluating the findings can be problematic due to the differing epistemologies across methods (Fielding & Fielding, 1986). However, adopting a pragmatic theoretical perspective can be advantageous in applied research. A pragmatic approach allows a researcher to adopt whichever research method is most beneficial for answering a particular research question without being restricted to one methodology and view point (Yardley & Bishop 2007). Pragmatism allows a study to select whichever method is best suited and appropriate to a particular area of research, which can often be through the use of both qualitative and quantitative research methods (Tashakkori & Teddlie, 2008). Therefore in the development and evaluation of a computer-delivered intervention, a pragmatic approach can support the use of both qualitative and quantitative methodologies.

1.6.3 Use of mixed methods within this thesis

This thesis involved the development and evaluation of a theory based, computer-delivered intervention. In the development of the intervention, a qualitative study was used to gain in-depth insight with which to inform the creation of the computer-delivered prompts. This involved exploring both issues which may influence GPs' use of the prompts, and GPs' views and perceptions of the prototype prompts as they were developed. The study resulted in the development of an intervention which was used in a trial (separate study not included in the thesis). An evaluation of the intervention was conducted immediately after the trial, which used both qualitative and quantitative methods. The qualitative study aimed to explore complex issues which may have influenced use of the intervention, while the quantitative study provided an examination of attitudes towards the intervention components and investigated theory based attitudinal measures across groups in order to assess the impact of the intervention on attitudes that are known to influence behaviour.

1.7 Thesis aims and overview

1.7.1 Key Aims

Non-adherence to clinical guidelines has been identified as a consistent finding in general practice (e.g. Grimshaw, Eccles, Walker, & Thomas, 2002).

- The overarching purpose of this research was to develop and evaluate theory-informed, computer-delivered interventions to promote the implementation of guidelines in general practice.
- The research aimed to develop a computer-delivered intervention which was viewed by GPs as both feasible and acceptable for use in a general practice setting.
- Specifically, the aim was to develop and evaluate computer-delivered prompts to promote guideline adherence for antibiotic prescribing in

respiratory tract infections (RTIs), and adherence to recommendations for secondary stroke prevention.

The prompts were designed to a) promote adherence to antibiotic prescribing recommendations for RTI in accordance with the NICE guidelines (National Institute for Health and Clinical Excellence, 2008) and b) promote adherence to recommendations from the Intercollegiate Stroke Working Party for secondary prevention of stroke (Intercollegiate Stroke Working Party, 2008).*

****NICE guidelines for antibiotic prescribing in RTI targeted:*** *Antibiotics should not be prescribed to most patients with a RTI (a prescription of antibiotics should only be issued to patients with specific additional underlying medical conditions and high risk groups as stated in the guidelines).*

****ICSWP guidelines for prevention of secondary stroke targeted:*** *Patients who have suffered from their first stroke within the last five years should be treated as follows-*

- 1) An optimal target blood pressure for stroke patients is 130/80 mmHg.*
- 2) Aspirin prescribed together with Dipyridamole should be standard treatment following non-haemorrhagic stroke.*
- 3) All stroke patients with total cholesterol >3.5 mmol/l should be treated with a statin.*

1.7.2 Thesis structure

Following this Chapter, there are 6 further Chapters within this thesis. Chapter two presents a systematic literature review of computer-delivered interventions which promote the implementation of guidelines in the primary care. The aim of this review was to assess the effectiveness of computer-delivered interventions for healthcare professionals within a primary care setting, and to identify which factors may influence the success of these interventions. The third Chapter discusses the use of behaviour change theory in relation to

healthcare professionals, in order to identify which theoretical components may be best applied to computer-delivered interventions in primary care. Chapter four presents a study which involved the development of a computer-delivered intervention to promote guideline adherence for antibiotic prescribing in respiratory tract infections (RTIs), and adherence to recommendations for secondary stroke prevention. Following this study, the intervention was then used in a cluster randomised trial in GP surgeries, which does not appear within this thesis. Chapter five presents the findings from a qualitative process evaluation of the intervention, and Chapter six presents findings from a quantitative questionnaire evaluation of the intervention. Finally, Chapter seven discusses conclusions and implications of the research findings.

1.8 Research context

The development and trialling of the intervention was funded by the Wellcome trust in a grant awarded to Kings College London in collaboration with the University of Southampton. I was employed as a research fellow at the University of Southampton to undertake a study which would involve the development of the computer-delivered interventions, one for RTI and one for stroke (this study is presented in Chapter four of this thesis). Following the development study, the interventions entered into two cluster randomised trials within GP practices which lasted for one year each, and were run at Kings College London. The trial and its findings do not appear within this thesis. Following the development study, as part of my PhD I developed and gained permission to conduct two further studies for my thesis which would form a process evaluation of the intervention, and involve GPs who had taken part in the trials. These studies are presented in Chapters five and six of this thesis. Due to technical issues implementing the stroke prompts, the stroke trial was significantly delayed and therefore process evaluation studies related only to the RTI intervention and trial. The intervention development study and protocols for the RTI and stroke trials have all been published in peer reviewed journals (McDermott, Yardley, Little, Ashworth, & Gulliford, 2010; Gulliford et al., 2011; Dregan et al., 2012). Figure 1 presents a flow chart of the research and setting within the thesis.

Figure 1 Research program in relation to thesis

Chapter 1: Introduction- Guideline implementation in primary care
Chapter 2: Systematic literature review- Computer-delivered interventions in primary care
Chapter 3: Theory Chapter- Behaviour change theory and healthcare professionals
Chapter 4: Study 1- Intervention development study (RTI and stroke)
<i>[Trial OF RTI Intervention run at Kings College London- * Not included in thesis]</i>
Chapter 5: Study 2- Qualitative process evaluation of RTI intervention
Chapter 6: Study 3- Quantitative process evaluation of RTI intervention
Chapter 7: Discussion and Conclusions- Development and evaluation of intervention

2. Chapter two: A systematic literature review of computer-delivered interventions to promote the implementation of guidelines in primary care

2.1 Chapter overview

The following chapter presents findings from a systematic literature review of computer-delivered interventions which promote the implementation of guidelines in the primary care. The aim of this review was to assess the effectiveness of computer-delivered interventions for healthcare professionals within a primary care setting, and to identify which factors may influence the success of these interventions. The chapter first discusses findings from previous similar reviews in the area, highlighting why this review was necessary. Following this, evidence relating to possible moderators of intervention success is presented. The chapter then describes the aims of the review and the methods used in analysis, before presenting the research findings and the implications of these in relation the development of interventions.

Please note that detailed examinations of topics which may aid the reading of this chapter can be found in the following locations:

- The use of computer-delivered interventions in relation to the overarching aims of this research: Chapter 1
- Non-adherence to guidelines in primary care: Chapter 1.
- Behaviour change theory in relation to healthcare professionals and guideline adherence: Chapter 3.

2.2 The effectiveness of computer-delivered interventions for healthcare professionals

A number of systematic literature reviews have investigated topics relevant to the use of computer-delivered interventions to implement guidelines for healthcare professionals. For example, Arnold et al (Arnold, Straus, & Arnold, 2005) reviewed behaviour change interventions for healthcare professionals; however, the review focused on the implementation of only one specific guideline (antibiotic prescribing for respiratory tract infections) and also included a mixture of techniques which prevent findings being directly related to computer-delivered methods. However, some reviews have included only studies that involve only computer-delivered interventions to implement a variety of guidelines for healthcare professionals. These comprise of: Shiffman et al (Shiffman et al., 1999) which reviewed computer based guideline implementation systems, Garg et al (Garg et al., 2005) which reviewed effects of computerised decision support on practitioner performance, and Hesslemans et al., (Hesselmans et al., 2009; 2009) which reviewed electronic guideline implementation systems in ambulatory care settings. These three reviews are examined in greater detail as they contain attributes which could assist in assessing the effectiveness of computer-delivered interventions to promote the implementation of guidelines in primary care. Shifman et al (1999) focused on which functions of computer-delivered systems were most effective, Garg et al (2005) reviewed a large and wide ranging selection of studies (100 trials in total), and Hesslemans et al (2009) reviewed only studies which were conducted in ambulatory care, which may be more closely related to primary care than previous reviews in the area.

Shifman (1999) reviewed intervention studies published between 1992 and 1998. The review reported that guideline adherence improved in 14 out of 18 systems evaluated. However, this review is now considerably dated (due to advances in technology and computer systems used) and included interventions which occurred across all healthcare services such as surgery, laboratories and hospital departments, which make it difficult to generalise to primary care. In addition, some of the interventions took place in services where the use of a computer would not normally be part of the care service

and may lack validity in relation to usual care settings (such as the use of a computer in a GP consultation).

Garg et al (2005) also conducted a systematic review on the effect of computerised clinical decision support systems on practitioner performance. The review encompassed a wide range of techniques including reminder systems, drug dosing systems, and diagnostic systems. The review reported that 64% of systems improved practitioner performance. Systems which provided automatic information improved performance in 73% of interventions, compared to 47% in programmes which required the practitioner to activate them. However, it is difficult to generalise the findings to primary care guideline adherence as many of the studies took place in hospital settings such as; the emergency department, cardiology and oncology. In addition, the systems did not have to be in use during a patient consultation which also prevents a direct comparison to a primary care setting.

More recently, Hesslemans et al (2009) conducted a systematic review on the effectiveness of electronic guideline implementation systems in ambulatory care settings. The review reported that none of the studies successfully improved at least 50% of the outcome variables tested, and that less than half of the studies reported improvements in process of care variables. The authors concluded that there was no incremental effect of computer-delivered interventions over the distribution of paper versions of the guidelines and that overall there was little evidence supporting the use of guideline implementation systems. It is difficult to generalise the findings to primary care, as the studies were conducted in various healthcare settings including hospital emergency departments and specialist outpatient clinics. In addition, the review only included studies which involved a sample where at least 50% of the participants were physicians. In a primary care setting nurse practitioners frequently see patients for a range of conditions such as the management of chronic illness and many also prescribe medication, all of which relate to guidelines. Therefore, the participation of nurse practitioners is of equal importance in primary care to that of general practitioners in terms of guideline adherence. In addition, a number of criteria used to exclude studies

from the review make it difficult to assess the possible success of computer-delivered interventions in a primary care setting. For example, the review only included interventions which consisted of several aspects or steps and excluded studies which used simple prompts. However, previous research has reported that computer-delivered systems in primary care which use simple prompts or reminders (and do not consist of several steps) can increase adherence to guidelines (Fiks, Grundmeier, Biggs, Localio, & Alessandrini, 2007). Finally, the review also excluded interventions which involved the education of healthcare professionals. This is also problematic as previous computer-delivered interventions which included an aspect of education for the practitioners, have reported increased adherence to primary care guidelines (Wells et al., 2008).

2.3 Moderators of the effectiveness of implementation techniques

2.3.1 Behaviour change theory

Psychological theories of behaviour change could attempt to explain the wide variety in success rates of computer-delivered interventions and help predict which techniques may be most successful. Applying psychological theory to the interventions can help to provide understanding of the components which may facilitate change for the behaviour involved in adhering to the guideline (Michie et al., 2005). Most computer-delivered interventions in the area have not explicitly used psychological theory; however, a number of trials have applied theory to the intervention development and various theoretical components which may be influential have been identified (these are discussed in greater detail in Chapter 3 of this thesis).

2.3.2 Self-efficacy

Although research in the area is extremely limited, the theoretical construct of self-efficacy has been associated with healthcare professionals' adherence to guidelines. Self-efficacy is a construct from social-cognitive theory (Bandura, 1977) and refers to an individual's beliefs in their ability to conduct a specific behaviour. Self-efficacy can be incorporated into interventions using a number of techniques which include verbal persuasion and modelling (which relates to individuals identifying with others who have successfully established a behaviour) (Bandura, 1977). Self-efficacy has been significantly associated with healthcare professionals' adherence to clinical guidelines across a wide variety of conditions including: RTI (Hrisos et al., 2008; Eccles et al., 2007), smoking cessation (Hoving, Mudde, & de Vries, 2007; O'Loughlin et al., 2001), obesity (Miller Perrin, Flower, Garrett, & Ammerman, 2005) and fertility treatment (Haagen et al., 2005). Therefore, it would be predicted that computer-delivered interventions which include a feature to increase self-efficacy (or a similar construct) would result in greater adherence to guidelines than those which did not take this factor into consideration. However, few interventions in this area refer to self-efficacy and it would be expected that very few computer based interventions would directly use the construct.

2.3.3 Environment

Specific features of the environment have also been associated with healthcare professionals' adherence to guidelines. This concept is described by social cognitive theory (Bandura, 1977) which suggests that an individual is more likely to engage in a behaviour if their environment is perceived as controllable and supportive. Interventions can incorporate this construct by providing a user with a number of features to support them in adhering to a behaviour (e.g. facilities, leaflets, easy access to information) and ensuring an environment is controllable for example, by the incorporation of features which the user can independently select. Interventions which have provided features in the consultation environment that offer control and support in conducting a behaviour have been effective in increasing healthcare professionals' adherence to guidelines. This finding has been supported in relation to a number of clinical conditions including: RTI (Berild, Ringertz, Aabyholm, Lelek, & Fosse, 2002), diabetes (Montori et al., 2002), aspirin

prescribing (Filippi et al., 2003) and preventative healthcare recommendations (Dexter et al., 2001). Therefore, a computer-delivered intervention which provides the user with features that are both controllable and supportive would be expected to result in greater guideline adherence compared to those which do not include these features. However, as few interventions in the area explicitly refer to theory and many do not include extensive descriptions of the system used in a trial, it is often difficult to identify the use of this theoretical factor.

2.3.4 Outcome expectancies- risk presentation

Finally, a theoretical construct which can be directly applied to computer-delivered interventions is the concept of outcome expectancies from social cognitive theory (Bandura, 1977). Outcome expectancies refer to an individual's beliefs that engaging in a behaviour will directly result in specific outcomes. It is the beliefs relating to the perceived outcomes which determine the likelihood that an individual will engage in a particular behaviour. Outcome expectancies have been significantly associated with practitioners' adherence to guidelines in relation to a range of conditions including: cancer (Travado, Grassi, Gil, Ventura, & Martins, 2005), RTI (Eccles et al., 2007; Hrisos et al., 2008), smoking cessation (Vogt, Hall, & Marteau, 2005) and radiography referrals (Bonetti et al., 2005). In addition, alternative theoretical constructs which refer to similar behaviour beliefs as outcome expectancies have also been related to healthcare professionals' guideline adherence. For example, the construct of attitude in the theory of planned behaviour (Ajzen, 1991) relates to an individual's perception of the consequences which will result from performing the behaviour. The attitude towards conducting a task can then be favourable or unfavourable depending on the evaluation which has taken place of the behaviour. This construct has also been significantly associated with adherence to guidelines across conditions which include: RTI (Hrisos et al., 2008), x-ray referrals (Bonetti et al., 2005) and smoking cessation (McEwen, West, & Preston, 2006). In relation to computer-delivered interventions for healthcare professionals, outcome expectancies can relate to the way in which information is presented about the likely patient outcomes which will result from the practitioner adhering to the guideline. This information is often

presented in relation to a patient's risk of developing a condition. For example, the intervention may inform the practitioner that a patient is at high risk of developing a condition, which they could reduce by following the guideline (Emery et al., 2007). Alternatively, the intervention may inform the practitioner of the percentage by which a patients' risk of suffering from a condition can be reduced if a guideline is followed (McDermott et al., 2010). Therefore, it would be predicted that computer-delivered interventions which present information relating to patient risk would result in greater adherence to guidelines than those which do not provide this information.

2.3.5 Complex interventions

Computer-delivered interventions for healthcare professionals can use simple or complex techniques. A simple intervention presents the guidelines and may advise the practitioner on what they should do to follow the recommendation (e.g. which medication to prescribe). In contrast, a complex intervention (Craig et al., 2008) refers to the presentation of recommendations in addition to other components which could include: guideline education (e.g. online presentations, information documentation, and instructional activities to complete), audit or performance feedback, and tools such as printable documents or patient information sheets. For example, an intervention which aimed to increase adherence to recommendations for breast cancer risk presented the guidelines and provided an educational session, patient tools and further information tools for the practitioner (Wilson et al., 2006). Complex interventions may also relate more closely to psychological behaviour change theory, as the wider range of components are more likely to include theoretical concepts. For example, the range of tools on offer for the practitioner are more likely to provide the supportive and controllable environment which social cognitive theory (Bandura, 1977) suggests would increase behaviour change. In addition, the use of tools which present information on a patient's risk of developing a condition are likely to influence the outcome expectancies associated with following the guideline, which may also encourage adherence. A recent review of general interventions to increase adherence to antibiotic prescribing guidelines for RTI concluded that complex techniques were most successful in increasing physician adherence to the

recommendations (Arnold et al., 2005). It would therefore be expected that computer-delivered interventions which use a complex technique would result in greater adherence to guidelines than those which use a simple intervention design.

2.3.6 Tailoring

The degree to which an intervention is tailored to an individual can also influence the likelihood of a behaviour being engaged in. Tailored interventions refer to the presentation of information which is specific to an individual based on an evaluation of personal characteristics (Kreuter, Strecher, & Glassman, 1999). In relation to guideline adherence in healthcare professionals, interventions can be tailored towards individual patients whom the practitioner is seeing. For example, the intervention may only appear on the screen when a patient with a condition relevant to the target guideline is being seen during a consultation (rather than presenting the intervention for every patient). A review of intervention content concluded that programmes which included a form of tailoring resulted in greater adherence to health behaviours than those which did not include this feature (Noar, Benac, & Harris, 2007). In addition, a review of computer-delivered web interventions concluded that tailoring could successfully change health behaviour if only factors which are specific and unique to the target behaviour are manipulated (Lustria, Cortese, Noar, & Glueckauf, 2009). In relation to primary care guidelines, these could refer to tailoring only selective areas of the patient information available, such as providing a body mass index score to encourage adherence to obesity recommendations and omitting any information which is not directly relevant, such as patient age (which the GP can view separately). Psychological theory also supports the concept of tailoring in relation to behaviour change. For example, the elaboration likelihood model (Petty & Cacioppo, 1986) suggests that an individual's perception of the personal relevance of information presented directly influences their decision to engage in a behaviour. In the case of healthcare professionals, the information presented in an intervention can have increased relevance to the practitioner, the more closely it relates to the individual patient they are seeing during a consultation.

The degree to which information is tailored can vary from direct tailoring to one person or targeting towards a specific population with shared characteristics (Kreuter & Skinner, 2000). Both forms of tailoring can be used in computer-delivered interventions for healthcare professionals, as information presented can be tailored towards a specific patient (e.g. a risk score for developing cardiovascular disease) or targeted towards a patient group (e.g. patients with diabetes). Interventions which are tailored towards individual patients provide the GP with information which is of greater relevance during a consultation than those which are targeted towards an entire patient group. Therefore it would be predicted that computer-delivered interventions for healthcare professionals which are tailored towards individual patients would result in greater adherence to guidelines than those which are targeted at patient groups only.

2.4 Summary and aims

Therefore, a number of factors may moderate the effectiveness of computer-delivered interventions for healthcare professionals. These factors include: the presentation of patient risk information, the level to which an intervention is tailored to an individual patient and the use of complex techniques. To date, no known review has directly assessed the effectiveness of computer-delivered interventions to increase healthcare professionals' adherence to guidelines in primary care. Previous reviews have evaluated computer-delivered interventions in relation to healthcare professionals; however these have often included clinical settings which differ substantially from primary care, such as hospital emergency departments. In addition, previous reviews in the area have reported conflicting conclusions concerning the benefit of using computer-delivered interventions.

The aim of this systematic literature review was to assess the effectiveness of computer-delivered interventions which implement guidelines in primary care. The review aimed to:

- Assess the overall effectiveness of computer-delivered interventions in primary care.
- Identify any factors which may influence the effectiveness of these interventions.

2.5 Method

2.5.1 Design

A systematic literature review was conducted to investigate the effectiveness of computer-delivered interventions to implement guidelines in primary care. The search was conducted to ensure that all studies included in the review involved only trials of interventions which had occurred within a primary care setting.

2.5.2 Search strategy

2.5.2.1 Initial search

An electronic literature search of all relevant articles between the years of 1995 and March 2011 was conducted. The year 1995 was selected, as by this time around 80% of GPs in Great Britain were using computer systems during a consultation (Als, 1997) and therefore the use of computer-delivered information could be integrated into standard clinical practice. The search was conducted in Embase, Medline and the Web of Science. A librarian assisted and advised on selecting appropriate search terms to enter. This process involved extensive investigation of potential search terms which were tested against the presence of articles already known to fit the criteria. The terms 'evaluation'/'trial'/'intervention' were not included as these yielded thousands of papers which were not relevant and instead it was discovered that including the terms surrounding 'computer delivered' and 'guidelines' was more appropriate as all studies of interest would arise under these categories. The Medline search was performed using the following MeSH terms: [Physicians, primary care] OR [Primary health care] OR [Primary care nursing] AND [Decision making, computer-assisted] OR [Computer-assisted instruction] OR [Software]

OR [Computers] OR [Internet] OR [Decision support systems clinical] OR [Decision support systems management] OR [Decision support systems technique] OR [Clinical pharmacy information systems] OR [Ambulatory care information systems] AND [Guideline adherence] OR [Health planning guidelines] OR [Guidelines as topic] OR [Practice guidelines] OR [Guideline] OR [Practice guidelines as topic] OR Healthcare quality access and evaluation]. These terms were modified appropriately for both Embase and Web of Science to ensure that all possible combinations in accordance with the MeSH terms were located.

2.5.2.2 Selection of papers

Titles or abstracts of all papers identified in the search were then assessed to determine which studies met the inclusion criteria for review. Full text articles were obtained and read if more information was needed to determine the eligibility of a study, or to confirm that a study which appeared eligible did meet the full criteria for selection. Reference lists of relevant articles were also scanned, to search for further studies which met the criteria for inclusion in the review.

2.5.2.3 Data extraction

Papers selected for review were then assessed in relation to factors which had been identified in the literature as possible moderators of intervention effectiveness (described in the introduction, including; self-efficacy, environment, outcome expectancies/risk presentation, intervention style, and tailoring). This involved recording and describing the presence of any of these factors. Any factor which was consistently reported across papers could then be categorized and the findings compared in analysis. (For example, the way in which information within each intervention was tailored towards either an individual patient or a patient group was recorded. It was found that all papers had reported the type of tailoring used and that the findings from each type of tailoring could be compared in two groups: patient tailored vs. patient group specific).

In addition, papers were also assessed to identify any further methodological differences which may relate to the effectiveness of the interventions. This involved an extensive inspection of each article, recording details of the method and intervention such as; the number of participants, the number of patients, the number of surgeries, the location of the trial and as many details as possible about the intervention content. Any factor which was consistently reported across papers could then be categorized and the findings compared in analysis. An example of a data extraction table for each article can be seen below.

Data extraction sheet for included articles

Authors	
Date	
Title	
Medical condition	
Guideline targeted	
Guideline aim	
Guideline type (e.g. prescribing)	
Aim of study	
Effective? (Y/N)	
Effective on all measures? (Y/N)	
Summary of Intervention	
Type of intervention (e.g. Reminders)	
Complex intervention? (Y/N)	
Components listed in intervention	
Detailed description of intervention	
Does intervention involve other services or practitioners?	
Participant type (e.g. nurses)	
Participant total	
Patient total	
Practice total	
Details of patient group	
Setting	
Country	
Area (e.g. London)	
Primary outcomes	
Secondary outcomes	
Adherence related outcomes	
Patient related outcomes	
Inclusion of psychological theory? (Y/N)	
Information tailored to individual patient?	
Information tailored to patient group?	
Inclusion of patient risk information?	

Inclusion of risks not related to patient?	
How are outcomes reported?	
Randomisation procedure	
Audit information available to practitioners?	
Financial compensation?	
Length of intervention?	
Development of computer program description	
Additional factors of interest?	

2.5.3 Inclusion criteria

Studies were included in the review if they reported the trial of an intervention that was presented electronically via a computer and encouraged healthcare professionals to adhere to guidelines within a primary care setting.

2.5.3.1 Eligibility criteria

A set of eligibility criteria was developed to ensure that studies were relevant to the purpose of the review and to assess the suitability of trial characteristics. Studies were included in the review if they met the following criteria:

- **Study characteristics**

The study must have been published in the English language.

A full and clear description of the intervention procedure or technique must have been presented (this could include studies which published the protocol elsewhere).

- **Guidelines**

The guidelines targeted in the intervention must have been related to some form of patient care (e.g. not simply a managerial or professional procedure guideline). Guidelines could relate to a range of actions such as preventative healthcare, prescribing recommendations or disease management. Guidelines could also relate to care for physical or psychological conditions.

- **Intervention**

The intervention had to be delivered using a computer and involve the appearance of information on a computer screen. The intervention must also have involved some form of interaction with the practitioner and not simply involve the system automatically changing a decision, which could not be controlled by the practitioner.

The intervention could include additional factors such as seminars, educational materials or patient related tools; however it must be delivered to healthcare practitioners primarily by computer.

- **Participants**

The main user of the intervention must have been a healthcare professional and not a patient. However complex interventions which also required a level of patient involvement could be included, as long as the primary user was a healthcare professional.

The healthcare professional using the intervention could be either a general practitioner or other form of practitioner (e.g. nurse) who was directly involved in adhering to a guideline relating to the patient's care.

- **Setting**

The intervention must have been delivered in a primary care setting (e.g. GP surgery), during real clinical practice.

• **Outcomes**

Outcome measures must have related to the practitioner's guideline adherence. This could be in the form of either patients' clinical measures (e.g. blood pressure) or recorded rates of practitioners' guideline related behaviour (e.g. prescribing rates).

2.5.4 Risk of bias

A risk of bias assessment was then conducted on all studies included in the review, in order to assist in explaining any variation in the results. The assumption was that the findings of studies with more rigorous procedures would represent results which were closer to the true effects of an intervention, compared to studies which had a high risk of bias. In addition studies were also examined in relation to sample size and study design which are also strongly related to the risk of bias.

This assessment was based on the Cochrane guidelines for assessing methodological quality and validity of studies (Higgins, Green, & Collaboration, 2008). Assessment is conducted by creating a risk of bias table in which a specific feature of the study is assessed individually and a judgement for each entry is provided. The study features assessed in the table are as follows: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting and other potential sources of bias. Each feature is judged by answering a question with 'yes' indicating a low risk of bias, 'no' indicating a high risk of bias, and 'unclear' indicating that either a lack of information is available or there is uncertainty over the possibility of bias.

Sequence generation

Sequence generation refers to the way in which interventions are allocated to participants. If interventions are allocated to participants at random, the risk of selection bias (differences between the baseline characteristics of groups) is reduced. In this review the risk of bias was considered as low if each practice was allocated to an intervention group at random.

Allocation concealment

The strict implementation of a system to randomly allocate participants to an intervention by preventing foreknowledge of the forthcoming allocations is referred to as allocation concealment. If this process is adhered to, the risk of selection bias is considered as low. In this review, the risk of bias was considered as low if the process by which a practice was assigned to an intervention was not directly selected or influenced by the study researchers.

Blinding

Blinding refers to both participants and personnel involved in a trial being unaware of who has been allocated to each group. Effective blinding is conducted in order to reduce the risk of performance bias (in which factors other than the intervention may influence performance), attrition bias (systematic differences in withdrawals between groups) and detection bias (differences between groups in terms of how outcomes are determined).

In relation to the topic of this review, it is likely that participants would be aware of the intervention they were receiving, as new computer-delivered messages would appear to them. Adequate blinding was therefore considered in studies which has used cluster randomisation (allocated the intervention groups to practices rather than individual practitioners). In this situation all practitioners in a target surgery would receive the intervention, which reduces the possibility that practitioners receiving the intervention could discuss this with colleagues in the same practice who had been allocated to the control

group. Therefore, the risk of bias was assessed as low in studies which allocated the intervention groups by practice and not by individual participant.

Incomplete outcome data

Incomplete outcome data refers to situations where participants are omitted from analysis (i.e. intention to treat analysis). If large numbers of participants are omitted or data is not suitably adjusted for any omissions, attrition bias may occur (in which there are systematic differences between groups in withdrawals from a study).

Selective reporting

Selective reporting occurs when a study omits non-significant findings from the report. This can lead to reporting bias in which there are substantial differences between reported and unreported findings. This risk of bias is considered as low if findings from all outcome measures are reported in the results.

Other sources of bias

Additional sources of bias are specific to a study area and can include issues surrounding the recruitment method, intervention delivery or features provided to the control group. In this review potential sources of bias were considered in relation to the intervention delivery and specifically considered whether the intervention involved additional factors to those described. For example, interventions might be described as only involving computer messages but participants were also provided with training and education. The factors which the control group received were also taken into consideration, such as the use of usual care or additional control features which are not normally present (e.g. guideline information).

Overall assessment

An overall assessment was then made of the possible risk of bias in each study included in the review, based on the judgement made for each feature.

2.6 Results

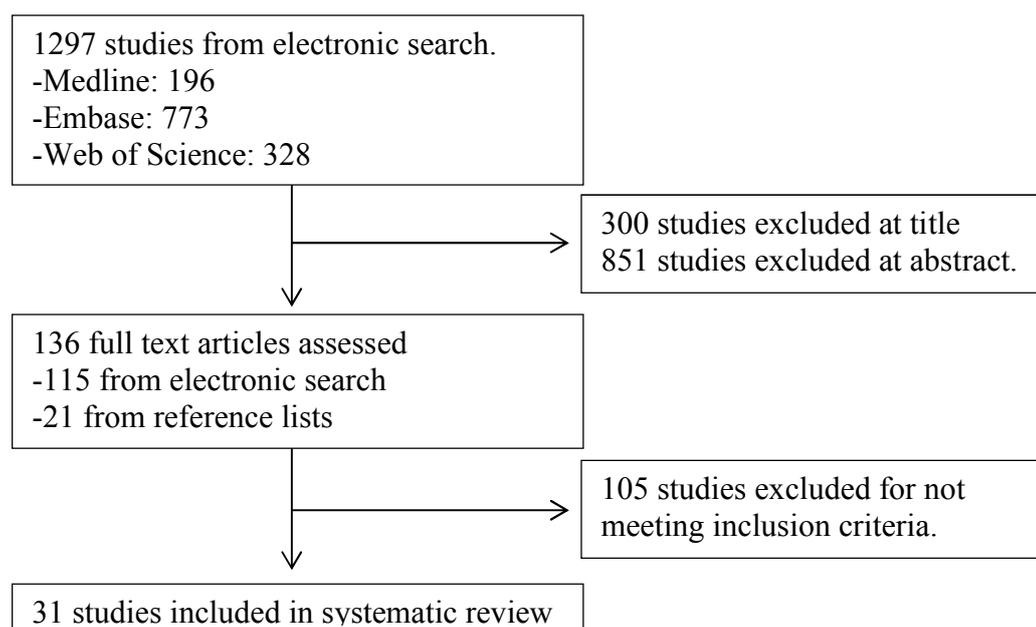
2.6.1 Summary

In total 1297 papers were identified by the electronic search for inclusion in the review. A further 21 papers were identified from reference lists of relevant articles. During the review process 300 papers were excluded based on their title, a further 851 papers were excluded after abstract reading, and finally 105 papers were rejected after obtaining and reading the full article. This left 31 studies which met the criteria for inclusion in the review. Figure 2 displays the process of article review and selection used to identify the included papers.

2.6.2 Excluded studies

There were a number of key reasons for the exclusion of potentially relevant studies. Many articles described the development of a computer-delivered intervention but did not provide trial results of testing the system in practice. A number of articles which did report the trial of an intervention only provided usage data (e.g. how many times a page had been viewed), but did not directly examine the effect of the intervention on guideline adherence. Further papers were also excluded as many computer interventions were delivered to healthcare professionals but were predominantly for patient use. Additional papers were rejected on the basis that the intervention was not primarily computer-delivered and had only involved the use of a computer in a minimal way during the study.

Figure 2 PRISMA diagram showing the identification of studies for review



2.6.3 Study characteristics

Participants

It was difficult to draw comparisons across studies in relation to the number of participants as each paper presented this size in a different way. Articles reported the participant number as either the number of practices recruited, the number of healthcare professionals taking part, or the number of patients whose health outcomes could be influenced by the intervention. Of the papers which reported these figures, the total number of practices recruited ranged from 1 to 87, the number of healthcare professionals participating ranged from 10 to 377, and the number of patients eligible to receive care in the intervention criteria ranged from 140 to 87,886.

The participants in most studies were general practitioners (GPs), although a mixture of both nurse practitioners and GPs were used in some studies. However, papers often did not report the total number of each practitioner type who participated and many did not specify clearly whether or not nurse practitioners were included in a trial in addition to GPs.

Intervention

The interventions targeted a variety of different clinical guidelines which related to disease management, preventative healthcare (including vaccinations and screening), and prescribing recommendations.

The guidelines included in the studies covered a wide range of clinical conditions and issues which mainly involved; asthma, diabetes, hypertension, cancer risk, respiratory tract infection (RTI) and cardiovascular disease. A few studies also involved conditions such as dementia, dyslipidemia and depression.

Almost all of the studies involved an intervention which automatically appeared on computer screens; however, two studies used on-demand systems which required practitioners to activate them manually.

In terms of intervention content, most studies involved a form of reminder or direction of action to be taken by the practitioner. This could involve entering data such as blood pressure or direction as to which medication should be prescribed. Many interventions included a form of education either directly delivered by the intervention or delivered by a member of the research team at a practice group meeting, before or during the trial. A number of interventions included the input from both GPs and nurses during separate meetings with patients. In addition, some intervention involved interaction with patients via additional documentation or web-based information (outside of the consultation).

Most of the studies identified were conducted in the UK or USA. In addition, studies also took place in The Netherlands, Canada and New Zealand.

Outcome variables

Outcome measures and type of variable used varied greatly across the studies; however, all outcomes referred to guideline adherence. Outcome measures in most studies related to patient health outcomes such as blood pressure. Studies also reported prescribing rates of target medication or recorded referral rates in order to evaluate the impact of the intervention.

2.6.4 Risk of bias

An assessment for the risk of bias in articles included for review revealed that methodological quality varied widely across studies. Of all 31 studies included, only 7 were assessed as having a low risk of bias.

Sequence generation was considered adequate in over half (19) of the studies, however an evaluation could not be made on the remaining 12 articles as the technique used was not clearly described. Allocation concealment was assessed as adequate in 9 of the studies and was unclear in the majority of papers as the method used was not clearly presented. Blinding was evaluated as being adequate in 22 of the studies and inadequate in 4 articles. Blinding was not fully described and therefore could not be examined in 5 studies. Incomplete outcome data was addressed in all articles and all papers were also considered to be free of selective reporting. A summary of the risk of bias assessment for each paper is presented in Table 1. The final column labelled 'assessment' relates to the resulting assessment of the paper according to the Cochrane (Higgins et al., 2008) criteria.

Chapter 2

Table 1 Risk of bias assessment in papers selected for review

Study	Sequence generation	Allocation concealment	Adequate blinding	Incomplete data addressed	Free of selective reporting	Assessment
Bell et al.,2010	Yes	Unclear	Yes	Yes	Yes	Unclear
Bertoni et al.,2009	Yes	Unclear	Yes	Yes	Yes	Unclear
Bosworth et al.,2009	Yes	Yes	No	Yes	Yes	Unclear
Calderon et al 2008	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Cho et al 2010	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Cleveringa et al 2008	Yes	Unclear	Yes	Yes	Yes	Unclear
Downs et al 2006	Unclear	Unclear	Yes	Yes	Yes	Unclear
Eccles et al 2002	Yes	Yes	Yes	Yes	Yes	Yes
Emery et al 2007	Yes	Yes	Yes	Yes	Yes	Yes
Fiks et al 2007	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Fordis et al 2005	Yes	Yes	Yes	Yes	Yes	Yes
Fox et al 2008	Unclear	Unclear	No	Yes	Yes	Unclear
Gance-Cleveland et al 2010	Unclear	Unclear	No	Yes	Yes	Unclear
Gill et al 2011	Unclear	Unclear	Yes	Yes	Yes	Unclear
Grant et al 2003	Yes	Unclear	Yes	Yes	Yes	Unclear
Hicks et al 2008	Yes	Unclear	Yes	Yes	Yes	Unclear
Hobbs et al 1996	Unclear	Unclear	Yes	Yes	Yes	Unclear
Holbrook et al 2009	Yes	Yes	Yes	Yes	Yes	Yes
Maclean et al 2009	Yes	Unclear	Yes	Yes	Yes	Unclear
Montgomery et al 2000	Yes	Yes	Yes	Yes	Yes	Yes
Nagykaldi et al 2007	Yes	Unclear	Yes	Yes	Yes	Unclear
Poley et al 2007	Unclear	Unclear	Yes	Yes	Yes	Unclear
Rollman et al 2002	Yes	Yes	No	Yes	Yes	Unclear
Samore et al 2005	Yes	Unclear	Yes	Yes	Yes	Unclear
Sequist et al 2005	Yes	Unclear	Yes	Yes	Yes	Unclear
Simon et al 2005	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Svetkey et al 2009	Yes	Yes	Yes	Yes	Yes	Yes

Chapter 2

Study	Sequence generation	Allocation concealment	Adequate blinding	Incomplete data addressed	Free of selective reporting	Assessment
Tamblyn et al 2003	Yes	Unclear	Yes	Yes	Yes	Unclear
Van Wyk et al 2006	Yes	Yes	Yes	Yes	Yes	Yes
Wells et al 2008	Unclear	Unclear	Unclear	Yes	Yes	Unclear
Wilson et al 2006	Unclear	Unclear	Yes	Yes	Yes	Unclear

2.6.5 Effects of intervention

In total 31 papers were reviewed, which included 32 interventions, as one article (Nagykaldi et al 2007) reported two intervention studies. Of all articles reviewed, 24 studies reported a significant effect and 8 studies reported no effect of the intervention which had been implemented. Table 2 presents a summary of all studies which reported a significant effect and Table 3 presents those which reported no effect. Of the studies which reported the intervention as having a significant effect, only 7 found a significant change on all outcome measures.

In the studies which report a significant result, the risk of bias was assessed as being low in 5 trials, but unclear in 19 of the articles. A similar result was also seen in the studies which reported no significant findings, as the risk of bias was evaluated as low in 2 trials and unclear in 6 of the papers.

Based on the availability of data in the study descriptions which were provided, comparisons across trials were made in order to identify factors which may have influenced the success of the interventions. Factors identified for comparison were: the type of data presented (control group vs. follow-up data), the type of patient tailoring (patient tailored vs. patient group specific) the intervention style (simple vs. complex), and psychological factors (risks of non-adherence vs. no risks presented).

