How has the transition to remote consulting affected the delivery of preventive interventions?

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Abstract

Interventions for smoking cessation, weight management, excess alcohol and physical activity are known to be effective and are recommended in clinical guidelines. Despite this, evidence suggests that implementation in UK primary care is low. Historically, this type of care has been delivered opportunistically in face-to-face consultations, and the impact of the transition to a greater proportion of consultations being conducted remotely is unclear. Therefore, this thesis investigated how the transition to remote consulting has affected the delivery of preventive care in primary care, specifically interventions for smoking cessation, weight management, excess alcohol and physical activity.

Initially, I conducted an interrupted time series analysis looking at how the COVID-19 pandemic affected the delivery of preventive care in primary care. I found that there was an initial reduction in both advice and referral for all four health behaviours with a variable recovery of preventive activity. Referrals for smoking cessation had not returned to pre-pandemic levels, referrals for excess alcohol had approximately returned to pre-pandemic levels, while referrals for weight management and physical inactivity had exceeded pre-pandemic levels. All recorded interventions apart from smoking cessation advice remain low in comparison to the prevalence of the corresponding risk factors.

Next, I completed a mixed methods analysis with audio recorded telephone and face-to-face general practice consultations followed by semi-structured interviews. There was no evidence that the number and length of preventive care segments differed between remote and face-to-face consultations, however GPs typically gave advice rather than signposting for

further support or referral for all behaviours and for all consultation modes. Remote consultations bought new interpersonal dynamics that required additional consultation skills to manage. Technology was integrated with prevention to differing extents across health behaviours and this additionally shaped how, when and to whom preventive care was delivered.

To more precisely estimate preventive care delivery between face-to-face and remote consultations, I developed a novel primary care activity categorisation system that categorised the full spectrum of primary care workload including consultation mode. This categorisation system allowed me to analyse the electronic health record data of 10,630,465 people in Clinical Practice Research Datalink (CPRD) Aurum database from 1st January 2019-31st December 2022. I found that recorded preventive interventions for smoking cessation, weight management, excess alcohol and physical activity were significantly less likely to occur in remote consultations compared to face-to-face consultations (OR 0.10; 95% CI 0.10, 0.11).

Finally, I conducted a systematic review and meta-analysis to investigate which strategies could increase the implementation of preventive interventions in primary care. I found that clinical reminders, clinician education, facilitated relay of information and multicomponent interventions increased the occurrence of preventive processes of care. However, there was no consistent evidence that these process changes translated into improved behavioural outcomes such as weight loss or smoking cessation.

Findings from this thesis suggest that there are insufficient interventions for smoking cessation, weight management, excess alcohol and physical activity in primary care given

their prevalence in the population. These interventions are also less likely to occur during remote compared to face-to-face consultations. Addressing these gaps will require improvements in how prevention is delivered within primary care, including clinician training, practical decision-support tools and new approaches to remote preventive care. However, achieving prevention at the scale required is likely to require a wider transformation of the health system. This conclusion aligns with the NHS 10-Year Health Plan, which identifies a shift from treatment to prevention as a central strategic priority. In the discussion I outline several potential approaches to support this transition, including greater involvement of the wider healthcare workforce, coordinated referral pathways, strategic use of technology, and new models of care designed to improve access to preventive support for those with the greatest need.

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Statement of Contribution

For **Chapter 2,** ethical approval for this study was granted as part of a larger series of COVID-19 related big data projects led by Professor Clare Bankhead. I wrote the code in R with coding support from Dr José Ordóñez-Mena. The code list was developed by me and was checked for completeness by another academic GP, Dr William Elson. Support for navigating the ORCHID platform was provided by data scientist Cecilia Okusi. I performed the analysis and interpreted the data with statistical support from Professor Richard Stevens. I wrote the manuscript for publication which was adapted for this thesis.

For **Chapter 3,** I worked with Clinical Research Network staff in the Northwest, West Midlands and South Central to produce promotional materials to recruit sites. I was principal investigator for the mixed methods study and worked with three site chief investigators, all NHS GPs who helped coordinate research activities at their GP practice. I conducted all site initiation visits and attended regular meetings with the site leads. Second coders for the quantitative codes included Dr Rachel Brettel and Dr Isabella De Vere Hunt. These second coders provided data to calculate the coding system validity. I calculated the inter-rater reliability with statistical support from Dr Susannah Flemming. I conducted all data analysis and interpretation with input from my supervisory team.

For **Chapter 4**, I led the protocol development and ethical approval with support from Professor Clare Bankhead, Dr Brian Nicholson, Dr Margaret Smith, Dr Cynthia Wright-Drakesmith and Dr Susannah Flemming. I led the categorisation of codes, with support from Dr Brian Nicholson, who was the second coder. Any discrepancies were discussed with the wider CPRD team (Professor Clare Bankhead, Dr Margaret Smith, Dr Cynthia Wright-Drakesmith and Dr Susannah Flemming). Data extraction from the CPRD database was done by Dr Cynthia Wright-Drakesmith and initial mapping of the data onto the new OPCAC system was done by Dr Susannah Flemming. I led the data analysis and interpretation with support from statistician Dr Susannah Flemming and data scientist Dr Cynthia Wright-Drakesmith. I wrote the manuscript for this work, which was reviewed by all co-authors, and I adapted this manuscript into Chapter 4.

For **Chapter 5**, I led the protocol development and ethical approval with support from Professor Clare Bankhead, Dr Brian Nicholson, Dr Margaret Smith, Dr Cynthia Wright-Drakesmith and Dr Susannah Flemming. Data extraction from the CPRD database was done by Dr Cynthia Wright-Drakesmith and Mr Innocent Erone. I conducted all data analysis and interpretation with support from Professor Richard Stevens.

For **Chapter 6**, I developed the search strategy for the systematic review with support from Nia Roberts, a specialist librarian. I screened all the articles and extracted the data with second reviewers (Dr Min Gao, Dr Caitriona Callan and Dr Simona Haasova). Disagreements were resolved through discussion with Professor Paul Aveyard, and where necessary the wider supervisory team. I completed all data analysis and synthesis, with statistical support from Professor Richard Stevens. I wrote the manuscript for publication with input from co-authors and then adapted this for Chapter 6.

I declare that this thesis is entirely my own work, with supervisory support from Professor Susan Jebb, Dr Brian Nicholson, Dr Joseph Wherton, and Professor Paul Aveyard all from the Nuffield Department of Primary Care Health Sciences, University of Oxford. Each project in this thesis was conceptualised in discussion with my supervisory team, with expert additional support and expertise given where necessary. These contributions from co-authors and collaborators are given above. I led the writing of all chapters and associated manuscripts presented in this thesis. I declare that no part of this thesis has been submitted for any other degree at this or any other university.

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1 Introduction

1.1 Summary

This chapter aims to outline the background for this thesis. I start with personal motivations for studying this topic, important definitions for terminology used in this thesis and an overview of the evidence base for clinical action on the four main preventable causes of ill health (smoking, excess weight, physical inactivity and excess alcohol intake). I then consider the challenges associated with effective delivery of preventive interventions in primary care including the COVID-19 pandemic; the rise of remote consulting; implementation challenges and the interaction with social determinants of health. I finish with the gaps in the evidence base, and the aims and objectives of this thesis to address some of these challenges.

1.2 Personal motivation for this thesis

This DPhil is inspired by my time working as a resident doctor in the NHS and in particular, my work on the respiratory department in the John Radcliffe hospital, Oxford in 2016. On the ward, most inpatients should not have been there. Admissions were almost entirely the result of preventable causes of ill health; mostly smoking related disease (COPD, lung cancer) or increasingly obesity related disease (obstructive sleep apnoea, obesity hypoventilation syndrome). Even respiratory disease not traditionally associated with preventable causes, for example asthma, were worsened by smoking or obesity and metabolic syndrome. The system was intervening far too late, with high cost, poor efficacy interventions. I wanted to be involved in more upstream interventions that prevented this suffering in the first place, so I trained as an academic GP and joined the Health Behaviours team. My DPhil builds on these experiences by investigating how action on these core behavioural risk factors (smoking, obesity, excess alcohol and physical inactivity) are integrated into modern primary care.