Chapter 2

Table 2 Studies which reported a significant effect

Study	Condition	Aim of study	Effective	Effective on all measures?	Intervention summary	Participant number	Patient number	Practice number	Risk of bias score
Bell et al 2010	Asthma care	Improve adherence to asthma care guidelines in primary care (in children)	Yes	No	Computer reminders (to use asthma care tools).	NA	19,450	12	Unclear
Bertoni et al 2009	Cholesterol	Increase use of guideline related management of cholesterol in Primary care	Yes	No	Computer prompts (patient risk score and treatment recommendations)	NA	1776	61	Unclear
Calderon et al 2008	Intimate partner violence in pregnant women	Increase recommendations to screen for and counsel pregnant women for intimate partner violence	Yes	Yes	Computer prompts (reminder of possible risk and suggestions)	NA	286	5	Unclear
Cho et al 2010	Asthma	Increase use of asthma management guidelines	Yes	No	Computer prompts (patient severity and recommendations displayed).	377	4682	NA	Unclear
Cleveringa et al 2008	Diabetes	Reducing cardiovascular risk in type two diabetes patients.	Yes	No	Computer prompts (patient tailored advice and performance feedback).	NA	3391	55	Unclear
Downs et al 2006	Dementia	Improve detection and management of dementia in primary care	Yes	No	Computer prompts (to investigate and manage possible dementia).	Na	450	36	Unclear

Chapter 2

Study	Condition	Aim of study	Effective	Effective on all measures?	Intervention summary	Participant number	Patient number	Practice number	Risk of bias score
Emery et al 2007	Cancer	Increase referrals to the genetics clinic for familial breast or colorectal cancer	Yes	No	Computer reminders of patient risk (patient tailored)	NA	NA	45	Yes
Fliks et al 2007	Immunization in children	Improve immunization rates of children.	Yes	Yes	Patient reminder prompts that vaccinations are due	50	15928	4	Unclear
Fordis et al 2005	Cholesterol	Increase use of guideline recommended treatment and screening for adults with high risk cholesterol	Yes	No	Computer support tools- guideline education (presentations, cases to complete, risk assessment calculator, guideline summary)	97	2768	21	Yes
Fox et al 2008	Kidney disease	Delay progression of chronic kidney disease (through implementation of the guidelines)	Yes	No	Reminders -patient tailored recommendations (and academic tasks)	10	181	2	Unclear
Gance-Cleveland et al 2010	Obesity	Increase usage of obesity guidelines for children and adolescents (collection of appropriate cardiovascular risk factors/ plotting of BMI/ documentation of BP/ Plotting of BMI and BP for age, sex and height).	Yes	Yes	Computer prompts (patient specific guidelines and tools to show patient)	NA	897	1	Unclear

Chapter 2

Study	Condition	Aim of study	Effective	Effective on all measures?	Intervention summary	Participant number	Patient number	Practice number	Risk of bias score
Gill et al 2011	Gastro-intestinal complications for patients on NSAIDS meds.	Reduce NSAIDS prescribing/ encourage prescribing of alternative medications and gastroprotective medication).	Yes	No	Computer prompts (alert for high risk patients and tools to change prescription).	119	5234	27	Unclear
Grant et al 2003	Diabetes (type 2)	Increase use of evidence based guideline for diabetes type 2 care.	Yes	Yes	Computer reminders (email alerts and recommendations for high risk patients)	59	149	2	Unclear
Hicks et al 2008	Hypertension	Improve hypertension care and outcomes	Yes	No	Computer prompts (patient specific-risks and recommendations)	NA	2027	14	Unclear
Holbrook et al 2009	Diabetes	Improve process of care and clinical markers of diabetes care	Yes	No	Computer prompts (tailored patient goals and progress)	46	511	NA	Yes
Maclean et al 2009	Diabetes	Improve clinical outcomes for patients with diabetes	Yes	No	Computer prompts (overdue tests and abnormal results to act and progress reports).	132	7412	64	Unclear
Nagykaldi et al 2007 a	Childhood vaccinations and 3 preventive advice services	Increase documentation and delivery of childhood vaccinations and preventive advice services	Yes	No	Computer prompt (to ask risk questions - patient tailored information presented)	NA	549	6	Unclear

Chapter 2

Study	Condition	Aim of study	Effective	Effective on all measures?	Intervention summary	Participant number	Patient number	Practice number	Risk of bias score
Nagykaldi et al 2007 b	Childhood and adult vaccinations/ and 4 preventive advice services	Increase documentation and delivery of vaccinations and preventive advice services	Yes	No	Computer prompt (to ask risk questions - patient tailored information presented)	NA	1110	12	Unclear
Samore et al 2005	Antibiotic prescribing in RTI	Reduce inappropriate prescribing of antibiotics in RTI	Yes	Yes	Computer prompts (patient specific treatment suggestions).	334	NA	18	Unclear
Sequist et al 2005	Diabetes and coronary artery disease	Improve quality of care for diabetes and coronary artery disease.	Yes	No	Computer prompts (guideline reminders and recommendations for treatment)	194	6748	20	Unclear
Svetkey et al 2009	Hypertension	Reduce blood pressure in patients with hypertension	Yes	No	Computer based guideline education (performance feedback/ patient tools).	32	574	8	Yes
Tamblyn et al 2003	Adverse drug related events in the elderly	Reduce inappropriate prescribing in the elderly and therefore adverse drug related events.	Yes	No	Computer prompts (risk information and alternative treatment advice)	107	NA	1	Unclear
Van Wyk et al 2006	Dyslipidemia	Improve dyslipidemia treatment	Yes	Yes	Computer prompts (risk score and recommendations).	77	87886	38	Yes
Wells et al 2008	Cardiovascular disease	Improve cardiovascular risk management	Yes	Yes	Computer prompts (patient risk score and recommendations)	84	3564	1	Unclear

Chapter 2

Table 3 Studies with no significant effect

Study	Condition	Aim of study	Effective	Effective on all measures?	Intervention summary	Participant number	Patient number	Practice number	Risk of bias score
Bosworth et al 2009	Hypertension (Blood pressure)	Increase BP control in patients with hypertension	No	No	Computer reminders (patient treatment recommendations).	32	588	1	Unclear
Eccles et al 2002	Asthma and angina	Increase adherence to guidelines for asthma and angina care	No	No	Computer prompts (guideline reminder and treatment suggestion)	NA	9811	60	Yes
Hobbs et al 1996	Hyperlipidaemia	Increase use of hyperlipidaemia guidelines	No	No	Computer prompts (reminder to calculate risk-recommendations then presented)	NA	NA	25	Unclear
Montgomery et al 2000	Hypertension	Improve cardiovascular risk outcomes in patients with hypertension	No	No	Computer prompt (To take patient risk information - cardiovascular risk presented to GP).	85	614	27	Yes
Poley et al 2007	Blood test ordering	Encourage appropriate requests for laboratory blood tests in primary care.	No	No	Computer prompt (recommendation of appropriate reasons for blood test request)	109	156	87	Unclear

Chapter 2

Study	Condition	Aim of study	Effective	Effective on all measures?	Intervention summary	Participant number	Patient number	Practice number	Risk of bias score
Rollman et al 2002	Major depression	Improve clinical outcomes for patients with depression	No	No	Computer prompts (reminder of diagnosis and treatment advice and web link to more information)	19	200	1	Unclear
Simon et al 2005	Diabetes and hypertension	Increase adherence to guidelines for diabetes care and hypertension	No	No	Computer reminder of personal audit information	12		14	Unclear
Wilson et al 2006	Inherited breast cancer risk	Encourage appropriate referral of patients who have an elevated genetic risk of breast cancer.	No	No	Computer prompts (reminder of guidelines and patient tools).	346	140	86	Unclear

2.6.6 Factors identified as possible influences of intervention effectiveness:

The review identified four factors which could be examined in order to assess the influence these may have had on the success of the interventions. The factors were identified following close examination of all data presented in each study which could be consistently compared across each interventions. The factors were identified as follows:

- **Risks of non-adherence vs. no risks presented**

This factor had been identified in the literature as a possible influence on the effectiveness of interventions. Close examination of articles revealed that there was sufficient detail to record and categorize the presence of risk information and compare interventions which presented information on the risks of non-adherence to those which did not. (A detailed description of evidence relating to this factor can be found in Chapter 3, which examined research relating to outcomes expectancies from social cognitive theory. This was also summarised in the introduction to this review under the heading 'Outcome expectancies-risk presentation').

- **Simple vs. complex interventions**

This factor was identified from the literature following an examination of evidence relating to behaviour change theory (a full examination of all relevant literature is reported in Chapter 3) which is summarised in the introduction of this review (under the heading 'Complex interventions'). Close examination of articles revealed that there was sufficient detail to record and categorize the presence of a simple or complex interventions and compare the findings of these.

- **Patient tailored vs. patient group specific**

This factor was identified following an examination of the literature related to tailoring in interventions (a summary of which is described in the introduction of this review under the heading 'Tailoring'). Close inspection of articles

revealed that there was sufficient detail to record and categorize the type of tailoring used by each intervention and compare the findings of these.

- **Study design: control group vs. follow-up data**

This factor was identified following a close inspection of the differing methods used in each intervention. Articles were examined closely for any methodological differences which could be compared. It was found that all articles had reported this factor and that it was possible to record and categorize the presentation of either a control group or follow-up data in order to compare the findings across these groups.

2.6.7 Psychological factors: risks of non-adherence vs. no risks presented

Description

The only psychological factor which could be identified within the articles related to the presentation of patient non-adherence risks within the interventions. It was noted that some interventions directly presented participants with information about the risks of non-adherence to the relevant guidelines. This involved the presentation of patient risks for specific health problems in order to encourage practitioner adherence to the recommendations. This was used in both patient tailored and patient group specific interventions, in that a patient's risk of developing particular health problems could be presented either in relation to an individual patient or a group of patients such as those with diabetes.

Totals

In total 19 studies presented information about the risks of non-adherence, and 13 studies did not explicitly present risk information.

Findings

Risk information presented: 84.2% (16) of studies which presented risk information reported a significant effect.

No risk information presented: 61.5% (8) of studies which presented no risk information reported a significant effect. . Findings are presented in tables 4 and 5.

Chi-square comparison: There was no significant association between risk information presented and whether or not the intervention had a significant effect, $\chi^2(1) = 2.12$, $p = 0.14$.

Table 4 Interventions which presented information about risks of non-adherence

Study	Condition	Significant effect	Risk of bias score
Bertoni et al 2009	Cholesterol	Yes	Unclear
Calderon et al 2008	Intimate partner violence in pregnant women	Yes	Unclear
Cho et al 2010	Asthma	Yes	Unclear
Downs et al 2006	Dementia	Yes	Unclear
Emery et al 2007	Cancer	Yes	Yes
Fordis et al 2005	Cholesterol	Yes	Yes
Gance et al 2010	Obesity	Yes	Unclear
Gill et al 2011	Gastro-intestinal complications in patients on NSAIDS medication.	Yes	Unclear
Grant et al 2003	Diabetes (type 2)	Yes	Unclear
Hicks et al 2008	Hypertension	Yes	Unclear
Hobbs et al 1996	Hyperlipidaemia	No	Unclear
Holbrook et al 2009	Diabetes	Yes	Yes
Montgomery et al 2000	Hypertension	No	Yes
Nagykaldi et al 2007 a	Childhood vaccinations and 3 preventive advice services	Yes	Unclear
Nagykaldi et al 2007 b	Childhood and adult vaccinations and 4 preventive advice services	Yes	Unclear
Tamblyn et al 2003	Adverse drug related events in the elderly	Yes	Unclear
Van Wyk et al 2006	Dyslipidemia	Yes	Yes
Wells et al 2008	Cardiovascular disease	Yes	Unclear
Wilson et al 2006	Inherited breast cancer risk	No	Unclear

Table 5 Interventions which did not present information about risks of non-adherence

Study	Condition	Significant effect	Risk of bias score
Bell et al 2010	Asthma care	Yes	Unclear
Bosworth et al 2009	Hypertension (Blood pressure)	No	Unclear
Cleveringa et al et al 2008	Diabetes	Yes	Unclear
Eccles et al 2002	Asthma and angina	No	Yes
Fiks et al 2007	Immunization in children	Yes	Unclear
Fox et al 2008	Kidney disease	Yes	Unclear
Maclean et al 2009	Diabetes	Yes	Unclear
Poley et al 2007	Blood test ordering	No	Unclear
Rollman et al 2002	Major depression	No	Unclear
Samore et al 2005	Antibiotic prescribing in RTI	Yes	Unclear
Sequist et al 2005	Diabetes and coronary artery disease	Yes	Unclear
Simon et al 2005	Diabetes and hypertension	No	Unclear
Svetkey et al et al 2009	Hypertension	Yes	Yes

2.6.8 Style: Simple vs. Complex interventions

Description

A simple intervention refers to the presentation of recommendations which can include: a reminder of the guideline and advice on guideline related actions to be conducted. A mixed intervention refers to the guideline related recommendations being presented with a number of additional components which can include: guideline education (e.g. online presentations, information documentation, and instructional activities to complete), audit or performance feedback, and tools such as printable documents or patient information sheets.

Totals

In total 18 studies used complex interventions and 14 used simple interventions.

Findings

Complex interventions: 83% (15) of studies which used a complex intervention reported a significant effect.

Simple interventions: 64% (9) of studies which used a simple intervention reported a significant effect. Findings are presented in tables 6 and 7.

Chi-square comparison: There was no significant association between intervention style and whether or not the intervention had a significant effect, $\chi^2(1) = 1.52$, $p = 0.21$.

Table 6 Studies which used complex interventions

Study	Condition	Significant effect	Risk of bias score
Bell et al 2010	Asthma care	Yes	Unclear
Bertoni et al 2009	Cholesterol	Yes	Unclear
Cleveringa et al et al 2008	Diabetes	Yes	Unclear
Emery et al 2007	Cancer	Yes	Yes
Fordis et al 2005	Cholesterol	Yes	Yes
Fox et al 2008	Kidney disease	Yes	Unclear
Gance et al 2010	Obesity	Yes	Unclear
Gill et al 2011	Gastro-intestinal complications in patients on NSAIDS medication.	Yes	Unclear
Hicks et al 2008	Hypertension	Yes	Unclear
Holbrook et al 2009	Diabetes	Yes	Yes
Maclean et al 2009	Diabetes	Yes	Unclear
Rollman et al 2002	Major depression	No	Unclear
Samore et al 2005	Antibiotic prescribing in RTI	Yes	Unclear
Sequist et al 2005	Diabetes and coronary artery disease	Yes	Unclear
Simon et al 2005	Diabetes and hypertension	No	Unclear
Svetkey et al et al 2009	Hypertension	Yes	Yes
Wells et al 2008	Cardiovascular disease	Yes	Unclear
Wilson et al 2006	Inherited breast cancer risk	No	Unclear

Table 7 Studies which used simple interventions

Study	Condition	Significant effect	Risk of bias score
Bosworth et al 2009	Hypertension (Blood pressure)	No	Unclear
Calderon et al 2008	Intimate partner violence in pregnant women	Yes	Unclear
Cho et al 2010	Asthma	Yes	Unclear
Downs et al 2006	Dementia	Yes	Unclear
Eccles et al 2002	Asthma and angina	No	Yes
Fiks et al 2007	Immunization in children	Yes	Unclear
Grant et al 2003	Diabetes (type 2)	Yes	Unclear
Hobbs et al 1996	Hyperlipidaemia	No	Unclear
Montgomery et al 2000	Hypertension	No	Yes
Nagykaldi et al 2007 a	Childhood vaccinations and 3 preventive advice services	Yes	Unclear
Nagykaldi et al 2007 b	Childhood and adult vaccinations and 4 preventive advice services	Yes	Unclear
Poley et al 2007	Blood test ordering	No	Unclear
Tamblyn et al 2003	Adverse drug related events in the elderly	Yes	Unclear
Van Wyk et al 2006	Dyslipidemia	Yes	Yes

2.6.9 Tailoring: Patient tailored vs. Patient group specific

Description

Patient tailored advice refers to the use of recommendations which were specific to an individual patient's needs (such as cardiovascular risk score and advice), whereas patient group specific advice refers to recommendations which are relevant to a particular disease or condition (such as diabetes).

Totals

In the reviewed articles, 17 interventions were patient tailored and 15 were patient group specific.

Findings

Patient tailored: 76% (13) of studies which provided patient tailored advice reported a significant effect.

Patient group specific: 73% (11) of studies which provided patient group specific advice reported a significant effect. Findings are presented in tables 8 and 9.

Chi-square comparison: There was no significant association between intervention tailoring style and whether or not the intervention had a significant effect, $\chi^2(1) = 0.42$, $p = 0.84$.

Table 8 Studies which used patient tailored advice

Study	Condition	Significant effect	Risk of bias score
Bertoni et al 2009	Cholesterol	Yes	Unclear
Bosworth et al 2009	Hypertension (Blood pressure)	No	Unclear
Cho et al 2010	Asthma	Yes	Unclear
Cleveringa et al et al 2008	Diabetes	Yes	Unclear
Eccles et al 2002	Asthma and angina	No	Yes
Emery et al 2007	Cancer	Yes	Yes
Fox et al 2008	Kidney disease	Yes	Unclear
Gance et al 2010	Obesity	Yes	Unclear
Hicks et al 2008	Hypertension	Yes	Unclear
Holbrook et al 2009	Diabetes	Yes	Yes
Maclean et al 2009	Diabetes	Yes	Unclear
Montgomery et al 2000	Hypertension	No	Yes
Nagykaldi et al 2007 a	Childhood vaccinations and 3 preventive advice services	Yes	Unclear
Nagykaldi et al 2007 b	Childhood and adult vaccinations and 4 preventive advice services	Yes	Unclear
Rollman et al 2002	Major depression	No	Unclear
Samore et al 2005	Antibiotic prescribing in RTI	Yes	Unclear
Wells et al 2008	Cardiovascular disease	Yes	Unclear

Table 9 Studies which used patient group specific advice

Study	Condition	Significant effect	Risk of bias score
Bell et al 2010	Asthma care	Yes	Unclear
Calderon et al 2008	Intimate partner violence in pregnant women	Yes	Unclear
Downs et al 2006	Dementia	Yes	Unclear
Fiks et al 2007	Immunization in children	Yes	Unclear
Fordis et al 2005	Cholesterol	Yes	Yes
Gill et al 2011	Gastro-intestinal complications in patients on NSAIDS medication.	Yes	Unclear
Grant et al 2003	Diabetes (type 2)	Yes	Unclear
Hobbs et al 1996	Hyperlipidaemia	No	Unclear
Poley et al 2007	Blood test ordering	No	Unclear
Sequist et al 2005	Diabetes and coronary artery disease	Yes	Unclear
Simon et al 2005	Diabetes and hypertension	No	Unclear
Svetkey et al et al 2009	Hypertension	Yes	Yes
Tamblyn et al 2003	Adverse drug related events in the elderly	Yes	Unclear
Van Wyk et al 2006	Dyslipidemia	Yes	Yes
Wilson et al 2006	Inherited breast cancer risk	No	Unclear

2.6.10 Study design: Control group vs. Follow-up data

Description

In order to investigate the effect of the intervention, some studies reported data between the control group and the intervention group whilst 10 studies reported baseline to follow-up data obtained after the intervention had ended.

Totals

23 studies reported control group data, whilst 10 studies reported baseline to follow-up data.

Findings

Control group data: 73% (17) of studies which used control group data reported a significant effect.

Follow-up data: 80% (8) of studies which used follow-up data reported a significant effect. Findings are presented in tables 10 and 11.

Chi-square comparison: There was no significant association between intervention study design and whether or not the intervention had a significant effect, $\chi^2(1) = 0.19$, $p = 0.66$.

Table 10 Studies which used control group comparison data

Study	Condition	Significant effect	Risk of bias score
Bell et al 2010	Asthma care	Yes	Unclear
Bertoni et al 2009	Cholesterol	Yes	Unclear
Bosworth et al 2009	Hypertension (Blood pressure)	No	Unclear
Calderon et al 2008		Yes	Unclear
	Intimate partner violence in pregnant women		
Cleveringa et al et al 2008	Diabetes	Yes	Unclear
Downs et al 2006	Dementia	Yes	Unclear
Emery et al 2007	Cancer	Yes	Yes
Fordis et al 2005	Cholesterol	Yes	Yes
Gill et al 2011	Gastro-intestinal complications in patients on NSAIDS medication.	Yes	Unclear
Grant et al 2003	Diabetes (type 2)	Yes	Unclear
Hicks et al 2008	Hypertension	Yes	Unclear
Hobbs et al 1996	Hyperlipidaemia	No	Unclear
Holbrook et al 2009	Diabetes	Yes	Yes
Macleane et al 2009	Diabetes	Yes	Unclear
Montgomery et al 2000	Hypertension	No	Yes
Poley et al 2007	Blood test ordering	No	Unclear
Rollman et al 2002	Major depression	No	Unclear
Samore et al 2005	Antibiotic prescribing in RTI	Yes	Unclear
Sequist et al 2005	Diabetes and coronary artery disease	Yes	Unclear
Svetkey et al et al 2009	Hypertension	Yes	Yes
Tamblyn et al 2003	Adverse drug related events in the elderly	Yes	Unclear
Van Wyk et al 2006	Dyslipidemia	Yes	Yes
Wilson et al 2006	Inherited breast cancer risk	No	Unclear

Table 11 Studies which included follow-up data comparison

Study	Condition	Significant effect	Risk of bias score
Bertoni et al 2009	Cholesterol	Yes	Unclear
Cho et al 2010	Asthma	Yes	Unclear
Eccles et al 2002	Asthma and angina	No	Yes
Fiks et al 2007	Immunization in children	Yes	Unclear
Fox et al 2008	Kidney disease	Yes	Unclear
Gance et al 2010	Obesity	Yes	Unclear
Nagykaldi et al 2007 a	Childhood vaccinations and 3 preventive advice services	Yes	Unclear
Nagykaldi et al 2007 b	Childhood and adult vaccinations and 4 preventive advice services	Yes	Unclear
Simon et al 2005	Diabetes and hypertension	No	Unclear
Wells et al 2008	Cardiovascular disease	Yes	Unclear

2.7 Discussion

The systematic review identified 31 studies which met the eligibility criteria and had used computer-delivered interventions to promote the implementation of guidelines in primary care. Of all the interventions identified, 75% reported a significant effect on at least one outcome measure. However, only 21% of the studies reported a significant effect on all outcome measures. This finding suggests that computer-delivered interventions may be of some benefit for promoting the use of guidelines in primary care; however no strong conclusions can be drawn from these results alone. A closer examination of factors which may moderate the success of interventions was also conducted.

2.7.1 Psychological theory- the role of risk presentation

In order to investigate the role of psychological theory in relation to the effectiveness of computer-delivered interventions, the presentation of patient risk information was examined. Specifically, interventions which presented information on patient risk (relating to a patients risk of developing a health

problem) were compared to interventions which did not present this information. Interventions which presented patient risk information reported a significant effect in 84% of studies (a significant effect across all outcome measures was reported in 31% of studies) whereas interventions which did not present risk information reported a significant effect in 61% of studies (a significant effect across all outcome measures was reported in 25% of studies).

Although no significant difference was identified, this trend suggests that presenting information relating to a patient's risk of developing future health problems may be beneficial in promoting the use of guidelines in primary care. Furthermore, the finding suggests that presenting specific information to influence an individual's outcome expectations of what may result from following a guideline (such as lowering a patient's risk of disease) may increase guideline adherence in primary care. This therefore supports the construct of outcome expectancies from social cognitive theory (Bandura 1977), and the possible application of the theory in intervention development.

However, patient risk presentation only relates to one aspect of the possible outcomes which may result from guideline adherence and it is likely that outcome expectancies relating to additional factors may also influence an individual's decision to follow a guideline. Additional factors involving outcome expectancies which have been reported as influencing guideline adherence in primary care include: concerns about time limitations, health authority targets, and perceived patient pressure (Eccles et al., 2007, Hrisos et al., 2008, Little et al., 1997). In addition, alternative psychological theories also describe constructs with similar attributes to that of outcome expectancies, in that they emphasise the importance of perceived future consequences on an individual's decision to engage in a task. These constructs include attitude from the theory of planned behaviour (Ajzen, 1991) and anticipated consequences from operant learning theory (Skinner, 1950; Blackman & Fontana, 1984). These theories are discussed in detail in Chapter 3 of this thesis.

Overall, the findings suggest that interventions which present information relating to a patient's risk of developing medical problems may assist in promoting adherence to guidelines in primary care. In addition, the findings support some aspects of the construct of outcome expectancies from social cognitive theory, which also suggests that adherence could be further improved if interventions presented information on a wider range of outcome expectations relating to a specific guideline. However, it is important to note that as only a small sample of studies were identified and included in each group, this finding can only reflect a suggestive trend in the results and no strong conclusions can be drawn.

2.7.2 Complex interventions

A further examination of intervention content compared interventions which had used a simple design to those which had used a complex technique. Simple interventions presented only the guideline or recommendation, whereas complex interventions included a number of components in addition to this such as: education (presentations, activities etc), interactive tools (e.g. patient information sheets) and performance feedback. Interventions which used a complex design reported a significant effect in 83% of studies (a significant effect across all measures in 27% of studies) whereas interventions which used a simple design reported a significant effect in 64% of studies (a significant effect across all outcome measures was reported in 28% of studies).

Although no significant difference was identified, this trend suggests that using a complex intervention may be more beneficial in promoting the use of guidelines in primary care than interventions which use only a simple presentation of guideline recommendations. Complex interventions may be more effective as the techniques may relate more closely to behaviour change theory, in that the use of a wider range of components are likely to include theoretical constructs. For example, in relation to social cognitive theory, an intervention which includes a page with evidence supporting the guideline may

influence 'outcome expectancies', a monthly update on practitioners performance may increase 'self-efficacy' and the provision of tools such as patient information sheets may provide an optimum environment for behaviour change according to the theory. In contrast, a simple presentation of the guidelines does not provide an opportunity for the intervention to deeply engage with the individual. In addition, this finding has also been reported by a similar review in the area which found that GPs were more likely to adhere to guidelines for antibiotic prescribing in respiratory tract infection, if the intervention promoting them consisted of a variety of features (Arnold et al., 2005).

However, although the findings suggest that using a complex technique may be beneficial, they do not provide any indication as to which factors may specifically promote guideline adherence. Furthermore, during the analysis of studies included in the review, it was often difficult to identify the exact nature of which factors were being used in an intervention due to unclear descriptions and the use of many features within a single intervention. Therefore, more detailed analysis of features was not possible. Despite a lack of description, many interventions did include a strong aspect of practitioner education within their designs. The education appeared to take many forms (such as seminars at the beginning of the study, documentation, or education embedded within the computer intervention) but was not always explicitly described by the study. It is therefore possible that the inclusion of guideline related education may have had an impact on the success of the intervention. Further investigation of this factor and the format in which it is delivered within an intervention of this nature should be further investigated.

Therefore, the results indicate that complex interventions may be of more benefit in promoting the use of guidelines in primary care than simple interventions which present only guideline recommendations. However, the findings are not conclusive and specific factors which may be of most benefit cannot be identified by these findings.

2.7.3 Tailoring

In relation to the advice provided by the interventions, the review also compared the effectiveness of interventions which were patient tailored to those which were patient group specific. Patient tailored interventions provided advice which was relevant to a specific patient (e.g. based on a cardiovascular risk score), whereas patient group advice provides information which is relevant to a wider group of patients with a particular condition (e.g. diabetes). Interventions which used patient tailored advice reported a significant effect in 76% of studies (a significant effect across all outcome measures was reported in 17% of studies). Interventions which provided patient group specific advice reported a significant effect in 73% of studies (a significant effect across all outcome measures was reported in 26% of studies). Furthermore no significant difference was identified between the success rates of these intervention types.

This finding was unexpected, as it was predicted that interventions which provided patient tailored advice would be more effective in promoting guidelines than those which used patient group specific information. This assumption was based on the fact that patient tailored interventions would be of increased relevance to the healthcare professional during a consultation as all information presented is relevant to the patient being seen. However, this finding may be explained by the widely varying content of information presented in the interventions which were patient group specific. Some interventions defined a patient group by a set of values which would be highly relevant to most patients who met these criteria during a consultation. For example, presenting recommendations for blood glucose levels in patients with diabetes is highly relevant to this group of patients as they all have the disease and must monitor this value regularly (Simon & Soumerai, 2005). In contrast, some studies define a patient group in much broader terms, such as presenting advice relating to dementia during all consultations with elderly patients (Downs et al., 2006). Therefore, it is possible that interventions which present advice that is as specific as possible to the patient being seen (which

can be in the form of patient group information) may be more beneficial than interventions which present advice to a broadly defined patient group. However, closer examination of the intervention content of studies identified in the review was not possible, as clear descriptions of exactly which patients were triggering advice to be presented was often not clear.

Therefore further research should aim to compare interventions which present advice when specific and closely defined patient groups consult, to interventions in which recommendations are presented to larger and more broadly defined patient groups (such as the elderly).

2.7.4 Control group comparisons

In addition to examining possible moderators of effectiveness which had been identified from the literature, studies were also analysed to identify further methodological differences which may influence the success of an intervention. It was noted that the studies had presented two main types of data comparison in order to evaluate the effectiveness of an intervention. Each study compared either control group and intervention group data or baseline and follow-up data (where measures were recorded before the intervention began and then at the end date of the study). The review compared these two techniques and found that studies which used a control group comparison reported a significant effect in 73% of interventions (a significant effect across all outcome measures was reported in 17% of studies) whereas studies which used follow-up data reported a significant effect in 80% of interventions (a significant effect was reported in 30% of studies). Although no significant difference was identified, this trend indicates that there was a slightly higher success rate in studies which presented follow-up data for analysis than those which used a control group.

Studies which used a control group may be expected to display a lower success rate as this method is considered as more stringent in that it aims to prevent effects which may occur simply due to a study taking place. In a study with no control group, participants may change their behaviour simply because they are aware of a study being conducted (e.g. that a study aims to increase use of a particular primary care guideline), whereas the use of a control group aims to ensure that any effect is due to the presence of the intervention only (as both groups are aware of the study). However, it was noted that studies which used a control group often provided this group with facilities which they would not have received under a natural practice setting. For example, in some studies the control group were provided with a paper version of the guidelines and an education session (Emery et al., 2007), both of which would not have been standard practice. This type of procedure could lead to increased guideline use in the control group due to the guideline reminder and education they have been provided with, as both of these factors have previously been associated with increasing guideline adherence (Arnold et al., 2005). Therefore, an increase in guideline use in the control group could lead to a smaller effect size being identified between control and intervention groups, which could result in an incorrect conclusion that an intervention was not effective.

Overall, the review found that studies which used a follow-up data comparison were slightly more effective than those which used a control group comparison. Although there was not a large difference in the effectiveness of interventions used across these techniques, it is possible that there was a lower success rate reported in the control group comparison studies due to the extra components and facilities which this group is often provided with. Future research using a control group comparison to determine the effectiveness of an intervention in this area should aim to ensure that the setting remains as natural as possible and limit the amount of additional facilities or tools which are provided to this group.

2.7.5 Limitations

The review identified the potential effectiveness and moderators of computer-delivered interventions to promote the implementation of guidelines in primary care; however, there were a number of limitations to the review's findings. Firstly, the review identified a relatively small number of studies (31 papers) from which to draw conclusions. The main reason for this was the highly specific nature of the review area and inclusion criteria. Studies were only included in the review if the intervention was computer-delivered, promoted guidelines and occurred in a primary care setting. If papers had been included from all healthcare settings it is likely that many more studies would have been identified. For example, a review of computerised decision support across health settings identified 100 papers in 2005 (Garg et al., 2005). However, an analysis of interventions within primary care only was essential to determine the benefit of this intervention technique within this environment. In addition, the present review found a similar intervention success rate to that of a previous review which occurred across health settings and included a larger number of studies (Garg et al 2005). This suggests that the benefit of computer-delivered interventions in promoting the implementation of guidelines may be similar across health settings.

A further limitation of the review was the relatively low number of studies which reported a significant effect across all outcome measures (21%). This may be linked to the fact that some studies included a large number of outcome variables in order to identify the way in which an intervention can improve practitioner performance and patient health (Gance-Cleveland, Gilbert, Kopanos, & Gilbert, 2010). However, if the target guidelines are examined closely it is possible that some studies may have included outcome variables which could not be significantly improved even if the intervention resulted in a significant increase in guideline adherence. Therefore in assessing an individual intervention, the potential benefits of the guideline should be taken into consideration, in addition to the effect the intervention may have had on the outcome variables recorded. Interventions which did not significantly improve all outcome measures may still be of benefit if some outcomes were improved during a study.

Another potential limitation of the review was the fact that a wide variety of guidelines referring to an array of conditions and clinical recommendations were assessed together. For example, guidelines used in the interventions included recommendations for conditions such as: obesity (Gance-Cleveland et al., 2010), diabetes (Bosworth et al., 2009), cancer (Wilson et al., 2006) and dementia (Downs et al., 2006). However, it is possible that factors which influence a healthcare professional to adhere to guidelines for less severe conditions such as obesity may be different to factors which influence recommendations for more urgently life threatening conditions such as cancer.

In addition, computer-delivered interventions may be of differing levels of benefit across different types of guideline. It was however, difficult to identify specific guideline types to compare in the review as it was noted that if interventions were grouped according to the medical condition of the guideline, a vast array of recommendation types were grouped in the same category (e.g. prescribing, screening, disease management). In this grouping, although the medical condition may be the same, the behaviours required by the guideline may be very different, such as screening for diabetes or prescribing a specific medication for the condition. However, if interventions were grouped according to the recommendation type (e.g. prescribing, prevention etc) a wide array of medical conditions would be grouped within one category, such as prescribing recommendations for conditions which could include sinusitis, depression or dementia, all of which may have led to differing results. Furthermore, interventions within a study often targeted more than one condition or type of recommendation which also made grouping together the interventions problematic. However, the findings of this review can be assessed in relation to purely a primary care setting which was not possible with previous reviews in the area (e.g. Hesselmans et al 2009, Garg et al 2005, Shifman et al 1999).

2.7.6 Conclusions

In summary, the review found that computer-delivered interventions to promote the implementation of guidelines in primary care may be an effective technique. Interventions which presented information relating to a patient's risk of developing a medical condition were more effective than those which did not (considering additional practitioner outcome expectancies associated with a guideline may also be beneficial). Interventions which used a complex design (and contained a variety of features) were more beneficial than those which used a simple presentation of guideline recommendations (however, it is not clear which components may be most beneficial). There was little difference between the effectiveness of interventions which provided patient tailored advice to those which used patient group specific advice (although it is likely that patient group specific advice should relate to a small and specific category of individuals). Studies which used baseline and follow-up data in order to assess the benefit of an intervention were more likely to be effective than those which used a control group comparison (however, control groups were often exposed to additional facilities which may have influenced findings). However, as only a small sample of studies were identified and included in each group comparison, these findings can only reflect suggestive trends in the results and no strong conclusions can be drawn.

Therefore, the findings of the review suggest that computer-delivered interventions to promote the implementation of guidelines in primary care can be an effective method. An intervention may be most effective if it presents information on a patient's risk of developing a condition and uses a design which includes a variety of features (and not just a simple presentation of guidelines). However, due to the limited number of studies included in the sample, further research is needed to confirm and explore the trends identified in this review.

Following this systematic review, a close examination of behaviour change theory in relation to the behaviour of healthcare professionals was conducted and is discussed in the next chapter.

3. Chapter three: The use of behaviour change theory in relation to healthcare professionals' adherence to guidelines

3.1 Chapter overview

In order to identify appropriate theoretical components to include in the development of the computer-delivered intervention described in this thesis (McDermott et al., 2010), a literature search of research which had applied behaviour change theory in relation to healthcare professionals was conducted. Due to time restrictions for the completion of the intervention development study (which was to be used in a trial) a brief examination of the literature was initially conducted. Following the intervention development, a more detailed search and examination of the literature later took place. This subsequent literature search both confirmed the findings which had been used for the development study and provided additional factors which could be used to inform future interventions in the area.

3.2 Introduction

Research involving healthcare professionals and behaviour change theory was examined in order to identify any components which could be used in the intervention to increase general practitioners' (GPs) adherence to guidelines in primary care. As the intervention study was related to guidelines for antibiotic prescribing in respiratory tract infection (RTI) and the prevention of secondary stroke, research relating to both prescribing and preventative healthcare behaviours were identified. Studies in this area involved a wide range of research methods and outcome measures which included: theory based questionnaires, recorded clinical data (e.g. prescribing rates), self-reported intention to adhere, self-reported adherence to guidelines, reports from

qualitative interview studies, and anticipated adherence in scenarios which simulate a consultation.

Following a review of the relevant evidence, three components from social cognitive theory (Bandura, 1977) were selected to inform the intervention development. The theoretical constructs used in the study design were: self-efficacy, outcome expectancies and environment. The selection of these factors and evidence relating to the constructs is discussed below. In addition, components from a number of alternative theories were also considered and evidence relating to these is also discussed. Additional theories considered for use in the intervention included: the theory of planned behaviour (Ajzen, 1991), operant learning theory (Skinner, 1950; Blackman, 1974), implementation intention theory (Gollwitzer, 1993), self-regulation theory (Leventhal & Cameron, 1987), self-perception theory (Bem, 1973) and the elaboration likelihood model (Petty & Cacioppo, 1986). In addition, a further theory was implicated in the findings from the qualitative development study (Chapter 4) which had not initially been reviewed or considered for inclusion in the intervention. GPs reported views which appeared to be consistent with self-determination theory (Deci & Ryan, 1980) in relation to their decision to adhere to guidelines. This theory was not originally included in the review for use in the intervention as it has not been widely or directly researched in relation to the behaviour of healthcare professionals. However, aspects of the theory which were supported in the qualitative study findings and in research relating to adherence in alternative settings (e.g. health behaviours and chronic disease management) are discussed.

Therefore, the following Chapter refers to research involving the behaviour of healthcare professionals in relation to: the constructs from social cognitive theory which were selected for the intervention development (self-efficacy, outcome expectancies and environment); the alternative theories which were considered for the intervention; and self-determination theory.

3.3 Social cognitive theory

Social cognitive theory (Bandura, 1977) proposes a model which attempts to explain the way in which individuals acquire and maintain patterns of behaviour. The model consists of three major components which constantly interact with one another to influence an individual's decision to engage in a behaviour. The key three components of the model include: personal factors (e.g. cognitive, affective, and biological), the environment (e.g. social and physical), and behaviour. These three constructs of the model are continually interacting and the influence each factor exerts on behaviour can differ across situations. Social cognitive theory also argues that self-efficacy (the belief in one's ability to succeed in a task) is one of the most important influences on an individual's decision to engage in a behaviour. The theory also suggests that an individual's outcome expectancies relating to the result of conducting a specific activity act as a major influence on the decision to engage in a task. Finally, the conditions provided by the environment also strongly influence the decision to act. If the environment provides an optimum social and physical situation, an individual can be encouraged to conduct a particular behaviour. Specifically, the theoretical constructs of self-efficacy, outcome expectancies, and environment have all been associated with the behaviour of healthcare professionals.

3.3.1 Self-efficacy

Social cognitive theory (Bandura, 1977) proposes that self-efficacy beliefs closely relate to the motivation to engage in a behaviour. Perceived self-efficacy refers to an individual's beliefs in their ability to conduct a specific behaviour. The self-efficacy belief system is not a global trait and a set of specific self-beliefs exist for distinct areas of behaviour. An individual's perceived self-efficacy exerts its influence on behaviour through four major routes which include cognitive, motivational, affective, and selection processes (Bandura, 1993). According to the theory, individuals with high self-efficacy for a task are said to be more likely to perform the behaviour. In a healthcare setting, self-efficacy could refer to a GP's belief in their ability to reduce

antibiotic prescribing for RTI by overcoming perceived barriers to this task, such as a patient's demand to be prescribed antibiotics. A GP with high self-efficacy for this task would believe in their ability to deal with patient concerns and demand for the antibiotics and successfully not prescribe.

Self-efficacy has been significantly associated with healthcare professionals' intention to adhere to clinical guidelines. In particular, GPs who report high levels of self-efficacy for conducting a guideline related task are more likely to report a strong intention to adhere to these guidelines. For example, self-efficacy has predicted GPs' intention to adhere to antibiotic prescribing guidelines for RTI (Hrisos et al., 2008; Eccles et al., 2007). Self-efficacy has also predicted practitioners' intention to adhere to preventative healthcare guidelines which include; providing smoking cessation advice (Hoving et al., 2007), radiological recommendations (Bonetti et al., 2005), preventative health treatments (Bonetti et al., 2010) and patient education (Ten Wolde, Dijkstra, Van Empelen, Knuistingh Neven, & Zitman, 2008).

Self-efficacy has also been related to self-reported adherence to clinical guidelines across healthcare fields. GPs who report high levels of self-efficacy for conducting guideline related tasks also report high levels of adherence to clinical guidelines in practice. Self-reported adherence to guidelines has been associated with GPs' self-efficacy in a wide range of healthcare areas which include; smoking cessation (O'Loughlin et al., 2001), breast feeding recommendations (Burglehaus, Smith, Sheps, & Green, 1997), assessment of depression in general practice (Main, Lutz, Barrett, Matthew, & Miller, 1993), and patient lifestyle recommendations (Hyman, Maibach, Flora, & Fortmann, 1992). In addition to self-reported adherence in clinical practice, self-efficacy has also been related to self-reported adherence to guidelines in tasks which simulate a consultation. Specifically, GPs who reported high self-efficacy scores for conducting a guideline related task were more likely to adhere to the guideline in tasks which recreate a clinical scenario. For example, self-efficacy has predicted adherence to guidelines in consultation simulation tasks which include antibiotic prescribing in RTI (Hrisos et al., 2008; Eccles et al., 2007),

primary care x-ray requests (Bonetti et al., 2005), and preventative medical and dental treatments (Bonetti et al., 2010; Bonetti et al., 2006).

In addition, self-efficacy has also been reported by healthcare professionals as a factor which directly influences their decision to adhere to guidelines. Specifically, GPs have reported that confidence in their ability to successfully adhere to a guideline related task acts as an important influence on how they decide to respond to guidelines. In particular, GPs have reported that if they are confident in their ability to perform a guideline related behaviour, they will be more likely to adhere to the guidelines. This finding has been reported in relation to a variety of healthcare guidelines which include, nutrition advice and information provision (Visser et al., 2008), prevention and treatment of obesity (Miller Perrin et al., 2005), fertility recommendations (Haagen et al., 2005), smoking cessation advice (Vogt et al., 2005) and communication in cancer care (Wilkinson, 1991).

Most importantly, self-efficacy beliefs have also been related to GPs' recorded clinical behaviour in practice. Specifically, GPs who report high self-efficacy scores for a guideline recommended task are likely to display high rates of adherence to the guideline in clinical data, such as the rates of a medication being prescribed. This finding has been demonstrated across healthcare settings. For example, GPs who reported high self-efficacy in their ability to adhere to antibiotic prescribing guidelines for RTI were more likely to demonstrate evidence of this adherence in relation to prescribing rates when clinical data was examined (Eccles et al., 2007). A review of various healthcare professionals' behaviour found that reported self-efficacy for conducting a guideline task was significantly associated with clinical adherence to the guideline (Cabana et al., 1999). A further review, which recorded healthcare professionals behaviour across a wide range of settings, identified a concept labelled as 'beliefs about capabilities' (Michie et al., 2005) which encompassed the varying terms used for self-efficacy beliefs across studies. The review concluded that these self-efficacy beliefs were one of the factors most consistently associated with behaviour and adherence to guidelines in a healthcare setting. Specifically, healthcare professionals who had stronger

beliefs in their ability to engage in a behaviour were more likely to adhere to it in a clinical setting (Godin et al., 2008).

Therefore, the construct of self-efficacy has been associated with healthcare professionals' adherence to clinical guidelines. However, much evidence in support of this construct relates to outcome measures which are not directly comparable to recorded clinical behaviour in practice. For example, evidence supporting the importance of self-efficacy has often reported GPs' intention to adhere, self-reported adherence, and adherence in simulation tasks relating to a clinical consultation. Moreover, GPs' descriptive self-reports of factors (such as self-efficacy) which they believe influence their decision to adhere to a guideline may not reflect their behaviour in practice. Despite this, a number of studies have reported that recorded clinical behaviour within a practice setting has been significantly associated with GPs' self-efficacy. In addition, review evidence has also suggested that self-efficacy is related to clinical behaviour (Cabana et al., 1999), with a recent review concluding that self-efficacy is one of the most important predictors of healthcare professionals' behaviour (Godin et al., 2008). In conclusion, evidence relating to a variety of outcome measures, including self-reports and recorded clinical behaviour, has suggested that self-efficacy is associated with the behaviour of healthcare professionals. Self-efficacy was therefore included in the intervention development as a construct to assist in encouraging adherence to clinical guidelines.