1.3 Definitions and terminology in this thesis

Despite prevention and preventive healthcare being a commonly used phrase amongst health policy experts and government, consensus on what this means in clinical practice is limited. Some describe prevention as stopping disease occurring in the first place, by acting on the social determinants of health such as investment in housing or early years. Others describe chronic disease management or fall prevention services as preventive healthcare. Primary care is arguably all preventive healthcare; even acute treatment of disease in primary care is initiated to prevent further deterioration and a hospital admission. It is the imprecise nature of the term that underpins inaction on some of these key interventions. Understanding what prevention means in the context of a complex healthcare system, and how to implement evidence-based preventive healthcare in primary care is the subject of this thesis.

Traditional classification divides preventive healthcare into primary, secondary, tertiary and quaternary prevention. Descriptions of what these terms mean and examples at each level are given in the table below.

Table 1.1 Summary of traditional definitions of prevention

Level of prevention	Description	Example
Primary	Preventive activities targeted at the whole population regardless of risk or disease status. The aim is to prevent disease before it arises	E.g., vaccination, healthy eating guidelines
Secondary	Detect a health problem at an early stage to prevent progression into more severe disease	Cervical cancer screening, Faecal Occult Blood colorectal cancer screening
Tertiary	Prevent progression or complications of an established disease	Eye screening and foot checks in diabetes to prevent micro and macrovascular complications
Quaternary	Action to prevent over medicalisation	Deprescribing in polypharmacy

This classification is limited in its scope to accurately represent a complex, overlapping preventive care landscape. For example, offering treatment for obesity could fit in primary, secondary, tertiary or quaternary prevention, depending on the population or clinical context, or definition of disease and severity of obesity. Therefore, in this thesis, I thought about prevention in a pragmatic, clinically informed way. Rather than a linear categorisation, I identified the clinically relevant areas that preventive healthcare in primary care should target. The criteria for consideration in this thesis were:

1. Preventive interventions reasonably possible for clinicians in a primary healthcare setting to act on with current resource and technology.

2. Upstream preventive interventions that sit early in the causal chain, that target either pre-disease (risk factors) or very early disease states across multiple body systems.

3. Risk factors that have the most significant role in the in the development of future ill health for a large proportion of the adult population and which, with action, could improve health outcomes for a large proportion of the population.

Broadly, this covers elements of primary and secondary prevention and excludes elements of prevention that are less feasible within a healthcare system, for example action on air pollution or housing. Similarly, traditionally defined tertiary or quaternary preventive care activities that aim to prevent the progression or minimise the impact of chronic disease such as ischaemic heart disease or type 2 diabetes have their own set of challenges to implementation and are out of the scope of this thesis. With this definition I therefore considered interventions for the four main behavioural risk factors for future ill health (smoking, excess weight, poor diet or obesity, physical inactivity and excess alcohol intake) to be preventive healthcare in this thesis. Specifically, the definition was restricted to behavioural risk factors to maintain conceptual coherence and avoid conflating prevention with vaccination (with its own unique set of implementation challenges), early disease management (e.g., statin prescribing and hypertension management) or early detection (e.g., cervical cancer screening).