3.3.2 Outcome expectancies

Social cognitive theory proposes that outcome expectancies influence the decision to conduct a behaviour. Outcome expectancies refer to an individual's beliefs that engaging in a behaviour will directly result in specific outcomes. These expectancies influence an individual's motivation to perform a behaviour, with negative outcome expectancies resulting in an individual being less likely to engage in a specific behaviour, and positive expectancies

predicting a stronger likelihood that a behaviour will be engaged in. In a healthcare setting, this could refer to a GP being likely to adhere to antibiotic prescribing guidelines for RTI if they believe this will result in positive outcomes such as reducing the problem of antibiotic resistant infections. In contrast, a GP may be less likely to adhere to these guidelines if they believe there will be negative outcomes such as increasing a patient's risk of developing further clinical complications if antibiotics are not prescribed.

Outcome expectancies have been related to practitioners' self-reported intention to adhere to clinical guidelines in various healthcare settings. For example, GPs' intention to appropriately educate patients about medication side effects has been related to both positive and negative outcome expectancies (Ten Wolde et al., 2008). Negative outcomes included the belief that the behaviour would be time consuming for the GP, and positive outcomes included the belief that the patient would directly benefit from receiving the additional information. Outcome expectancies have also been significantly associated with practitioners' intention to adhere to a variety of healthcare guidelines including: the recommendation of radiographs (Bonetti et al., 2006), smoking cessation (Vogt et al., 2005; Vogt, Hall, & Marteau, 2007; Vogt, Hall, & Marteau, 2006), and preventative dental treatment (Bonetti et al., 2010). In addition, a systematic review which included a wide variety of healthcare settings concluded that beliefs relating to the consequences of engaging in a behaviour significantly predicted practitioners' intention to conduct a behaviour (Godin et al., 2008).

Outcome expectancies have also been highlighted as influencing self-reported adherence to clinical guidelines. For example, outcome expectancies have predicted self-reported guideline adherence in relation to smoking cessation ((Vogt et al., 2005; Vogt et al., 2007; Vogt et al., 2006; Clasper & White, 1995), preventative dental care (Bonetti et al., 2010), and communication of information to cancer patients (Travado et al., 2005). In relation to antibiotic prescribing guidelines for RTI, outcome expectancies have also been found to predict both GP intention to adhere and self-reported adherence to guidelines (Eccles et al., 2007; Hrisos et al., 2008). Most importantly, a review of

behaviour across contrasting healthcare settings also concluded that beliefs relating to the consequences of a behaviour predicted recorded clinical behaviour in practice (Godin et al., 2008).

GPs have also reported specific outcome expectancies which they believe influence their decision of whether to adhere to guidelines. Negative outcome expectancies which GPs have reported as making adherence to guidelines difficult include beliefs that the behaviour will be ineffective, unpleasant for the GP, and result in emotional distress for the patient (Travado et al., 2005; Vogt et al., 2005; Clasper et al., 1995). Positive outcome expectancies which GPs have reported as factors which encourage them to adhere to guidelines include beliefs that the behaviour will result in a benefit to patients, and a belief that the GP will feel a sense of accomplishment for conducting the behaviour (Travado et al., 2005). A systematic review has also concluded that outcome expectancies influence practitioners' self-reported clinical behaviour (Vogt et al., 2005).

Outcome expectancies specifically relating to the doctor-patient relationship have been consistently identified as an important influence on GPs' decision to engage in a behaviour. For example, GPs' perception of patient pressure in the consultation has been found to significantly influence the decision to adhere to the prescribing guidelines for RTI (Little et al., 2004). If the GP believes that the patient strongly expects a prescription of antibiotics they are more likely to prescribe in order to avoid the negative outcome of the patient being dissatisfied with the consultation. Outcome expectancies relating to the practitioner relationship with the patient have also been found to influence healthcare professionals' decision to provide patients with full information about medication prescribed. GPs reported being less likely to provide patients with information on medication side-effects if they believed that this would have a negative impact on the doctor-patient relationship (Ten Wolde et al., 2008). This belief has also been reported in preventative healthcare behaviours such as providing the recommended smoking cessation advice to patients. GPs reported that they were often prevented from providing advice about smoking cessation as they believed it may have an adverse effect on

their relationship with the patient (McLeod, Somasundaram, Howden-Chapman, & Dowell, 2000).

In addition, qualitative interview studies have also identified outcome expectancies which GPs report as influencing their decision to adhere to a guideline. For example, outcome expectancies relating to the perceived characteristics and outcomes of a disease have been reported as factors which influence adherence to guidelines in a range of conditions including asthma, epilepsy and coronary heart disease (Rashidian et al., 2008). Perceived credibility of the guideline source and content has also been reported as a factor which influences GPs' expectancy of positive or negative outcomes associated with following the recommendation (Rashidian et al., 2008). Additionally, the perceived level of emotional distress which may be experienced by both the GP and the patient as a direct result of engaging in a behaviour, has also been reported as influencing GPs decision to adhere to guidelines (Maguire, 1985).

Therefore, the construct of outcome expectancies has been associated with healthcare professionals' adherence to clinical guidelines. However, much evidence supporting the construct has related to GPs' intention to adhere to guidelines, which does not directly reflect the behaviour which may actually be conducted in a practice setting. In addition, many studies have used GPs' self-reported adherence to guidelines as an outcome measure, which also cannot be verified in terms of clinical practice. Despite this difficulty, a systematic review across healthcare settings has reported that beliefs relating to the consequences of engaging in a behaviour do predict recorded clinical behaviour in practice. In addition, GPs have reported specific outcome expectancies as factors which influence their decision to adhere to a guideline. Therefore, evidence from a variety of sources including self-reported measures and recorded clinical behaviour in practice support the use of outcome expectancies in the design of a behaviour change intervention for healthcare professionals.

3.3.3 Environment

Social cognitive theory proposes that the environment plays a key role in influencing an individual's behaviour (Bandura, 1977). The environment is said to interact with both the individual and the behaviour to successfully result in a task being conducted. It is argued that one of the most important mechanisms involved in behaviour change is an individual's belief in their ability to exercise control over their environment (Bandura, 2001). If an individual perceives their environment to be controllable, they are more likely to succeed in conducting a specific task (Bandura, 1991). The theory also suggests that an environment which provides forms of support to assist with conducting a behaviour is likely to encourage behaviour change. Therefore, according to social cognitive theory, a successful behaviour change intervention would occur in an environment that is relevant to a specific behaviour or decision making process, and which provides the individual with both a sense of control and forms of support to enable a task to be easily conducted. In a primary care setting, this could refer to guideline adherence being increased if information encouraging adherence was presented during a relevant consultation, using a system which GPs could control and which provided a supportive and easy opportunity to adhere. Research which has manipulated various environmental factors in order to create behaviour change interventions for healthcare professionals can provide evidence in support of social cognitive theory. Specifically, studies have examined concepts relating to the theory which include: embedding an intervention within a relevant environment (e.g. a consultation), providing a controllable environment, and offering support within the environment to enable a healthcare professional to engage in a behaviour.

Social cognitive theory suggests that environment interacts directly with both the individual and the behaviour. Therefore, interventions which occur in the environment which is most relevant to the specific behaviour would be expected to encourage adherence to a guideline related task. This notion has been supported in healthcare settings, in that interventions which are

presented during relevant patient consultations have resulted in increased adherence to clinical guidelines. For example, an intervention aimed at increasing adherence to antibiotic prescribing guidelines for otitis media was presented to GPs during a consultation, at the point at which they attempted to select a prescription of antibiotics for a patient on the computer screen. The intervention resulted in a significant reduction in antibiotic prescriptions compared to a control group, and therefore successfully increased guideline adherence (Christakis et al., 2001). This finding has also been reported in interventions which have involved adherence to a variety of healthcare guidelines which include: diabetes care (Filippi et al., 2003) and preventive treatments such as vaccinations and aspirin use (Dexter et al., 2001). Furthermore, a large review across healthcare settings reported that interventions which use prompts to present information during a consultation or at the point of practitioner decision making are significantly more effective than interventions which do not use this technique (Garg et al., 2005). In addition, reviews of theory based interventions targeting varying healthcare guidelines have also concluded that the most effective interventions occur during a setting and context which is relevant to the specific healthcare behaviour (Ceccato, Ferris, Manuel, & Grimshaw, 2007; Godin et al., 2008).

Social cognitive theory also argues that an individual will be more likely to engage in a behaviour if they believe that they have the ability to control aspects of their environment and freely choose how to act within it. This notion has been supported in relation to antibiotic prescribing for RTI, in that GPs who are given interactive training-based interventions, which allow them to control and choose how they would respond to prescribing decisions, can significantly increase both intention to adhere and recorded adherence to guidelines (Berild, Ringertz, Aabyholm, Lelek, & Fosse, 2002; Hrisos et al., 2008). This finding has also been reported in research which has examined preventive healthcare treatments including; vaccinations for conditions such as flu and pneumonia. Specifically, an intervention which involved the presentation of messages which encouraged adherence, but allowed practitioners to choose and control the level of information which was viewed, resulted in significantly increased guideline adherence across all preventive treatments in the study (Dexter et al., 2001). In addition, a large multi-faceted

intervention which provided practitioners with the ability to control how the system was used in practice (which could include audits, patient reports and reminders), significantly increased adherence to a range of diabetes care guidelines (Montori et al., 2002). Furthermore, a recent review of interventions for healthcare professionals concluded that techniques involving reminders which allow the GP to individually control how to respond, resulted in significantly increased guideline adherence (Boren, Puchbauer, & Williams, 2009).

According to social cognitive theory, an individual is likely to engage in a task if the environment provides forms of support for a behaviour to occur. This concept has been supported in the area of antibiotic prescribing for RTI. For example, an intervention which provided GPs with varied forms of support including: lectures, meetings with colleagues, and reminders, significantly increased guideline adherence and reduced antibiotic prescribing rates (Berild et al., 2002). Similar findings have also been reported in relation to preventative healthcare such as the prescription of aspirin in diabetes patients. An intervention which provided GPs with varied support in the form of both computer reminders and automatically generated letters for patients, resulted in significantly increased guideline adherence (Filippi et al., 2003). Furthermore, a review of interventions for healthcare professionals concluded that techniques which offered support for GPs in relation to drug dosing and prescribing, significantly increased adherence to guidelines (Garg et al, 2005). In addition, GPs have also reported that aspects of the clinical environment which they perceive as supportive, can influence their decision to adhere to guidelines. In qualitative interviews regarding a variety of conditions, GPs reported that they would be more likely to adhere to guidelines if they felt support was available from colleagues, the practice setting, and the information technology offered (Rashidian et al., 2008).

Social cognitive theory also argues that an optimum environment for a behaviour to occur in would offer an individual both control over aspects of the setting, and support for a specific task to be engaged in. Intervention research in healthcare settings has also supported this concept. For example,

interventions which provide GPs with control in terms of the ability to select which features of a system they wish to use and varied forms of support (including reminders and feedback reports) have significantly increased adherence to guidelines across settings (Bonetti et al., 2010 Montori et al., 2002). Furthermore, review evidence has concluded that interventions which include factors that offer an individual both control and support, such as prompts and reminders, can significantly increase guideline adherence and are more effective than techniques which just use reminders alone (Garg et al., 2005). In addition, evidence from qualitative interviews has revealed that GPs report being more likely to engage in a specific task if a wide range of evidence and resources is easily available to them (Bekkers et al., 2010). This finding supports the notion of an optimum environment proposed by social cognitive theory, in that these are factors which support adherence to guideline related tasks and which the GP has control over in terms of when and how the evidence and information is used.

Examining the components of interventions which were not successful in changing the behaviour of healthcare professionals, can also provide support for the optimum environment suggested in social cognitive theory. For example, a computer-delivered intervention aimed at increasing guideline adherence for asthma and angina, required GPs to enter patient information into the system in order to view treatment suggestions (Eccles et al., 2002). The intervention did not have an effect on behaviour and had low usage levels recorded. This finding has also been reported in a review of healthcare interventions, which concluded that systems which require GPs to enter data are not effective and are rarely used (Hersh & Hickam, 1998). This may be due to the lack of control GPs have in terms of when they can view the information (which is only available after data has been entered) and the lack of support in view of the limited time GPs have with each patient (in relation to the time-consuming nature of entering information).

In summary, although most research in the area has not directly aimed to investigate the construct of environment in social cognitive theory, it is possible to examine aspects of this construct via the use of intervention

research. Evidence which has manipulated various aspects of healthcare professionals' environment has supported key elements of the construct. These include; the importance of embedding information within a relevant environment (such as a consultation), ensuring an individual feels in control of their environment, and providing adequate support within the environment to encourage a behaviour to be engaged in. Therefore the concept of environment proposed by social cognitive theory provides a suitable construct with which to develop a behaviour change intervention aimed at healthcare professionals.

3.4 Alternative theories

In addition to social cognitive theory, a number of other theoretical models have been applied to the behaviour of healthcare professionals in order to identify constructs which may be implicated in behaviour change. These models include: the theory of planned behaviour (Ajzen, 1991), operant learning theory (Skinner, 1950; Blackman & Fontana, 1984), implementation intention theory (Gollwitzer, 1993), self-regulation theory (Leventhal & Cameron, 1987), self-perception theory (Bem, 1973) and the elaboration likelihood model (Petty & Cacioppo, 1986). However, recent reviews of the literature have concluded that research involving behaviour change theory and healthcare professionals is severely limited (Godin et al., 2008; Perkins et al., 2007; Watson, Bond, Walker, & Grimshaw, 2006) with most studies examining only the theory of planned behaviour (Godin et al., 2008; Ceccato et al., 2007).

3.4.1 Theory of planned behaviour

The theory of planned behaviour (Ajzen 1991) is a motivational theory of behaviour change which proposes that an individual's intention to engage in a behaviour and their perceived level of control over the behaviour predicts the likelihood that an action will be performed. In addition, the intention to

conduct a behaviour is influenced by three factors which include: attitude (opinion based on beliefs about the behaviour), subjective norm (beliefs in relation to perceived social pressure to perform a behaviour) and perceived behavioural control (beliefs relating to individual control over behaviour and ability to perform a task).

Attitude towards conducting a task can be favourable or unfavourable depending on an individual's evaluation of the behaviour. This evaluation results from beliefs relating to the perceived outcomes and consequences which will result from performing the behaviour. In relation to healthcare professionals, adhering to a guideline would be more likely if it was assessed as providing positive consequences, such as a benefit for the patient. Evidence has suggested that this concept may be significantly related to the behaviour of healthcare professionals. For example, attitude has been found to predict practitioners' intention to adhere to guidelines in relation to various healthcare settings including: antibiotic prescribing for RTI (Saengcharoen, Chongsuvivatwong, Lerkiatbundit, & Wongpoowarak, 2008; Hrisos et al., 2008; Eccles et al., 2007), x-ray referrals (Bonetti et al., 2005), psychiatric guidelines (Casper, 2008; Green, Johnston, Cabrini, Fornai, & Kendrick, 2008), and recommendations for non-prescription medication (Watson et al., 2006). Adherence to guidelines in tasks which simulate a consultation have also been significantly related to attitude, in areas such as antibiotic prescribing (Eccles et al., 2007) and radiology recommendations (Bonetti et al., 2005). Finally, some studies have also reported that attitude is a predictor of recorded clinical behaviour in practice settings which include: antibiotic prescribing (Eccles et al., 2007), smoking cessation (McEwen et al., 2006), and adherence to dental guidelines (Bonetti et al., 2010, Bonetti et al., 2006).

However, despite evidence which supports the role of attitude in relation to the behaviour of healthcare professionals, inconsistent findings have been reported. For example, research has often reported that attitude is not related to recorded clinical behaviour in practice settings which include: dental referral procedures (Bonetti et al., 2006), cancer screening (Wade, Smith, Hankins, & Llewellyn, 2010), and mental health recommendations (Rebergen et al., 2006).

Inconsistent findings have also been reported across different outcome measures of recorded clinical behaviour in relation to the same guideline. For example, attitude was related to some but not all outcome measures of adherence to asthma related guidelines by practitioners in a hospital setting (Limbert & Lamb, 2002). Furthermore, in many cases where attitude was found to relate to guideline adherence, the clinical situations were not always directly comparable with either the management of respiratory tract infection or secondary stroke prevention which will be the focus of the intervention. For example, although both prescribing and preventative health behaviours have been studied, much of the evidence has focussed on professionals outside of general practice, such as general dental practitioners and pharmacists. In addition, one study which found attitude was related to antibiotic prescribing for RTI (Saengcharoen et al., 2008) involved a sample of Thai pharmacists who are able to prescribe antibiotics. This sample of practitioners cannot be directly compared with GPs in the UK, due to the differing guidelines and practitioner role. Another instance which demonstrated the link between attitude and behaviour found that only one measure of attitude was related to guideline adherence (McEwen et al., 2006).

Therefore, in relation to the behaviour of healthcare professionals there is some evidence to suggest that attitude may be related to guideline adherence. However, this evidence is inconsistent and the construct has not been directly included in the intervention development. The intervention design used in this thesis did however include outcome expectancies from social cognitive theory, which represents a similar concept to attitude in relation to beliefs about the consequences of a planned behaviour. Outcome expectancies relate to an individual's perceptions of the likely outcomes resulting from a behaviour, whereas 'attitude' is described by the theory of planned as relating to a single evaluation which an individual has made based on both the positive and negative consequences perceived as resulting from a behaviour.

Outcome expectancies was selected in the early stages of intervention development as it was felt that this construct was supported by the literature and represented a relevant concept which could be used in the design. The

intervention therefore includes a number of factors which could relate to either attitude or outcome expectancies, such as GP concerns about patient pressure.

Subjective norm has also been implicated in the behaviour of healthcare professionals. This construct refers to an individual's perceptions of the social pressure from others to comply with a behaviour. The subjective norm is derived from both beliefs about the preferences of others (groups or individuals) and the motivation to comply with this perceived social norm. In healthcare settings, these social influences could come from a range of sources including: members of the clinical team, senior staff, patients, managers, or professional organisations (Watson et al., 2006). Some evidence has suggested that subjective norm may be linked to the behaviour of healthcare professionals. For example, the construct has predicted GPs' intention to adhere to guidelines in various settings including: RTI (Hrisos et al., 2008), preventative cancer care (Wade et al., 2010), psychiatric care (Casper, 2008; Green et al., 2008), alternative medicine use (Godin et al., 2008), and medication information provision (Ten Wolde et al., 2008). Subjective norm has also predicted self-reported adherence to guidelines for mental health care (Rebergen et al., 2006) and preventive dental treatments (Bonetti et al., 2010). The construct has also been significantly associated with recorded clinical behaviour in relation to adherence to abortion guidelines (Foy et al., 2005). In addition, subjective norm was reported to mediate the effect of an intervention which aimed to improve adherence to antibiotic prescribing guidelines (Hrisos et al., 2008).

However, many inconsistent findings have also been reported. For example, although recorded clinical behaviour was associated with subjective norm in relation to adherence to abortion guidelines, this finding was not replicated for all clinical tasks recommended by this guideline (Foy et al., 2005). In addition, research which has included a measure of subjective norm has often reported that the construct was not associated with recorded clinical behaviour in practice, in relation to a variety of guidelines which include: antibiotic prescribing in RTI (Hrisos et al., 2008; Eccles et al., 2007), mental health recommendations (Rebergen et al., 2006), cancer screening (Wade et al.,

2010), radiology recommendations (Bonetti et al., 2005), and preventative dental treatment (Bonetti et al., 2006). Furthermore, although intention to adhere and self-reported adherence have been associated with subjective norm, this has often been an inconsistent finding across different outcome measures of behaviour within the same participant sample (Bonetti et al., 2010; Wade et al., 2010; Hrisos et al., 2008; Watson et al., 2006; Walker, Watson, Grimshaw, & Bond, 2004). A recent review also concluded that subjective norm is not consistently related to healthcare professionals' behaviour (Perkins et al., 2007). Therefore, this construct was not included in the intervention development.

Perceived behavioural control refers to the degree to which a person feels able to perform a behaviour. This relates to control beliefs about the extent to which an individual feels they are able to overcome barriers or be assisted by facilitators to successfully engage in a behaviour. This concept therefore relates to the level of confidence a person has in their ability to conduct the behaviour. In relation to healthcare settings, factors which may influence an individual's control beliefs can include both organisational issues and patient preferences (Watson et al., 2006). Perceived behavioural control has predicted practitioners' intention to adhere to guidelines across healthcare environments including: antibiotic prescribing for RTI (Eccles et al., 2007), cancer screening (Wade et al., 2010), x-ray referrals (Bonetti et al., 2006), psychiatric recommendations (Casper et al., 2008), preventative dental treatments (Bonetti et al., 2006; Bonetti et al., 2010), abortion guidelines (Foy et al., 2005) and alternative medicine recommendations (Godin et al., 2008). The construct has also predicted self-reported adherence behaviour across settings such as antibiotic prescribing (Eccles et al., 2007), x-ray recommendations (Bonetti et al., 2005), preventative dental treatment (Bonetti et al., 2006; Bonetti et al., 2010), and mental health guidelines (Rebergen et al., 2006). Some research has also suggested that perceived behavioural control is related to recorded clinical behaviour in practice settings which include antibiotic prescribing (Eccles et al., 2007) and preventative cancer screening (Wade et al., 2010).

Therefore, there is some evidence to suggest that perceived behavioural control may be associated with the behaviour of healthcare professionals. However, much of the evidence refers to GPs' intention to adhere to a guideline or self-reported adherence which does not always relate to what GPs actually do in practice (Perkins et al., 2007). In addition, this construct does not consistently predict healthcare professionals' behaviour across differing settings and outcome measures (Rebergen et al., 2006; Walker et al., 2004; Green et al., 2008; Watson et al., 2006). Perceived behavioural control therefore was not directly targeted in the intervention development in this thesis, however the design did include self-efficacy from social cognitive theory which refers to similar behavioural beliefs. Both perceived behavioural control and self-efficacy refer to an individual's beliefs about the degree to which they have the ability to control their behaviour. Furthermore, Ajzen (Ajzen, 2006) also argues that perceived behavioural control does include components which directly relate to self-efficacy beliefs. In the early stages of intervention development an assessment of the literature led to the construct of self-efficacy being included in the design; however factors which target this in the intervention are likely to also target aspects of perceived behavioural control.

Intention is proposed to be the most important influence and predictor of behaviour, and refers to an individual's motivation to act in a specific way. The intention to engage in a behaviour is influenced by the three constructs of attitude, subjective norm and perceived behavioural control. Intention is proposed to be the precursor of behaviour and a strong intention is likely to result in an individual engaging in a behaviour. In a healthcare setting intention has been found to predict GPs' self-reported adherence in clinical simulation tasks in relation to antibiotic guidelines for RTI (Hrisos et al., 2008; Eccles et al., 2007). Intention has also been found to predict recorded clinical behaviour in various healthcare settings including; antibiotic prescribing (Eccles et al., 2007), use of investigative radiographs (Bonetti et al., 2006), preventative dental fissure sealants (Bonetti et al., 2010), cancer screening procedures (Wade et al., 2010), and non-prescription medication recommendations (Walker et al., 2004). A systematic review also concluded that intention is consistently related to the behaviour of healthcare professionals (Godin et al., 2008). However, conflicting evidence has been

reported, and in some cases intention has not predicted recorded clinical behaviour or self-reported measures (Rebergen et al., 2006; Foy et al., 2005). In addition, a recent review concluded that intention is not always a strong predictor of behaviour (Perkins et al., 2007).

Therefore there is evidence to suggest that intention may be related to the behaviour of healthcare professionals. However, this construct was not included in the intervention development as it is problematic to directly target and include intention in a brief intervention of this nature which appears at the point of consultation and decision making, immediately before the behaviour is performed. The use of intention may work more efficiently in an intervention involving a greater amount of detail and time with the practitioner, such as a training or education program. In addition, as intention is influenced by the three additional constructs of attitude, subjective norm and perceived behavioural control, these must also be considered individually.

In conclusion, evidence has suggested that constructs from the theory of planned behaviour may relate to guideline adherence in healthcare professionals. However, some inconsistent findings have been reported and reviews have concluded that there may be a lack of strong evidence for applying the theory of planned behaviour specifically to healthcare professionals (Godin et al., 2008; Perkins et al., 2007; Ceccatto et al., 2007). No individual constructs from the theory of planned behaviour have been directly used in the intervention development, however, some components from social cognitive theory which represent similar beliefs have been included in the design. These include, outcome expectancies which represent comparable beliefs to those of attitude, and self-efficacy which may be closely related to perceived behavioural control beliefs.

3.4.2 Operant learning theory

Operant learning theory (Skinner, 1950; Blackman & Fontana, 1984) has also been implicated in the behaviour of healthcare professionals. Research has examined the theory according to the format proposed by Blackman and

Fontana (1984). The theory proposes that the consequences an individual perceives as resulting from a behaviour will directly determine the likelihood that a behaviour will be conducted. In addition to this factor, how frequently an individual performs the same behaviour influences the likelihood it will become 'habitual' and performed consistently in the future. In a healthcare setting, 'anticipated consequences' could relate to a GP conducting a guideline related task (such as achieving a reduction in patient blood pressure) in order to receive the financial reward of meeting a goal set in the national quality and outcomes framework (QOF).

If an individual perceives the 'anticipated consequences' of a behaviour as being favourable, they are more likely to repeat the behaviour in the future. In contrast, behaviours which are perceived as leading to unpleasant consequences are less likely to be engaged in. This construct has been supported by research in relation to the behaviour of healthcare professionals across settings which include, adherence to antibiotic prescribing guidelines for RTI (Eccles et al., 2007; Hrisos et al., 2008), and adherence to guidelines for the recommendation of dental procedures (Bonetti et al., 2006; Bonetti et al., 2010). Specifically, the construct has been found to significantly predict both prescribing and preventative healthcare behaviours across measures of recorded clinical behaviour, intention to adhere and self-reported adherence in clinical simulation tasks (Eccles et al., 2007; Bonetti et al., 2010).

However, a lack of research has been conducted directly on this construct in relation to healthcare settings and studies have often focused on constructs from alternative models which may share the same characteristics and cognitions as 'anticipated consequences' (Eccles et al., 2007). For example, both attitude from the theory of planned behaviour (Ajzen 1991) and outcome expectancies from social cognitive theory (Bandura 1977) relate to an individual's beliefs regarding the outcomes which will result from a behaviour, and both constructs have been more frequently investigated and supported in research. The notion that these factors may be describing a similar concept is also supported in research which has included all three constructs (anticipated consequences, attitude, and outcome expectancies) as outcome measures, and

found that all three are significantly related to the behaviour of healthcare professionals (e.g. Eccles et al., 2007; Hrisos et al., 2008). Therefore, although anticipated consequences was not directly included in the intervention development, outcome expectancies from social cognitive theory was included in the design and relate to similar behavioural beliefs.

The construct of habitual behaviour refers to the notion that the more frequently a behaviour is conducted the more likely it will become 'automatic' and repeated on future occasions. In addition, the 'habit' to conduct a behaviour is triggered by both explicit and implicit cues within an individuals environment. This concept has been widely supported across healthcare settings, and has been significantly associated with both prescribing and preventative guideline related tasks (Eccles et al., 2007; Hrisos et al., 2008; Bonetti et al., 2006; Bonetti et al., 2010). Furthermore, habitual behaviour has been reported as the strongest predictor of GP adherence to antibiotic prescribing guidelines for RTI, in trials which have assessed a variety of theoretical constructs (Eccles et al., 2007, Hrisos et al., 2008).

Therefore, evidence suggests that habitual behaviour may be closely related to the behaviour of healthcare professionals. However, it is difficult to incorporate this construct into a behaviour change intervention, as it represents an attribute of behaviour as opposed to a causal determinant which can be manipulated (Eccles et al., 2007). The intervention targeted constructs which could be modified (such as self-efficacy) in order to result in adherence to the selected guidelines becoming more of a habitual behaviour for the GPs. Habitual behaviour was therefore an outcome the intervention aimed to achieve, rather than a factor which could enable behaviour change.

In conclusion, operant learning theory does provide constructs which have been related to the behaviour of healthcare professionals. Anticipated consequences closely relates to the concept of outcome expectancies from social cognitive theory, which has been included in the intervention development. Outcome expectancies were directly targeted in the intervention, as it was felt this construct had a stronger evidence base to

support its use compared with that of anticipated consequences. Although evidence does support the construct of habitual behaviour, it does not provide a modifiable factor which can be directly targeted in a brief intervention of this nature.

3.4.3 Implementation Intention theory

Implementation intention theory (Gollwitzer, 1993) has been implicated in the behaviour of healthcare professionals and refers to the plans an individual makes to conduct a specific behaviour. The concepts of prior planning and action planning refer to precise plans individuals develop to ensure a behaviour is conducted, despite a variety of possible barriers occurring. In relation to a healthcare setting, this could refer to an individual planning to reduce their antibiotic prescribing rate for RTI and deal with barriers related to this goal. The constructs of prior and action planning have been found to significantly predict adherence to guidelines in relation to both prescribing and preventative healthcare behaviours (Bonetti et al., 2006; Casper, 2008; Hrisos et al., 2008; Eccles et al., 2007; Bonetti et al., 2010). However, these constructs describe factors which encourage a behaviour to be conducted in individuals who already intend to adhere to it. For example, 'prior planning' describes a construct referring to an action which occurs before a behaviour (such as adhering to a guideline) is conducted. Therefore, as these are 'post-intentional' variables it is inappropriate to include them in an intervention aimed at encouraging behaviour change in individuals who may not already intend to conduct the guideline related behaviour. Targeting this construct is not appropriate for this intervention design as the prompts appear at the point at which the target behaviour is being conducted in the consultation. Therefore there is little time for the GP to develop behaviour plans from the time of the prompts appearing on the screen during the consultation and a decision to act being made.

3.4.4 Self-regulation model

The self-regulation model of illness representations (Leventhal & Cameron, 1987) has also been linked to the behaviour of healthcare professionals. The model refers to the way in which an individual's pre-existing beliefs, knowledge, and cognitions relating to a condition guide and influence the way in which they respond to it. The beliefs and responses are constantly evolving and individuals will continue using techniques they perceive as being effective in relating to a condition. Beliefs about an illness relate to five components which include: identity, cause, controllability, duration, and consequences, which are also influenced by an individual's emotional response to the condition. In a healthcare setting, a general practitioner's behaviour and response to a patient's condition may be influenced by their beliefs relating to the specific illness (Walker et al., 2004). Although few studies have investigated this model in relation to healthcare professionals, some trials have included constructs from the theory.

The identity (or label) of the illness influences the way in which an individual responds to the condition. In the behaviour of healthcare professionals, identity has been found to significantly predict practitioners' intention to adhere to guidelines for preventative treatments (Bonetti et al., 2006). However, in a variety of trials across healthcare settings, identity did not relate to guideline adherence over a selection of outcome measures which included recorded clinical behaviour, intention to adhere and self-reported adherence (Eccles et al., 2007; Bonetti et al., 2006; Bonetti et al., 2010).

Beliefs which relate to the 'cause' of an illness have also been significantly associated with GPs' prescribing decisions (Eccles et al., 2007). However, trials involving both preventative and prescribing healthcare guidelines have reported that causal beliefs are not consistently related to adherence across all outcome measures of behaviour (Bonetti et al., 2006; Eccles et al., 2007; Bonetti et al., 2010).

Healthcare professionals' beliefs about the duration of the illness have significantly predicted practitioner adherence to guidelines in relation to intention to adhere and self-reported adherence (Eccles et al., 2007; Bonetti et al., 2010). However, duration beliefs have not been significantly associated with recorded clinical behaviour for GPs and dental practitioners in relation to both prescribing and preventative healthcare behaviours (Bonetti et al., 2006; Eccles et al., 2007).

Perceived consequences have also been implicated in the behaviour of healthcare professionals. Specifically, this construct has been significantly linked to GPs' intention to adhere to guidelines and dental practitioners recorded adherence to guidelines in practice (Eccles et al., 2007; Bonetti et al., 2006). However, research has reported that the construct does not consistently predict recorded clinical behaviour or self-reported adherence to guidelines across both preventative and prescribing related healthcare behaviours (Bonetti et al., 2006; Eccles et al., 2007; Bonetti et al., 2010). Although there is not a strong evidence base to support the use of this construct in the intervention development, perceived consequences does share some characteristics with outcome expectancies which has been supported by research and included in the design. Both outcome expectancies and perceived consequences relate to an individual's expectation of what will occur as the direct result of a behaviour being conducted. Therefore, although the intervention did not directly target perceived consequences, a consideration for the issues relating to this construct was included in the intervention design.

Controllability in the model refers to an individual's beliefs regarding the degree to which a condition can be cured or the symptoms controlled. This concept has been significantly related to practitioners' intention to adhere and self-reported adherence to both prescribing and preventative healthcare guidelines (Bonetti et al., 2006; Eccles et al., 2007). However, trials across healthcare settings have reported that controllability was not related to recorded clinical behaviour in practice, (Bonetti et al., 2006; Eccles et al., 2007) and did not consistently relate to self-reported outcome measures of adherence (Bonetti et al., 2010).

According to the model, the emotional response to an illness directly influences the way in which an individual responds to the condition. Emotional response has been reported to predict GPs' intention to adhere to clinical guidelines (Bonetti et al., 2006). However, most trials have reported that emotional response is not associated with healthcare professionals' adherence to guidelines across various outcome measures including; recorded clinical behaviour, intention to adhere and self-reported adherence (Bonetti et al., 2006; Eccles et al., 2007; Bonetti et al., 2010).

Therefore, some research has supported the self-regulation model in relation to explaining the behaviour of healthcare professionals. However, in general the constructs within this model do not consistently predict adherence to clinical guidelines. In addition, analysis has revealed that the model accounts for little or no variance in outcome measures of healthcare professionals' behaviour (Eccles et al., 2007; Bonetti et al., 2010). Therefore, there is little justification to directly utilise any components of this theory in a behaviour change intervention targeted at clinical guideline adherence.

3.4.5 Additional theoretical constructs

Additional theories of behaviour have also been applied to healthcare settings and adherence to clinical guidelines. These include self-perception theory (Bem, 1973) and the elaboration likelihood model (Petty & Cacioppo, 1986). Self-perception theory proposes that individuals create their own attitudes, opinions and internal states towards engaging in a behaviour by observing themselves and others. Behaviour change can occur by providing individuals with feedback relating to their behaviour which can create a new evaluation of engaging in a specific behaviour. In a healthcare setting this could involve telling GPs that they have high rates of adherence towards a particular guideline, which may result in increased adherence to the behaviour. However, in a primary care setting self-perception theory has been reported as unrelated to GP behaviour in a study relating to smoking cessation guidelines (Vogt, Hall,

Hankins, & Marteau, 2009). Therefore due to a lack of research and support for this model in relation to healthcare professionals' behaviour, the theory was not included in the intervention development.

Additional constructs which may be involved in the behaviour of healthcare professionals have also been investigated. An individual's knowledge relating to a guideline or condition has been proposed as a factor which may relate to clinical guideline adherence. For example, if a GP is presented with information and evidence supporting the use of a guideline, it is possible that they will be more likely to adhere to the recommended behaviour. This notion has been supported by research, in that knowledge has predicted practitioners' intention to adhere and self-reported adherence to antibiotic prescribing guidelines and radiograph recommendations (Eccles et al., 2007; Bonetti et al., 2006). However, knowledge does not consistently predict intention to adhere or self-reported adherence across healthcare settings (Bonetti et al., 2010). In addition, this construct has been reported as unrelated to recorded clinical behaviour in practice for both prescribing and preventative healthcare guidelines (Bonetti et al., 2006; Eccles et al., 2007). Therefore, there is not a strong evidence base to support the direct use of this construct in the intervention design.

In summary, evidence has supported a number of theoretical constructs in relation to explaining the behaviour of healthcare professionals. For example, some constructs within the theory of planned behaviour (Ajzen, 1991), operant learning theory (Skinner, 1950; Blackman & Fontana, 1984), and the self-regulation model (Leventhal & Cameron, 1987) have predicted adherence to both prescribing and preventative healthcare guidelines. However, no constructs have consistently predicted clinical behaviour or practitioners' adherence to guidelines across healthcare settings and outcome measures of behaviour. Some constructs from various models were found to share characteristics with the components from social cognitive theory which have been used in the intervention design. For example, outcome expectancies

refers to the way in which an individual's decision to engage in a behaviour is associated with their concerns about the outcomes which will occur as a result of this behaviour being conducted. This concept also shares characteristics with constructs from alternative theories including: attitude (theory of planned behaviour), anticipated consequences (operant learning theory) and perceived consequences (self-regulation model). Therefore, although the intervention design used constructs from social cognitive theory, these were closely related to some constructs from alternative theories.

3.5 Self-determination theory

Self-determination theory (Deci & Ryan, 1980) was not initially included in the literature search for consideration in the intervention as it has not been widely researched in relation to the behaviour of healthcare professionals. However, results from GP interviews in the intervention development study described in this thesis (Chapter 4/ McDermott et al., 2010) related to key components from the theory and implicated the possible importance of the model in relation to GP behaviour. Although previous research does not directly relate to healthcare professionals, components from the model which were supported in the GP interviews have been examined in the areas of adherence to healthy behaviours (e.g. diet and weight loss), patient management of chronic conditions and education.

Self-determination theory is concerned with the ways in which an individual is motivated to behave. The theory suggests that factors which encourage intrinsic motivation are more likely to bring about behaviour change than extrinsic motivators. Specifically, self-determination theory proposes that behaviour change will occur and persist if it is autonomously motivated and reflects an individual's choice to act. In contrast, behaviour change which is brought about by enforcement or the use of communication which is pressurising and controlling is thought to result in less maintained behaviour. Therefore, an individual will be more likely to engage in and maintain a behaviour if they perceive this to be their personal choice and under their own control. The theory suggests that behaviour change can be encouraged by the

use of techniques which provide autonomy support. This method encourages and supports a particular behaviour but offers the individual the choice to freely act as they wish and does not force the use of any actions.

In interviews conducted for the intervention development study, GPs reported that they would be more likely to adhere to guidelines and use the prompts if they perceived them as a 'support tool' to aid their own decision to follow guidelines. GPs also reported strong rejection and opposition towards any technique they perceived as a method of 'guideline enforcement', but in contrast reported approval for prompts which provided them with choice and control over their use. These findings support self-determination theory in that GPs appear to approve of and be more open to using methods which provide autonomy support, but opposed to the use of enforcement techniques. Although research has not focused on healthcare professionals, behaviour change studies have provided evidence on the success of interventions which are 'autonomy supportive', and the use of controlling enforcement techniques in comparison to methods which support autonomy.

Interventions which use autonomy supportive techniques have been reported to successfully increase adherence to a range of health behaviours including: diet, physical activity, and diabetes management. For example, in a weight loss intervention, participants who perceived the programme as being autonomy supportive were more likely to adhere to the programme and achieve better clinical outcomes (in terms of weight lost and maintained) than those who did not perceive their autonomy to be supported (Williams, Grow, Freedman, Ryan, & Deci, 1996). Furthermore, an intervention designed to increase physical activity found that participants who experienced autonomy supportive instructions reported more frequently taking part in exercise compared to the control group (Chatzisarantis & Hagger, 2009). In relation to disease management, a computer-delivered intervention designed to support patient autonomy resulted in improved clinical outcomes (e.g. changes in lipid levels) and increased patient adherence to diabetes care recommendations (Williams, Lynch, & Glasgow, 2007).

Although research has not directly aimed to study healthcare professionals' adherence to guidelines in relation to self-determination theory, evidence involving autonomy support and physicians can be examined. For example, medical students on a six month training course who perceived class instructions as being autonomy supportive also reported improved levels of perceived competence, and autonomous learning styles (Williams & Deci, 1996). In addition, a computer-delivered intervention which aimed to increase practitioner adherence to guidelines for prescribing in postoperative nausea, increased autonomy support by selecting relevant patients and communicating an automated message which offered a reminder and suggestion for treatment which the practitioner could choose to follow or ignore (Kooij et al., 2008). This technique successfully resulted in significantly increased adherence to guidelines.

Self-determination theory argues that techniques which adopt enforcement methods that remove an individual's sense of control are unlikely to result in successful and maintained behaviour change. This idea has been supported in that enforcement style policies can result in defiance towards conducting the desired behaviour and negative views of the individual delivering the policy (Assor, Roth, & Deci, 2003). Intervention research has contrasted techniques which offer autonomy to those which adopt enforcement and controlling methods of encouraging behaviour change. In relation to smoking cessation, messages which encourage informed choice and support autonomy result in increased use of smoking cessation services compared to messages which promote fear relating to the dangers of smoking (Williams, Cox, Kouides, & Deci, 1999). Healthy eating has also been investigated, and techniques which encourage autonomous regulation of eating behaviour in comparison to controlled regulation techniques have been associated with healthier and less dysfunctional eating patterns (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004). In addition, an intervention to encourage weight loss and exercise reported that participants who received autonomy supportive instructions and advice (e.g. presenting reasons why people may 'choose' to adhere) resulted in greater adherence and longer term weight loss than a contrasting condition

which presented instructions using controlling communication techniques (Ryan, Patrick, Deci, & Williams, 2008). Furthermore, a review of studies which had investigated self-determination theory and adherence to public policies (e.g. smoking cessation, healthy eating, recycling) concluded that techniques which encourage autonomous motivation as opposed to methods which use behavioural enforcement and control are more likely to result in behaviour change and adherence to recommendations (Moller, Ryan, & Deci, 2006).