1.3.1.1 Definition of a brief intervention

Interventions in primary care for smoking cessation, excess weight, excess alcohol, and physical inactivity have been described as ‘brief interventions’, which the National Institute for Health and Care Excellence (NICE) describes as an ‘*oral discussion, negotiation or encouragement, with or without written or other support or follow-up. It may also involve a referral for further interventions, directing people to other options, or more intensive* *support. Brief interventions can be delivered by anyone who is trained in the necessary skills and knowledge. These interventions are often carried out when the opportunity arises, typically taking no more than a few minutes for basic advice.'*[1]

Of note, NICE describes brief interventions as with or without other support or follow-up. However, it is the offering of support and follow up that is often the most efficacious part of the intervention.[2 3 4] For example, there is evidence that offering assistance to all smokers may be more efficacious for smoking cessation, than offering medical advice to stop smoking, and then offering further assistance to only those that express an interest.[5] Despite this, implementation efforts with healthcare professionals in the past have struggled to move past the basic advice stage of preventive healthcare. Reasons why implementation has been suboptimal or missing in routine clinical practice are explored in section 1.7.

1.3.1.2 Behavioural risk factors and disease classification

Throughout this thesis, terms relating to behavioural risk factors and their management are used pragmatically rather than as strict diagnostic or intervention categories. Weight management, excess weight and obesity are used interchangeably to refer to the continuum of elevated adiposity as a modifiable determinant of health, recognising that obesity may be classified as a disease state and weight management as an intervention. These distinctions are conceptually important but do not materially alter the clinical pathways or how GPs address this in clinical practice. Similarly, physical inactivity is treated as the behavioural exposure of interest, while physical activity and exercise are used to describe both the inverse behaviour and the interventions aimed at modifying it. In relation to alcohol, the focus is on excess alcohol consumption as a behavioural risk factor, rather than alcohol dependence or addiction, which represent clinically distinct conditions with different aetiology and management pathways. Smoking and smoking cessation are likewise considered together, reflecting exposure to tobacco use and the primary behavioural intervention targeting its reduction. This approach reflects the aim of the thesis to examine upstream behavioural determinants of health and their modification, rather than to draw fine distinctions between disease classification and behavioural risk factors.

1.3.1.3 Justification of adult population

Prevention was restricted to the adult population, recognising that paediatric populations have their own unique set of challenges and specialist interventions. For example, smoking and alcohol use may have a safeguarding component. Interventions for weight management are often based in secondary care and involve a whole family approach and interventions that target physical activity are often located in schools or community settings.

1.4 Evidence for preventive care

The aim of this thesis is not to investigate the efficacy of preventive interventions. Rather, to understand and optimise their implementation in modern UK primary care. Today, the problem is not typically that we do not know what works, rather we don't know how to best implement what we know works. As a background, a summary of the evidence for each area of prevention considered in this thesis, is described below.

1.4.1 Smoking

Smoking remains the most significant cause of preventable morbidity and mortality in the UK. Two out of three smokers will die from smoking-related disease unless they quit, reducing life expectancy by an average of 10 years.[6 7] A quarter of all deaths from cancer are associated with smoking.[8] The annual cost of smoking to the UK is around £17 billion, with the cost to the National Health Service (NHS) of around £2.5 billion.[9] Whilst there has been some significant progress on smoking prevalence in recent decades in the UK, prevalence has stalled at around 12%.[10] Both population level and individual smoking cessation interventions, as well as changing social norms around smoking, in particular reduced uptake amongst young people, have contributed to this decline.[11] The recently passed Tobacco and Vapes Bill, has banned the sale of tobacco products for individuals born on or after 1st January 2009.[12] This legislation has been widely regarded as a major public health initiative with the potential to protect future generations from tobacco related harm. Nevertheless, substantial challenges remain in supporting current smokers to quit and reducing the ongoing burden of smoking related disease.

Despite knowledge about what works; nicotine replacement therapy;[13] nursing interventions;[14] use of electronic cigarettes,[15] smoking cessation services have often been the first to be out-sourced, de-commissioned and under-funded as part of cost-saving policies.[16] This out-sourcing does not reflect the 'make every contact count' movement that encourages healthcare professionals to offer smoking cessation support at every clinical encounter.[17] It also deskills the primary care workforce in smoking cessation.

The result of this is that a decreasing number of smokers who want to quit smoking are able to access a stop smoking service every year.[18] The difference in successful quit rates with active intervention is stark. Of those who go it alone, the success rate is around 4%.[19] However, quit rates with intensive support and pharmacotherapy can reach over 50%.[20] There is a clear implementation problem. The impact that smoking can have on an individual's lifetime health status is currently not met with a proportionate preventive healthcare response, despite a broad evidence base to support action.

1.4.2 Excess weight

Approximately two thirds of UK adults are overweight (BMI 25-30kg/m^2) or obese (BMI >30kg/m^2) and prevalence continues to rise.[21] Obesity is a risk factor for a number of diseases including heart disease, type 2 diabetes, liver disease and certain cancers such as breast, endometrial and bowel cancer,[22] and severe obesity reduces life expectancy by 10 years.[23] One in five women of reproductive age have obesity and obesity in pregnancy is associated with an increased risk of almost all adverse pregnancy outcomes.[24] The increased prevalence of obesity will take up an increasing proportion of finite healthcare resources in the future.[25] The current annual social cost of obesity is estimated to be £58 billion which is approximately 3% of the UK Gross Domestic Product (GDP) in 2020. Treating obesity related conditions costs the NHS £6.5 billion a year.[26]

Research has shown that brief weight loss interventions can be effective in encouraging modest weight loss when delivered in primary care.[27] Clinical trials have shown that referral to weight management programmes can support individuals to lose weight,[4] and that these interventions are cost-effective and equitable. [28,29] Patients also tend to welcome supportive discussions about weight.[30] A recent systematic review confirmed that weight management interventions in primary care can be effective, with a mean difference in weight loss between the intervention and comparator groups at 12 months of -2.3kg (95% confidence interval -3.0 to -1.6kg).[31] Referral to more intensive programmes, such as total diet replacement (TDR) are associated with greater weight loss at 12 months.[32]

Recently, there have been significant advances in pharmacotherapy options. Glucagon-like peptide-1 receptor agonists (GLP-1 RAs), including semaglutide and tirzepatide, have been approved by NICE for the treatment of obesity.[33] Randomised clinical trials have demonstrated substantial weight loss with semaglutide, achieving reductions of 14–17% at 68 weeks alongside improvements in cardiovascular risk factors.[34 35] Tirzepatide has demonstrated even greater efficacy than semaglutide, with mean percent change in weight at week 72 of approximately 20%.[36] Recently, oral agents have also shown promise in clinical trials, with once daily oral Orforglipron resulting in a mean percent change in weight of approximately 10% at 26 weeks.[37]

Despite this evidence, clinicians remain reluctant to discuss obesity with their patients, often describing weight management as a low priority issue, lack of time, and concern that they may cause offence.[38] Qualitative studies found GPs hold competing views simultaneously; that obesity is both an individual behavioural problem, and that obesity is also situated within a complex social environment where patients are powerless to lose weight.[39] The result is that recording weight and offering treatment and support for weight loss in primary care is not optimised.[40] In previous work, I theorised that the omission of discussing excess weight when clinically relevant can be seen as a form of caring (caring to avoid stigma), however this inadvertently reinforces the external structure of weight as a topic to be avoided.[41] Again, there is an implementation gap between what we know works and what happens in clinical practice.

1.4.3 Physical inactivity

The World Health Organisation describes physical activity (PA) as any bodily movement produced by skeletal muscles that requires energy expenditure.[42] The UK Chief Medical Officer's population based guidance for adult PA suggests a minimum of 150 minutes of moderate or 75 minutes of vigorous exercise per week for good health, in addition to muscle strengthening exercises at least twice a week.[43] However, around one in three males and one in two females are not meeting these goals, and the UK has the highest levels of physical inactivity (less than 30 minutes of PA a week) compared to other comparable countries.[21 44]