Therefore, although research has not directly investigated self-determination theory in relation to healthcare professionals' adherence to guidelines, evidence has supported its use in encouraging adherence to various health related behaviours such as healthy eating and physical activity. In addition, the intervention development study reported in this thesis (Chapter 4/ McDermott et al., 2010) revealed that GPs' decision to adhere to guidelines and use of computer-delivered prompts appears to be influenced by constructs from the theory (e.g. use of autonomy support). In summary, techniques which support and encourage a GP's sense of personal choice in adhering to a guideline and avoid enforcement messages could improve the likelihood of recommendations being followed. In conclusion, results of the intervention development study and previous research involving 'autonomy supportive' techniques support the use of self-determination theory in future interventions aimed at healthcare professionals' adherence to guidelines.

3.6 Conclusion

A range of theories which had been investigated in relation to the behaviour of healthcare professionals were considered for inclusion in the computer-delivered intervention. The research which was identified involved varying methodologies and outcome measures. The research also involved both prescribing and preventative healthcare behaviours.

After examination of the literature, three components from social cognitive theory were selected for use in the intervention development. The theoretical constructs chosen for inclusion were self-efficacy, outcome expectancies and environment. Self-efficacy has been significantly associated with healthcare professionals' intention to adhere, self-reported adherence to guidelines, and recorded clinical behaviour (e.g. prescribing rates). Outcome expectancies have consistently been reported as factors which influence GPs decision to adhere to guidelines across a range of studies based on interventions, questionnaires, and interviews. In addition, research has suggested that interventions which create an optimum environment according to the principles suggested by social cognitive theory can increase healthcare professionals' adherence to clinical guidelines.

Evidence relating to alternative behaviour change theories was also examined and some support for additional theoretical constructs was identified. However, it was noted that these constructs may be indirectly included in the intervention due to similarities between concepts from the alternative models and the selected constructs from social cognitive theory. For example, outcome expectancies shares characteristics with constructs such as attitude (theory of planned behaviour), anticipated consequences (operant learning theory), and perceived consequences (self-regulation model). In addition, self-efficacy shares a similar concept to perceived behavioural control (theory of planned behaviour).

Finally, self-determination theory was also examined following evidence from findings of the intervention study in which GPs reported factors consistent with the theory as influencing their decision to adhere to guidelines. Evidence from the intervention study in addition to research in alternative areas of healthcare and guideline adherence suggests that self-determination theory could be useful to inform further interventions relating to healthcare professionals.

4. Chapter four: Developing a computer-delivered, theory based intervention for guideline implementation in general practice.

4.1 Chapter Overview

The aim of the study was to develop theory informed, computer-delivered interventions intended to promote adherence to guidelines by presenting GPs with prompts during a consultation. The aim was to produce prompts which GPs would view as feasible and acceptable in practice. The intervention was developed to be assessed in a trial which followed. The use of the term 'prompt' throughout this thesis refers to the screens of the computer delivered intervention which was developed in the following study.

The prompts were designed to a) promote adherence to antibiotic prescribing recommendations in accordance with the NICE guidelines (promote no antibiotic prescribing, or delayed antibiotic prescribing, instead of the immediate prescription of antibiotics for RTI) and b) promote adherence to recommendations from the Intercollegiate Stroke Working Party for secondary prevention of stroke (Intercollegiate Stroke Working Party, 2008; National Institute for Health and Clinical Excellence, 2008). The development of prompts was informed by both theory and feedback from qualitative interviews with GPs. The aim of the interviews was to identify factors and characteristics likely to influence adherence to the guideline behaviours, in order to inform development and refinement of prompts.

****NICE guidelines for antibiotic prescribing in RTI targeted:*** Antibiotics should not be prescribed to most patients with a RTI (a prescription of antibiotics should only be issued to patients with specific additional underlying medical conditions and high risk groups as stated in the guidelines).

****ICSWP guidelines for prevention of secondary stroke targeted:*** Patients who have suffered from their first stroke within the last five years should be treated as follows-

- 1) An optimal target blood pressure for stroke patients is 130/80 mmHg.
- 2) Aspirin prescribed together with Dipyridamole should be standard treatment following non-haemorrhagic stroke.
- 3) All stroke patients with total cholesterol >3.5 mmol/l should be treated with a statin.

Please note that detailed examinations of topics which may aid the reading of this Chapter can be found in the following locations:

- An overview of how this development study fits within the overarching aims of the research (Chapter 1).
- Non adherence to primary care guidelines: in particular antibiotic prescribing in RTI and secondary stroke prevention (Chapter 1).
- A systematic review of computer-delivered interventions in primary care (Chapter 2).
- Behaviour change theory in relation to healthcare professionals and guideline adherence (Chapter 3).

4.2 Method

4.2.1 Design of study

The study used a qualitative design involving both semi-structured and 'think-aloud' interviews with 33 GPs. The study excluded nurse practitioners as the guidelines of interest are almost exclusively delivered by GPs in most daily practice. Face-to face interviews lasting approximately 40 minutes were conducted in GP surgeries. In the first stage 22 semi-structured interviews with GPs were conducted using paper-based prompts. The second stage involved 11 'think aloud' interviews with GPs using computer-based prompts. All interviews were recorded using a digital voice recorder, and were fully transcribed.

4.2.2 Participants

Participants were 33 GPs from practices across the south of England (these included both inner-city and rural locations). The primary care trusts which were recruited from include Southampton City, Hampshire, Portsmouth, Bournemouth and Poole, Wiltshire, Lambeth, Southwark, and Lewisham. The surgery size varied widely across practices with the number of full time or equivalent GPs ranging from 1 to 11, and the number of patients registered to each full time equivalent GP ranging from 826 to 2896. The index of multiple deprivation score (IMD) also varied greatly, and ranged from 2 to 43. The primary care research network (PCRN) assisted in recruitment and contacted participating practices via fax/newsletter. Practices which were interested in taking part were sent an information sheet on the study (Appendix 1). At this stage GPs were given the opportunity to ask any questions about the study and what participating would involve. Consecutive GPs responding to the study invitations were recruited to take part. Written informed consent was obtained prior to each interview (Appendix 2), and following participation GPs were paid £75 for taking part.

4.2.3 Procedure

The study was approved by the London – Surrey Borders REC and received PCT R&D approval (09/H0806/7). A semi-structured interview (Figure 3) was designed to identify factors likely to influence successful implementation of the prompts and discover likely responses to the proposed messages, in order to further inform prompt development and aid refinement of prompts. GPs were asked questions regarding their views, expectations, acceptability and feasibility of prompts. The semi-structured interview was conducted after showing GPs the initial paper-based versions of the prompts. The semi-structured interviews were used in the earlier stages of development as they provided a greater flexibility to explore and discover issues which may be related to prompt content and usage.

Think-aloud interviews (Figure 4) were then conducted to study reactions to the computer-delivered prompts (described in detail below). GPs were asked to explore and try out the features of the prompts freely as they would if the messages had appeared during a consultation and say aloud what they were thinking and feeling about each feature. GPs were also prompted to reveal which functions were most/least useful and why. At the end of the interview GPs were asked their views on any of the pages or functions they had not commented on. This technique allowed GPs to explore and openly discuss the prompts as they wished, but also ensured that opinions were obtained for all aspects of the prompts. The think aloud interviews were used in the later stages of development as soon as a working version of the prompts had been created. The semi-structured interviews had allowed a detailed exploration of issues and later the think aloud style of interview provided a detailed focus and feedback on the way in which the prompts could be used in practice and any usability issues which may have arisen. Interviews with paper based versions of the prompts were initially conducted to focus on the content presented within the intervention. Later ‘think aloud’ interviews were conducted with the prototype computer version of the prompts to place a greater focus on the functionality of the programme.

The interview guides were developed by first including questions surrounding topics which could influence GPs decision to follow guidelines, and also topics which could influence GPs use of computer delivered prompts which would appear on their screens. The interview guides were pilot tested with GPs who were involved with the trial development team at both the University of Southampton and Kings College London. Feedback from the pilot testing informed the order of questions and some slight rewording of some questions to gain maximum discussion of topics covered.

Figure 3 Semi structured interview schedule

<u>Semi-structured interviews</u>
<i>[PAPER-BASED PROMPTS WERE FIRST DISPLAYED AND EXPLAINED]</i>
1. What do you think about these messages?
2. How would you feel about getting these messages in practice?
3. How do you think patients would feel about you getting these messages?
4. How do you think colleagues would feel about getting these messages?
5. Can you describe any situations in which you feel that getting these messages would be helpful?
6. Can you describe any situations in which you feel that getting these messages would not be helpful?
7. How do you think these messages could be improved or made easier to use?
8. Can you think of any existing prompts or features on the system which may conflict with these?

Figure 4 Think aloud interview schedule

Think aloud interviews

[COMPUTER PROMPTS PRESENTED ON LAPTOP FOR GP TO USE]

*[Ask participant to try out the features of the prompts freely and say aloud what they are **doing, thinking, and feeling** about each feature (content and functions)]*

To ask during interview:

- Question why certain choices or comments are being made if full description is not given.

After participant has finished exploring prompts:

- How did you feel about this set of prompts?
- Which features (if any) would be used and why?
- Which features would not be used and why?
- Did features/options meet expectations before they were clicked on?
Ask why any features have not been used or clicked on.
- Ask for comments on any features which were not discussed.

4.2.4 Materials

4.2.4.1 Aim of prompts

A series of prompts were designed to a) promote adherence to antibiotic prescribing recommendations in accordance with the NICE guidelines (National Institute for Health and Clinical Excellence, 2008) (promote no antibiotic prescribing, or delayed antibiotic prescribing, instead of the immediate prescription of antibiotics where appropriate for RTI) and b) promote adherence to recommendations from the Intercollegiate Stroke Working Party for secondary prevention of stroke (ICSWP, 2008). The guidelines which the stroke prompts aimed to promote were as follows: 1) An optimal target blood pressure for stroke patients is 130/80 mmHg; 2) All stroke patients with total cholesterol >3.5 mmol/l should be treated with a statin; 3) Aspirin and Dipyridamole should be the standard secondary prevention treatment following non-haemorrhagic stroke. The prompts were designed to remind GPs of the recommended behaviour, convince them it will be beneficial and assist them with implementation.

4.2.4.2 Inclusion of theory

Prompts (for both RTI and stroke) were created drawing on aspects of Social Cognitive Theory (Bandura, 1977) following a review of the literature described previously in this thesis (Chapter 3). The theoretical constructs were chosen for inclusion if research suggested that they may encourage healthcare professionals to adhere to clinical guidelines. Based on findings of the theory review (Chapter 3), the components of the theory which were targeted included: environment, outcome expectancies, and self-efficacy. Messages were designed to provide a controllable and supportive environment, promote positive outcome expectancies and increase self-efficacy.

The GP's environment was modified to provide support for guideline adherence, in that prompts were designed to appear on the GP's computer screen during a consultation for RTI or stroke (prompts were designed to

automatically appear at appropriate consultations based on electronic condition read codes). This environment was designed to create maximum perceived controllability. The prompts appearing were controllable in terms of the range of functions and options available for GPs to select. The GP could therefore control if any information appeared, and the specific information which would be presented. All functions were supportive in terms of the messages and information to help the GP follow the guideline behaviour.

Outcome expectancies were addressed in the RTI prompts by presenting evidence that severity and duration of illness, as well as the risk of further complications, would not generally be increased by withholding an antibiotic prescription. Outcomes relating to concerns about patient expectations for antibiotics were addressed by presenting evidence suggesting that patients not prescribed antibiotics may be less likely to re-consult and believe antibiotics to be effective in future. Stroke prompts promoted positive outcome expectancies by emphasising the patient's reduced risk of suffering a further stroke if the GP followed the guidelines.

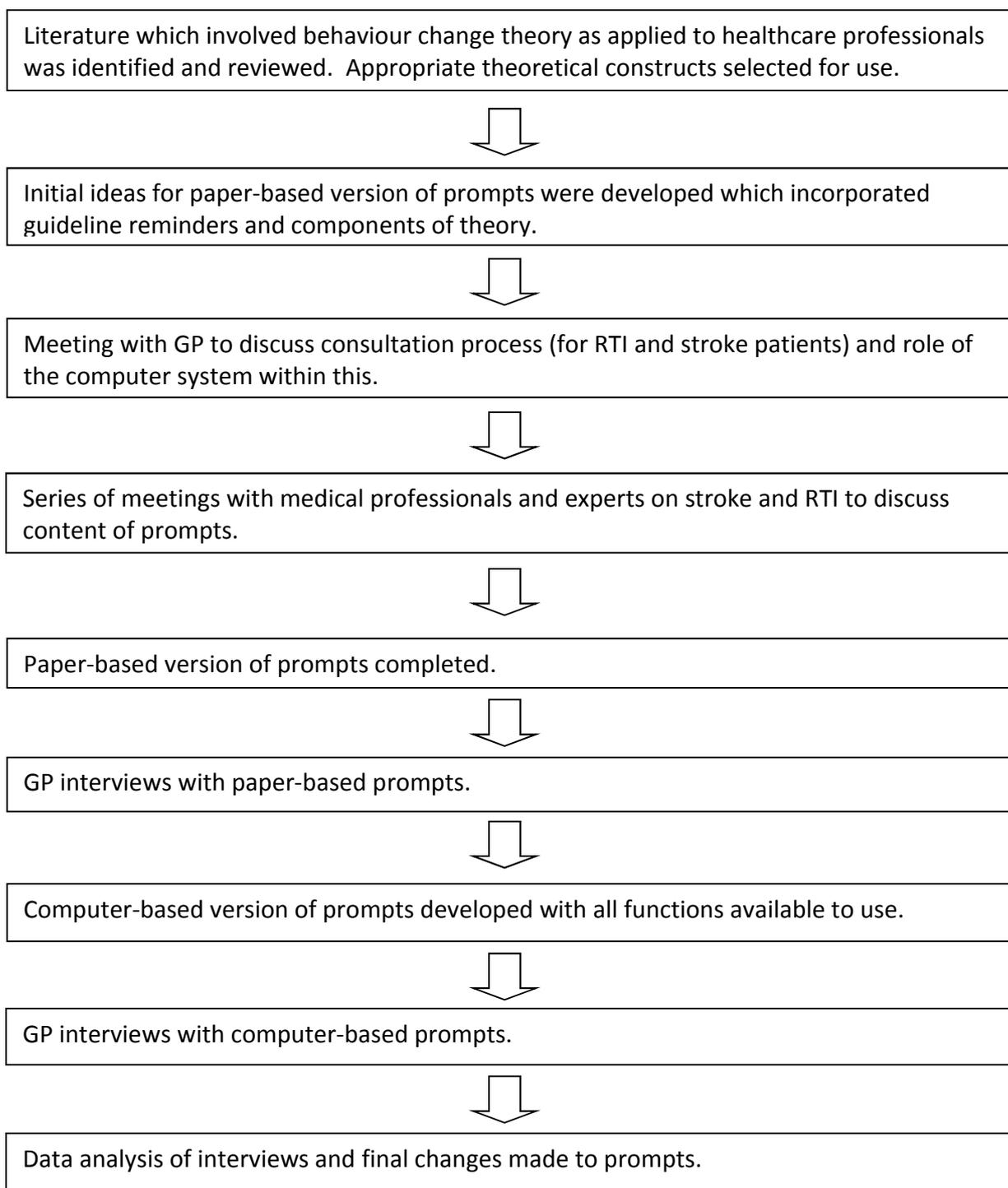
Techniques used to increase self-efficacy included elements of verbal persuasion and modelling. Verbal persuasion involved 'positive encouragement' in that GPs were told directly what they could do (e.g. "You can.."). For RTI, GPs were also given encouragement as to what actions they could take ('Instead of prescribing now you could...'). Verbal persuasion was only used to a minimal level in prompts due to lack of space and need for information to be concise as the GP would be viewing them during a consultation. The prompts also included information about the health consequences of the behaviour by presenting evidence of the effect that performing the recommended behaviour has had on other patients.

4.2.4.3 Development process

The development process also involved close consultation with a working group of general practitioners and experts in the area of stroke prevention and

RTI. During this stage a 'mock' consultation for both RTI and stroke patients was conducted with a GP to understand how and when the computer prompts could best be implemented during a consultation. This involved the GP explaining how a typical consultation would work, which screen options would be clicked on during this time, and common issues which may arise. The prompts were then developed to form a series of electronic messages which would pop-up on the GP computer screen during a relevant consultation. Prompts were initially produced in a paper based form, with each sheet representing a screen. Prompts were refined and improved as interviews progressed based on feedback provided. Final prompt content included a reminder of the guideline, a summary of evidence relating to the guideline and the option to print a patient information sheet. After 22 interviews the prompts were developed into a prototype html- based format, which represented the way they would function in practice. This allowed GPs to view the prompts on a laptop during interviews and try out the various functions and pages. Figure 5 illustrates the overall development process of the prompts.

Figure 5 Prompts development process



4.2.4.4 Content of prompts

Prior to information appearing, RTI prompts first ask the GP to select which type of RTI they would like to view specific information for; these conditions are separated according to the NICE guidelines (sore throat/pharyngitis/tonsillitis, cough/bronchitis, otitis media, rhinosinusitis, and the common cold). After selecting a condition, a menu page then appears presenting all pages available to select and view (this is identical for each condition; however, information appearing within each selection presents evidence specific to the condition). Appendix 3 presents an RTI menu page and Appendix 4 presents an example RTI content page. For the stroke prompts, a menu page is first presented offering a selection of three guidelines (Appendix 5), each guideline page then provides information and further options relating to the guideline selected. An example guideline content page for each guideline can be seen in Appendix 6.

4.2.5 Analysis

Inductive thematic analysis (Braun & Clarke, 2006) was conducted on all transcripts to determine likely responses to the prompts and identify factors involved in the decision to use the prompts and adhere to the guidelines. Analysis began after the first interview had been conducted and continued throughout data collection for all interviews conducted. Interviews were read in detail and re-read, and then following this immersion in the transcript's commonly occurring patterns and prominent themes were identified in the data and labelled with codes. Each code label referred to the operationalisation of the theme content. A coding manual (Appendix 7) was developed containing the label, a definition of each theme, positive examples from the interview transcripts, and possible exclusions for each code. The coding manual was refined as more data became available and transcripts were re-read, the continuing process involved themes being linked, grouped, moved, re-labelled, added and removed to produce a set of themes and coding manual which adequately fit and thoroughly explained the data. The coding was initially conducted by one author (L.M), themes and codes were then discussed with a second author (L.Y) and adjustments made where appropriate based on

this discussion. Following this, inter-rater agreement was then reached on all codes.

4.3 Results

Five themes emerged from the interviews, relating to the decision to use prompts and adhere to guidelines. Sub-themes were identified within each theme and are presented in Table 12. Themes were noted as being common across all interviews and did not differ across practice characteristics.

Table 12 Themes and sub-themes identified in GP interviews

Themes	Sub-themes
Perceptions of role of prompts	Rejection of enforcement and approval for choice. Acceptance of support tool.
Patient outcomes	Assistance in persuading patients. Perceived clinical appropriateness.
Prescriber differences	Willingness to use prompts. Useful for inexperienced staff.
Accessibility and presentation of prompts	Usability. Optimal information presentation. Tailored information. Provision of additional features.
Acceptability of guidelines	Caution about guideline differences Credibility of source.

4.3.1 Description of themes

Perceptions of role of prompts

The way in which the GP perceived the role of the prompts seemed to strongly affect whether they thought they would be likely to use them. The following sub-themes relate to the differing perceptions and how these were related to GPs' opinions of the prompts.

- **Rejection of enforcement and approval for choice.**

The GPs reported strong rejection and opposition towards any technique perceived as being a method to enforce behaviour. However, there was a positive view and approval for methods perceived as allowing choice and control over prompt use.

“Whereas I’ve clicked into here voluntarily, I’ve not come into the room to be shouted at. It’s just got to be, it’s got to be in neutral. For me to take information in it’s got to be my choice (...) But if I feel that it’s actually behaviour modification... I won’t, I won’t probably go there.”
(P01)

- **Acceptance of support tool**

There was an acceptance and willingness to use the prompts if they were perceived as a support tool to aid the GP’s own decision to follow guidelines.

“Well I think it’s always you know, if you’ve decided on a delayed prescription, then the delayed prescription is now being supported by something useful” (P01)

“I think it will be ... a tool that is nice to know is there and more and more we have bits of paper in our drawers and they don’t get pulled out cause we’re too busy and something immediately accessible, that is linked to the patient’s recent history, is quite useful.” (P19)

“You could put this in the background somewhere. Something you could click on if you just want to remind yourself what the guidelines are.”
(P31)

Anticipated patient outcomes

GPs reported that their use of prompts would be influenced by expected patient outcomes. The sub-themes relate to patient expectations and patients medical need.

- **Assistance in persuading patients**

The prompts were seen as potentially providing assistance in persuading patients who may not be willing to adhere to advice recommended in the guideline.

“But if you want to try and persuade a patient who needs a bit of persuasion – you might like to try these screens.” (P14)

- **Perceived clinical appropriateness**

Willingness to use the prompts was related to the perceived clinical need of the patient, and the specific benefit to the individual patient.

“Well I guess, you’re always going to have some people who are not going to necessarily be – it’s not really appropriate for them to be going from really ... aggressive medication just by having had a stroke, so if they’ve got incredible co-morbidity or just can’t take more tablets or whatever, ...again it’s a case of as long as you can ignore.” (P08)

“But, of course, it wouldn’t be appropriate, I guess, for a patient who’s elderly, with chronic bronchitis and has an exacerbation. So that would be different.” (P21)

Prescriber differences

GPs reported that individual differences amongst practitioners were likely to influence the use of prompts. Sub-themes related to willingness to use prompts and differing staff influences.

- **Willingness to use prompts**

GPs predetermined willingness to use prompts determines whether or not prompts are used, regardless of content or potential benefit.

“I think it’s partly going to depend on the GP’s attitude towards it because if you’ve got somebody going, oh, this is ridiculous, it’s on the screen, I don’t use it, don’t worry about it, then it’s going to ... it won’t be particularly helpful, but I think as long as you’ve got somebody who is into the idea and presents it properly, then, again, it’s another useful way of objectifying it and saying, oh look, there’s the evidence and I’m not just making it up.” (P08)

- **Useful for inexperienced staff**

Inexperienced staff were often viewed as likely to benefit from using the prompts. This could refer to temporary staff, new members of staff or staff who had recently completed their training.

“Yeah, I can see this being useful for registrars, new doctors, very useful for locums, actually, because we try to put together things for locums. We analyse our referral rates, for example, locums refer twice as many as we do.” (P03)

Accessibility and presentation of prompts

Participants suggested that usability issues concerning accessibility and presentation of information in prompts would influence the GP use of prompts. The sub-themes relate to various features of the prompts.

- **Usability**

All features of prompts should be easy to use and view, which will encourage their use.

“These would be very, very useful backups for us, just as long as there’s not loads and loads of things that we have to wade through, and so, as long as it’s quick and easy to understand, I think is ... very valuable, I think very good.” (P06)

- **Optimal information presentation**

Evidence and information should be presented to include maximum detail in a minimal clear and concise format.

“I mean, there’s a balance to be had, isn’t there, between how much detail you offer and the accessibility of it and, clearly, it’s a bit like doing slide presentations, you know, if you put too much stuff on, people think oh, I can’t actually understand it and switch off.” (P02)

- **Tailored information**

Information provided and prompts shown should be tailored as much as possible to the individual patient. This could involve personal requirements related to medication, age or reminders about events in the patient’s medical history.

“I think it’s great, I think it would be particularly good if it could be tailored to the person in front of me. Men, women, um you know, age, and co-morbidities maybe, but certainly age you know.” (P01)

- **Provision of additional features**

Additional features should be added to the prompts to provide additional further benefit and support.

“The little bit of concern with me is that it’s not quite integrated, I think this is getting better but we’ve got these other gaps, if you like, so the bit that’s missing for me is the local information about referral routes, referral forms and so forth.” (P07)

Acceptability of guidelines

GPs’ attitudes towards the prompts were related to the perceived acceptability of guidelines. Sub-themes relate to guideline differences and source of information.

- **Caution about guideline differences**

If GPs were aware of differences across guidelines, they reported being cautious about using the prompts. GPs were often aware of guideline differences (or remuneration recommendations in the case of QOF) and the reasons behind the differences.

“Well, who do we follow, NICE or QOF [Quality and outcomes framework], that’s the thing. You’ll always get conflict. Some of us follow QOF because it’s ... that’s what we get paid for, so you’ve got a conflict really, but is it the best thing for the patient?” (P04)

- **Credibility of source**

Participants stated that they would be comfortable using prompts if the guideline was perceived as coming from a credible source.

“Yes. Seeing the Royal College of Physicians and the Stroke Working Party is enough, really. Yes. I’d look at that and think, oh, we should be doing that.” (P19)

4.3.2 Development of prompts

The prompts were refined throughout the interview process based on continuing feedback. Early interviews provided many constructive criticisms and suggestions for change. Key changes and adaptations made to the prompts and the main themes which informed these can be seen in Table 13.

Key changes made to all prompts included adding a ‘cancel’ option on every page to allow GPs to close the prompts whenever they chose. Tabs providing the option to print the page or return to the main menu in order to view further pages were also added to each prompt; this provided the GPs with greater flexibility to use the prompts as they wished and navigate easily across different functions. In addition, a main menu page was created for both sets of prompts to appear before information pages are viewed. This was done to allow GPs to have full control of which pages were viewed and to easily see all functions which were available.

Key changes made to RTI prompts included merging the information from the ‘alternative treatments’ page onto the patient information sheet. This was done as GPs felt it would be useful to have alternative treatment information on a sheet which patients could take away and use at a later date; it also prevented the GP from having to print both the patient information sheet and the alternative treatments page. This also reduced the number of options to

click on in the menu page, which made other options clearer to view and select. Advice on what to do such as “instead of prescribing now you could issue a delayed prescription” was removed from all information pages. This was done to reduce the likelihood that GPs felt the prompts were a method of enforcement, following a number of GP comments. This also made the pages clearer to read and less cluttered with text. The names of all information pages available from the menu page were slightly renamed to ensure it was clear what each page referred to. This made the menu page easier to read and made it quicker for GPs to choose their selected page.

Changes to the stroke prompts included, creating a patient information sheet for each guideline. This provided the GP with an additional tool to help convince patients of the benefit of following the specific guideline, which the GPs reported would help assist them during a consultation. The stroke prompts were also designed so that only relevant prompts appeared for each patient. This meant that if the patient record indicated that the blood pressure was already at the target level, the prompt for the blood pressure guideline would not appear. This was also the case for the cholesterol level and the prescription of statins recommended by the guidelines. This ensured that the GP was only viewing information and reminders that were relevant to the patient in the present consultation. Finally a web link was added onto the stroke prompts which could be clicked on to lead directly to the full guideline document from the Intercollegiate Stroke Working Party. This provided the GPs with the option to look in detail at the guideline and ensure it originated from a trusted and credible source.

Once these features had been incorporated into the prompts, in the later interviews GPs expressed mainly positive comments about their use.

Table 13 Themes used to inform key changes in prompts

Prompt Set	Key changes made	Relevant theme
ALL	Cancel option on all pages.	Rejection of enforcement and approval for choice.
	Tabs to print, and return to menu added on every page.	Usability.
	Menu page to select which information is viewed.	Rejection of enforcement and approval for choice. Support tool.
RTI	Alternative treatments tab merged into patient information sheet.	Optimal information presentation. Usability.
	Advice on what to do removed from all additional information tabs.	Rejection of enforcement and approval for choice. Optimal information presentation.
	Names of additional tabs made clearer.	Usability. Optimal information presentation.
Stroke	Printable patient information sheet added.	Assistance in persuading patients. Provision of additional features.
	Only guidelines relevant to individual patient appear.	Tailored information.
	Link to Intercollegiate Stroke Working Party Guidelines.	Credibility of source. Guideline conflict.

4.3.3 Final content: Application of themes to prompts

The following section summarises the way in which themes were included into the final design of prompts. A summary of the key themes and changes are presented in table 13.

Perception of the role of prompts

Overall, the key themes and findings from the study were incorporated into the prompt design. For the theme relating to ‘perception of the role of prompts’, all messages aimed to emphasise autonomy and support and reduce any perception of enforcement. Autonomy was encouraged in that there were many page options for the GP to individually select, none of which were enforced as all pages could be cancelled and prompts exited immediately at any time. The prompts offered tools to support GPs in overcoming barriers reported to influence adherence. For example, GPs reported that patient pressure for a prescription of antibiotics often leads to non-adherence and a prescription being issued. The patient information sheet provided GPs with a tool to help reduce patient pressure and explain why a prescription of antibiotics may not be needed.

Anticipated patient outcomes

The theme which related to ‘anticipated patient outcomes’ involved GPs’ concerns regarding the clinical appropriateness of adhering to the guidelines for specific patients. These concerns were addressed by the prompts with the use of evidence which demonstrated the benefit to patients’ symptoms and condition if the guidelines were adhered to. For example, the RTI prompts provided two information pages which addressed medical concerns, including: ‘prescription indication’ (which presented cases where an antibiotic prescription would be necessary) and ‘complications/risk of non-prescribing’ (which presented evidence demonstrating the limited risk of a patient developing further medical complications if a prescription was not issued). GPs also reported that the prompts could be useful in persuading patients to follow their advice, which would in turn encourage the GP to adhere to the

guideline. For example, GPs reported that stroke patients are often unwilling to take statin medication due to the side effects, and this may lead to the GP not adhering to the guideline if they feel the patient will not follow the advice they provide. The prompts addressed such concerns by providing a patient information sheet, which the GP could use to help persuade patients of the reduced risk of having a further stroke if the guideline was followed.

Accessibility and presentation of prompts

'Accessibility and presentation of prompts' was a key theme identified in the findings. The prompts aimed to be easy to use in that menu pages clearly indicated options available and navigation across prompts was easily achieved with the provision of all menu options visible on each prompt at any time. Optimal information presentation was maintained within the prompts by using simple and brief statements, and offering the option to view information (such as NICE guidelines, or evidence) in greater detail on further pages if the GP wished. Additional features which GPs requested were incorporated into some of the prompts, these included full access to guideline documents, articles, and patient information sheets. GPs also requested prompts which were tailored to individual patients as much as possible. This was done for stroke patients, in that guidelines which were already being met for an individual patient did not appear on the screen during a consultation.

Acceptability of guidelines

Finally, acceptability of guidelines was reported as an important influence in the GP's decision to adhere to a guideline. The prompts ensured guidelines were acceptable by always referring to the guideline source wherever a reminder was presented (e.g. NICE 2008). In addition, wherever a guideline source was presented, GPs had the option to click on the link which would lead directly to the full guideline document and website which could provide detailed information endorsing the guideline and group associated with it.

4.4 Discussion

This study drew on social cognitive theory to develop prompts for two contrasting conditions, one acute and self-limiting and one involving secondary prevention. Analysis of data from interviews with GPs identified five key themes that GPs reported as likely to influence willingness to use prompts and adhere to guidelines. The themes identified included: perceptions of the role of prompts; anticipated patient outcomes; prescriber differences; accessibility and presentation of prompts; and acceptability of guidelines.

The themes were used to refine and adapt the original prompts, and led to the addition of features such as: printable patient information sheets; increased choice over information viewed; the option to cancel prompts; tailoring advice to patient characteristics; clearer information presentation, and other improvements to usability. Once these features had been incorporated GPs expressed generally positive views of the prompts.

4.4.1 Main findings

The most important influence on GP attitudes appeared to be 'perception of the role of prompts'. GPs reported that if they felt that the guidelines or prompts were being enforced they would develop a negative attitude towards them and be unlikely to use them constructively. However, if the GPs felt that they had control to choose to use the prompt and that it was supporting them, they would be likely to use it. This finding is consistent with the idea that control of environment plays an important role in successful behaviour change, which is an aspect of social cognitive theory (Bandura, 1977) that had been included in the intervention development. In this instance, the GP was controlling the environment in terms of which prompts appeared when selected, and had the ability to cancel the prompts if required. The finding is consistent with previous research which implicates the importance of environmental control in relation to guideline adherence, and is discussed thoroughly in Chapter 3 of this thesis.

This finding is also consistent with self-determination theory (Deci & Ryan, 1980), which argues that motivation towards a behaviour is strongest if an individual feels that they are acting autonomously, rather than responding to external influences. In relation to the intervention, GPs reported that they would be more likely to use the prompts if they were able to autonomously choose to view specific pages and were not being forced to view set screens and messages. A large body of research has also supported self-determination theory, and demonstrated that methods encouraging autonomy can result in greater adherence or behaviour change. These findings are discussed in detail within the theory chapter (Chapter 3) of this thesis. However, previous research on the importance of autonomy has generally focussed on health related behaviours conducted by the general public (e.g. healthy eating and exercise) and it has not been related to guideline adherence in healthcare professionals. This finding therefore provides an additional insight into the behaviour of healthcare professionals and suggests that self-determination theory may be a useful tool with which to develop a further intervention related to clinical guideline adherence.

A further factor which appeared to strongly influence the GPs' opinions of whether they were likely to use the prompts was anticipated patient outcomes. GPs reported that they would be more likely to use the prompts with patients who they felt needed persuasion to follow the guideline advice, and with patients who they felt it was clinically appropriate (e.g. patients unlikely to develop complications). This finding is consistent with the concept of outcome expectancies proposed in social cognitive theory (Bandura, 1977) and used in the development of the intervention. In this case, GPs reported the need to reduce the negative outcomes of the patient being dissatisfied with the advice or experiencing further medical problems. These findings are also consistent with those of Little et al., (2004) who reported that both perceived medical need and perceived patient pressure had a significant effect on GPs' antibiotic prescribing decisions. Previous research has also consistently identified GP concerns over medical complications and negative medical consequences as major influences in prescribing decisions (Wood, Simpson, & Butler, 2007; Kumar et al., 2003) which are prioritised over worries about antibiotic resistance in the case of RTIs (Simpson, Wood, & Butler, 2007).

Acceptability of the guidelines was also identified as influencing GPs' willingness to use prompts and follow the guidelines. GPs reported that they would be more likely to follow the advice if the guideline source was perceived as credible, and the recommendations did not conflict with any other guidelines. These findings are consistent with those of Rashidian (2008), who found that both credibility of source and content of guidelines were related to GPs' willingness to follow prescribing guidelines over a variety of conditions. Guideline differences have also been previously reported as a factor which may contribute to both confusion and lack of guideline uptake in GPs (Calderon et al., 2006). This finding therefore suggests that interventions or programs aiming to increase guideline adherence in healthcare professionals may achieve greater success simply by ensuring that the target guideline is adequately endorsed and supported by a source which GPs trust.

Individual prescriber differences were reported as influencing GPs' decisions to use the prompts. Many participants expressed the view that inexperienced staff (including trainees, nurses and registrars), were more likely to benefit from the prompts and that GPs would be likely to use these if they were training others. Although not possible in the current study, an additional application of the prompts as a training guide could be further developed, with the aim to increase adherence to guidelines in inexperienced or new staff. It was also reported that some GPs would simply be unwilling to even look at the prompts and may close them without trying or reading the contents. This is a difficult obstacle to overcome, however the study attempted to incorporate all key opinions expressed by GPs regarding factors which would encourage them to use the prompts, and as development continued, comments towards the prompts became very positive in general. In addition, none of the GPs who took part in the study reported that they would not use the prompts, suggesting that the pages were acceptable to be used in practice. However, the group of GPs who may be unwilling to use the prompts may also be a sample who would not agree to take part in this research. If this is the case, prompt usage data and feedback obtained from all GPs in surgeries who took part in the trial of the intervention could provide insight into individual GPs who may be unwilling to try the prompts. If a sample of GPs who are unwilling to try the prompts are identified, surgery training sessions incorporating positive

experiences of other GPs could be implemented in the future to address any concerns which have been raised.

4.4.2 Limitations

A limitation of this study relates to the feasibility of incorporating all findings and feedback into the intervention. The GPs highly valued simple information presentation and usability, which were incorporated into the prompts, but many also suggested adding a range of additional features to prompts such as local service information and detailed advice on medication. Since a wide and varying range of features were requested it was difficult to identify further features which would benefit the majority of GPs, without creating an intervention which would be complex and difficult to use. GPs also expressed a desire for information tailored to the individual patient. This feature was included in development, in that if a patient has been recorded as already meeting any of the stroke targets recommended, the prompt relating to this guideline would not appear. However, the range of tailored information which many GPs requested could not be implemented fully due to the complexity involved in creating software that would make different recommendations based on a large number of patient characteristics. Finally, although the study revealed a number of interesting factors which GPs report as potentially being influential in their decision to adhere to the intervention and guideline behaviours, the study did not trial the intervention or record the GPs' actual use of the prompts in practice. To establish the benefit of the intervention in adherence to guidelines a trial is necessary recording actual GP behaviour and patient outcomes, and further investigating GP views of using the prompts in daily practice.

4.4.3 Reflexivity

As the interviews progressed it became clear that many of the same prominent themes were consistently being discussed. As analysis of the interviews had already begun, I was aware of themes and had to ensure that I did not 'lead' participants into discussing these issues. For example, the theme 'rejection of

enforcement and approval for choice', appeared very consistently from early interviews and care was taken not to coerce participants into discussing this issue if it had not naturally arisen in the interview. Similarly, about half way through analysis it seemed that 'saturation' had been reached, in that no new themes appeared to be emerging and a few key themes appeared dominant in every transcript. Therefore, during analysis of later interviews I was careful to ensure that I was still closely examining the transcripts for any new themes which may emerge and noting the way in which themes were being discussed to ensure I was not imposing descriptions which best applied to earlier interviews on any themes which appeared in later interviews.

4.4.4 Conclusions

The qualitative process of working with GPs to develop a computer-delivered intervention to follow guidelines, successfully resulted in the creation of prompts which GPs approved of. The study identified a number of factors which GPs reported would encourage them to use computer-delivered prompts and adhere to guidelines.

A key characteristic of an acceptable computer-delivered intervention appears to be that it should be perceived as a useful tool supporting GP practice, rather than as didactic advice.

5. Chapter five: A qualitative process evaluation of a computer-delivered intervention trial to implement guidelines for antibiotic prescribing in respiratory tract infection

5.1 Chapter overview

The following chapter presents findings from a qualitative process evaluation of a computer-delivered intervention trial to implement guidelines for antibiotic prescribing in respiratory tract infection. The intervention had been previously developed in the study presented in Chapter 4, and had since entered into a cluster randomised trial across 100 GP surgeries which lasted for 1 year. The study aimed to evaluate the use and implementation of the RTI computer prompts by conducting qualitative interviews in order to investigate views and experiences of using prompts and the way in which they were implemented into practice during the trial. The study was conducted to inform the main trial results and assist in the interpretation of the trial findings. A sample of GPs who had experienced the prompts for one year as part of the trial took part in the interviews. In addition a small sample of staff who had been involved in the implementation of the intervention also took part in qualitative interviews.

5.2 Method

5.2.1 Design of study

The study used a qualitative design involving semi-structured interviews with 20 GPs and 4 study implementation staff. Telephone interviews lasting approximately 30 minutes were conducted with all participants. Two semi-

structured interview guides were used, one for GPs and one for implementation staff. All interviews were recorded using a digital voice recorder and were fully transcribed.

5.2.2 Participants

Participants were 20 GPs from 15 practices (from a possible 50 practices) across the country who had taken part in a trial of the computer prompts for antibiotic prescribing in RTI, which were developed in the study reported in Chapter 4 (McDermott et al., 2010). The areas which were recruited from included: Surrey, London, Oxford, Devon, Birmingham and Warwickshire. The surgery size varied across practices with the number of full time or equivalent GPs ranging from 2 to 12, and the number of patients registered to each full time equivalent GP ranging from 602 to 998. The index of multiple deprivation score (IMD) also varied greatly and ranged from 11 to 47. Recruitment took place by contacting practices at the end of the trial, who had been part of the intervention group and receiving the electronic prompts via an invitation letter (Appendix 8). Practices had consented to being contacted for participation in an interview when they had signed up to take part in the trial (a copy of the trial information sheet and consent form consent form can be found in Appendix 20 and 21).

If a practice wished to book an interview or ask any questions they contacted the researcher (LM) using the email or telephone number provided on the recruitment letters. Following participation in an interview, each GP received a payment by cheque of £50. All GPs who responded to the invitations took part in an interview (in total 50 practices were in the intervention group all of which were invited to take part).

For the implementation staff interviews, 4 participants were invited from each of the groups involved in the study (in order to include a range of views from all aspects of the trial implementation). Staff members were selected for interview if they had worked on the study from the beginning of the trial. One

participant was from the IT company who implemented the prompts onto the system, one participant was the trial manager responsible for practice recruitment and finally two members of the GPRD, who had been involved in recruitment and implementation were also interviewed. Implementation staff were invited to take part via email (Appendix 9) and consented to having their interviews recorded and transcribed. All staff members who were invited to take part agreed to an interview. *Although this was a small sample group of participants, it was included in the chapter as the findings provided additional context with which to interpret the GP study.

5.2.3 Procedure

The study was approved by the London – Surrey Borders REC and received PCT R&D approval (09/H0806/7). GPs were recruited from practices who had taken part in the trial of electronic prompts for RTI. These prompts had been developed in the study described in Chapter 4 of this thesis (McDermott et al 2010) and a trial of the prompts had then commenced. The trial was co-ordinated by Kings College London and involved 100 practices across the country. The protocol is fully described in the paper Gulliford et al (2011). GPs were recruited from the 50 practices who had been assigned to the intervention group and been receiving the electronic prompts in practice for one year. An invitation letter was sent to each of the intervention practices (Appendix 8) four weeks before the end of the trial. If no contact had been received from the practice a reminder email was then sent to the surgery two weeks before the end of the trial (Appendix 10). Finally, if a practice had still not been in touch to arrange or decline an interview, a final reminder letter was sent on the date the trial ended in each practice (Appendix 11).

Practices contacted the researcher (LM) directly by email or telephone (details of these were provided in the invitation letters) to arrange a convenient interview time or ask questions regarding the nature of the interviews. Each GP was contacted on their nominated telephone number at the allotted time and a semi-structured interview (figure 6) was conducted.

In addition to GPs, 4 interviews were also conducted with staff who had been involved in the implementation of the study and prompts (IT company, trial manager, GPRD). A separate semi-structured interview guide was used with this group (figure 7). These staff were recruited via email (Appendix 9) and contacted the researcher by phone or email to ask questions regarding the study and to arrange a convenient time for the telephone interview.

5.2.4 Materials

5.2.4.1 Semi-structured interview guide for GPs

The interview used a series of open-ended questions and followed a similar format to the structure which had previously been used in the intervention development phase (Chapter 4) as this had been successful in facilitating in-depth discussion of the prompts. The questions began by asking the GP how they felt about the prompts; this was designed to evoke conversation and begin a general discussion which then lead to more specific questions concerning, patients, colleagues, prompt use and problems.

The interview was designed to discuss the use of prompts within a clinical setting, problems with the prompts or implementation, improvements which could be made, and to highlight any issues with the intervention which may not have previously been considered. Overall the interview aimed to encourage GPs to discuss their experience of using the prompts and provide GPs with the opportunity to raise any issues they considered important. The interview guide is presented in figure 6 below.

Figure 6 Semi-structured interview schedule for GPs

GP interview guide

1. How did you feel about the prompts appearing?
2. How do you think patients felt about the prompts?
3. How much did you discuss the use of prompts with colleagues? (What did they think?).
4. Can you tell me about any situation where you successfully used the prompts?
5. Can you tell about any situation where you chose not to use the prompts.
6. Can you give me an example of a situation where you used the prompts but experienced a problem or difficulty?
7. How do you think the prompts could be improved or made easier to use?
8. Can you give me any examples of features of the prompts that you did not like?
9. How do you think the prompts impacted practice? (Any impacts on practice positive or negative. i.e. did they think the prompts 'worked'?)

- **Implementation staff semi-structured interview**

A semi-structured interview guide was also constructed for members of staff who had been involved in the implementation of prompts. The questions were designed to explore factors which may have influenced the implementation of the intervention/prompts and allow the participant to describe their experiences. The interview began by asking the participant about their role within the study, in order to allow them to begin talking freely to a simple question and open the interview with conversation. Figure 7 displays the semi-structured interview guide used for the implementation staff interviews.

Figure 7 Interview schedule for implementation staff

<p style="text-align: center;"><u>Implementation staff interview</u></p> <p>1. Could you briefly outline your role in the implementation of the RTI prompts used in this trial?</p> <p><u>Evaluation of Context</u></p> <p>Thinking about the implementation of the trial within the GPRD...</p> <p>2. What do you think were the main challenges in setting up the trial?</p> <p>3. How do you feel these may have impacted the trial overall?</p> <p><u>Reach</u></p> <p>4. How do you think the recruitment methods used to allocate practices may have influenced the trial?</p> <p><u>Fidelity</u></p> <p>5. How do you think the level of communication between the team and practices may have influenced the overall implementation of the trial?</p> <p><u>Additional</u></p> <p>6. Overall what do you think the main difficulties are in implementing an intervention of this nature?</p> <p>7. What do you think could be done in the future to improve the implementation of interventions like these?</p> <p>8. Finally, do you have any further comments you'd like to add based on your experience of this intervention?</p>

5.2.5 Analysis

Inductive thematic analysis (Braun & Clarke, 2006) was conducted on all transcripts to identify participants' experiences of using the prompts and

experiences of the study implementation. Analysis began after the first interview had been conducted and continued throughout data collection for all interviews conducted. Interviews were read in detail and re-read, and then following this immersion in the transcripts commonly occurring patterns and prominent themes were identified in the data and labelled with codes. Each code label referred to the operationalisation of the theme content. A coding manual (Appendix 12) was developed containing the label, a definition of each theme, positive examples from the interview transcripts, and possible exclusions for each code. The coding manual was refined as more data became available and transcripts were re-read, the continuing process involved themes being linked, grouped, moved, re-labelled, added and removed to produce a set of themes and coding manual which adequately fit and thoroughly explained the data. The coding was initially conducted by L.M, themes and codes were then discussed with L.Y and adjustments made where appropriate based on this discussion. Following this, inter-rater agreement was then reached on all codes.

5.3 Results

Four themes emerged from the interviews relating to GPs' experience of using the prompts in practice and study implementation. Sub-themes were identified within each theme and are presented in Table 14. Themes were noted as being common across all interviews and did not differ across practice characteristics.

Table 14 Themes and sub-themes identified in interviews

Themes	Sub-themes	
Awareness of implementation		Aware of implementation and confident to use prompts
		Unaware of implementation and confusion of prompts purpose
Usefulness of prompts	Benefits of use	Useful for inexperienced practitioners Support for decision A reminder/reference tool Can help reduce prescribing
	Barrier to use	Not needed as guidelines already followed
Positive impact on patients		Assistance in persuading patients Acceptable to patients Patient information sheet very useful feature.
Usability issues	Benefits of design	Easy to use Easy to control
	Barriers to use	Limited time to read and use Only English language available
	Improvements for future	Additional features Simplify further Increase visibility of prompts

5.3.1 Description of themes

Awareness of implementation

The GPs' level of awareness regarding the implementation of the prompts onto their system often influenced their willingness to use them or even notice them. Two distinct sub-themes were identified within this theme, relating to whether or not GPs were aware of the prompts.

- **Aware of implementation and confident to use prompts**

GPs who reported being aware of the implementation of the prompts either before or during the study reported being confident to use the prompts if they chose or wished to. Confidence in using the prompts was reported as being a result of the fact that GPs who were aware of the study: understood the prompts purpose, were expecting them, and the source of information within the prompts was considered plausible and trustworthy. Awareness of the study was reported as occurring via a number of methods which included; official emails detailing the implementation sent to all staff members; information presented during a staff meeting; informal chats with colleagues; or informal chats with a practice manager or practice research co-ordinator.

"We talked about it in practice so I was expecting it....I thought it was a very useful aid for me" (P08)

- **Unaware of implementation and confusion of purpose**

GPs who reported being unaware of the implementation of the prompts often reported being confused of their purpose. GPs who saw the prompts appear but had not been formally made aware of the study or the appearance of prompts often reported being less likely to use or look at them for a number of reasons which included: a lack of understanding for the prompts function; unclear about the source of information; uncertainty about whether the information could be trusted; uncertainty about whether the prompts were an advertisement (which are often shown in the same screen location). GPs who were unaware of the implementation also appeared to be less likely to have noticed the prompts. However, during the interviews once the purpose of the prompts had been made clear, some GPs reported that they would have been happy to use and try the prompts if they had been aware of this information sooner.

"I don't think anyone actually pointed it out to me.....I might have just thought 'Oh is that some sort of advertisement'...I probably would have used it, but definitely I would you know" (P05)

Usefulness of prompts

The prompts were often discussed in relation to their use as a tool in practice, either during a consultation or during the GPs' own time.

- **Useful for inexperienced practitioners**

GPs often reported the prompts as being particularly useful for inexperienced practitioners. These inexperienced staff members referred to newly qualified GPs, student doctors, locums, and nurse practitioners. GPs reported that these 'inexperienced staff' may benefit from the prompts as they would be less aware of the guidelines in general, the evidence and the recommendations not to prescribe antibiotics.

"New colleagues or new prescribers might be needing to look at it more" (P01)

- **Support for decision**

The prompts were reported as providing GPs with support in prescribing decisions they had already made. GPs were happy and willing to engage with and use the prompts if they perceived them as a tool which could support their own decision to either not prescribe antibiotics or issue a delayed prescription.

"First of all they give confidence to the doctor, that there is some evidence behind the decision" (P08)

- **A reminder/reference tool**

The prompts were often described by GPs as a reminder or reference tool. GPs reported using the prompts as a reminder for the guidelines and in particular as a facility to obtain and read references for the evidence which supports the guidelines. The use of the prompts as a reminder and reference tool was often reported as being used outside of the consultation time when a GP would have more time to read through these details if required.

"I think that it is a useful reminder, it doesn't take long before having seen them and you've refreshed your memory of the NICE guidelines"
(P04)

- **Can help reduce prescribing**

The prompts were perceived by many GPs as being a tool which could lead to an overall reduction in antibiotic prescribing rates. This reduction in prescribing was reported as being an effect which may occur for the individual GP, colleagues, the practice or all areas involved with the prompts.

"Oh I would have thought they will have reduced the amount of antibiotics prescribing" (P07)

- **Not needed as guidelines already followed**

The main barrier to using the prompts was due to the fact that some GPs reported not needing them as they were already following the advice recommended in the guidelines. In this instance, the prompts were described as not being needed in any way as the GP was already fully adhering to the advice and had their own methods and procedures for doing this. GPs in this group did not report any problem with the functions or features of the prompts specifically, but simply that they were not needed.

"I mean I don't find or look at them...because I'm usually relatively comfortable with my respiratory management shall we say, I do very few respiratory referrals etc" (P02)

Positive impact on patients

In general, the prompts were described as having a positive impact on patients and patient care and being acceptable to patients. No negative effects or views of the prompts in relation to patients were reported by GPs.

- **Assistance in persuading patients**

The prompts were often reported as providing GPs with assistance in persuading patients of the benefits in following the advice recommended in the guidelines. This particularly referred to persuading patients that antibiotics were not necessary for a RTI in patients who the GP perceived as being unwilling to or apprehensive about accepting this advice.

"There's always that kind of feeling like 'oh' (they want antibiotics), but actually its very good because it's helpful in guiding patients" (P10)

- **Acceptable to patients**

The prompts were reported as being acceptable to patients. This was discussed in relation to the various functions and features of the prompts and the way in which they appeared. GPs felt that the information contained in the prompts was useful to patients in relating to a prescribing decision and they could not think of any problems that their patients would have with the system appearing.

"I think they give confidence to the patient" (P08)

- **Patient information sheet very useful feature**

Overall the patient information sheet was discussed as being one of the most useful aspects of the prompts. GPs felt that the sheets were a very useful feature which could easily be given to patients who had not been prescribed antibiotics or who were receiving a delayed prescription. GPs often mentioned being familiar with the use of patient information sheets and feeling comfortable in using them.

"Its quite nice to give an information sheet because it's a sort of reminder for the patient about what we talked about.....it's quite a nice way to reinforce what our conversation has been about" (P06)

Usability issues

A number of issues relating to the usability of the prompts was discussed. This included discussion surrounding controlling the prompts, access and content issues, in addition to suggested improvements for the future.

- **Easy to control**

The prompts were reported as being easy to control when they appeared on the screen. GPs felt that the prompts could easily be controlled as they did not obstruct the computer screen when they appeared during a consultation, and could easily be either viewed or exited with a minimal number of clicks on the screen.

"I didn't find them particularly intrusive or anything like that, that I didn't want to use them, it was easy to ignore them" (P07)

- **Easy to use**

The prompts were perceived as being easy to use both during a consultation or in the GPs own time. GPs reported that the prompts were simple to navigate, it was clear which features were available, and that the content of the prompts was easy to read.

"It's very easy and simple to click that" (P06)

- **Limited time to read and use**

Some GPs reported that the prompts were often not used or used rarely due to the fact that they had limited time during a consultation or within their busy day to read the prompts. This limited time meant that GPs were not able to read and look through all options and features available within the prompts, or select which functions of pages they may wish to use. In some instances, despite being curious of information within the prompts, GPs felt they did not have enough time to consider them, and therefore did not use them.

"So it was sort of a nice idea but it's just that sort of real pressure on time, thinking you know, I can't go through all of this and it put me off" (P06)

- **Only English language available**

GPs in some areas reported that the prompts were difficult to use with a significant percentage of their patients who did not speak or read English. As the prompts were only available in the English language, information sheets could not be printed and screens could not be displayed to these patients (as some GPs reported that when they explained to patients the reason for not prescribing antibiotics they showed them the evidence displayed directly on the prompts which had appeared on their computer screen). Some GPs

reported that they would have liked to use the prompts if they were available in additional languages.

"If it's just in English it's not going to be useful specifically for us...um for our patient population Urdu or Mirpuri" (P01)

- **Additional features**

A number of GPs reported that the prompts could be improved by adding various additional features and functions to them. These features included adding further advice for the GP and patient in multimedia format (such as videos), links to additional healthcare services, and information relating to which antibiotic to prescribe.

"It's quite far-fetched but having some kind of recorded message as well,.....or videos detailing about you know...coughs, colds, not needing antibiotics, not needing consultations with the GP as well" (P01)

- **Simplify further**

Some GPs felt that the features, functions and content of the prompts could be simplified further. GPs acknowledged that the information was already concise, but felt that further simplifications could be made to make the prompts even easier to read and use in practice. Some suggestions for this included removing the number of options available on the menu page and reducing text.

"Well I don't like it when you have to go through several sub-menus really...and a lot of them had more buried you know" (P04)

- **Increase visibility of prompts**

It was also reported that the prompts would have been easier to use if they had been more visible on the computer screen during a consultation. GPs reported that they would have used the prompts more often if they had noticed them more and felt that other GPs may have done the same. Suggestions for increasing the visibility of prompts included: making them move across the screen, making them flash, or using brighter colours.

"I think they just didn't attract your attention away from what you were doing to notice them, so if they were somehow made to stand out more, or moved across to a different part of the screen this would help me" (P12)

5.3.2 Additional analysis: description of themes from implementation staff interviews

Interviews from staff involved in the implementation of the study were analysed along with the GP interviews. Analysis identified one theme which was common to all interviews 'Awareness of implementation', which is described above. Four additional themes, unique to the implementation staff interviews, were also identified, these are described below.

Table 15 Themes and sub-themes from implementation staff interviews

Themes	Sub-themes
Research governance approval problems	-Inconsistent procedures -Delay bias sample
Practice payment concerns in recruitment	-Difficulties due to non-payment for study -Payment bias sample
Communication to practices supported	-GPRD as a trusted group -GPRD bias sample
Communication difficulties within practices	-Delays due to practice staff unawareness of study. -Improvements to staff awareness needed.

Research governance and approval problems

Problems in obtaining research governance approval to conduct the study within NHS sites was reported as a factor which caused difficulties and delays for the implementation of the prompts and study. Two sub-themes were identified within this theme.

- **Inconsistent procedures**

Procedures were reported to differ widely across many research governance offices. These included differences in the information required, the nature of questions asked and the time taken to respond to queries and applications. These procedural issues often led to delays in receiving approvals for an area. Staff often discussed the possibility of this problem being due to the fact that the study was fairly unique which may have led to confusion across the research governance offices.

"the R&D offices, some of them were asking for completely different things...there would be delays with some...and just different procedures with the different offices..." (P IS 1)

- **Delay bias sample**

Some research governance offices took significantly longer than others to grant approval for the study to begin recruiting practices in their area. Therefore, due to the time constrictions of the study, recruitment was only conducted in areas which had given approval in a faster timeframe, and areas which had incurred long delays were not recruited from. Staff felt that this may have led to a bias in the sample recruited, as only practices from areas which had given fast approval were included in the sample.

"And we didn't get to recruit the areas who were slower in giving approval and things..." (P IS 1)

Practice payment concerns in recruitment

Practices were not being paid to take part in the study or view the prompts. During recruitment it was reported that many practices raised concern over this issue which may have had consequences on the process and outcome of practices recruited. Two sub-themes were identified within this category.

- **Difficulties due to non-payment for study**

Staff reported that difficulties often arose during recruitment due to the fact that practices were not being paid to take part in the study. These included delays in the time it took for a practice to respond to any contact (letter/phone call etc), receiving additional queries from practices about this issue and practices refusing to take part simply due to non-payment.

"but it definitely slowed it down a bit.....the majority of cases were just not willing to take on board this study without funding etc" (PIS 3)

- **Payment bias sample**

As practices were not paid to take part in the study, staff felt that this may have led to a sample which only represented practices who were happy to take part in research for free. It was suggested that practices who did take part in the study may have represented a group which shared certain research friendly attributes (such as being more open towards using the prompts etc).

"it meant that we only recruited a certain type of practice...um...that didn't mind not getting paid...so that would be a slightly different type of sample in the study" (P IS 1)

Communication with practices supported

Communication with practices was reported as being greatly supported by the GPRD in particular. The GPRD appeared to be viewed by practices as a trusted organisation with which to communicate. However, concerns were raised that this may have led to potential sample bias of GPRD only practices.

- **GPRD as a trusted group**

It was reported that throughout the implementation of the study, practices viewed the GPRD as a trusted group with which they were happy and willing to communicate. Due to this, the GPRD were able to facilitate communication between other staff involved in the prompts implementation and the practice. For example, the practice would liaise with the GPRD in order to approve involvement of the IT company responsible for setting up the system. This was necessary as some practices were unwilling to approve the prompt's set-up directly with the company.

“So then all the practices were in the GPRD...but this was a good thing because the practices know them and trust them” (P IS1)

- **GPRD bias sample**

As all practices recruited into the study were members of the GPRD, which is a research based collaboration, staff were concerned that this sample may not have adequately represented a typical practice. In particular it was reported that members of the GPRD may be more interested in research and more likely to engage with the prompts than a non-GPRD surgery.

“there is a set of practices who are part of these GPRD and research networks who are involved in research on almost a daily basis, we may have recruited a lot of these...so things may have been a bit easier” (P IS 4)

Communication difficulties within practices

It was reported that there were problems with communication between staff within each practice. This was primarily due to the fact that staff members were not being made aware of the surgeries’ participation in the study. Two sub-themes were identified within this theme.

- **Delays due to practice staff unawareness of studies**

Due to the fact that staff members within each practice were often not aware of the study, the implementation of the computer prompts was often delayed. This was due to the fact that permission for the study IT company to implement prompts on the practice system could not be given until a staff member who knew about the study confirmed participation. It was often the case that no other members of the practice staff had been informed of the study, therefore delays in this process were common.

“we soon learned that they had absolutely no clue or awareness about the study.....the study just ends up running for 18 months if not longer and I think a lot of that frankly was us not being able to get hold of the right person” (P IS 2)

- **Improvements to staff awareness needed**

All implementation staff reported that in future, measures should be taken to improve practice staff awareness of involvement in the study. This was seen as essential in order to improve the speed and efficiency of implementation procedures.

“In terms of pressing the practice...’well look- you have signed up for this thing, so can you please make your practice aware, maybe during the next practice meeting’.....and that would have made all the difference actually...so there was just a complete lack of awareness in my opinion” (P IS 2)

5.4 Discussion

The study aimed to evaluate the use and implementation of the RTI computer prompts by conducting qualitative interviews in order to investigate views and experiences of using prompts and the way in which they were implemented into practice during the trial. Analysis of GP interviews identified a number of themes relating to experiences of using the prompts and the study implementation. Analysis of implementation staff interviews identified a number of further themes relating to the implementation of prompts into GP practices.

5.4.1 Awareness of implementation

The most important factor to influence GPs' use of the prompts appeared to be their awareness of the implementation of the system into their practice. GPs who were aware of the implementation of the prompts reported feeling confident in using them if they chose to and understanding the purpose of them. However, GPs who had not been made aware that the prompts were going to be appearing, often reported feeling confused when they saw the prompts appear on the screen and not fully understanding what they were for or how they could be used. This finding would imply that GPs who worked in practices which informed staff that the prompts would be appearing on their screens and provided details of this, may be more likely to use and engage with the prompts.

Awareness of an intervention has also been identified as a key factor influencing GPs' response to the intervention and use of guidelines in previous research which evaluated tailored interventions for sore throat and respiratory tract infection guidelines (Flottorp, Havelrud, & Oxman, 2003). The evaluation reported that only 33% of practices had discussed the project with staff members before the intervention started. Furthermore, problems with internal communication within a practice (related to a lack of awareness) were identified as a factor which contributed to the lack of GP behaviour change and adherence to guidelines in the trial. Furthermore, over 13% of practices were described as having 'serious' problems with internal communication.

Reviews of interventions to implement clinical guidelines have also identified practice staff 'awareness' as an important factor which can influence the success of an intervention. Cabana (Cabana et al., 1999) reviewed 76 studies of interventions for clinical practice guidelines and reported that 'lack of awareness' was a major influence in the outcomes and use of the advice provided. Furthermore, a review of interventions to increase the use of evidence based practice (Grol & Wensing, 2004) concluded that the organisational context (practice setting) in which an intervention takes place can act as a major barrier to the uptake and use of the guidelines

recommended. In this study, the organisational context of practice managers or senior practice research staff who signed up to take part in the study, i.e. not informing GPs that the computer prompts would be appearing may have directly influenced their use and views of the intervention.

In addition, a review of computer-delivered clinical guidelines (Moxey et al., 2010) recently reported that factors which influenced physicians' use of computer interventions included both system training and endorsement by colleagues. The findings of the present study support this in that GPs who had been informed of the intervention and its functions by colleagues reported feeling confident to try and use the prompts in practice. This perhaps reflects both an element of training in that the GPs understood how the prompts could be used and also an endorsement by colleagues, in that practice staff were providing information that the prompts were appearing from a trusted source which the practice had agreed to.

Therefore, findings seem to suggest that future studies should aim to ensure that GPs are fully informed of an intervention before a trial or implementation begins. However, studies which have attempted to inform staff in this way have reported difficulties in communicating the information to staff. For example, a cluster randomised trial to increase clinical guideline adherence provided practices with project newsletters for all staff; however a process evaluation of the trial later revealed that the newsletters were not being distributed within some practices (Flottorp et al., 2003). Therefore, measures would need to be taken to ensure that GPs are receiving any information relating to an intervention which has been deemed as necessary. Methods such as direct emails to GPs, start of study meetings with researchers and staff, or direct meetings with individual GPs could be considered to ensure that relevant information relating to an intervention is passed to staff. However, presenting information to GPs relating to an intervention could seriously influence the outcome of the trial and lead to GPs changing their behaviour based on their knowledge of participation in the trial as opposed to an effect relating to the intervention itself. Findings of the present study and previous research in the area does suggest that some information should be presented

to GPs, as no information on the intervention may result in the system being avoided by GP's and subsequently not tested in practice. Therefore, ensuring that some information is presented to GPs relating to the presence of computer-delivered messages appearing but keeping the details as minimal as possible may result in greater engagement with an intervention.

5.4.2 Self-determination theory

The findings of the GP interviews also appear to be consistent with self-determination theory (Deci & Ryan, 1980). When discussing the use of prompts, GPs reported finding the prompts useful if the information which appeared supported their own prescribing decision. This suggests that rather than changing behaviour or persuading them not to prescribe antibiotics, the GPs thought the prompts were useful if they were perceived as supporting a decision to adhere to the guidelines which the GP had made autonomously. This is consistent with self-determination theory which suggests that techniques which encourage autonomy would result in greater compliance and engagement. A large body of research has supported this claim and is discussed in Chapter 3 of this thesis.

In addition, GPs also reported finding the prompts useful as they were easy to control. This would also be consistent with self-determination theory as placing the GP in control of the prompts and not forcing information to appear increases autonomy and according to the theory would make an individual more likely to engage in a behaviour (as they are in control and behaving completely autonomously in regards to the information they view).

Furthermore, this finding is also consistent with social cognitive theory (Bandura 1977), which proposes that an individual will be more likely to engage with a behaviour if their environment is perceived as controllable. In this instance, the GP was controlling the environment in terms of which prompts appeared when selected and had the ability to cancel the prompts if required. The finding is consistent with previous research which implicates the

importance of environmental control in relation to guideline adherence, and is discussed thoroughly in Chapter 3 of this thesis. This finding was also supported in the prompts development study (Chapter 4/ McDermott et al 2010) as GPs reported that if they felt that the guidelines or prompts were being enforced they would develop a negative attitude towards them and be unlikely to use them constructively. However, if the GPs felt that they had control to choose to use the prompt and that it was supporting them, they would be likely to use it. This repeated finding therefore suggests that GPs may be more likely to engage in a computer-delivered intervention if it is perceived as being easy to control and not enforcing recommendations but supporting GPs autonomy.

5.4.3 Outcome expectancies

Aspects of social cognitive theory (Bandura 1977) also appeared to be supported in relation to outcome expectancies. GPs felt encouraged to use the prompts if they were perceived as having a positive impact on patients. GPs reported that using the prompts could lead to positive patient outcomes which included assistance in persuading patients to follow the guidelines and the use of information (sheets and screens) which patients would understand. This finding appears to support social cognitive theory which proposes that an individual would be more likely to engage in a behaviour (in this case, engaging with the prompts) if positive outcomes are expected to result from it. Previous research in the area has also suggested that GPs may be more likely to follow recommendations or use a computer-delivered intervention if they perceive positive patient outcomes as likely to result from this. Evidence relating to this theory in a healthcare setting is discussed in Chapter 3.

This finding was also reported in the intervention development study (Chapter 4/ McDermott et al 2010) as GPs felt that they would be more likely to use the prompts if they thought that use would have a positive outcome on persuading patients to follow the advice and not have any negative health outcomes. This repeated finding suggests that promoting positive patient outcomes may encourage GPs to engage with and use computer interventions in this area.

Furthermore, the finding that GPs reported the prompts as being beneficial in persuading patients to accept the guideline based advice has also been supported in previous literature. For example, Little et al (Little et al., 2004) reported that perceived patient pressure had a significant effect on GPs' antibiotic prescribing decisions. The fact that GPs in the present study felt they needed to persuade patients that antibiotics were not necessary suggests that they perceived a patient pressure to prescribe. This finding has also been consistently reported across studies in the area (Coenen, Michiels, Renard, Denekens, & Van Royen, 2006) which include the intervention development study (Chapter4/McDermott et al 2010). This would also suggest that interventions which promote the use of information or facilities to assist a GP in encouraging patients to accept the guideline based recommendations may also increase GPs' engagement with and use of them in practice.

5.4.4 Implementation staff interviews

In addition to GP interviews, a small sample of interviews with implementation staff was conducted. Although the sample was small, the findings of the interviews were included in this chapter as they provide additional insight with which to interpret the GP findings. The main finding from the GP interviews related to 'awareness of the implementation' in that GPs who had not been made aware of the study reported being less confident in trying to use the prompts as they were uncertain of their purpose, in contrast to GPs who were aware of the study and confident in using the prompts. This theme was also reflected in the staff interviews, in that one of the key findings related to communication difficulties within practices. Implementation staff revealed that a lack of internal communication across practice staff resulted in severe delays in the prompts being implemented onto some practice systems. It was reported that practice staff had often not been made aware that the study was going to take place by the head of research at the practice and refused to give permission to access the practice system until this was confirmed. However, confirming the practice participation could often take weeks and if the head of research for the practice was away at the time a delay of months could occur.

Although the sample of implementation staff used in this study was relatively small, the findings are also reflected in the evaluation of similar trials investigating GP interventions. For example, practice staff discontent and communication difficulties, delays in implementation and surgeries requiring several reminders in order to install intervention software have also been previously reported (Perkins et al., 2008; Lobo et al., 2003; Flottorp et al., 2003). In one severe case reported, the authors found that it was often difficult to get through to the correct practice staff on the phone and concluded that internal communication problems had resulted in making the trial difficult to run and implement in a total 25% of all practices involved (Flottorp et al 2003).

These findings demonstrate that problems with internal communication within practices can influence both the implementation of computer-delivered interventions and the possible use of such systems, as the findings of the GP interviews reported. The findings also suggest that future interventions should include measures to ensure that practice staff are made aware of the implementation of a trial and exactly what this will involve. For example, obtaining names and contact details of alternative members of staff who can authorise the implementation of software could improve the speed with which this occurs.

5.4.5 Limitations

In relation to limitations in the usability of the prompts, GPs reported that they were often prevented from using the prompts as they felt that they did not have enough time to read the content and decide which features to select. During the intervention development study, similar comments were made and based on the GPs' advice the content of the prompts was made as concise as possible. Many of the GPs who reported this as a problem did acknowledge that it would be difficult to reduce the content further and admitted that in some cases they had not even looked through the prompts as they were afraid

this would take too long and were unsure of how much there was to view. Therefore it is possible that these GPs would have been happier to try to use the prompts if they were shown the content of the prompts or given information at the beginning of the trial showing what the screens contained. This is a feature which could be incorporated into future studies to deal with GP concerns and encourage prompt use.

A further limitation of the prompts was identified by GPs as the lack of additional languages available for the patient information sheets or information presented on the screens. GPs in some areas reported many of their patients could not read English and therefore the screens or patient information sheets could not be presented to them. The use of prompts could be increased if future studies identify specific language preferences of each practice and ensure that all information is available in each language required.

A number of GPs felt that the prompts could be improved by including additional features to the selection available. These features included providing information about which medication to prescribe for a specific condition and information about local service providers and secondary care contact details. This finding was also reported in the intervention development study. However, although many of the additional features requested by GPs may be beneficial for general practice, they do not relate to the aim of the prompts which is antibiotic prescribing in RTI and including all suggestions in future studies would require significant additional resources and may confuse and complicate the intervention purpose. In addition there was not an individual feature which was consistently reported across GPs that was universally agreed as a necessary addition. Despite this, responding to the most prevalent requests and feedback provided by GPs if possible could improve future interventions (e.g. increasing staff awareness of the implementation). In particular, the patient information sheet was widely regarded by GPs as one of the most beneficial functions of the prompts and most regularly used feature.

As participation in the interviews was voluntary, a large proportion of GPs who had been involved in the trial and receiving the prompts were not included as they did not respond to invitations for a telephone interview. This may have resulted in the GPs not representing those from a typical surgery and instead represented GPs with a specific interest in the prompts or research of this nature. In addition, larger proportions of GPs may have been unaware of the prompts implementation, confused when they appeared and declined an interview for this reason. Furthermore, invitations were sent to the head of research at each practice who had signed up to the original study and may not have been distributed as requested to all practice GPs (as was often the case with information regarding the implementation of the study). However, the telephone interviews were funded and GPs were offered a fee for taking part, which was not the case with the trial, and may have encouraged GPs who did not have a specific interest in the prompts to take part.

Overall the interviews presented a number of interesting findings which can be used to inform future studies which aim to implement computer-delivered guidelines into a primary care setting. However, the findings represent GPs' self-reported views and experiences and further data from the trial will inform the analysis of the intervention benefit in relation to actual GP behaviour and patient related outcomes. The qualitative findings can however provide additional insight to the final trial outcomes.

5.4.6 Conclusions

Findings from the interviews suggest that practice staff awareness of the implementation of a computer-delivered intervention may strongly influence both GP use of prompts and efficiency of implementation. Future interventions should aim to ensure that the protocol includes methods to inform all practice staff of the computer prompts which are to be implemented onto their system.

The interviews also suggested that GPs may be more likely to perceive computer-delivered prompts as useful if they are viewed as tools which support practice and can be easily controlled, as opposed to a technique which is trying to change practice. This finding supports self-determination theory (Deci & Ryan, 1980) and suggests that future interventions could benefit from ensuring that computer-delivered messages and systems are perceived by GPs as tools which support their autonomous decision to follow recommendations as opposed to methods of guideline enforcement.

GPs widely reported that they were encouraged to use the prompts as they were perceived as having positive patient related outcomes (in relation to persuading patients to follow advice and acceptability of patient information sheets and information). This supports the idea of outcome expectancies from social cognitive theory (Bandura 1977) and suggests that future interventions could increase GP engagement with prompts if they promote a positive impact on patients and include features to assist GPs in persuading patients to accept advice (such as patient information sheets).

The findings suggest that future interventions could be improved by including a feature of the prompts or information provided which reassures GPs that the prompts are brief and will not take excessive amounts of time to view or use in practice. In addition providing patient screens and information sheets in languages which are applicable to the population of each practice may also increase GP use of prompts.

Overall, GPs reported that the prompts were considered as useful and acceptable in practice. The findings suggest that computer-delivered prompts may be viewed as useful and engaged with by GPs if they are aware that prompts will be appearing prior to implementation and perceive the prompts as tools which support practice and have a positive impact on patients.

6. Chapter six: A quantitative process evaluation of a computer-delivered intervention trial to implement guidelines for antibiotic prescribing

6.1 Chapter overview

The following chapter presents findings from a quantitative process evaluation of a computer-delivered intervention trial to implement guidelines for antibiotic prescribing in respiratory tract infection. A key focus of this study was the assessment of theory use within the intervention. The intervention had been previously developed in the study presented in Chapter 4, and had since entered into a cluster randomised trial across 100 GP surgeries which lasted for one year. The study aimed to assess the impact of the prompts by examining group differences in self-efficacy and outcome expectancies related to treating a patient with a RTI without prescribing antibiotics (in accordance with the NICE guidelines). These factors were assessed using two theory based measures which were developed specifically for this study. In addition the study aimed to evaluate the success of various aspects of the intervention with the use of an intervention evaluation measure which had also been designed for this trial.

6.2 Method

6.2.1 Design of study

The study involved the design and implementation of three questionnaire measures which were completed by 83 GPs. The questionnaires consisted of two theory based measures, one for outcome expectancies and one for self-

efficacy (both derived from social cognitive theory) and one intervention evaluation measure. The intervention group completed all three measures and the control group completed only the two theory based measures (outcome expectancies and self-efficacy) as this group had not used the intervention and therefore could not evaluate it.

6.2.2 Participants

Participants were 83 GPs from practices who had participated in a nationwide trial of computer prompts for antibiotic prescribing in RTI, which were developed in the study reported in Chapter 4 (McDermott et al., 2010). In total 56 GPs from the control group and 27 GPs from the intervention group completed a questionnaire.

Areas from which GPs took part in the questionnaire included: Surrey, London, Oxford, Devon, Birmingham, and Warwickshire. The surgery size varied across practices with the number of full time or equivalent GPs ranging from 1 to 12, and the number of patients registered to each full time equivalent GP ranging from 598 to 1194. The index of multiple deprivation score (IMD) also varied greatly and ranged from 7 to 47. Recruitment took place by contacting all practices who had taken part in the study at the end of the trial, (from both the intervention and control groups) via an invitation letter (Appendix 13 and 14).

6.2.3 Procedure

The study was approved by the London – Surrey Borders REC and received PCT R&D approval (09/H0806/7). GPs were recruited from practices that had taken part in the trial of electronic prompts for RTI. These prompts had been developed in the study described in Chapter 4 of this thesis (McDermott et al 2010) and a trial of the prompts had then commenced. The trial was co-

ordinated by Kings College London and involved 100 practices across the country. The protocol is fully described in the paper reported by Gulliford et al (2011). GPs were recruited from practices that had been assigned to both the intervention and control groups of the trial (trial information sheet and consent form can be viewed in Appendix 20 and 21).

An invitation email was sent to each of the 100 practices (Appendix 13 and 14) four weeks before the end of the trial (the email contained a web-link to the questionnaire or the option to request paper questionnaires). If no questionnaires had been completed by a practice, a reminder letter was then sent to the surgery two weeks before the end of the trial (Appendix 15 and 16), (this letter also contained paper versions of the questionnaire which the surgery could complete if they wished and an addressed stamped envelope with which to return it). Finally, if a practice had still not completed a questionnaire two weeks later, a final reminder email was sent on the date the trial ended in each practice (Appendix 17 and 18).

Practices could contact the researcher (LM) directly by email or telephone (details of these were provided in the invitation) to ask any questions about the trial or to request paper versions of the questionnaire.

6.2.4 Materials

There were two versions of the questionnaire, one for the intervention and one for the control group. The intervention group received all 3 measures which consisted of the outcome expectancies questionnaire, the self-efficacy questionnaire and the intervention evaluation questionnaire. The control group received only the outcome expectancies and self-efficacy questionnaires (as they had not seen the intervention therefore could not evaluate it).

6.2.4.1 Outcome expectancies questionnaire

The outcome expectancies questionnaire was designed to measure GPs' outcome expectancies relating to managing a patient with a RTI without prescribing antibiotics (in accordance with the NICE, 2008 guidelines). Outcome expectancies refer to the theoretical construct proposed by social cognitive theory (Bandura, 1977) and discussed in detail in Chapter 3 of this thesis. In summary, the questionnaire aimed to measure the degree to which GPs believed that positive or negative outcomes would arise from treating a patient with an RTI without prescribing an antibiotic.

Each item related to a possible outcome which could occur (positive or negative) if the GP treated a patient without using an antibiotic. The GP had to rate the degree to which they believed this outcome would be likely to occur on a five point scale ranging from agree strongly to disagree strongly. The format of the questionnaire was developed according to concepts suggested by Bandura (Bandura, 1998; Bandura, 2006) and aimed to capture the outcomes which GPs expected to result from following the NICE guidelines and not prescribing antibiotics in the majority of patients with a RTI.

The outcomes presented in each item were devised by identifying issues which had been highlighted in previous research as influencing GP's decision to prescribe antibiotics to patients with a RTI. The items related to the issues of: antibiotic resistance, patient education, patient pressure, time constraints, patient risk of clinical complications, and patient re-consultations. These issues had been identified in both qualitative and quantitative studies previously (e.g. McDermott et al, 2010; Eccles et al.,2007; Hrisos et al, 2008; Rashidian et al, 2008; Little et al 2004) and are discussed in more detail in the theory Chapter (Chapter 3) and the intervention development Chapter (Chapter 4) of this thesis.

The items can be seen in figure 8 below; a full version of the questionnaire as it appeared to participants is presented in Appendix 19 (the control group

were only presented with section 5). The online version of the questionnaire was presented using 'iSurvey' which is a secure, password protected website run by the University of Southampton (<https://www.isurvey.soton.ac.uk/>).

Figure 8 Outcome expectancies questionnaire

For each option please rate your level of agreement using the scale below to the following statement:					
“If I treat a patient with an RTI without prescribing antibiotics....”					
	Agree strongly	Agree	Neither agree nor disagree	Disagree	Strongly disagree
I will help reduce antibiotic resistance*					
This will help to educate the patient that antibiotics are not always necessary for treating RTI*					
The patient will be dissatisfied with the outcome					
The patient may develop further clinical complications					
The consultation will take longer (in order to explain non-prescribing decision to patient)					
The patient will be more likely to re-consult with the problem					
The patient is more likely to book an appointment with another GP in future					

6.2.4.2 Self-efficacy questionnaire

The self-efficacy questionnaire was designed to measure GPs' self-efficacy in relation to managing a patient with a RTI without prescribing antibiotics (in accordance with the NICE, 2008 guidelines). Self-efficacy refers to the theoretical construct proposed by social cognitive theory (Bandura, 1977) and discussed in detail in Chapter 3 of this thesis. In summary, the questionnaire aimed to measure the degree to which GPs believed they had the ability to treat a patient with a RTI without prescribing antibiotics.

Each item related to a situation which may occur during a consultation. The items presented a variety of situations, some of which contained facilitators that may make non-prescribing easier and some situations contained barriers which may make non-prescribing more difficult or problematic for the GP. The GP had to rate how confident they were in their ability to treat a patient without using antibiotics in each of the situations presented on a 10 point scale (ranging from 0-cannot do at all to 10-highly certain can do). The format of the questionnaire was developed according to concepts suggested by Bandura (Bandura, 1998; Bandura, 2006) and aimed to capture the GPs' perceived self-efficacy in adhering to the NICE guidelines and not prescribing antibiotics in the majority of patients with a RTI.

The situations presented in each item were devised by identifying issues which had been highlighted in previous research as influencing GPs' decision to prescribe antibiotics to patients with a RTI. The facilitators and barriers presented in each item related to issues surrounding patient pressure, time constraints and the patient risk of clinical complications. These issues had been identified in both qualitative and quantitative studies previously (e.g. McDermott et al, 2010; Eccles et al.,2007; Hrisos et al, 2008; Rashidian et al, 2008; Little et al 2004) and are discussed in more detail in the theory chapter (Chapter 3) and the intervention development chapter (Chapter 4) of this thesis.

The items can be seen in figure 9 below, a full version of the questionnaire as it appeared to participants is presented in Appendix 19. The online version of the questionnaire was also presented using 'iSurvey'.

Figure 9 Self-efficacy questionnaire

<p>How certain are you that you could treat a patient with an RTI <u>without</u> an immediate prescription of antibiotics? Please use the scale below to rate each statement.</p>											
	Cannot do					Moderately certain can do					Highly certain can do
	0	1	2	3	4	5	6	7	8	9	10
When a patient DOES want antibiotics.											
When a patient DOES NOT want antibiotics.											
When you are in a rush											
When you have plenty of time to talk to a patient											
When you think a patient is at LOW risk of developing further medical complications.											
When you think a patient may be at HIGH risk of developing further medical complications.											
When a patient has used self-management techniques for the RTI before consulting.											

6.2.4.3 Intervention evaluation questionnaire

This questionnaire aimed to evaluate the intervention as part of a wider process evaluation in conjunction with the qualitative interviews which were also carried out at the end of the trial (Chapter 5). The questionnaire development was guided by the key criteria suggested by Linnan and Steckler (Linnan & Steckler, 2002) for the process evaluation of public health interventions and research. These criteria include an evaluation of the interventions: context (external factors which may influence prompt use), reach (the proportion of participants which use the prompts), dose delivered (prompt appearance), dose received (prompt usage), fidelity (quality of implementation), and use of theoretical constructs. Table 16 demonstrates the way in which each component was evaluated in this study. Each component was then incorporated into a section of the evaluation questionnaire; the way in which each component was used in the questionnaire can be seen in table 17.