The benefits of being physically active on health are multifaceted. Physical activity is known to play a significant role in preventing or delaying the onset of non-communicable disease, such as type 2 diabetes, ischaemic heart disease or colon cancer. [45-47] Physical activity has an important role in mental health too, lowering the risk of developing depression.[48] It has been estimated that physical inactivity accounts for as many deaths in the UK as smoking (one in six) and costs the NHS around £7.4 billion annually.[49] Those who are physically inactive have a 20-30% increased risk of death compared to those who are physically active. [42] A recent study found that even a small amount of physical activity a day, just five minutes, could reduce the risk of premature death by up to 10%.[50]

Existing literature has shown that brief interventions for physical activity can improve the (self-reported) duration of physical activity at one year. Studies have shown that professional PA interventions in primary care are efficacious and cost-effective, [51 52] with a number needed to treat to meet physical activity guidance from a sedentary baseline of 12, favourable to that of smoking.[51 53]

Again, there is a mismatch between what GPs recognise as an important part of holistic healthcare and what happens in practice. For example, a recent cross-sectional survey found 99% of GPs recognise the importance of physical activity to the health of their patients, yet only 36% felt 'somewhat familiar' with the current physical activity guidelines. [54] This message was reinforced by a recent systematic review that showed brief interventions to encourage physical activity are not delivered frequently or consistently in primary care.[55] The authors suggested further training or system-level changes such as increased time with the patient, to increase implementation.

1.4.4 Excess alcohol

There is no safe level of alcohol consumption, and alcohol has been identified as a causal factor for multiple health conditions including depression, heart disease, stroke, liver disease and multiple cancers.[56] Risk is proportional to quantity consumed.[57]

The UK Chief Medical Officer's updated guidance in 2015 to bring the maximum units of alcohol per week for men in line with the recommendations for women. They recommend no more than 14 units of alcohol per week, with a minimum of 2 alcohol free days per week.[58] Despite the guidance, an estimated 10 million adults in England drink at a level that risks harm to their health, with 1.6 million adults having some level of alcohol dependence.[59] This is estimated to cost the NHS £4.9 billion, with an additional £14.6 billion cost for alcohol related crime and £7 billion lost through unemployment and sickness.[60]

There are numerous systematic reviews that have shown brief intervention for patients in primary care can reduce heavy drinking.[61 62] However, despite this evidence, studies suggest routine implementation in primary care is limited. A review using the Capability-Motivation-Behaviour system and Theoretical Domains Framework to identify potential barriers to implementation, found 'Environmental Context and Resources'; 'Beliefs about Capabilities'; and 'Skills' to be the barriers most represented in the literature. The authors suggest appropriate training and sufficient consulting time could address these.[63] Another qualitative study amongst primary care practitioners found that discussions around alcohol were deprioritised compared to managing older people's long term conditions. Practitioners with dedicated time to screen for alcohol use, such as pharmacists, had greater opportunity to provide support and were more confident to do so than GPs, who were managing a range of care needs.[64]

1.5 Challenges for the effective preventive care in primary care

1.5.1 The COVID-19 pandemic

The COVID-19 pandemic had marked effects on what and how primary care services were delivered both in the UK and internationally. [65-67] In the UK, primary care was tasked with delivering the COVID-19 vaccination programme, requiring staff to work additional hours to deliver COVID-19 vaccines to their community.[68] There was increased workload due to additional and new administrative tasks such as triaging and liaising with new hospital systems and performing workforce risk assessments.[69] Referral pathways and secondary care pathways were closed or adapted as secondary care staff were redeployed to acute COVID-19 care resulting in more complex patients being managed for longer in the community.[70] Staff were off sick or asked to isolate, resulting in increased patient load for those able to work, there was a shortage of personal protective equipment (PPE) and personal risk of infection. This resulted in GPs reporting higher levels of stress or burnout than they did pre-pandemic, with women GPs and older GPs having poorer psychological outcomes.[71] To reduce health system pressures and relieve practices of additional workload, NHS England and NHS Improvement in agreement with the BMA's General Practitioners Committee simplified and reduced the Quality and Outcomes Framework (QOF) requirements for 2020/21, which rewarded doctors for giving smoking cessation advice and offering referral to cessation services but no other health behaviours.[72]