Table 16 Process evaluation components and method used

Evaluation component	Evaluation method
Context	Evaluation questionnaire/Interview
Reach	Interview
Dose delivered	Interview
Dose received	Evaluation questionnaire/Interview
Fidelity	Evaluation questionnaire/Interview
Theoretical constructs	Theory Questionnaires

Table 17 Evaluation components used in intervention questionnaire

Evaluation component	Questionnaire items	Questionnaire section
Context	Consultation	3
	Additional issues (Agreement with guidelines/ Communication)	4.1 and 4.2
Dose received	Prompt type	2
Fidelity	Software	1

Section 1: Software

This section of questions aimed to evaluate the functionality of the prompts which had been delivered during the intervention. The questions required the GP to rate their level of agreement with statements relating to the way in which prompts could be accessed, read and used during a consultation. Figure 10 presents the questions in the section.

Figure 10 Items presented in section 1 of the intervention evaluation questionnaire

How much do you agree or disagree with the following statements:				
	Agree strongly	Agree	Disagree	Disagree strongly
The prompts were easy to read				
There were no problems accessing the prompts				
The program was too slow				
The prompts were difficult to access				
The prompts appeared during consultations for patients with RTIs				
The prompts appeared at an appropriate time during a consultation				
The prompts appeared at an inappropriate time during a consultation				

Section 2: Prompt type

This section of questions aimed to assess how useful the prompts were for each condition in practice. The questions required the GP to rate their level of agreement to the statement that a prompt was useful in supporting practice (this was conducted for each type of prompt). Figure 11 presents the questions in the section.

Figure 11 Items presented in section 2 of the intervention evaluation questionnaire

How much do you agree or disagree that each of the following prompts were useful in supporting your practice:				
	Agree strongly	Agree	Disagree	Disagree strongly
Sore throat/ pharyngitis/ tonsillitis				
Cough/ acute bronchitis				
Otitis media				
Rhinosinusitis				
Common cold				

Section 3: Consultation

This section aimed to assess the ease with which the prompts could be used during a consultation. The questions required the GP to rate their level of agreement with statements relating to using the prompts during a consultation. Figure 12 presents the questions in the section.

Figure 12 Items presented in section 3 of the intervention evaluation questionnaire

How much do you agree or disagree with the following statements:				
	Agree strongly	Agree	Disagree	Disagree strongly
The prompts are easy to use during a consultation for RTI.				
There are problems using the prompts <i>during</i> a consultation for a RTI.				

Section 4: Additional issues

This section combined the two topics of agreement with guidelines and communication.

Agreement with guidelines: These questions aimed to assess the degree to which GPs were familiar with and agreed with NICE guidelines (2008) for the non-prescription of antibiotics in patients with RTI. The questions required the

GP to rate their level of agreement with statements relating to the NICE guidelines for RTI.

Communication: These questions aimed to assess the quality of communication relating to the prompts and implementation with GP practices. The questions required the GP to rate their agreement or answer 'yes' or 'no' to statements relating to communication within practices relating to the prompts. Figure 13 presents the questions in the section.

Figure 13 Items presented in section 4 of the intervention evaluation questionnaire

4.1 How much do you agree or disagree with the following statements:				
	Agree strongly	Agree	Disagree	Disagree strongly
I am familiar with the NICE guidelines for antibiotic prescribing in RTI.				
I agree with the NICE guidelines for antibiotic prescribing in RTI (which recommend limited prescribing of antibiotics for RTIs).				
I was satisfied with the level of communication within the practice relating to the trial.				
Communication within the practice relating to the trial could have been improved.				
4.2 Please answer 'Yes' or 'No' to the following statements:				
	Yes		No	
I discussed starting the trial with other members of practice staff before it began				
I met to discuss the prompts with colleagues during the trial				

A full version of the questionnaire as it appeared to participants is presented in Appendix 19. The online version of the questionnaire was also presented using 'iSurvey'.

6.2.5 Analysis

The two theory based questionnaires (outcome expectancies and self-efficacy) were assessed for reliability using Cronbach's alpha on both scales (following any reverse score items being transformed to ensure consistency- items which were reverse scored are marked with a * on figures 8 and 9). In addition a factor analysis was conducted on each scale; however, this did not yield any interpretable factors*. Therefore, due to the diverse nature of each item relating to very different aspects of self-efficacy and outcome expectancies, individual item analysis was conducted on each measure. The measures and items were compared for group differences using Kruskal Wallis comparisons due to the nature of the data. The intervention evaluation questionnaire was assessed for responses to each section and percentage scores for each question were inspected.

**Factor analysis was conducted to investigate any sub-factors which may be related within the questions. For example, it was expected that items which relate to patient risk may have been correlated. However, this was not the case and there were no significant or interpretable grouping of items.*

6.3 Results

6.3.1 Response rates

GPs from 100 practices were invited to take part in the questionnaire (50 control practices and 50 intervention practices). In total 56 GPs from control group practices and 27 GPs from intervention group practices completed the questionnaire.

Practices could take part in the questionnaire anonymously; however there was an option to provide the study team with a postcode in order to provide some data on the location of surgeries (all practices who took part did provide a postcode). In total practices from 54 different postcodes across the country took part in the survey (there were 21 different postcodes in the intervention group and 33 in the control group).

Total practice response rate was 54% overall. The response rate for intervention group practices was 42%, and 66% for control group practices.

6.3.2 Item analysis

Cronbach's alpha for the outcome expectancies questionnaire was 0.73, indicating an acceptable level of internal consistency and suggesting that the items were measuring a similar construct. When looking at each group individually similar scores were found (intervention group $\alpha=0.73$, control group $\alpha=0.71$).

The Cronbach's alpha score for the self-efficacy questionnaire was 0.84, indicating an acceptable level of internal consistency and suggesting that items were measuring a similar construct. When looking at individual groups, similar scores were also found (intervention group $\alpha=0.9$, control group $\alpha=0.7$).

6.3.3 Responses to theory questionnaires

Tables 18 and 19 below present the responses for each group to all theory based questionnaire items.

Overall the strongest trends in the outcome expectancies questionnaire related to most GPs reporting that treating a patient without antibiotics would help in reducing antibiotic resistance and educate patients that antibiotics are not always necessary. Most GPs were also in agreement that non-prescribing would result in a consultation taking longer to complete.

In the self-efficacy questionnaire, GPs generally reported that they are more confident in treating a patient without antibiotics: when a patient does not want an antibiotic prescription, when a patient is at low risk of developing further complications and when there is plenty of time to talk to the patient.

Chapter 6

Table 18 Percentage of responses to each item of the Outcome expectancies questionnaire

For each option please rate your level of agreement using the scale below to the following statement: "If I treat a patient with an RTI without prescribing antibiotics...."	INTERVENTION GROUP					CONTROL GROUP				
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I will help reduce antibiotic resistance	0	0	22.2	51.9	25.9	0	1.8	5.4	62.5	30.4
This will help to educate the patient that antibiotics are not always necessary for treating RTI.	0	0	18.5	40.7	40.7	0	0	0	51.8	48.2
The patient will be less satisfied with the outcome of the consultation.	14.8	18.5	47.1	18.5	0	3.6	30.4	57.1	8.9	0
The patient will be at risk of developing further clinical complications.	0	35.7	44.4	25	3.7	0	14.8	39.3	37	0
The consultation will take longer (in order to explain non-prescribing decision to patient).	3.7	3.7	14.8	66.7	11.1	0	14.3	10.7	64.3	10.7
The patient will be more likely to re-consult with the same problem.	3.7	44.4	22.2	29.6	0	1.8	39.3	21.4	37.5	0
The patient is more likely to book an appointment with another GP in future.	0	51.9	18.5	29.6	0	1.8	33.9	42.9	24.1	0

Chapter 6

Table 19 Percentage of responses to each item of the Self-efficacy questionnaire (*0=Cannot do, 10= Highly certain can do)

How certain are you that you could treat a patient with an RTI without an immediate prescription of antibiotics? Please use the scale below to rate each statement.	INTERVENTION GROUP											CONTROL GROUP										
	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
When a patient DOES want antibiotics	11.1	0	0	3.7	0	48.1	0	11.1	7.4	3.7	14.8	1.8	0	1.8	5.4	8.9	37.5	12.5	17.9	12.5	1.8	0
When a patient DOES NOT want antibiotics	11.1	7.4	0	11.1	0	0	0	11.1	22.2	7.4	29.6	1.8	0	0	0	0	46.4	0	5.4	23.2	23.2	0
When you are in a rush	11.1	0	0	11.1	0	33.3	3.7	14.8	0	3.7	22.2	1.8	1.8	1.8	8.9	8.9	23.2	16.1	26.8	8.9	1.8	0
When you have plenty of time to talk to a patient.	11.1	0	0	0	0	18.5	3.7	11.1	11.1	18.5	25.9	1.8	0	0	1.8	0	19.6	12.5	16.1	33.9	14.3	0
When you think a patient is at LOW risk of developing further medical complications.	11.1	0	0	0	0	29.6	0	0	11.1	18.5	29.6	1.8	0	0	1.8	0	19.6	5.4	14.3	35.7	21.4	0
When you think a patient may be at HIGH risk of developing further medical complications.	11.1	0	22.2	11.1	11.1	14.8	3.7	7.4	0	18.5	0	7.4	10.7	44.6	17.9	0	5.4	7.1	3.6	3.6	0	0
When a patient has used self-management techniques for the RTI before consulting.	11.1	0	0	14.8	0	33.3	11	0	7.4	18.5	3.7	1.8	3.6	19.9	10.7	14.3	23.2	10.7	8.9	5.4	3.6	0

6.3.4 Group differences across measures

Preliminary tests indicated that the data was not normally distributed across nearly all questionnaire measures (for the Shapiro-Wilk test, $p < 0.05$ on most measures). In addition, the Levene's test for equality of variance was also significant on most questionnaire measures indicating that data variance in each group was significantly different, which also violates the assumptions necessary for a MANOVA (multiple analysis of variance). Therefore in light of these findings the non-parametric Kruskal-Wallis analysis of variance test was conducted on the data as recommended by Field (Field, 2009). **(Please note: 'mean rank' refers to an equivalent of a typical 'mean' score created by the Kruskal-Wallis analysis).*

Table 20 presents findings for both the outcome expectancies and self-efficacy measures. There was a significant difference between the intervention and control group in relation to the self-efficacy score ($H=5.69$, $p=0.02$). The results indicated that the intervention group reported a significantly higher self-efficacy score than the control group. No significant difference was observed in the outcome expectancies score between the two groups ($H=0.58$, $p=0.45$).

Tables 21 and 22 present full results for each questionnaire. Overall a significant difference between groups was found on one item only from each questionnaire. On the outcome expectancies questionnaire, there was a significant difference between the intervention and control group responses to the 'patient risk of developing complications' item ($H=4.37$, $p=0.03$). This difference indicates that GPs in the intervention group were significantly less likely to believe that patients would be at risk of developing further clinical complications if antibiotics were not prescribed for an RTI, compared to GPs in the control group.

On the self-efficacy questionnaire, there was a significant difference between the intervention and control group responses to the 'patient at high risk of

developing complications' item ($H=6.89$, $p=0.009$). This difference indicates that GPs in the intervention group felt more confident in treating a patient who may be at risk of clinical complications without using antibiotics than GPs in the control group

Table 20 Results of Kruskal-Wallis group comparisons for theory measures

	Kruskal-Wallis (H)	Significance level (p)	Mean Rank (Intervention group)	Mean Rank (Control group)
Outcome expectancies	0.58	0.45	39.13	43.38
Self-efficacy	5.62	0.02*	51.07	37.63

Table 21 Results of Kruskal-Wallis group comparisons for Outcome expectancies questionnaire

	Kruskal-Wallis (<i>H</i>)	Significance level (<i>p</i>)	Mean Rank (Intervention group)	Mean Rank (Control group)
For each option please rate your level of agreement using the scale below to the following statement: "If I treat a patient with an RTI without prescribing antibiotics...."				
I will help reduce antibiotic resistance	1.42	0.23	38.02	43.92
This will help to educate the patient that antibiotics are not always necessary for treating RTI.	1.99	0.16	37.22	44.3
The patient will be less satisfied with the outcome of the consultation.	0.06	0.80	41.15	42.41
The patient will be at risk of developing further clinical complications.	4.37	0.03*	34.52	45.61
The consultation will take longer (in order to explain non-prescribing decision to patient).	0.35	0.55	40.07	42.93
The patient will be more likely to re-consult with the same problem.	0.01	0.95	42.24	41.88
The patient is more likely to book an appointment with another GP in future.	0.09	0.76	40.89	42.54

Table 22 Results of Kruskal-Wallis group comparisons for Self-efficacy questionnaire

	Kruskal-Wallis (<i>H</i>)	Significance level (<i>p</i>)	Mean Rank (Intervention group)	Mean Rank (Control group)
How certain are you that you could treat a patient with an RTI <u>without</u> an immediate prescription of antibiotics? Please use the scale below to rate each statement.				
When a patient DOES want antibiotics	0.7	0.79	43	41.52
When a patient DOES NOT want antibiotics	1.04	0.31	45.78	40.18
When you are in a rush	0.85	0.77	43.09	41.47
When you have plenty of time to talk to a patient.	1.93	0.17	47.2	39.49
When you think a patient is at LOW risk of developing further medical complications.	1.1	0.29	45.91	40.12
When you think a patient may be at HIGH risk of developing further medical complications.	6.89	0.009*	51.7	37.32
When a patient has used self-management techniques for the RTI before consulting.	3	0.08	48.52	38.86

6.3.5 Intervention evaluation questionnaire

Tables 23-25 present all responses to the intervention evaluation questionnaire (completed by GPs in the intervention group only).

Software: Most GPs agreed that the prompts were easy to read and access, and that the speed of the program was not too slow (51-80%). Most GPs felt that the prompts appeared appropriately during consultations for RTI, however

approximately 25% of GPs reported that the prompts appeared inappropriately during a consultation.

Prompt type: There was little difference in GPs' views of how useful prompts were in supporting practice across the different RTI conditions. GPs were divided approximately equally in their views as to whether or not the prompts were useful in supporting practice for these conditions (48% vs 52%).

Use during consultation: Views were also divided as to how easy the prompts were to use during a consultation. Approximately 48% felt the prompts were easy to use, and 63% felt that there were no problems using the prompts during a consultation.

Guidelines: Around 95% of GPs reported that they were not familiar with the NICE guidelines for antibiotic prescribing in RTI; however approximately 75% reported that they did agree with the guidelines.

Communication: Most GPs were satisfied with the level of practice communication during the trial and did not think that communication could have been improved (approx. 60%). However, around 50% of GPs reported that they did not discuss the trial with other members of staff before it began and 70% did not meet with colleagues to discuss the prompts during the trial.

Chapter 6

Table 23 Responses in percentage to Sections 1-3 of intervention evaluation questionnaire

	Agree strongly	Agree	Disagree	Disagree strongly
SOFTWARE				
The prompts were easy to read	0	51.9	37.0	11.1
There were no problems accessing the prompts	0	59.3	25.9	14.8
The program was too slow	0	18.5	70.4	11.1
The prompts were difficult to access	11.1	18.5	59.3	11.1
The prompts appeared during consultations for patients with RTIs	0	55.6	29.6	14.8
The prompts appeared at an appropriate time during a consultation	0	51.9	22.2	22.2
The prompts appeared at an inappropriate time during a consultation	7.4	18.5	51.9	18.5
PROMPT TYPE-Useful in practice				
Sore throat/ pharyngitis/ tonsillitis	3.7	44.4	37.0	14.8
Cough/ acute bronchitis	3.7	44.4	37.0	14.8
Otitis media	3.7	44.4	37.0	14.8
Rhinosinusitis	3.7	37.0	44.4	14.8
Common cold	3.7	44.4	37.0	14.8
USE DURING CONSULTATION				
The prompts are easy to use during a consultation for RTI.	3.7	44.4	37.0	14.8
There are problems using the prompts <i>during</i> a consultation for a RTI.	7.4	29.6	55.6	7.4

Chapter 6

Table 24 Responses in percentage to Section 4.1 of intervention evaluation questionnaire (part 1)

	Agree strongly	Agree	Disagree	Disagree strongly
GUIDELINES				
I am familiar with the NICE guidelines for antibiotic prescribing in RTI.	3.7	0	14.8	81.5
I agree with the NICE guidelines for antibiotic prescribing in RTI (which recommend limited prescribing of antibiotics for RTIs).	18.5	55.6	22.2	0
COMMUNICATION satisfaction				
I was satisfied with the level of communication within the practice relating to the trial.	3.7	55.6	18.5	22.2
Communication within the practice relating to the trial could have been improved.	3.7	37.0	29.6	29.6

Table 25 Responses in percentage to Section 4.1 of intervention evaluation questionnaire (part 2)

	Yes	No
COMMUNICATION within practice		
I discussed starting the trial with other members of practice staff before it began	44.4	51.9
I met to discuss the prompts with colleagues during the trial	25.9	70.4

6.4 Discussion

Overall the study aimed to conduct a quantitative process evaluation of the RTI electronic prompt trial by delivering a questionnaire to GPs in both the intervention and control groups.

The study aimed to assess the impact of the prompts by examining group differences in self-efficacy and outcome expectancies related to treating a patient with a RTI without prescribing antibiotics (in accordance with the NICE guidelines). These factors were assessed using two theory based measures which were developed specifically for this study. In addition the study aimed to evaluate the success of various aspects of the intervention with the use of an intervention evaluation measure which had also been designed for this trial.

Analysis revealed that the intervention group had a significantly higher score on the self-efficacy measure than the control group; this finding appeared to be driven by a significant group difference across one item from the questionnaire, which related to patients at high risk of developing complications.

There was no significant difference between the intervention and control groups on the outcome expectancies measure, however there was a significant group difference on one item from the questionnaire, which related to patients who were at risk of developing complications.

The intervention evaluation measure revealed that overall GPs were happy with the software and functionality of the prompts; however GPs appeared to be divided in their views as to how useful the prompts were in supporting practice, with around half reporting the prompts as useful and half reporting them as not being useful. Communication appeared to be the greatest problem during the intervention with around half of GPs reporting that they were unaware the prompts were going to appear and three quarters of all GPs questioned, reporting that they did not discuss the prompts with colleagues.

6.4.1 Self-efficacy

The intervention group scored significantly higher on the self-efficacy measure than the control group, suggesting a possible effect of the intervention in increasing GPs self-efficacy. However, in looking at findings from individual items it was revealed that there was a significant group difference across only one of the questions from the measure, suggesting that any difference between groups was due to a higher level of self-efficacy in relation to a single specific aspect of prescribing, as opposed to an increase in overall self-efficacy for managing patients in accordance with the guidelines. In particular, the intervention group reported significantly higher levels of self-efficacy in relation to managing a patient who was at high risk of developing complications without using antibiotics.

Therefore it is possible that the information provided in the intervention made GPs more aware of the small likelihood that patients would go on to develop complications and also made them more familiar with exactly which patients fell into the category of needing an immediate prescription (as recommended by the NICE guidelines). This may have therefore given GPs higher levels of self-efficacy when faced with managing patients who may be at risk of complications in the future.

This finding is also supported by those of the qualitative evaluation (Chapter 5) in which GPs reported that the prompts were useful in acting as a reference tool (for information relating to the NICE guidelines in RTI) and as a tool which could support their decision. Although the finding implies that GPs may incorrectly manage a high risk patient without prescribing an antibiotic, findings from the qualitative studies suggest it is more likely that GPs in the intervention group felt more confident in managing a high risk patient as they felt increased support for their prescribing decision and had been able to use the prompts as a reference tool for gaining information relating to patient risk/likely consequences of non-prescribing to various patient groups. Interview study findings suggest that GPs would not intend to manage a high risk patient without antibiotics, but that tools such as the patient information

sheet may provide them with additional confidence in non-prescribing for patients who they would traditionally have treated with antibiotics.

Therefore, overall the study found a significant difference between groups on the self-efficacy measure. This difference appears to be driven by the fact that GPs in the intervention group reported significantly higher levels of self-efficacy on the item relating to managing patients who are at high risk of developing complications. This suggests that information provided by the intervention in relation to patients developing complications may have increased GPs self-efficacy in managing this patient group in accordance with the guidelines. However, these findings should be interpreted with caution, as a significant difference was only found on one individual questionnaire item, relating to a single aspect of self-efficacy. Future research could extend the variation of questions relating to patients who are at high risk of complications to confirm the possibility of this finding.

6.4.2 Outcome expectancies

There was no significant difference between the intervention and control groups on the outcome expectancies measure. However, findings from individual item analysis revealed that there was a significant difference between groups on the item relating to the patient being at risk of developing complications. In particular, GPs in the control group were significantly more likely to believe that managing a patient without using antibiotics would result in the patient being at risk of developing complications, compared to those in the intervention group.

This finding implies that information provided in the intervention may have made GPs more aware that patients who do not receive antibiotics are not necessarily more likely to develop further clinical complications. This may therefore have reduced GPs negative outcomes expectancies relating to patient

risk of complications. This finding is also supported in those of the intervention development study (McDermott et al., 2010, Chapter 4) in which GPs reported that clinical appropriateness in relation to patients' risk of suffering from complications was an influence in their decision to manage a patient without prescribing antibiotics.

However, this finding should be interpreted with caution as no other items on the outcome expectancies scale differed across the groups. It is possible that this item may have been measuring a different construct which is unrelated to other outcome expectancies of non-prescribing. This question was the only item relating to possible medical outcomes arising from not prescribing antibiotics, whereas all other items related to outcomes such as patient satisfaction, antibiotic resistance, time concerns and patient education, suggesting that medical risk may be viewed by GPs in a separate way to other issues which may influence their prescribing decisions. However, in order to confirm this possibility and the apparent difference between groups on this measure, an extended and fully tested questionnaire would have to be developed with a wider range of items relating to patients being at risk from complications.

Therefore, overall the study found no significant difference between groups on the outcome expectancies measure. However, the intervention group were significantly less likely to believe that not prescribing antibiotics for a patient with a RTI would result in complications, compared to GPs in the control group. This suggests that information provided by the intervention may have reduced GPs concerns about patients developing a complication if antibiotics are not prescribed. However, this finding should be interpreted with caution as there were no significant differences identified on any other item on the outcome expectancies measure. Future research could extend the variation of questions relating to the risk of patients developing complications, in order to confirm the possibility of this finding.

6.4.3 Intervention evaluation

On the intervention evaluation measure, one of the most prominent findings related to communication issues. Approximately half of the GPs reported that they had not discussed the trial with colleagues before it began and around 70% did not discuss the prompts with colleagues during the trial. This finding is interesting as it is supported by evidence from the qualitative process evaluation (Chapter 5) which found that communication difficulties were often reported within practices in relation to the trial. Furthermore, the qualitative evaluation also found that GPs who were not aware that the trial had been implemented were more likely to feel confused about the use of the prompts compared to GPs who has been made aware of the trial and reported feeling confident in using the prompts if they wished to. Findings from the questionnaire suggests that a large proportion of GPs may have been unaware of the trial due to a lack of communication within practices and therefore may not have understood or felt confident in using the prompts. This finding also supports those of a previous intervention evaluation for RTI, which reported that 67% of GPs had not discussed the trial within the practice before it began (Flottorp et al 2003). In this instance, poor communication was directly linked to guideline non-adherence. In addition, systematic reviews of interventions delivered to healthcare professionals have also identified poor communication as a major influence on trial outcomes (Grol & Wensing, 2004; Cabana et al., 1999; Moxey et al., 2010). However, as all GPs involved in the trial did not take part in a questionnaire, it is difficult to estimate whether the same proportion of GPs across the trial as a whole experienced the same problems with trial communication within their practices. Although coupled with findings from the qualitative study and those of previous literature, this finding would seem to suggest that future studies could aim to ensure that communication within practices remains consistent by providing a checklist of actions that the practice could take when the study begins, such as highlighting participation at a staff meeting and handing out information packs to all GPs.

Although many GPs did not report discussing the study, and qualitative findings indicate that a lack of awareness relating to the trial may have reduced

GP engagement with prompts, it is also important to recognise that the prompts were designed to function alone without any additional support or discussion. The study was designed to assess the impact the prompts would have in a naturalistic setting, such as being automatically implemented into GPs systems nationwide, without a trial context. The prompts were therefore designed to be noticed on the GP screen, explain in a simple and clear way what their functions were, and be presented from a credible source (e.g. inclusion of University logo and link to NICE guidelines). However, the findings of the qualitative study suggest that GPs who are not made aware of the presence and nature of the prompts prior to seeing them appear, may be less likely to engage with or use them in practice. In addition findings of the questionnaire study suggest that a large proportion of practices may not implement any discussion or awareness of prompts appearance. Therefore, the findings indicate that the prompts may not have served as a successful stand-alone intervention or system which could be automatically implemented into practices. The findings suggest that GPs may require prior knowledge of the appearance and function of such prompts in order to engage with them in a clinical setting. It is possible however, that this 'awareness' could be brought about by methods other than a discussion or meeting. For example, any contact which is guaranteed to be read by GPs and is presented via a trusted source may also serve to effectively inform GPs about the appearance of prompts. For example, an email from a practice manager or senior GP may be as effective as a meeting. Further research could explore possible methods with which to simply and effectively inform GPs of new prompts or messages appearing within the clinical system.

In addition to issues with communication, the evaluation measure also found that GPs were divided in their opinions of how useful the prompts were in supporting practice. Half of the GPs reported that the prompts were useful in supporting practice whilst half reported that they were not useful. The response was similar for each type of prompt (sore throat, cold etc). From these figures it is hard to assess GPs' views of the prompts, however findings from the qualitative evaluation (Chapter 5) can provide some insight into this issue. The interview study revealed that some GPs viewed the prompts as unnecessary, as they felt that guidelines were already being followed, whereas

others viewed the prompts as useful reference tools which could support their prescribing decision. Therefore it is possible that GPs who rated the prompts as not being useful in supporting practice may have done this as they view the prompts as unnecessary due to guidelines already being followed.

Furthermore, the intervention development study (McDermott et al., Chapter 4) also reported that some GPs may be unwilling to use the prompts due to pre-held views without trying or engaging in them. It may also have been the case in this study that some GPs reported the prompts as not being useful, despite having not tried or looked at them. However, as the GPs did not have to provide a reason as to why they did not think the prompts were useful, future studies could expand this question and include options as to why GPs held this view of the prompts in order to clarify this issue.

Overall software and usability of the prompts was rated highly by the GPs. This suggests that GPs who did not view the prompts as being useful were not referring to any problems in functionality with regards to this. However, approximately one quarter of GPs reported that the prompts did not appear at an appropriate time during the consultation. Findings from other questions would suggest that this was not related to usability of the prompts or perceptions of usefulness, suggesting that a separate issue led GPs to hold this opinion. Findings from the qualitative interviews (Chapter 5) did not reveal any particular issues linked to how the prompts appeared during a consultation. However, some GPs did feel that visibility of the prompts could be increased, so it is possible that this may have influenced their views of prompts appearance. In addition, as previously discussed, the qualitative studies (Chapters 4 and 5) revealed the fact that some GPs would be unwilling to try the prompts, whilst some also considered them unnecessary. Therefore it is possible that GPs who felt this way about the prompts may have rated them as appearing at an inappropriate time during a consultation. Expansion of the question on this measure to include possible reasons for the view as to whether prompts appeared appropriately could be conducted in the future to clarify this matter. In contrast, approximately two thirds of GPs felt that the prompts did appear at an appropriate time during a consultation, so in this instance the majority of GPs were happy with the system.

One unusual finding on the measure relates to the fact that 95% of GPs reported that they were not familiar with the NICE guidelines for antibiotic prescribing in RTI. It was expected that most GPs would have been familiar with these. None of the findings from the qualitative study presented a possible reason for this. However, due to the nature of the research it is possible that GPs interpreted the question as referring to being familiar with the entire guideline document in detail. However, over two thirds of GPs reported that they agreed with the guidelines so must have felt that they knew enough about the recommendations to agree with them. Future research could explore this issue further by expanding the selection of questions and providing options for a participant to select a reason behind their answer.

Overall, the intervention evaluation measure revealed difficulties with communication relating to the trial within practices, which confirmed findings reported in the qualitative evaluation. GPs were divided in their opinions as to how useful the prompts were in supporting practice, however most GPs were happy with the software and usability of the prompts. Future research could expand the questionnaire to include items which provide GPs with a selection of reasons as to why they chose an answer, in order to investigate possible issues which did not appear in the interview study.

6.4.4 Limitations

One of the main limitations of this study lies in the sample size of each group. In total only 83 GPs completed a questionnaire, 56 of these were in the control group and 27 in the intervention group. This disparity and small sample size in each group made comparisons in data limited. In particular, the small sample size in the intervention group meant that any assumptions relating to possible effects of the intervention were based on data from less than 30 questionnaires. The small sample size available for analysis also led to underpowered statistics which may have resulted in an incorrect interpretation of findings and conclusions regarding the prompts.

Specifically a 'type 2 error' may have occurred in that findings which were present (such as increased self-efficacy levels across all items) may not have been visible as 'significant' in such a small group. Therefore a larger sample would need to be conducted in order to produce findings which could lead to more confident conclusions as to the effect of the prompts.

The fact that more GPs in the control group completed a questionnaire may have been due to the option to take part in an interview which was available to the intervention group only. Therefore, some GPs in the intervention group who were willing to share their views may have taken part in an interview and then opted not to complete a questionnaire. If the number of participants who took part in an interview are added to the questionnaire total for the intervention group, the figure becomes similar to the number of GPs who took part in the control group (47). It is also possible that GPs in the control group felt more inclined to take part, as up until this point they had not had to do anything in order to complete their role in the trial. The possibility of recruiting additional GPs to take part was also limited due to the structure of contact and chase up protocol which had been implemented and approved by the ethics committee. This meant that after the three letters and emails inviting participants to take part and providing links and copies of the questionnaire (which were sent via the GPRD to keep anonymity of practices) no further contact could be made. In the future, making the process evaluation questionnaire a compulsory part of a trial could yield far higher completion rates and provide a better overall summary of GPs' views.

The voluntary nature of participation in the study may also have led to an unrepresentative sample of GPs taking part. In particular, GPs with an interest in research or antibiotic prescribing in RTI may have led to responses which were more in favour of guideline adherence or use of prompts. However, findings suggest that this may not have been the case, as GPs' views were often divided as to how beneficial the prompts had been. This was also reflected in the interview study which also used a voluntary sample and found that GPs reported both positive and negative views of the prompts, for example with some finding them to be supportive, whilst others dismissed

them as unnecessary. However, the sample may also have been biased towards GPs who were aware of the study, and not represented the views of GPs who were unaware of the trial or prompts. The findings from both the qualitative interviews and questionnaire studies indicate that a large proportion of GPs may have been unaware of the prompts. GPs in this group may have been less likely to complete a questionnaire if they were unsure what the prompts were and as a result a sample which only represented the views of GPs aware of the trial may have occurred. In this instance, making the questionnaire a compulsory part of the trial would also assist in ensuring that views which represent all GPs who took part in the study are presented.

In terms of the questionnaires used in the study, findings suggest that all measures would benefit from an expansion in the number of items presented. This issue was difficult to avoid as the questionnaires were designed to be as short as possible to encourage GPs to complete them in the limited time they have available, particularly as no financial incentive was being offered. The questionnaires were also adapted to appear relevant to GPs in relation to the guidelines being targeted. However in some cases this may have limited the applicability to the theory which was being targeted. In the example of self-efficacy, GPs were asked how certain they were of conducting target behaviours, rather than how 'confident' they were. This may limit the applicability of the question to the direct target construct of self-efficacy. In addition the questionnaires had not previously been piloted due to strict time restrictions within the trial. However, following findings from the study analysis, all questionnaires should be extended and fully tested in the future to confirm possible findings and provide greater detail relating to the way in which prompts could be improved. An extension of items in the questionnaires could also reduce the risk of possible 'type 1' error, which may have occurred in analysis. Specifically, the multiple analysis of the data, involving every individual item used may have led to the presence of apparent significant findings which do not reflect an effect brought about by the intervention, but are simply the product of so many analysis being conducted on the data. This is particularly a possibility given that only one item from each of the theory measures significantly differed across groups, yet no significant differences were found across any other items. Therefore adding

additional items related to each topic would enable firmer conclusions to be drawn as to the possible effects of the intervention on the various aspects of self-efficacy and outcome expectancies presented in the questionnaires.

Following an extension in the items, it would also be beneficial to pilot a future questionnaire to ensure that the correct items have been selected, that the questions are easily understood, and to confirm the time likely to be involved in completing the measures (therefore if a large amount of time is required a financial incentive could be considered).

6.4.5 Summary

Overall the study suggested that GPs in the intervention group may have higher levels of self-efficacy than those in the control group. Analysis suggested that in particular, GPs in the intervention group may specifically have higher levels of self-efficacy in managing patients who are at high risk of developing complications. Similarly, individual item analysis revealed that GPs in the intervention group may have reduced negative outcome expectancies related to patients likelihood of developing complications if an antibiotic is not prescribed for a RTI. These findings imply that the intervention may have provided information which reduced GPs' concerns relating to patient risk of complications if an RTI is managed without prescribing antibiotics (in accordance with the NICE guidelines). However, as differences between groups were only identified on one item from each theory based measure, no firm conclusions can be drawn. Future research could confirm these findings by expanding the range of questions on each measure relating to these items.

The intervention evaluation measure revealed that overall GPs were happy with the prompts, the software and the usability of the system. However, problems were identified in communication within practices relating to the implementation of the prompts. The study reported low rates of practice communication relating to participation in the trial, which the qualitative study (Chapter 5) suggested may influence GPs' engagement with and use of

prompts. Future interventions should aim to implement systems to improve internal practice communication relating to implementation and achieve consistency of this across surgeries.

Overall the findings suggest that including information relating to a patient's risk of developing complications may assist in increasing GPs self-efficacy and reducing negative outcome expectancies relating to managing a patient with a RTI without prescribing antibiotics. However, these findings are not conclusive and further research is needed to thoroughly investigate this possibility. Furthermore, ensuring that communication within each practice is consistent and that all GPs are aware of the implementation of the intervention may also assist in encouraging GPs to engage with the system.

7. Chapter seven: Discussion

7.1 Chapter overview

The following chapter will recap the aims of the research and the main findings presented within the thesis. The chapter will then draw together key findings from the research and discuss both the theoretical and practical implications in relation to the development of computer-delivered intervention for healthcare professionals. The strengths and limitations of the research will be examined in detail and possible directions for future research will be presented. The way in which the development process could be amended and improved in future studies will also be highlighted. Finally the chapter will present the key conclusions from the research as a whole.

7.2 Research aims

The purpose of this research was to develop theory-informed, computer-delivered interventions to promote the implementation of guidelines in general practice. Specifically, the aim was to develop and evaluate computer-delivered prompts to promote guideline adherence for antibiotic prescribing in respiratory tract infections (RTIs), and adherence to recommendations for secondary stroke prevention.

Following a summary of the rationale for this research, highlighting the problem of non-adherence to clinical guidelines in primary care, the thesis then comprised of six further chapters. The second chapter presented a systematic literature review of computer-delivered interventions which promote the implementation of guidelines in the primary care, in order to assess the effectiveness of these interventions and to identify which factors may influence their success. The third chapter discussed the use of behaviour change theory in relation to healthcare professionals, in order to identify which theoretical components may be best applied to computer-delivered interventions in

primary care. Chapter four presented a study which involved the development of a computer-delivered intervention to promote guideline adherence for antibiotic prescribing in respiratory tract infections (RTIs) and secondary stroke prevention. Following this study, the RTI intervention was then used in a cluster randomised trial in GP surgeries, which does not appear within this thesis. Chapter five presented the findings from a qualitative process evaluation of the intervention, and Chapter six presented findings from a quantitative questionnaire evaluation of the intervention.

7.3 Main Findings

7.3.1 Systematic review of computer-delivered interventions

The systematic review identified 31 studies which met the eligibility criteria and had used computer-delivered interventions to promote the implementation of guidelines in primary care. Of all the interventions identified, 75% reported a significant effect on at least one outcome measure. However, only 21% of the studies reported a significant effect on all outcome measures. This finding suggests that computer-delivered interventions may be of some benefit for promoting the use of guidelines in primary care; however no strong conclusions can be drawn from these results alone

Overall, the findings of the review suggest that computer-delivered interventions to promote the implementation of guidelines in primary care can be an effective method. An intervention may be most effective if it presents information on a patient's risk of developing a condition and uses a design which includes a variety of features (and not just a simple presentation of guidelines). However, due to the limited number of studies included in the sample, further research is needed to confirm and explore the trends identified in this review.

7.3.2 Behaviour change theory and healthcare professionals

A range of theories which had been investigated in relation to the behaviour of healthcare professionals were considered for inclusion in the computer-delivered intervention. The theoretical constructs chosen for inclusion were self-efficacy, outcome expectancies and environment. Self-efficacy has been significantly associated with healthcare professionals' intention to adhere, self-reported adherence to guidelines, and recorded clinical behaviour (e.g. prescribing rates). Outcome expectancies have consistently been reported as factors which influence GPs' decision to adhere to guidelines across a range of studies based on interventions, questionnaires, and interviews. In addition, research has suggested that interventions which create an optimum environment according to the principles suggested by social cognitive theory can increase healthcare professionals' adherence to clinical guidelines.

It was noted that in relation to healthcare professionals' behaviour, some constructs from alternative models share close similarities with the social cognitive theory constructs which were selected for use in the intervention. Therefore, although the intervention used the terms as labelled in social cognitive theory ('self-efficacy', 'outcome expectancies' and 'environment') related constructs from alternative models may also have relevance in the development of interventions for healthcare professionals.

7.3.3 Development of computer-delivered intervention

The overall aim of the study was to produce prompts which GPs would view as feasible and acceptable in practice. The development of prompts was informed by both behaviour change theory and feedback from qualitative interviews with GPs.

In summary, the qualitative process of working with GPs to develop a computer-delivered intervention to follow guidelines, successfully resulted in

the creation of prompts which GPs approved of. The study identified a number of factors which GPs reported would encourage them to use computer-delivered prompts and adhere to guidelines. Overall, a key characteristic of an acceptable computer-delivered intervention appears to be that it should be perceived as a useful tool supporting GP practice, rather than as didactic advice. The prompts developed in this study then entered into two trials (one for RTI and later one for stroke), the trials were run at Kings College London and the findings are not presented within this thesis.

7.3.4 Qualitative process evaluation of intervention

The study aimed to evaluate the use and implementation of the RTI computer prompts by conducting qualitative interviews in order to investigate views and experiences of using prompts and the way in which they were implemented into practice during the trial. A sample of GPs who had experienced the prompts for one year as part of the trial took part in the interviews. In addition, a small sample of staff who had been involved in the implementation of the intervention also took part in qualitative interviews.

Overall, GPs reported that the prompts were considered as useful and acceptable in practice. The findings suggest that computer-delivered prompts may be viewed as useful and engaged with by GPs if they are aware that prompts will be appearing prior to implementation and perceive the prompts as tools which support practice and have a positive impact on patients.

7.3.5 Quantitative process evaluation of intervention

The study aimed to conduct a quantitative process evaluation of the RTI electronic prompt trial by delivering a questionnaire to GPs in both the intervention and control groups.

The study aimed to assess the impact of the prompts by examining group differences in self-efficacy and outcome expectancies related to treating a

patient with a RTI without prescribing antibiotics (in accordance with the NICE guidelines). These factors were assessed using two theory based measures which were developed specifically for this study. In addition, the study aimed to evaluate the success of various aspects of the intervention with the use of an intervention evaluation measure which had also been designed for this trial. Overall the findings suggest that including information relating to a patient's risk of developing complications may assist in increasing GPs self-efficacy and reducing negative outcome expectancies relating to managing a patient with a RTI without prescribing antibiotics. However, these findings are not conclusive and further research is needed to thoroughly investigate this possibility. Furthermore, ensuring that communication within each practice is consistent and that all GPs are aware of the implementation of the intervention may also assist in encouraging GPs to engage with the system.

7.4 Implications of the research

7.4.1 Theoretical implications

Although the research was not designed to test theories, the intervention did apply theory to the design and some findings appear to be consistent with particular models of behaviour change theory.

7.4.1.1 Self-determination theory

Self-determination theory (Deci & Ryan, 1980) is concerned with the ways in which an individual is motivated to behave. The theory suggests that factors which encourage intrinsic motivation are more likely to bring about behaviour change than extrinsic motivators. Specifically, self-determination theory proposes that behaviour change will occur and persist if it is autonomously motivated and reflects an individual's choice to act. In contrast, behaviour change which is brought about by enforcement or the use of communication which is pressurising and controlling is thought to result in less maintained behaviour. Therefore, an individual will be more likely to engage in and maintain a behaviour if they perceive this to be their personal choice and under

their own control. The theory suggests that behaviour change can be encouraged by the use of techniques which provide autonomy support and do not enforce compliance.

Extensive research in the area of health behaviours has consistently supported self-determination theory and interventions which use autonomy supportive techniques have been reported to successfully increase adherence to a range of health behaviours, including, diet, physical activity, and diabetes management (Chatzisarantis & Hagger, 2009; Williams et al., 1996; Williams et al., 2007). In contrast, interventions which adopt enforcement methods that remove an individual's sense of control have often been reported as unsuccessful and unlikely to result in maintained behaviour change (Moller et al., 2006; Assor et al., 2003; Pelletier et al., 2004). In addition, although limited, research has also demonstrated that interventions which involve autonomy support can increase practitioners' engagement with an intervention (Kooij et al., 2008). However, to date, little research has explored self-determination theory directly in relation healthcare professionals' guideline adherence.

Interestingly, the main findings across the empirical studies within this thesis seem to be consistent with self-determination theory in relation to the behaviour of healthcare professionals. In the intervention development study (Chapter 4) the most important influence on GP attitudes appeared to be their 'perception of the role of prompts'. GPs reported that if they felt that the guidelines or prompts were being enforced they would develop a negative attitude towards them and be unlikely to use them constructively. However, if the GPs felt that they had control to choose to use the prompt and that it was supporting them, they would be likely to use it. In relation to the intervention, GPs reported that they would be more likely to use the prompts if they were able to autonomously choose to view specific pages and were not being forced to view set screens and messages by any external influence.

Furthermore, findings from the qualitative process evaluation study (Chapter 5) also appear to be consistent with self-determination theory. When discussing the use of prompts, GPs reported finding the prompts useful if the information which appeared supported their own prescribing decision. This suggests that rather than changing behaviour or persuading them not to prescribe antibiotics, the GPs thought the prompts were useful if they were perceived as supporting a decision to adhere to the guidelines which the GP had made autonomously. In addition, GPs also reported finding the prompts useful as they were easy to control. This would also be consistent with self-determination theory as placing the GP in control of the prompts and not forcing information to appear, increases GPs' autonomy. In addition, these findings are also consistent with social cognitive theory (Bandura 1977), which proposes that an individual will be more likely to engage with a behaviour if their environment is perceived as controllable. In this instance, the GP was controlling the environment in terms of which prompts appeared when selected and had the ability to cancel the prompts if required.

7.4.1.2 Outcome expectancies

Social cognitive theory (Bandura, 1977) proposes that outcome expectancies influence the decision to conduct a behaviour. Outcome expectancies refer to an individual's beliefs that engaging in a behaviour will directly result in specific outcomes. These expectancies influence an individual's motivation to perform a behaviour, with negative outcome expectancies resulting in an individual being less likely to engage in a specific behaviour, and positive expectancies predicting a stronger likelihood that a behaviour will be engaged in. Outcome expectancies have been consistently associated with healthcare professionals' adherence to clinical guidelines. Research has reported outcome expectancies as being related to practitioners' self-reported intention to adhere to clinical guidelines and rates of adherence to guidelines across various healthcare settings (Bonetti et al., 2010; Vogt et al., 2009; Eccles et al., 2007). In addition, outcome expectancies have also been frequently reported as factors which influence GPs' decision to adhere to a guideline in practice (Ten Wolde et al., 2008; Travado et al., 2005; Little et al., 2004).

Research throughout the thesis is also consistent with some aspects of outcome expectancies as an influence of GPs decision to adhere to guidelines. The systematic review of computer-delivered interventions presented in Chapter 2 revealed that interventions which presented patient risk information reported a significant effect in 84% of studies whereas interventions which did not present risk information reported a significant effect in 61% of studies. This finding suggests that presenting information relating to a patient's risk of developing future health problems may be beneficial in promoting the use of guidelines in primary care. Furthermore, the finding suggests that presenting specific information to influence an individual's outcome expectations of what may result from following a guideline (such as lowering a patient's risk of disease) may increase guideline adherence in primary care. However, patient risk presentation only relates to one aspect of the possible outcomes which may result from guideline adherence and it is likely that outcome expectancies relating to additional factors may also influence an individual's decision to follow a guideline.

Findings from the intervention development study also supported the application of outcome expectancies in relation to healthcare professionals' behaviour. An important factor which appeared to strongly influence GPs' opinions of whether they were likely to use the prompts was anticipated patient outcomes. GPs reported that they would be more likely to use the prompts with patients who they felt needed persuasion to follow the guideline advice, and with patients who they felt it was clinically appropriate (e.g. unlikely to develop complications). In this case, GPs reported the need to reduce the negative outcomes of the patient being dissatisfied with the advice or experiencing further medical problems. These particular outcome expectancies are also consistent with those reported in previous studies. For example, Little et al (2004) reported that both perceived medical need and perceived patient pressure had a significant effect on GPs' antibiotic prescribing decisions. Previous research has also consistently identified GP concerns over medical complications and negative medical consequences as major influences in prescribing decisions (Wood et al., 2007; Kumar et al., 2003) which are prioritised over worries about antibiotic resistance in the case of RTIs (Simpson et al., 2007).

Further interviews conducted in the qualitative process evaluation study (Chapter 5) also reported findings which were consistent with the importance of some aspects of outcome expectancies. The study found that GPs felt encouraged to use the prompts if they were perceived as having a positive impact on patients. GPs reported that using the prompts could lead to positive patient outcomes which included assistance in persuading patients to follow the guidelines by the use of information (sheets and screens) which patients would understand.

Finally, the quantitative process evaluation study presented in Chapter 6, also reported some support for the construct of outcome expectancies. Overall, there was no significant difference between the intervention and control groups on the outcome expectancies measure. However, findings from individual item analysis revealed that there was a significant difference between groups on the item relating to the patient being at risk of developing complications. GPs in the control group were significantly more likely to believe that managing a patient without using antibiotics would result in the patient being at risk of developing complications, compared to those in the intervention group. This finding implies that information provided in the intervention may have made GPs more aware that patients who do not receive antibiotics are not necessarily more likely to develop further clinical complications. This may therefore have reduced GPs negative outcome expectancies relating to patient risk of complications.

Overall, the findings suggest that future interventions which present information relating to a patient's risk of developing future health problems and provide tools related to assisting GPs in persuading patients in the benefits of following recommendations may assist in increasing GPs' adherence to guidelines in primary care.

7.4.1.3 Self-efficacy

Social cognitive theory (Bandura, 1977) proposes that self-efficacy beliefs closely relate to the motivation to engage in a behaviour. Perceived self-efficacy refers to an individual's beliefs in their ability to conduct a specific behaviour. According to the theory, individuals with high self-efficacy for a task are said to be more likely to perform the behaviour. Self-efficacy and research relating to this is fully described in Chapter 3 of this thesis. Previous research has consistently reported self-efficacy as being associated with healthcare professionals' adherence to clinical guidelines. For example, self-efficacy has been related to GPs' intention to adhere to guidelines (Ten Wolde et al., 2008; Eccles et al., 2007; Hrisos et al., 2008), self-reported adherence (Bonetti et al., 2010; Hrisos et al., 2008; Bonetti et al., 2006), and recorded adherence within a practice setting (Miller Perrin et al., 2005; Vogt et al., 2005). In addition, review evidence has also suggested that self-efficacy is related to clinical behaviour (Cabana et al. 1999), with one review concluding that self-efficacy is one of the most important predictors of healthcare professionals' behaviour (Godin et al., 2008).

Overall, the research within this thesis identified some findings which were consistent with the importance of self-efficacy, in relation to healthcare professionals. The systematic review (Chapter 2) could not assess effects of self-efficacy, due to the fact that studies identified in the review did not explicitly report use of the construct. Findings from the qualitative studies (Chapters 4 and 5) both suggested that self-efficacy may be an influence in GPs' decision to adhere to guidelines. GPs reported that the prompts would be useful in helping them persuade patients to accept their advice, which implies that GPs may not be totally confident (or have high self-efficacy) in managing the condition in accordance with guidelines under usual practice circumstances. However, although this finding is consistent with self-efficacy, it does not provide strong support for the construct overall, it simply implies that self-efficacy may be involved in GPs' guideline adherence decisions.

The quantitative process evaluation (Chapter 6) also reported some support for the use of self-efficacy. Specifically, the intervention group scored significantly higher on the self-efficacy measure than the control group, suggesting a possible effect of the intervention in increasing GPs self-efficacy. However, in looking at findings from individual items, it was revealed that there was a significant group difference across only one of the questions from the measure, suggesting that any difference between groups was due to a higher level of self-efficacy in relation to a single specific aspect of prescribing, as opposed to an increase in overall self-efficacy for managing patients in accordance with the guidelines. In particular, the intervention group reported significantly higher levels of self-efficacy in relation to managing a patient who was at high risk of developing complications without using antibiotics. Therefore it is possible that the information provided in the intervention made GPs more aware of the small likelihood that patients would go on to develop complications and also made them more familiar with exactly which patients fell into the category of needing an immediate prescription (as recommended by the NICE guidelines). This may have therefore given GPs higher levels of self-efficacy when faced with managing patients who may be at risk of complications in the future. However, these findings should be interpreted with caution, as a significant difference was only found on one individual questionnaire item, relating to a single aspect of self-efficacy. Furthermore, the significant item identified related to patient risk of developing complications, which is similar to the only significant item identified on the outcome expectancies questionnaire. Therefore, it is possible that this question could have been measuring a construct which is more closely related to patient risk, rather than self-efficacy.

The limited support for the role of self-efficacy within the thesis does not suggest that it may not be important in relation to the behaviour of healthcare professionals as there was no evidence 'against' use of the construct, but simply that this research could only identified limited evidence in support of application of the theory. One possible reason for this finding could be due to the limited way in which it was possible to incorporate techniques to increase self-efficacy within the brief and simplistic nature of computer prompts. The prompts could not provide a detailed intervention which GPs would have time

to read thoroughly and consider in-depth. Therefore it is possible that the ability to incorporate techniques to increase self-efficacy within computer-delivered prompts which appear during GP consultations may be limited. Interventions which incorporate methods to increase self-efficacy have often been presented using a more detailed format. For example, the STAR trial (Stemming the Tide of Antibiotic Resistance) addressed self-efficacy in a web-based educational intervention which aimed to reduce inappropriate antibiotic prescribing in GPs (Simpson et al., 2009). The intervention consisted of a series of 7 compulsory in-depth educational sessions which included varying methods of information presentation (e.g. videos and interactive tasks) and incorporated techniques to increase self-efficacy. The study was successful in that it reported a significant reduction in the prescription of antibiotics in the intervention group (Butler et al., 2012). This level of extensive information presentation is not possible in interventions which consists of 'reminder' style brief computer prompts, and it may be the case that the use of techniques to increase self-efficacy are better suited to educational style interventions which have more time to present a thorough explanation. Such educational interventions also often consist of components which are compulsory or interactive, that may be better able to ensure that any information which is presented can be considered in more depth and thoroughly processed by the GPs who are reading it. Therefore, brief computer prompts may not be an ideal technique for incorporating self-efficacy increasing measures into an intervention.

Overall, therefore the findings within the thesis identified some limited support for the application of self-efficacy in relation to computer-delivered interventions for health care professionals. However, it is possible that the brief nature of the prompts used in the intervention could not create an optimum environment for the effective delivery of self-efficacy increasing techniques.

7.4.1.4 Summary of theoretical implications

Overall, the qualitative findings were largely consistent with self-determination theory, and suggested that the theory may provide a useful tool with which to develop a further intervention related to clinical guideline adherence. Specifically the findings suggest that GPs may be more likely to engage in a computer-delivered intervention if it is perceived as being easy to control and supporting GPs' autonomous decisions, rather than as a method of enforcing adherence to guidelines. The findings also supported some aspects of outcome expectancies (from social cognitive theory) as an influence of GPs decision to adhere to guidelines. The findings suggested that future interventions which present information relating to a patient's risk of developing future health problems and provide tools related to assisting GPs in persuading patients in the benefits of following recommendations may assist in increasing GPs' adherence to guidelines in primary care. The findings provided some limited support for the construct of self-efficacy (from social cognitive theory) in relation to healthcare professionals' adherence to guidelines. However, the findings suggested that it may not be possible to incorporate self-efficacy increasing techniques into brief computer-delivered prompts which appear during GP consultations.

7.4.2 Practical implications

7.4.2.1 Awareness of intervention

The main practical implication identified within this research related to GP and practice staff awareness of the implementation of the intervention. Interviews conducted in the qualitative process evaluation study (Chapter 5) suggested that one of the most important factors to influence GPs use of the prompts appeared to be their awareness of the implementation of the system into their practice. GPs who were aware of the implementation of the prompts reported feeling confident in using them if they chose to and understanding the purpose of them. However, GPs who had not been made aware that the prompts were

going to be appearing often reported feeling confused when they saw the prompts appear on the screen and did not fully understand what they for or how they could be used. This finding would imply that GPs who worked in practices which informed staff that the prompts would be appearing on their screens and provided details of this may be more likely to use and engage with the prompts.

In addition to GP interviews, a small sample of interviews with implementation staff was conducted. Although the sample was small, the findings of the interviews were included in this chapter as they provide additional insight with which to interpret the GP findings. Implementation staff revealed that a lack of internal communication across practice staff resulted in severe delays in the prompts being implemented onto some practice systems (which delayed the trial commencing). It was reported that practice staff had often not been made aware that the study was going to take place by the head of research at the practice and refused to give permission to access the practice system until this was confirmed. Confirming the practice participation could often take weeks and if the head of research for the practice was away at the time, a delay of months could occur.

Furthermore, findings from the quantitative process evaluation (Chapter 6) reported communication issues as one of the most prominent findings on the intervention evaluation measure. Approximately half of the GPs reported that they had not discussed the trial with colleagues before it began and around 70% did not discuss the prompts with colleagues during the trial. This finding is interesting as it is supported by evidence from the qualitative process evaluation (Chapter 5) that communication difficulties were often reported within practices in relation to the trial. Findings from the questionnaire suggests that a large proportion of GPs may have been unaware of the trial due to a lack of communication within practices and therefore may not have noticed, understood or felt confident in using the prompts.

These findings are also consistent with some previous research which has identified issues relating to the awareness of intervention implementation as an influence on intervention success. For example, previous studies have also found that staff awareness of the implementation of an intervention can influence both practitioner response to an intervention and use of guidelines (Moxey et al., 2010; Grol & Wensing, 2004; Flottorp et al., 2003). In addition, previous research has also reported that a lack of awareness can lead to various difficulties in implementing an intervention (Perkins et al., 2008; Lobo et al., 2003; Flottorp et al., 2003). Therefore, the findings seem to suggest that future studies should aim to ensure that GPs are informed of an intervention before a trial or implementation begins. However, presenting information to GPs relating to an intervention could seriously influence the outcome of the trial and lead to GPs changing their behaviour based on knowledge of participation in the trial as opposed to an effect relating to the intervention itself. Despite this possibility, findings from the qualitative evaluation study suggest that GPs who are not made aware of the presence and nature of the prompts prior to seeing them appear, may be less likely to engage with or use them in practice. In addition findings of the questionnaire study suggest that a large proportion of practices may not implement any discussion or awareness of prompts appearance.

Overall, findings from both the qualitative and quantitative process evaluation studies (Chapters 5 and 6) in addition to previous research suggest that some information should be presented to GPs prior to an intervention commencing, as no information on the intervention may result in the system being avoided by GPs and subsequently not tested in practice. Ensuring that practice staff are made aware of the implementation of a new intervention (but keeping the details as minimal as possible to reduce the impact of the information) may result in greater engagement with a computer-delivered intervention and a more effective implementation process.

7.5 Limitations of the research

There were a number of limitations of the research reported in this thesis which should be considered in relation to the findings and conclusions. The systematic literature review (Chapter 2) identified the potential effectiveness and moderators of computer-delivered interventions to promote the implementation of guidelines in primary care. However, interpretation of the data included in the review may be limited due to the reliance on identifying study 'significance' in order to interpret intervention success within the variety of study methods identified. Studies with 'significant' effects may include both true positives (where the intervention is effective) and false positives (where there is in truth no effect of intervention). False positive results may result from bias, as discussed in the chapter, but may also result from random error (type 1 error). This type of error may be more frequent in larger studies or where several different outcomes are tested, as was frequently the case in most of the studies identified by the review. The review did attempt to indicate and make clear where a significant effect had been identified across all measures, in order to highlight studies which were more likely to indicate a 'true positive' effect. However, commonly studies would report a significant effect which was not consistently found across all outcome measures, and this limits conclusions which can be drawn from the data.

Similarly, studies reporting 'no significant effect' may include true negatives (where there was no effect) as well as false negatives (where there was an effect which was not identified). False negatives may result from bias but may also result from random error (type 2 error), especially when the sample size is too small to detect the intervention effect that is present. Unfortunately some studies included in the review did consist of small sample groups in terms of the number of practices involved (which could be as little as 1). This issue may also therefore hinder the conclusions which can be drawn from the data, in addition to the limited number of studies identified overall.

The intervention development study (Chapter 4) provided an in-depth analysis of factors which GPs reported would influence their use of prompts and adherence to guidelines in order to produce a set of prompts which GPs

approved of. However, a limitation of this study relates to the feasibility of incorporating all findings and feedback into the intervention. The GPs highly valued simple information presentation and usability, which were incorporated into the prompts, but many also suggested adding a range of additional features to prompts such as local service information and detailed advice on medication. Since a wide and varying range of features were requested it was difficult to identify further features which would benefit the majority of GPs, without creating an intervention which would be complex and difficult to use. GPs also expressed a desire for information tailored to the individual patient. This feature was included in development, in that if a patient has been recorded as already meeting any of the stroke targets recommended, the prompt relating to this guideline would not appear. However, the range of tailored information which many GPs requested could not be implemented fully due to the complexity involved in creating software that would make different recommendations based on a large number of patient characteristics.

The qualitative process evaluation study (Chapter 5) provided an insight into the views and experiences of GPs who had taken part in a trial of the RTI prompts. However, as participation in the interviews was voluntary, a large proportion of GPs who had been involved in the trial and receiving the prompts were not included, as they did not respond to invitations for a telephone interview. This may have resulted in the GPs not representing those from a typical surgery (as 50 practices took part in the intervention but only 20 GPs were interviewed) and instead represented GPs with a specific interest in the prompts or research of this nature. Larger proportions of GPs may have been unaware of the prompts' implementation and confused when they appeared, and these GPs may have declined an interview for this reason. Furthermore, invitations were sent to the head of research at each practice who had signed up to the original study and may not have been distributed as requested to all practice GPs (as was often the case with information regarding the implementation of the study). However, the telephone interviews were funded and GPs were offered a fee for taking part, which was not the case with the trial, and this may have encouraged GPs who did not have a specific interest in the prompts to take part.

The quantitative process evaluation study (Chapter 6) provided a detailed assessment of the prompts in relation to both theory use and features of the intervention. However, one of the main limitations of the study occurred due to the sample size of each group. In total only 83 GPs completed a questionnaire, 56 of these were in the control group and 27 in the intervention group. This disparity and small sample size in each group made comparisons in data limited. In particular, the small sample size in the intervention group meant that any assumptions relating to possible effects of the intervention were based on data from less than 30 questionnaires. The small sample size available for analysis led to underpowered statistics which may have resulted in an incorrect interpretation of findings and conclusions regarding the prompts. Therefore a larger sample would need to be conducted in order to produce findings which could lead to more confident conclusions as to the effect of the prompts.

In addition, the small sample size in relation to the number of GPs across all practices who experienced the prompts, may have led to a highly unrepresentative sample of GPs who had a strong interest in research or those who worked in practices which had made them aware of the prompts (as opposed to GPs who were unaware of the prompts). Therefore the sample size, coupled with the strong possibility of an unrepresentative sample, further limits conclusions which can be drawn from the quantitative study.

Furthermore, the tools used to record the data in the study may also have been problematic. Due to the strict time restrictions of the trial and lack of prior planning for a questionnaire component, the findings of the quantitative evaluation were further limited by the lack of a fully tested, reliable questionnaire measure. The questionnaires used in the study had to be developed during a very short timeframe which only allowed for a brief review of the literature and creation of measures which were not put through a thorough testing and analysis process. Therefore, the study cannot be confident that the measures were in fact relating to the target constructs, which heavily limits reliability of findings here. The way in which these issues could have been addressed and suggestions for how a future development process should occur are further discussed in section 7.6.

Overall the use of both qualitative and quantitative research within the thesis provided a key benefit to the research and provided useful findings which could not have been obtained using only one approach. For example, the use of a qualitative method in the development study revealed that GPs behaviour may be consistent with self-determination theory. This finding is interesting as it could provide a useful basis with which to develop a future intervention. However, very little previous research involving healthcare professionals' adherence to guidelines had been investigated in relation to this theory and therefore it was unlikely to be used in future interventions. This finding would not have been discovered if quantitative methods only measuring specific theories related to previous literature had been used in the research. Similarly, the benefit of using a mixed method approach was also prevalent in the process evaluation of the intervention. Both qualitative studies (Chapters 4 and 5) appeared to strongly support the importance of outcome expectancies in the content of interventions. However, the outcome expectancies measure in the quantitative study did not show strong support for the construct and suggested that only some aspects of the theory may be important. This prevented the research from overemphasising the possible importance of outcome expectancies in interventions for healthcare professionals, and assisted the research in focusing on which aspects of the theory may be important.

7.6 Improving the development process- key lessons for the future

After considering the strengths and limitations of the research which was conducted, a number of key improvements have been identified which could be applied to the overall development process of a similar intervention in future studies.

The first stage of the intervention development involved the identification and selection of theoretical constructs. This was done by reviewing and

considering previous research which had implicated theory in relation to the behaviour of healthcare professionals (Chapter 3). This method was not ideal as due to limited research in the area there was no one theory or construct which could strongly claim to predict healthcare professionals' behaviour in relation to the exact guidelines which the intervention was targeting. The findings were limited in that a number of theoretical constructs had been linked to the behaviour of healthcare professionals' adherence to guidelines, and could have been used. If circumstances had allowed (i.e. timescale and funding) it would have been beneficial at this stage to quantitatively explore which of these theoretical constructs may have explained GPs' behaviour in relation to the guidelines which the intervention was targeting (antibiotic prescribing in RTI and prevention of secondary stroke). This could have been done by creating questionnaire measures for each construct and conducting a study which investigated the theory-based measures in relation to GPs' behaviour in practice (such as prescribing rates). The questionnaire measures should involve a full development phase which is time scaled for prior to the study beginning, to ensure the creation of reliable measures. Unfortunately, the measures created within this research did not include a phase for full questionnaire development testing, due to the timescale involved in creating measures which had to be rapidly devised immediately after the intervention development study and prior to the commencement of the trial at Kings College (due to the need to be submitted and approved by NHS ethics prior to recruitment for the trial which the research team were keen to begin due to predetermined timeframes). During a questionnaire development phase additional testing could have been included. For example, initial construction of the questionnaires should be followed with a pilot test administered to GPs, to identify improvements or clarifications which can be made within the text and design. Following refinement of the questionnaires test-retest reliability should be assessed by re-administering the questionnaire. In addition, factor analysis could be conducted to examine and evaluate the factor structure of items within the measure. Therefore this process could have led to creation of reliable theory based measures which related to GP behaviour and the identification of theoretical constructs which had been directly correlated with GPs' clinical behaviour in relation to the interventions target recommendations.

Following this study the theoretical constructs which were most closely linked to GP behaviour could be selected for use in the intervention. In the research described within this thesis, once theoretical constructs had been selected from the literature, development of the intervention began, in preparation for the first qualitative interviews. However, the development of the intervention content at the point of theory selection could be improved by including an empirically informed approach at this stage. The theoretical constructs identified in the questionnaire study as being potentially relevant to the area of interest, could be mapped onto related theoretical domains identified by Michie et al (2005) for use in behaviour change interventions. A benefit of following this process is that once complete, the theoretical domains can be mapped onto corresponding evidence based behaviour change techniques, which research has identified as being beneficial in relation to the specific domains identified (e.g. Abraham and Michie, 2008; Michie et al., 2011). For example, in an intervention aimed to encourage appropriate management of RTI without the use of antibiotics, Hrisos et al (2008) mapped the selected theoretical constructs (e.g. self-efficacy) onto the construct domains (e.g. beliefs about one's capabilities) identified by Michie et al (2005) and then mapped these domains onto corresponding evidence based behaviour change techniques (e.g. graded tasks) which had been previously identified in the literature (Francis et al., 2005). Once the evidence based behaviour change techniques have been selected, these can then be operationalized into a suitable format for the intervention, and a prototype intervention can be created. For example, interactive tasks could be created within the intervention. This technique overall creates a more evidence based method and transparent process which can benefit both concise evaluation and future research.

At this stage the feasibility of the intervention can then be investigated as was the case with the research presented within this thesis. Once an intervention has been created, conducting a qualitative study to investigate the feasibility and acceptability of the technique can provide useful and in-depth feedback for the development process. The data collected in the qualitative development study successfully provided useful information on both format issues and wider issues such as factors which GPs report as influencing their decision to adhere to guidelines. It was also able to highlight issues which a quantitative

only technique may not have identified, such as the possible importance of self-determination theory in GPs' behaviour which had not been widely investigated in previous literature and may not have been identified in a literature review of relevant constructs.

Although the intervention was refined based on feedback from the qualitative development study, the research did not include a piloting phase and the intervention entered directly into a relatively large scale cluster randomised trial across GP surgeries (due to the predetermined timescale of the study). If time and resources had allowed a pilot trial at this stage, it may have been able to identify potential problems or issues which could be resolved in order to further improve the intervention for a full trial. For example, the communication problems which hindered implementation of the trial could have been identified at an earlier stage and a procedure put in place to relieve this problem when the trial was conducted.

Following the trial, two process evaluation studies were conducted, both of which were problematic due to a low uptake of participants, and the possibility of a largely unrepresentative sample which limited conclusions which could be drawn from both the quantitative and qualitative data. If this evaluation had been part of the compulsory trial protocol and at least one GP from each practice was required to take part in an interview and complete a questionnaire a more representative sample could have been achieved from which to draw conclusions (rather than only GPs who may have had more positive views regarding the prompts, who could have been those more likely to agree to an interview). Given that the participating practices are only required to experience the prompts appearing on their computer screen and do not have to take any action, an addition to the study of one interview and one questionnaire could be feasible. The quantitative process evaluation would also benefit from this study design as the tested and piloted questionnaire measures which had been created early in the intervention development could be re-used at this stage and would provide more reliable methods with which to collect theory-based end of study data.

Therefore, if time and resources allowed, this research could be improved by conducting the intervention development using a revised and amended study process. The first stage (**‘literature review stage’**) should involve conducting a review of the literature to identify theoretical concepts which relate to the guidelines that the intervention is aiming to target. This was done in the present research in Chapter 3. However at this stage an empirical study (**‘theory investigation questionnaire’**) should be conducted which involves the development of reliable theory based questionnaire measures (or use of previously tested measures), and identification of which constructs can be significantly related to GPs behaviour in clinical practice (e.g. prescribing rates) if possible. Once the theoretical constructs have been identified, these can be mapped (**‘intervention mapping stage’**) onto previously established construct domains in order to identify appropriate evidence based behaviour change techniques which can be selected and operationalized into the format for an intervention. A qualitative interview study (**‘qualitative development study’**) should then be conducted similar to that which was used effectively in Chapter 4. Prior to entering a trial, a pilot phase (**‘pilot trial’**) should be added into the procedure to identify any problems which can be resolved, before the intervention then enters the trial (**‘trial phase’**). As in the current research, a qualitative and quantitative process evaluation (**‘mixed method process evaluation’**) should occur to provide a variety of rich data with which to assess the intervention. However, the trial protocol should ensure that participation in an interview and questionnaire is compulsory for all practices taking part to provide a more representative sample.

7.7 Future research

In addition to amending the development process in future research and ensuring a thorough approach is scheduled within the timeframe and budget of a trial, the research within this thesis identified a number of factors which can help to inform the development of future interventions.

Key Features

The systematic review suggested that complex interventions which provide a variety of features may be more beneficial than those which use a simple presentation of guideline recommendations. Findings of both the development study and the qualitative process evaluation suggested that tools (such as patient information sheets) which assist GPs in persuading a patient of the benefits related to following recommendations are highly valued by GPs. Therefore interventions which include these patient tools may lead to greater use of an intervention and adherence to guidelines; however further research thoroughly investigating this possibly is required. In addition, future research should aim to provide clear and detailed descriptions of interventions to make assessing the benefits of intervention features more effective.

Additional Features

In the qualitative process evaluation study many of the GPs reported that they had not even looked through the prompts as they were afraid this would take too long and were unsure of how much there was to view. Therefore it is possible that these GPs would have been happier to try to use the prompts if they were shown the content of the prompts or given information at the beginning of the trial showing what the screens contained. This is a feature which could be incorporated into future studies to deal with GP concerns and encourage prompt use. In addition, GPs in some areas reported many of their patients could not read English and therefore the screens or patient information sheets could not be presented to them. The use of prompts could be increased if future studies identify specific language preferences of each practice and ensure that all information is available in each language required.

Staff awareness

Findings from the qualitative process evaluation suggest that practice staff awareness of the implementation of a computer-delivered intervention may strongly influence both GP use of prompts and efficiency of implementation.

In addition, findings from the quantitative process evaluation suggest that a large percentage of GP practice staff may not be aware of the implementation of computer-delivered interventions. Future interventions should aim to produce a protocol which includes methods to inform all practice staff of the computer prompts which are to be implemented onto their system. Future studies could also aim to ensure that communication within practices remains consistent by providing a checklist of actions that the practice could take when the study begins, such as highlighting participation at a staff meeting and handing out information packs to all GPs. This finding has contributed to the modification of the stroke intervention trial which is currently on-going, in that study documentation has been provided for all GPs, and staff have been encouraged to discuss the implementation at a staff meeting prior to the trial beginning.

Theory based questionnaires

Overall the quantitative process evaluation study suggested that GPs in the intervention group may have higher levels of self-efficacy in managing patients who are high risk of developing complications. Similarly, GPs in the intervention group may also have reduced negative outcome expectancies related to patients' likelihood of developing complications if an antibiotic is not prescribed for a RTI. These findings imply that the intervention may have provided information which reduced GPs' concerns relating to patient risk of complications if an RTI is managed without prescribing antibiotics (in accordance with the NICE guidelines). However, as differences between groups were only identified on one item from each theory based measure, no firm conclusions can be drawn. Future research could confirm these findings by expanding the range of questions on each measure relating to these items. In addition, a full questionnaire development and testing phase should be conducted prior to use in a study (to ensure validity and reliability of the measures).

Intervention evaluation questionnaire

In the intervention evaluation questionnaire, approximately half of the GPs reported that the prompts were useful in supporting practice whilst half reported that they were not useful. It would be interesting to explore why some GPs reported the prompts as not being useful. However, as the GPs did not have to provide a reason as to why they did not think the prompts were useful, future studies could expand this question and include options as to why GPs held this view of the prompts in order to clarify this issue. The qualitative study suggested that reasons for a GP not finding the prompts useful may be related to the belief that prompts are not needed as the guidelines are already being used, and usability issues such as a shortage of time and information sheets only being available in English. In order to clarify these reasons and confirm that they may explain the responses given in the questionnaire, a future measure could provide a tick box of reasons for the prompts not being useful linked to issues which were identified in the qualitative study (e.g. Information sheets only available in English language). In addition, software and usability of the prompts was generally rated highly by the GPs. However, approximately one quarter of GPs reported that the prompts did not appear at an appropriate time during the consultation. It would be interesting to explore exactly why they felt this was the case. Expansion of the question on this measure to include possible reasons for the views as to whether prompts appeared appropriately could be conducted in the future to clarify this matter. Therefore, future research could expand this questionnaire to include items which provide GPs with a selection of reasons as to why they chose an answer, in order to investigate possible issues which did not appear in the interview study.

7.8 Conclusions

In summary, the process of working with GPs to develop a theory informed, computer-delivered intervention to follow guidelines, resulted in the development of computer prompts which the GPs sampled in the qualitative studies generally approved of. Overall, GPs reported that the prompts were useful, feasible and acceptable in practice. However, uptake in the process

evaluation studies was very low and these views may not be representative of the whole sample. The research identified a number of factors which may encourage GPs to use computer-delivered prompts and adhere to clinical guidelines.

A key strength of the research related to its application of behaviour change theory within the intervention and the findings from the process evaluation which can be used to interpret findings from the main trial and optimise the intervention for future research.

Overall, a key characteristic of an acceptable computer-delivered intervention appears to be that it should be perceived as a useful tool supporting GP practice. In addition, findings suggested that practice staff awareness of the implementation of a computer-delivered intervention may strongly influence both GP use of prompts and efficiency of implementation.

The findings were largely consistent with self-determination theory (Deci & Ryan, 1980) and suggested that the theory may provide a useful tool with which to develop a further intervention related to clinical guideline adherence. The findings also supported some aspects of self-efficacy and outcome expectancies from social cognitive theory (Bandura, 1977) as influences on GPs' decision to adhere to guidelines. However, these findings are not conclusive and further research is needed to thoroughly investigate the implications.

Appendices

Appendix 1: Development study information sheet



University of London



INTERVENTION DEVELOPMENT FOR 'CLUSTER RANDOMISED TRIALS IN GPRD'

Part 1

We would like you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Talk to others about the study if you wish.

- Part 1 tells you the purpose of this study and what will happen to you if you take part.
- Part 2 gives you more detailed information about the conduct of the study. Please ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

What is the purpose of the study?

The purpose of this study is to investigate GPs' views of electronic messages to promote a) adherence with evidence-based recommendations for secondary prevention of stroke and vascular disease and b) to promote no antibiotic prescribing, or delayed antibiotic prescribing, instead of the immediate prescription of antibiotics for respiratory tract infections. Our aim is to find out your views of these messages and how you think they might be improved. The findings from this study will be used to improve the messages we use in a trial of their effects on patient care.

Why have I been invited?

You have been invited to take part as you have been identified as a GP currently working in a primary care setting; we are seeking views of GPs with diverse characteristics (e.g. age, gender, practice setting).

Do I have to take part?

Participation in this research is entirely voluntary. It is up to you to decide. You are free to withdraw at any time, without giving a reason.

What will happen to me if I take part?

If you consent to take part in the research you will be asked to take part in a face-to-face interview lasting approximately 1 hour **for which you will receive a payment of £75**. All interviews carried out will be tape recorded. If you would like to arrange an interview time or visit please use the contact details listed at the end.

What are the possible benefits in taking part?

You are unlikely to directly benefit yourself from taking part in the study. The information collected will help with the planning and development of the messages to be used in our trial, and if effective this could benefit patient care in the future.

Will my taking part in the study be kept confidential?

Yes. We will follow ethical and legal practice and all information about you will be handled in confidence. This completes Part 1. If the information in Part 1 has interested you and you are considering participation, please read the additional information in Part 2 before making any decision.

Part 2

What will happen if I don't want to carry on with the study?

You are able to withdraw from the study at any time without giving a reason.

What if there is a problem?

If you have any complaints about the conduct of this study or any people involved in it, you may write to or ask to speak to the researchers who will do their best to answer your questions (Contact no: 0207 848 6631).

Will my taking part in this study be kept confidential?

All interviews will be recorded on audio tape and transcribed. All data will be held on a secure site, only identified by a code number, with personal information removed. Your name will not be used in any reports or publications or given to the sponsor of the project or passed on to any other person. Anonymous quotes may be included in research reports. Anonymised records will be held indefinitely.

What will happen to the results of the research study?

The results will be published in recognised journals and also through international meetings.

Who is organising and funding the research?

The research is funded by the Wellcome Trust and is organised through the King's College London and University of Southampton.

Contact Details: Lisa McDermott, School of Psychology, University of Southampton, 02380 594518.

Appendix 2: Development study GP consent form



University of London

Study Number: 09/H0806/7
Centre Number:
Subject Identification Number for this study:

CONSENT FORM

Title of Project:

INTERVENTION DEVELOPMENT FOR 'CLUSTER RANDOMISED TRIALS IN GPRD'

Name of Researchers:

Martin Gulliford and Lucy Yardley

Please initial box

1. I confirm that I have read and understand the information sheet dated (version 4.2.2009) for the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.
3. I agree to take part in the above study.

Name of Subject

Date

Signature

Name of Person taking consent
(if different from researcher)

Date

Signature

Researcher

Date

Signature

1 for subject; 1 for researcher

Appendix 3: RTI prompts menu page example

The image shows a screenshot of a clinical decision support tool menu. At the top right, there are three buttons: "Menu", "Print", and "Close". Below these is a yellow box with the text: "Sore throat / Pharyngitis / Tonsillitis: click to view any of these tools to support delayed or non-prescribing". Below this box is a vertical list of seven yellow buttons, each containing a different tool option:

- Summary of recommendations for antibiotic prescribing
- Printable patient information about antibiotic use
- Summary of evidence
- Prescription indication
- Complications / risk of non-prescribing
- Alternative treatment options and suggestions

Appendix 4: RTI prompts content page example

[Menu](#)[Back](#)[Print](#)[Close](#)

Evidence for Sore Throat / Pharyngitis / Tonsillitis

Patients offered a delayed or non-prescribing strategy:

Experience a marginally longer duration of sore throat of less than 1 day compared to patients who are prescribed antibiotics (Little et al., 1997).

Experience marginally more symptoms (less than 1%) of sore throat, headache, and fever compared to patients who are prescribed antibiotics (Del Mar et al., 2006).

Are less likely to re-consult compared to those prescribed antibiotics. (Little et al., 1997).

Are less likely to believe antibiotics are effective (Little et al., 1997).

Appendix 5: Stroke prompts menu page

STROKE PATIENT

**16% risk of stroke recurrence over 5 years.
Mohan (2009)**

Click the links for stroke prevention advice:

Blood pressure target: 130/80 mm Hg

Cholesterol target: <3.5 mmol/l

**Aspirin PLUS dipyridamole for all patients
with non-haemorrhagic strokes**

**Record stroke as either haemorrhage or
infarct**

[Close](#)

[Print](#)

Appendix 6: Stroke prompts content page example

An optimal target BP after stroke is 130/80 mmHg

[Menu](#)

[Evidence](#)

[Print](#)

[Close](#)

Achieving this target BP can reduce the risk of recurrent strokes and other cardiovascular events by 28% or more. PROGRESS Collaborative Group (2001)

Prescribing two or three antihypertensive drugs at standard dose may reduce risk of cardiovascular events by up to 50%. Law (2009)

Intercollegiate Stroke Working Party Guidelines (2008), section 5.4, page 66

Appendix 7: Development study coding manual

	<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
1	Perceptions of role of prompts	The perception of the prompts role in relation to the GP. This relates to whether the GP perceives the prompts as a tool to support them, or a method to enforce them to follow the guidelines.				

Appendix 7

<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
<p><i>-Rejection of enforcement and approval for choice.</i></p>	<p>-Rejection and opposition towards any method interpreted as being a technique to 'enforce' behaviour. -Approval and positive view towards any method perceived as allowing choice and control over prompt use.</p>	<p>-Negative reactions towards perceived enforcement including: *Ignoring prompts and choosing not to follow them; *Switching prompts off if possible. -Positive reactions towards perceived choice and control including: *Ability to cancel prompts; *Choice over when prompts appear; *Choice of which prompts are viewed. -Perception of enforcement includes: *Use of language in prompts (authoritarian/ dictating etc); *How prompts appear (forcibly appearing on screen); *Monitoring of GP prompt use for enforcement.</p>	<p>-Cases where although the GP is talking about choice and control, this is more in relation to functional and usability issues of the prompt design / program. This should be coded as 'Usability'.</p>	<p>"Especially if you've summarised it as a, you know, a neutral academic, rather than a, a sort of preacher. If you're going to give me information in a neutral way, I would feel confident, that I'm going to get something here that's independent, that relates to the source. And that's attractive to me. So, I might only open this once every six months, I might open it when I have a patient with me to convince, and then I think this is a resource I can use. But if I feel that it's actually behaviour modification... I won't, I won't probably go there."</p>	<p>"I think if there's a quick reminder and we've got a list of things that we can just click on it, and a list comes down, basic information, this, that and the other, delayed prescriptions, and we just click on that and whoosh, print it out and just give that to the patient, then I think that's incredibly useful."</p>

Appendix 7

	<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
	-Acceptance of support tool.	-Acceptance and willingness to use prompts if perceived as support tool, to aid the GP with their own decision to follow guidelines.	-Prompts useful as tool for patients (e.g. to support/back up the GP's decision; to inform and educate the patient). -Prompts useful as tool for GP (e.g. as a reminder of guidelines; as a provider of evidence).	-Value and acceptance of prompts which offer choice, however not referring to prompts in supportive or tool based role. This should be coded as 'Rejection of enforcement and approval for choice'. -Prompts more/less likely to be used in certain patient groups (e.g. patients who expect antibiotics, patients with greater clinical need) but no direct referral to prompt role as supportive or a tool. This should be coded as 'Assistance in persuading patients' or 'Perceived clinical need'.	"Whereas the blood pressure level at 130 over 80 or a percentage of relapsing stroke, that does help me because that's information I might forget and I can share with the patient. I can share with the patient."	"It might be very helpful to patients who say well I'm worried Dr, you know, if you don't prescribe antibiotics I'll get pneumonia."
2	Anticipated patient outcomes	Decision to use the prompts based on expected patient outcomes. This can relate to outcomes of patient approval and clinical need.				

Appendix 7

	<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
	<i>-Assistance in persuading patients.</i>	-Prompts used seen as providing assistance in persuading patients who may not be willing to adhere to advice recommended in guideline.	-Prompts used to assist the GP in persuading/convincing a patient to follow guideline advice. -Prompts used to convince patients who are unwilling to adhere to guideline advice -More likely to use the prompts if patient perceived as being less accepting of guideline .	-Use of prompts benefit varying in relation to patient’s individual clinical need to follow the guideline, but not referring to persuading the patient to follow the guideline. Should be coded as ‘Perceived clinical need’.	“I think if you have patients who are, um, are unconvinced ; I think if people come in demanding antibiotics and it would be very helpful. ”	“Um, so I can see the public health message here but I’m now thinking, I thinking ok my patient is seventy-five, he’s had a stroke, what’s this twenty-eight percent and how does that relate to him? And it may be that at the age of seventy-five, that it doesn’t reduce his risk of stroke by twenty-eight percent, it reduces it by eight percent, you know? And so I think that, so my, this is the scientist in me, or the you know, saying ok, this is a public health message, is this good for the patient in front of me?”