The public perception and media narrative of this was critical, with some suggesting that GP surgeries were closed. This affected GP morale and patient trust. In addition, in England, government messaging advised the public to 'stay at home and protect the National Health Service (NHS)' and there is evidence this reduced other types of care such as acute presentations and urgent cancer referrals during this time. [73 74]

Based on patterns observed for other conditions, the delivery of preventive services in primary care may have decreased in this period. Other ITS analyses to assess the pandemic effect in primary care have focussed on acute conditions,[73] referral to cancer services, [74-76] asthma diagnoses,[77] and cardiovascular disease.[78] During the first wave of COVID-19 in the UK, primary care contacts for all acute conditions, other than alcohol-related events, reduced between 5-50%, with most not recovering to pre-pandemic levels by July 2020. [73] For example, there were reductions in consultations for depression, odds ratio (OR) 0.53 (95% CI 0.52-0.53) and for transient ischaemic attack, OR 0.63 (95% CI 0.58-0.67). Similarly, urgent referrals for breast cancer reduced by 28% in England in the first 6 months of 2020, compared to the same period in 2019.[74]

In contrast, there is evidence that consultation rates in primary care for mental health conditions increased after the onset of the pandemic in most countries. For example, data from the INTernational ConsoRtium of Primary Care Big Data Researchers, INTRePID, found that in Argentina, Canada, China, Norway, Peru and Singapore there was an immediate increase from an incident rate ratio of 1·118 [95% CI 1.053–1.187] to 2.240 [95% CI 2.057–2.439] when comparing the first month of the pandemic to the trend prior to the onset of the pandemic.[79] It was found that this increase was largely due to increased consultations for anxiety and depression. Therefore, it is too simplistic to say that the onset of the pandemic reduced care uniformly for all clinical presentations. Rather, the pandemic was associated with changes in the types of conditions for which care was sought.

Without a careful analysis of data, it is unclear how delivery of preventive health care fared during the COVID-19 pandemic. Preventive discussions about smoking, alcohol, weight, and physical activity are often brief, opportunistic, and variably coded, making them less visible within health system metrics. In addition to this, the transition to remote, predominantly telephone consultations may have added an additional layer of complexity to delivering this type of care. There is a need to quantify the scale and trajectory of preventive care disruption and recovery during this period to inform catch-up efforts and future health policy.

1.5.2 Transition to remote consulting

In addition to COVID-19 affecting the volume and type of clinical presentations to UK primary care, the pandemic also accelerated the transition to remote (predominantly telephone) consulting.[80] Before the pandemic, over 70% of GP consultations were face-to-face, whereas after the onset of the pandemic, in April 2020, over 70% were conducted remotely (typically by telephone).[81] The Royal College of General Practitioners (RCGP) called for research to investigate how consultation mode affects care.[82]

This pattern was also observed internationally.[83] For example, one Canadian study found that early in the pandemic, face-to-face visits declined sharply, but this was followed by an immediate increase in remote consultations.[84] This enabled the weekly consultation rate to remain approximately constant throughout the pandemic in this patient population. In US primary care, remote consultations increased from 1.1% of total consultations in 2018-2019 to 4.1% in the first quarter of 2020 and 35.3% of total consultations in the second quarter of 2020.[85]

A large multinational analysis completed by the INTernational ConsoRtium of Primary Care BIg Data Researchers (INTREePID) revealed that the reduction in primary care face-to-face consultations during the pandemic occurred in healthcare systems worldwide.[86] However, countries that successfully implemented remote services in primary care managed to offset declining rates of face-to-face visits by commensurate increases in remote consultation, thereby ensuring continuity of access to primary care services. For example, countries that experienced the largest reductions in consultation rates during the pandemic, such as China (RR 0.72, 95% CI 0.58 to 0.88), were those that did not adopt remote consulting (remote consultations = 0.0%). In contrast, in countries where remote consultations constituted a substantial proportion of overall consultations, such as Australia (remote consultations = 41.8%), overall consultation rates remained stable (RR 0.98, 95% CI 0.92 to 1.05; p = 0.59). It appears that the transition to remote consulting during the COVID-19 pandemic, may have maintained access to primary care services, but questions remain about how this affected the type of care delivered, and particularly preventive care.