Appendix 7

	<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
	<i>-Perceived clinical appropriateness</i>	Decision to use prompts related to the perceived clinical need of the patient and the specific benefit to the individual patient.	<p>-Perception of patient clinical need influences decision to use prompts.</p> <p>-For RTI, GP less likely to use prompt if patient clinical need for antibiotics perceived as high (e.g. Patients likely to develop complications; patients considered to have a bacterial infection).</p> <p>-For stroke, GP more likely to use prompt if risk perceived as high and resulting clinical problems perceived as low (e.g. side effects).</p>	-Discussion of varying benefit of prompt use related to patient individual differences in terms of patient approval of guidelines, however not in terms of clinical benefit or need. Should be coded as 'Assistance in persuading patients'.	"Well I guess, you're always going to have some people who are not going to necessarily be – it's not really appropriate for them to be going from really ... aggressive medication just by having had a stroke, so if they've got incredible co-morbidity or just can't take more tablets or whatever, ... again it's a case of as long as you can ignore."	"And who query the smallest result or... and I suppose I don't like to prompt that. They need very careful handling, so, and delivering a message, very often we have to think how they would react."
3	Prescriber differences	GP individual differences perceived as likely to affect use of prompts.				

Appendix 7

<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
-Willingness to use prompts	-GP's predetermined willingness to use prompts determines whether or not prompts are used, regardless of the content or potential benefit.	-GPs who are not open to the idea of using prompts will not use/benefit from them. -Prompts will not change the behaviour of GPs not willing to use them. -Willingness to use prompts is not dependent on whether or not the GP adheres to the guidelines.	-Discussion of how certain staff members may benefit from prompts, however not referring to their willingness/openness to use prompts. Should be coded as 'Benefit to inexperienced staff'.	"I think it's partly going to depend on the GP's attitude towards it because if you've got somebody going, oh, this is ridiculous, it's on the screen, I don't use it, don't worry about it , then it's going to ... it won't be particularly helpful, but I <u>think</u> as long as you've got somebody who is into the idea and presents it properly, then, again, it's another useful way of objectifying it and saying, oh look, there's the evidence and I'm not just making it up."	"But, you know, once again, if you're less experienced it could help you more."
-Useful for inexperienced staff.	-Inexperienced staff seen as likely to benefit from using the prompts.	-Inexperienced staff includes: nurses, locums, new GPs, trainee doctors, and staff unfamiliar with the guidelines. -Benefits to inexperienced staff include: familiarisation with guidelines and evidence to help make a clinical decision.	-Differing GP reactions to prompts based on view of guideline, not directly referring to the benefit across different staff groups. This should be coded as 'Willingness to use prompts'.	"Yeah, I can see this being useful for Registrars, new doctors, very useful for locums , actually, because we try to put together things for locums. We analyse our referral rates, for example, locums refer twice as many as we do. "	There are maybe one or two who ... are ... perhaps work in a slightly more intuitive way and ... sort of feel that ... they know best... and that linking the sort of diagnosis to the literature is not really the way to be making decisions and maybe they would find it less helpful."
4 Accessibility and presentation of prompts	Usability issues concerning accessibility and presentation of information in prompts influences GP prompt use.				

Appendix 7

<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
-Usability	-Prompts should be easy to access and use	-Prompts must be quick to access, and not cause any system to slow down. -A minimal amount of 'clicks' should be required to get to any screen. -It should be clear how to access each piece of information within the prompts.	-Description of information being easy to read, however this is related directly to the content of information presentation rather than just the ease to access the information. This should be coded as 'Optimal information presentation'.	"I think if there's a quick reminder and we've got a list of things that we can just click on it and a list comes down, basic information, this, that and the other, delayed prescriptions, and we just click on that, and whoosh , print it out and just give that to the patient, then I think that's incredibly useful....I think as long as we don't have endless hurdles that we have to click before we can actually say goodbye to the patient, or actually click out of the consultation, if you've got <u>endless</u> things, I'm telling you, it <u>really</u> does make a consultation an absolute nightmare."	"In a busy consultation you want something short and succinct, coupled with your ability to just click on it. So, it's probably over 100 words per slide here."

Appendix 7

<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
<i>-Optimal information presentation.</i>	-Evidence should be presented to include maximum detail in a minimal clear and concise format.	-Text used to present information should be as minimal as possible, but with the inclusion of maximum detail for facts and evidence. -Screens not overcrowded with information. -Information should be presented in a visually attractive way (e.g. inclusion of colour etc).	-Description of information presentation, however relating directly to ease of access issues, rather than information content. This should be coded as 'Usability'.	"I mean, there's a balance to be had, isn't there, between how much detail you offer and the accessibility of it and, clearly, it's a bit like doing slide presentations, you know, if you put too much stuff on, people think oh, I can't actually understand it and switch off , whereas if you just put one big statement, then people will think, oh, you think I'm an idiot and so you have to be somewhere between the two."	"Yes I think it's very important that when you get into a screen that it does what you thought, what you expect. So, so, clicking on these highlighted, no clicking on these titles, has got to give you what you want, what you expect to get, so I'm just one view, other people might interpret it the way you were looking at it, so I could be completely, you know completely excessive. But I think that it's very important that you get, that you get what you think you were getting."

Appendix 7

	<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
	<i>-Tailored information.</i>	-Information provided and prompts shown should be tailored as much as possible to the individual patient.	-Information tailored to individual patient. -Specific prompts to be omitted or included for certain patients.	-Discussion of patient individual differences, however relating to GP use of prompts rather than presentation of information. - This should be coded as 'Assistance in persuading patients' or 'Perceived clinical need'.	"I don't know how clever this system could be – if was possible to get pop ups if somebody needs a target BP of 140 over 80 or whatever, and it's not – you know, I think it's a QOF pop up that says this target hasn't been met, if these could come up for people that haven't reached the target , so that we then – so, for instance, if someone's got a blood pressure of 150 over 90, then for that one to continue to pop up would be fine, but, for instance, somebody who'd already had the cholesterol reduction, for that to keep on popping up when I've done that already. So if it would be possible to integrate it with the data set within the record. "	"Well I guess, you're always going to have some people who are not going to necessarily be – it's not really appropriate for them to be going from really ... aggressive medication just by having had a stroke, so if they've got incredible co-morbidity or just can't take more tablets or whatever, ... again it's a case of as long as you can ignore."

Appendix 7

	<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
	-Additional features	Additional features should be added to the prompts to provide additional further benefit and support.	<ul style="list-style-type: none"> -Added information on medication such as which drugs to use, drug costs, and doses. -Detailed information on when to prescribe, including links to decision making trees. -Additional tools such as links to further guidelines, local services, and more language options. 	-Suggestion of additional information relating directly to an individual patient (this should be coded as 'Tailored Information').	The other thing is that what would be quite useful for these things, and this is going beyond this, a long way, is that if you had a decision tree and you went down it, if the decision was to refer, then you'd click on the refer bit and it would populate your referral form electronically, with your patient demography, so just making life easier.	I think it's great, I think it would be particularly good if it could be tailored to the person in front of me. Men, women, um you know, age, and co-morbidities maybe, but certainly age you know.
5	Acceptability of guidelines	Decision to use prompts is related to acceptability of guidelines.				

Appendix 7

<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
<p><i>-Caution about guideline differences.</i></p>	<p>If GPs are aware of differences across guidelines, they are more likely to be cautious about using the prompts.</p>	<p>-GPs spend additional time deciding whether to use prompt if differing guideline advice is present. -GPs less likely to use the prompts if they are aware of differences or conflict in the advice recommended across different guidelines. -GPs may choose to only use specific prompts if they are unsure of which guideline should be followed.</p>	<p>-Discussion of guidelines in relation to following advice on the prompts, however emphasis is on the source of the guidelines and their credibility rather than content differences. This should be coded as 'Credibility of source'.</p>	<p>"Um, I think it brings to mind the difficulties we've had with hypertension, where you've had conflicting sets of advice, where you've had national standards and you've had the British Hypertension Society saying slightly different things. For example, about home monitoring of blood pressure and I think that is – that creates a bit of confusion in people's minds but also a degree of exasperation as to what you're supposed to do, because, you know, on the assumption that these are both groups of people who want to practise the highest standard, they come up with different guidelines, then it does beg the question, you know, which one you follow."</p>	<p>"It's NICE guidelines, it's professional guidelines and people, I think, actually respect that really."</p>

Appendix 7

	<u>Code</u>	<u>Description</u>	<u>Includes</u>	<u>Excludes</u>	<u>Positive example</u>	<u>Negative example</u>
	<i>-Credibility of source</i>	-GPs are comfortable using prompts if the guideline is perceived as coming from a credible source.	-GP happy to use prompt if perceived as credible source. -NICE, ICSWP, and QOF credible. -If guideline source seen as money-saving tool, less likely to use prompt.	-Discussion of guideline source, where emphasis relates to differences between guidelines, rather than credibility of the source. This should be coded as 'Caution about guideline differences'.	"The wording that gives it most weight of all is the Royal College of Physicians. That gives me weight because I'm a member of that college, whether that applies to other clinical groups, I'm not so sure, but I would hope it does. So I know about the clinical effects evaluation unit, bit of a mouthful, but, anyway, it'll do."	"Well, who do we follow, NICE or QOF, that's the thing. You'll always get conflict. Some of us follow QOF because it's ... that's what we get paid for, so you've got a conflict really, but is it the best thing for the patient? Probably sticking to these guidelines is."

Appendix 8: GP interview invitation letter



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

Thank you for your continued support in taking part in this research over the last year.

Now the trial is reaching its final stages we would like to conduct a short telephone interview (20- 30 mins) to discover GPs views and opinions of the trial. A fee of £50 for each interview will be offered.

Your comments will be of great value to us in evaluating the feasibility of implementing our computer prompts into general practice in the future.

We would like to speak with as many GPs as possible at your practice to best understand experiences of the trial. The interviews will be conducted over the phone at whatever time is most convenient to each GP (which can include early mornings, evenings, or weekends).

Please could you contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk to obtain more information and arrange a convenient interview time

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 9: Implementation staff interview invitation

As part of an evaluation of the electronic guideline reminders in respiratory tract infection trial, we're conducting interviews with people who were involved with the trial implementation.

We are really interested to hear your views on the trial and would very grateful if you would be able to take part in an interview.

The interviews ask about your experiences with this trial and your views on implementing trials of this nature within the GPRD in general. (The interview will last about 20-30 minutes and can be conducted over the telephone at a time which is convenient for you).

If you would like any more information or to arrange a convenient time for this please contact me by phone 02380599395 or l.mcdermott@soton.ac.uk

Many Thanks for your help,

Best Wishes,

Lisa

Lisa McDermott
Research Fellow in Health Psychology
University of Southampton
School of Psychology

Appendix 10: GP interview invitation reminder 1



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

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Your comments will be of great value to us in evaluating the feasibility of implementing our computer prompts into general practice in the future.

We would like to speak with as many GPs as possible at your practice to best understand experiences of the trial. The interviews will be conducted over the phone at whatever time is most convenient to each GP (which can include early mornings, evenings, or weekends).

Please could you contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk to obtain more information and arrange a convenient interview time.

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 11: GP interview invitation reminder 2



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

Thank you for your continued support in taking part in this research over the last year.

Now the trial is reaching its final stages we would like to conduct a short telephone interview (20- 30 mins) to discover GPs views and opinions of the trial. A fee of £50 for each interview will be offered.

Your comments will be of great value to us in evaluating the feasibility of implementing our computer prompts into general practice in the future.

We would like to speak with as many GPs as possible at your practice to best understand experiences of the trial. The interviews will be conducted over the phone at whatever time is most convenient to each GP (which can include early mornings, evenings, or weekends).

Please could you contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk to obtain more information and arrange a convenient interview time.

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 12: Process evaluation coding manual

	Code	Description	Includes	Excludes	Positive example	Negative example
1	AWARENESS OF IMPLEMENTATION	The GPs level of awareness regarding the implementation of the prompts onto their system often influenced their willingness to use them or even notice them				
	<i>Aware of implementation and confident to use</i>	If GPs had been made aware that the prompts were going to be implemented onto the system, they felt confident in viewing them and using them	*Awareness study was taking place, *Awareness prompts were appearing and what this meant/how to use prompts *Discussion of study/prompts taking place with staff	*Discussion of study awareness ONLY in relation to NOT being aware of study/prompts	<i>"We talked about it in practice so I was expecting it....I thought it was a very useful aid for me" (P08)</i>	<i>"I don't think anyone actually pointed it out to me....I might have just thought, 'Oh is that some sort of advertisement'...I probably would have used it, but definitely I would you know" (P05)</i>
	<i>Unaware of implementation and confusion of purpose</i>	If GPs were unaware that the prompts were going to be implemented onto their system they often did not notice them or realise what they were for or how they could be used when they saw them	*Being unaware of study/prompts, *Not understanding what prompts were	*Discussion of study awareness ONLY in relation to BEING aware of study/prompts	<i>"I don't think anyone actually pointed it out to me....I might have just thought, 'Oh is that some sort of advertisement'...I probably would have used it, but definitely I would you know" (P05)</i>	<i>"We talked about it in practice so I was expecting it....I thought it was a very useful aid for me" (P08)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
2	USEFULNESS OF PROMPTS	Overall the prompts are seen as a useful GP tool. There are various perceived benefits of use, and also a barrier to the use of prompts as a practice tool				
	Benefits of use					
	<i>Useful to inexperienced staff</i>	Inexperienced staff seen as likely to benefit from using the prompts.	*New staff/locums/nursing staff/student doctors would benefit from using the prompts	*Discussing usefulness of prompts as a reference tool but NOT in relation to inexperienced staff	<i>"New colleagues or new prescribers might be needing to look at it more" (P01)</i>	<i>"I think that it is a useful reminder, it doesn't take long before having seen them and you've refreshed your memory of the NICE guidelines" (P04)</i>
	<i>Support for decision</i>	Acceptance and willingness to use prompts if perceived as support tool, to aid the GP with their own decision to follow guidelines.	*Prompts are helpful in supporting GP to not prescribe/issue a delayed prescription, *Useful in supporting decisions already made by GP.	*Discussion of the GP already following prescribing guidelines (e.g. delayed prescription) but NOT using prompts to help with this	<i>"First of all they give confidence to the doctor, that there is some evidence behind the decision" (P08)</i>	<i>"I mean I don't find or look at them...because I'm usually relatively comfortable with my respiratory management shall we say, I do very few respiratory referrals etc" (P02)</i>

Appendix 12

Code	Description	Includes	Excludes	Positive example	Negative example
A reminder/reference tool	Prompts described as being useful to remind GPs of the guidelines and a source of useful references.	*Prompts used as a reminder for guidelines, *Prompts used as reference for evidence to read alone OR use with patients	*Discussion of prompts SPECIFICALLY being useful in supporting prescribing decisions and NOT as a reminder of reference.	<i>"I think that it is a useful reminder, it doesn't take long before having seen them and you've refreshed your memory of the NICE guidelines" (P04)</i>	<i>"First of all they give confidence to the doctor, that there is some evidence behind the decision" (P08)</i>
Can help reduce prescribing	The prompts are perceived as being a tool which can gradually help to reduce prescribing of antibiotics for individual GP and colleagues	*The prompts/study may help to reduce antibiotic prescribing across areas/with the individual GP/with colleagues.	*Discussion of how the prompts can support decisions not to prescribe WITHOUT discussing overall prescribing rates.	<i>"Oh I would have thought they will have reduced the amount of antibiotics prescribing" (P07)</i>	<i>"First of all they give confidence to the doctor, that there is some evidence behind the decision" (P08)</i>
Barrier to use					
Not needed as guidelines already followed	Prompts are seen as a useful tool but not necessary for individual GP who already follows guidelines	*Guidelines are already followed by the individual, *Prompts are not needed in any way to assist with following the guidelines	*Discussion of prompts being most beneficial for OTHER/ inexperienced staff.	<i>"I mean I don't find or look at them...because I'm usually relatively comfortable with my respiratory management shall we say, I do very few respiratory referrals etc" (P02)</i>	<i>"New colleagues or new prescribers might be needing to look at it more" (P01)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
3	POSITIVE IMPACT ON PATIENTS	Overall the prompts are viewed as having a positive impact on patients for a number of reasons.				
	Assistance in persuading patients	Prompts used seen as providing assistance in persuading patients who may not be willing to adhere to advice recommended in guideline.	*Using information/features of prompts to persuade a patient to accept guideline based advice	*Discussion of reducing antibiotic prescribing WITHOUT mentioning use of prompts in persuading patients to accept this.	<i>"There's always that kind of feeling like 'oh', but actually its very good because it's helpful in guiding patients" (P10)</i>	<i>"Oh I would have thought they will have reduced the amount of antibiotics prescribing" (P07)</i>
	Acceptable to patients	The prompts and information presented are perceived as being useful, clear and acceptable to patients.	*All information shown/given to patients in relation to the prompts is acceptable to patients, *Patients happy with all features of prompts	*Discussion of using prompts to persuade patients WITHOUT discussing the acceptability of the prompts for patients.	<i>"I think they give confidence to the patient" (P08)</i>	<i>"There's always that kind of feeling like 'oh', but actually its very good because it's helpful in guiding patients" (P10)</i>
	Patient information sheet very useful feature.	The patient information sheet is described as being the most useful and beneficial aspect of the prompts.	*Benefits of patient information sheet discussed, *Reasons for patient information sheet being beneficial discussed	*Discussion of prompts being acceptable to patients WITHOUT discussion about specific benefits of information sheet.	<i>"Its quite nice to to give an information sheet because it's a sort of reminder for the patient about what we talked about.....it's quite a nice way to reinforce what our conversation has been about" (P06)</i>	<i>"I think they give confidence to the patient" (P08)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
4	USABILITY OF PROMPTS	The usability of prompts includes perceptions of how easy prompts were to use and control, practical barriers to using them, and suggestions to improve them further in the future.				
	Benefits of design					
	<i>Easy to control</i>	Prompts were easy to control, in that they were not obstructive and could be viewed and exited easily.	*Prompts are easy to control in terms of exiting/ removing/ ignoring if not wanted	*Discussing using features/functions of prompts and NOT use in terms of control/removal.	<i>"I didn't find them particularly intrusive or anything like that, that I didn't want to use them, it was easy to ignore them" (P07)</i>	<i>"It's very easy and simple to click that" (P06)</i>
	<i>Easy to use</i>	Prompts were easy to access, navigate and use	*Prompts and features of prompts are easy to use in practice	*Discussing prompt use ONLY in relation to exiting/removing prompts if not wanted	<i>"It's very easy and simple to click that" (P06)</i>	<i>"I didn't find them particularly intrusive or anything like that, that I didn't want to use them, it was easy to ignore them" (P07)</i>
	Barriers to use					

Appendix 12

Code	Description	Includes	Excludes	Positive example	Negative example
Limited time to read and use	The limited time in a consultation made it hard to read over all options and details of the prompts in order to decide which were parts to use.	*Not enough time during consultation/in day to understand/read/select options/choose features of prompts to use.	*Discussion of the prompts being easy to use in a time limited situation	<i>"So it was sort of a nice idea but it's just that sort of real pressure on time, thinking you know, I can't go through all of this and it put me off" (P06)</i>	<i>"It's very easy and simple to click that" (P06)</i>
Only English language available	In some areas a significant proportion of the patients do not read English which meant the screens or patient sheets could not be used with them.	*Content of prompt screens/information sheet cannot be used due to non-English speaking/reading patients/more languages on prompts would be useful	*Cannot use prompts with patients due to issues OTHER than language (e.g. time)	<i>"If its just in English it's not going to be useful specifically for us...um for our patient population Urdu or Mirpuri" (P01)</i>	<i>"So it was sort of a nice idea but it's just that sort of real pressure on time, thinking you know, I can't go through all of this and it put me off" (P06)</i>
Improvements for future					
Additional features	Additional features should be added to the prompts to provide additional further benefit and support. E.g. linking these to other services etc.	*Prompts would be improved if extra features were added (e.g. services/phone numbers/drug recommendations etc)	*Discussion of how prompts could be improved if other languages were available.	<i>"It's quite far fetched but having some kind of recorded message as well,.....or videos detailing about you know...coughs, colds, not needing antibiotics, not needing consultations with the GP as well" (P01)</i>	<i>"If its just in English it's not going to be useful specifically for us...um for our patient population Urdu or Mirpuri" (P01)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
	<i>Simplify further</i>	The prompts could be made easier to use by further simplifying them and reducing the number of options available to select from on the menu page and text presented	*Prompts could be improved by simplifying them in terms of content/screens available/text on screen	*Prompts would be improved by ADDING additional features and functions	<i>"Well I don't like it when you have to go through several sub-menus really...and a lot of them had more buried you know" (P04)</i>	<i>"It's quite far fetched but having some kind of recorded message as well,.....or videos detailing about you know...coughs, colds, not needing antibiotics, not needing consultations with the GP as well" (P01)</i>
	<i>Increase visibility of prompts</i>	The prompts would be made easier to use if the visibility of them was increased. This could be done using a number of methods such as making the prompts flash, pop up, or using brighter colours.	*Prompts would be improved by increasing visibility on screen to make them noticed more (e.g. flashing/new colours/pop-ups etc)	*Prompts would be improved by ADDING additional features and functions	<i>"I think they just didn't attract your attention away from what you were doing to notice them, so if they were somehow made to stand out more, or moved across to a different part of the screen this would help me" (P12)</i>	<i>"It's quite far fetched but having some kind of recorded message as well,.....or videos detailing about you know...coughs, colds, not needing antibiotics, not needing consultations with the GP as well" (P01)</i>
5	AWARENESS OF IMPLEMENTATION	The GPs' level of awareness regarding the implementation of the prompts onto their system often influenced their willingness to use them or even notice them				

Appendix 12

Code	Description	Includes	Excludes	Positive example	Negative example
<i>Aware of implementation and confident to use</i>	If GPs had been made aware that the prompts were going to be implemented onto the system, they felt confident in viewing them and using them	*GPs aware of prompts/implementation/study and understand/feel confident etc with their use	*Discussion of being more aware of prompts if their visibility was increased	<i>"We talked about it in practice so I was expecting it....I thought it was a very useful aid for me" (P08)</i>	<i>"I think they just didn't attract your attention away from what you were doing to notice them, so if they were somehow made to stand out more, or moved across to a different part of the screen this would help me" (P12)</i>
<i>Unaware of implementation and confusion of purpose</i>	If GPs were unaware that the prompts were going to be implemented onto their system they often did not notice them or realise what they were for or how they could be used when they saw them	*GPs unaware of prompts/implementation/study and do not fully understand/feel confident with their use	*Discussion of being more aware of prompts if their visibility was increased	<i>"I don't think anyone actually pointed it out to me.....I might have just thought 'Oh is that some sort of advertisement'...I probably would have used it, but definitely I would now I know" (P05)</i>	<i>"I think they just didn't attract your attention away from what you were doing to notice them, so if they were somehow made to stand out more, or moved across to a different part of the screen this would help me" (P12)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
	Implementation staff only					
6	RESEARCH GOVERNANCE AND APPROVAL PROBLEMS	Issues relating to obtaining research governance approval for areas across the country from which practices would later be recruited were discussed as impacting the study implementation.				
	<i>Inconsistent procedures</i>	Procedures were reported to differ widely across many research governance offices. This included differences in the information required, the nature of questions asked and the time taken to respond to queries and applications. This often lead to delays in receiving approvals.	*Discussion of different procedures across R&D offices including differences in: questions asked/time taken in responding/delays/information requested.	*Discussion of different R&D delays leading to biased sample of practices	<i>"the R&D offices, some of them were asking for completely different things...there would be delays with some...and just different procedures with the different offices..." (P IS 1)</i>	<i>"And we didn't get to recruit the areas who were slower in giving approval and things..." (P IS 1)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
	Delay bias sample	As some areas took much longer than others to issue approvals, only practices which gave approvals in an appropriate time frame were recruited into the study. This may have biased the sample as areas which were delayed in providing approval were not recruited from	*Practices were only recruited from areas where no/little delays in R&D procedures had occurred/*Sample of practices biased towards areas with faster R&D procedures	*Discussion of different R&D procedures and timescales WITHOUT discussion of how this may have led to a bias sample	<i>"And we didn't get to recruit the areas who were slower in giving approval and things..." (P IS 1)</i>	<i>"the R&D offices, some of them were asking for completely different things...there would be delays with some...and just different procedures with the different offices..." (P IS 1)</i>
7	PRACTICE PAYMENT CONCERNS IN RECRUITMENT	This relates to the practices not being paid to take part in the study or use the prompts. A number of concerns and possible outcomes relating to this were reported.				

Appendix 12

Code	Description	Includes	Excludes	Positive example	Negative example
Difficulties due to non-payment for study	Difficulties often arose during recruitment due to the fact that practices were not being paid to take part in the study. These included delays in the time it took for a practice to respond, receiving additional queries from practices about this issue and practices refusing to take part simply due to non-payment.	*Problems/difficulties/delays in recruiting practices directly due to a practice not receiving payment for study participation/viewing prompts.	*Discussion of a difficulty in not paying practices in relation ONLY to the sample being bias towards practices happy to take part with no payment.	<i>"but it definitely slowed it down a bit.....the majority of cases were just not willing to take on board this study without funding etc" (PIS 3)</i>	<i>"it meant that we only recruited a certain type of practice...um...that didn't mind not getting paid...so that would be a slightly different type of sample in the study" (P IS 1)</i>
Payment bias sample	As practices were not paid to take part in the study, this may have led to a sample which was bias towards practices who were happy to take part in research for free (therefore a group which may share certain research friendly attributes such as being more open towards using the prompts etc)	*Only practices who were happy not to receive payment for study/using prompts took part, *Sample may be bias towards only practices happy to engage in research for no payment.	*Discussion of problems associated with not paying practices WITHOUT discussion of a bias sample group.	<i>"it meant that we only recruited a certain type of practice...um...that didn't mind not getting paid...so that would be a slightly different type of sample in the study" (P IS 1)</i>	<i>"but it definitely slowed it down a bit.....the majority of cases were just not willing to take on board this study without funding etc" (PIS 3)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
8	COMMUNICATION TO PRACTICES SUPPORTED	Communication to practices was reported as being greatly supported by the GPRD in particular. The GPRD appeared to be viewed by practices as a trusted organisation with which to communicate. However, concerns were raised this may have led to a bias sample group.				
	<i>GPRD as a trusted group</i>	The GPRD were seen by practices as being a trusted group whom they would freely and willingly communicate with. This was reported to assist in all areas the study.	*Communication with practices made easier/faster due to role of GPRD, *Practices trust GPRD and are happy/willing to communicate with them	*Discussion of practices being in GPRD ONLY in relation to a bias sample group	<i>“So then all the practices were in the GPRD...but this was a good thing because the practices know them and trust them” (P IS1)</i>	<i>“there is a set of practices who are part of these and research networks who are involved in research on almost a daily basis, we may have recruited a lot of these...so things may have been a bit easier” (P IS 4)</i>

Appendix 12

	Code	Description	Includes	Excludes	Positive example	Negative example
	<i>GPRD bias sample</i>	As all practices were members of the GPRD, it was suggested that the sample may be bias towards practices who have an interest in research.	*Practices used in study/recruited were ALL members of GPRD, *Using only GPRD practices may bias sample/create sample more research active/interested etc	*Discussion of practices being in GPRD WITHOUT discussing possible sample bias due to this	<i>“there is a set of practices who are part of these GPRD and research networks who are involved in research on almost a daily basis, we may have recruited a lot of these...so things may have been a bit easier” (P IS 4)</i>	<i>“So then all the practices were in the GPRD...but this was a good thing because the practices know them and trust them” (P IS1)</i>
9	COMMUNICATION DIFFICULTIES WITHIN PRACTICES	It was reported that there were problems with communication between staff within each practice, primarily due to the fact that staff members were not being made aware of the surgeries participation in the study.				

Appendix 12

Code	Description	Includes	Excludes	Positive example	Negative example
<i>Delays due to practice staff unawareness of study.</i>	Due to the fact that staff within a practice were often not aware of the study, the implementation of the computer prompts was often delayed as permission to put them on the practice system could not be given until a staff member who knew about the study confirmed participation.	*Delays in implementing prompts/starting study due to: practice staff being unaware of study/unable to contact/locate staff member who was aware/had given permission	*Discussion of staff being unaware of study ONLY in relation to future improvements in awareness being needed.	<i>“we soon learned that they had absolutely no clue or awareness about the study.....the study just ends up running for 18 months if not longer and I think a lot of that frankly was us not being able to get hold of the right person” (P IS 2)</i>	<i>“In terms of pressing the practice...‘well look- you have signed up for this thing, so can you please make your practice aware, maybe during the next practice meeting’.....and that would have made all the difference actually...so there was just a complete lack of awareness in my opinion” (P IS 2)</i>
<i>Improvements to staff awareness needed</i>	In future studies, measures should be taken to improve practice staff awareness of involvement in the study, in order to improve implementation procedures and engagement with prompts.	*Future studies/interventions/prompt systems should ensure/include measures to improve/increase practice staff awareness of new system/plans.	*Discussion of staff being unaware of study ONLY in relation to delays in study which resulted from this.	<i>“In terms of pressing the practice...‘well look- you have signed up for this thing, so can you please make your practice aware, maybe during the next practice meeting’.....and that would have made all the difference actually...so there was just a complete lack of awareness in my opinion” (P IS 2)</i>	<i>“we soon learned that they had absolutely no clue or awareness about the study.....the study just ends up running for 18 months if not longer and I think a lot of that frankly was us not being able to get hold of the right person” (P IS 2)</i>

Appendix 13: Intervention group questionnaire invitation



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

Thank you for your continued support in taking part in this research for the last year.

For the final part of the study we would like to ask you to complete a short questionnaire that asks about your opinion concerning clinical issues related to the trial.

We would like as many GPs as possible to complete the questionnaire. **Please could each GP at your practice complete the confidential online questionnaire which appears at the web address: www.isurvey.soton.ac.uk/1036/14778/JUG5VS/.** Please click on the link or copy it into your browser. The questionnaire is hosted by the University of Southampton in a secure environment.

If you would like a **paper version** of the questionnaire or any further information please contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk.

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 14: Control group questionnaire invitation



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

Thank you for participating in this research for the last year. Your practice was assigned to the control group and you would not have noticed any difference from usual care.

For the final part of the study we would like to ask you to complete a short questionnaire that asks about your opinion concerning clinical issues related to the trial.

We would like as many GPs as possible to complete the questionnaire. **Please could each GP at your practice complete the confidential online questionnaire which appears at the web address: www.isurvey.soton.ac.uk/1036/14778/JUG5VS/.** Please click on the link or copy it into your browser. The questionnaire is hosted by the University of Southampton in a secure environment.

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Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 15: Intervention group questionnaire reminder 1



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

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We would like as many GPs as possible to complete the questionnaire. **Please could each GP at your practice complete the confidential online questionnaire which appears at the web address: www.isurvey.soton.ac.uk/1036/14778/JUG5VS/ OR by completing the paper version which we have enclosed and returning using the addressed envelope.**

If you would like further information please contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk.

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 16: Control group questionnaire reminder 1



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

Thank you for participating in this research for the last year. Your practice was assigned to the control group and you would not have noticed any difference from usual care.

For the final part of the study we would like to ask you to complete a short questionnaire that asks about your opinion concerning clinical issues related to the trial.

We would like as many GPs as possible to complete the questionnaire. **Please could each GP at your practice complete the confidential online questionnaire which appears at the web address: www.isurvey.soton.ac.uk/1036/14778/JUG5VS/ OR by completing the paper version which we have enclosed and returning using the addressed envelope.**

If you would like further information please contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk.

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 17: Intervention group questionnaire reminder 2



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

Thank you for your continued support in taking part in this research for the last year.

For the final part of the study we would like to ask you to complete a short questionnaire that asks about your opinion concerning clinical issues related to the trial.

We would like as many GPs as possible to complete the questionnaire. **Please could each GP at your practice complete the confidential online questionnaire which appears at the web address: www.isurvey.soton.ac.uk/1036/14778/JUG5VS/.** Please click on the link or copy it into your browser. The questionnaire is hosted by the University of Southampton in a secure environment.

If you would like a **paper version** of the questionnaire or any further information please contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk.

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 18: Control group questionnaire reminder 2



University of London



Dear Colleague,

**CLUSTER RANDOMISED TRIALS IN GPRD:
RESEARCH INTO ELECTRONIC SUPPORT OF CLINICAL DECISION-MAKING
1. INTERVENTION FOR ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS**

Thank you for participating in this research for the last year. Your practice was assigned to the control group and you would not have noticed any difference from usual care.

For the final part of the study we would like to ask you to complete a short questionnaire that asks about your opinion concerning clinical issues related to the trial.

We would like as many GPs as possible to complete the questionnaire. **Please could each GP at your practice complete the confidential online questionnaire which appears at the web address: www.isurvey.soton.ac.uk/1036/14778/JUG5VS/.** Please click on the link or copy it into your browser. The questionnaire is hosted by the University of Southampton in a secure environment.

If you would like a **paper version** of the questionnaire or any further information please contact our researcher Lisa McDermott from The University of Southampton on 02380 599395 or email at l.mcdermott@soton.ac.uk.

Thank you again for taking part in the trial,

Yours sincerely

A handwritten signature in black ink that reads 'Martin Gulliford'.

Martin Gulliford, Professor of Public Health, King's College London

Appendix 19: Complete questionnaire as presented

GPRD Intervention questionnaire (RTI)		UNIVERSITY OF Southampton		
We would like to ask you some questions about your recent experience using the computer activated 'prompts' which contained guideline information for antibiotic prescribing in respiratory tract infection. For each question please click on the answer that applies to you.				
1. Software				
Question 1.				
How much do you agree or disagree with the following statements:				
	Agree strongly	Agree	Disagree	Disagree strongly
The prompts were easy to read	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There were no problems using the prompts	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The program was too slow	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The prompts were difficult to use	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Prompt type				
Question 1.				
How much do you agree or disagree that each of the following prompts were useful:				
	Agree strongly	Agree	Disagree	Disagree strongly
Sore throat/ pharyngitis/ tonsillitis	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cough/ acute bronchitis	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Otitis media	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rhinosinusitis	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Common cold	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Consultation				
Question 1.				
How much do you agree or disagree with the following statements:				
	Agree strongly	Agree	Disagree	Disagree strongly
The prompts are easy to use during a consultation for RTI	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are problems using the prompts during a consultation for a RTI	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4. Additional issues

Question 1.

How much do you agree or disagree with the following statements:

	Agree strongly	Agree	Disagree	Disagree strongly
I agree with the NICE guidelines for antibiotic prescribing in RTI	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was happy with the level of communication within the practice relating to the trial	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communication within the practice relating to the trial could have been improved	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Question 2.

Please answer 'Yes' or 'No' to the following statements:

	Yes	No
I discussed starting the trial within the practice before it began	<input checked="" type="radio"/>	<input type="radio"/>
I met to discuss the prompts with colleagues during the trial	<input checked="" type="radio"/>	<input type="radio"/>

5. Views and opinions

We would now like to ask your opinions on some of the issues which are related to guidelines for antibiotic prescribing in respiratory tract infection.

Question 1.

For each option please rate your level of agreement using the scale below to the following statement:

“If I treat a patient with a RTI without prescribing antibiotics....”

	Strongly disagree	Disagree	neither agree nor disagree	Agree	Strongly agree
I will avoid contributing to antibiotic resistance	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It will help to educate the patient that antibiotics are not always necessary for treating RTI	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The patient will be dissatisfied with the outcome	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The patient may develop further clinical complications	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The consultation will take longer (in order to explain non-prescribing decision to patient)	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The patient will be more likely to re-consult with the problem	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The patient will book an appointment with another GP in future	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5. Views and opinions

Question 2.

Using the scale below, please rate for each statement how certain you are that you could treat a patient with a RTI without an immediate prescription of antibiotics

	0 (Cannot do at all)	1	2	3	4	5 (Moderately certain can do)	6	7	8	9	10 (Highly certain can do)
When a patient DOES want antibiotics	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
When a patient DOES NOT want antibiotics	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
When you are in a rush	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
When you have plenty of time to talk to a patient	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
When you think a patient is at LOW risk of developing further medical complications	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
When you think a patient may be at HIGH risk of developing further medical complications	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				
When a patient has used self-management techniques for the RTI before consulting	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				

Appendix 20: Intervention trial information sheet



University of London



CLUSTER RANDOMISED TRIALS IN A PRIMARY CARE DATABASE: UTILISING ELECTRONIC PATIENT RECORDS FOR INTERVENTION RESEARCH

We would like to invite your practice to take part in a GPRD-related research study. Before you decide you need to understand why the research is being done and what it would involve for you and the practice. Please take time to read the following information carefully. Talk to others about the study if you wish.

- Part 1 tells you the purpose of this study and what will happen to you if you take part.
- Part 2 gives you more detailed information about the conduct of the study. Please ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish your practice to take part.

Part 1

What is the purpose of the study?

This research aims to provide 'proof of concept' of the feasibility and utility of implementing cluster randomised trials utilising primary care electronic patient records in a large national primary care database. A cluster randomised trial is one in which general practices are randomised to intervention and control groups. This application is in a common acute condition - antibiotic prescribing in respiratory illness. The research will provide guidance for the future conduct of cluster randomised trials using electronic patient records.

Why has my practices been invited?

All practices that contribute data to the GPRD are being invited to participate in this research.

Does my practice have to take part?

Participation in this research is entirely voluntary. It is up to your practice to decide. Your practice is free to withdraw at any time, without giving a reason

What will happen to my practice if it takes part?

If your practice agrees to take part, we will ask you to sign a consent form agreeing to the participation of your practice. The practice will be randomised either to an intervention group or a control group. Interventions will be implemented at the level of

the practice. Practices in the control group will continue with usual care. Practices in the intervention group will have electronic prompts installed in their practice computer system. Prompts will be downloaded automatically overnight through the DXS system. The prompts will be activated automatically during consultations by patients with respiratory illness. A 'pop-up' window will then appear reminding GPs of recommended standards of care for that condition. However, all clinical decisions will continue to be at the discretion of the practitioner, jointly with their patients. Patients will not notice any difference from usual care. All data required for the study will be that already routinely collected into GPRD. Towards the end of the study, participating practices will be asked to complete an optional questionnaire to find out about their views of participating in the research.

You will also be offered the opportunity to take part in an optional telephone interview at the end of the trial. You will be asked permission for us to contact you and invite you take part in the interview. You do not have to agree to this invitation to take part in the trial. If you do agree, we will contact your practice shortly before the trial ends and invite a GP to conduct a telephone interview to discuss their views and opinions of the trial (lasting approximately 30 minutes). All responses would remain confidential. If you agreed to receive an invitation you could still decide not to take part in the interview.

The study has been designed so as to minimise demands on practices. If you agree to take part in the study, you WILL be asked to sign a consent form, complete a short questionnaire, and consider taking part in an optional short interview. You WILL NOT be asked to complete any training, nor complete any other documentation, nor collect other data for the study.

What are the possible benefits in taking part?

You are unlikely to directly benefit yourself from taking part in the study. However, this research will develop a new research methodology. The information collected will help with the planning of future cluster trials in primary care. If effective the prompts developed for the study could benefit patient care in the future. This will contribute to improving clinical care and the health of the public.

Will my taking part in the study be kept confidential?

Yes. We will follow ethical and legal practice and all information about you will be handled in confidence.

This completes Part 1. If the information in Part 1 has interested you and you are considering participation, please read the additional information in Part 2 before making any decision.

Part 2

What will happen if my practice doesn't want to carry on with the study?

You are able to withdraw your practice from the study at any time without giving a reason.

What if there is a problem?

If you have any complaints about the conduct of this study or any people involved in it, you may write to or ask to speak to the researchers who will do their best to answer your questions [Contact no: at GPRD-MHRA, see below]

Will my practices' data be kept confidential?

All data will be collected within the framework already established by GPRD. The research team will only have access to anonymised data. Anonymised records will be held indefinitely.

What will happen to the results of the research study?

The results will be published in recognised journals and also through international meetings.

Who is organising and funding the research?

The research is funded by the Wellcome Trust and Research Councils through a programme of research to increase the utilisation of electronic patient records in medical research. The project is organised from the Department of Public Health Sciences, King's College London, the GPRD Division of MHRA and the University of Southampton.

Contact Details: [contact details at GPRD-MHRA. In order to preserve the anonymity of GPRD practices, all communications with practices will be through the GPRD Division, MHRA]

Appendix 21: Intervention trial consent form



University of London

Study Number:09/H0806/7

CONSENT FORM

CLUSTER RANDOMISED TRIALS IN A PRIMARY CARE DATABASE:

UTILISING ELECTRONIC PATIENT RECORDS FOR INTERVENTION RESEARCH

1. INTERVENTION TO REDUCE ANTIBIOTIC PRESCRIBING IN RESPIRATORY ILLNESS

Name of Researchers:

Martin Gulliford and Tjeerd van Staa (King's College London and GPRD Division, MHRA)

Please initial box

1. I confirm that I have read and understand the information sheet dated (version 11.12.2009) for the above study and have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.
2. I understand that the participation of my practice is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected.
3. I understand that relevant sections of my practices records and anonymised data collected during the study, maybe looked at by individual from Kings College London, from regulatory authorities or from the NHS Trust, where it is relevant to my practice taking part in this study. I give permission for these individual to have access to my practice records.
4. I agree to my practice taking part in the above study.
5. I agree to receive an invitation to take part in a telephone interview to discuss the experience of the trial

Name of Subject

Date

Signature

Researcher

Date

Signature

1 for practice; 1 for researcher

List of References

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Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

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