1.5.2.1 Remote consultation literature

Responses from healthcare professionals and patients about new consultation modes are mixed, with some excited by the digital first approach, and others concerned that this may increase GP workload, create barriers to accessing care, discriminate against people who struggle with digital technologies, and erode the doctor-patient relationship.[81] A UK study of primary care consultations reported that behavioural advice was less frequent during a telephone consultation (24%) or video consultation (14%) than a face-to-face consultation (44%).[87] The extent of this difference and the reasons behind it are currently unclear. The differing nature of the communication modes is probably key. An interview study reported that telephone consultations were more transactional, with less discussion of other reasons for the appointment.[88] Similarly, a conversation analysis study found that face-to-face consultations raised other health related topics while patients' additional concerns were less likely to be explored on the phone.[89] Telephone consultations seem less likely to place a problem in the patient's psychosocial context and seek their health understanding.[87] Video consultation seems similar to telephone consultation, being briefer with less content and quality than face-to-face.[87] Recent research has suggested that despite video being available for general practitioners, these are rarely used in practice. This may be due to GPs wanting to see and examine patients face-to-face. [90] However, there is potential for more innovative consultations, such as small-group consultations with video technologies.[91] One study found that video consultations could be successfully used to deliver physical activity advice to older adults, although it was harder to assess physical functioning remotely which may impact the quality of advice given.[92]

The situation may differ again for written consultation. A content analysis demonstrated that email consultation was used for discussing the availability of preventive care and was approached by GPs in a similar way to the face-to-face consultation.[93] Email consultation has been shown to facilitate the disclosure of information by patients and provides a lasting record of information shared.[94 95] However, the potential for using a written mode to deliver preventive care has not been studied.

Remote consultations tend to be favoured by certain groups. Online consultations tools are more likely to be used by women and younger people.[96 97] A systematic review showed that telephone consultations were more likely in women, working age people, non-immigrants, and the very old, but evidence on differences in relation to socio-economic status is lacking.[98] Efforts to understand what support is available to patients who may struggle to navigate online services showed that support was predominantly offered to an individual patient informally by reception staff.[99] A recent multi-site longitudinal study found that the introduction of remote and digital services in general practice had a number of unintended consequences including new forms of inefficiencies (for example repeating a clinical history when attending a face-to-face after a telephone consultation), contributing to staff stress, and creating accessibility challenges for some patient groups and reducing patient centredness.[100]

For consultations overall, those with more comorbidities have been shown to have longer consultations, although consultations are shorter for those from more deprived compared to those from the least deprived areas.[101] The number of consultations per person per year is increasing; the overall consultation rate increased from 4.92 in 2018-2019 to 5.66 in 2021-2022, with a greater proportion of consultations occurring remotely.[102]. During this time, the difference in consultation rate between those from the least and most deprived areas narrowed, implying that the greater health needs of those from more deprived areas may not be being met.[102] People from more deprived areas, women, smokers and those from some ethnic groups (Asian ethnicity) have been shown to consult more frequently in primary care.[103] However, there is no evidence that increased consultation rates are associated with beneficial clinical outcomes such as reduced mortality or hospital admission rates.[104]

A recent study highlighted the complexity of knowledge required to deliver high quality remote consultations to diverse populations.[105] Moving beyond acute care management of a simple clinical problem to holistic preventive care including behaviour change interventions, such as brief interventions are likely to be a component of this complexity. Furthermore, the use of digital and remote technologies appears to be unique to each general practice setting, making understanding the preventive care content of consultation more challenging.[106]

The growing literature on remote consultations has largely examined safety, efficiency, patient satisfaction, and clinical outcomes, often concluding that remote modalities are acceptable and effective for many types of care, but may introduce new inefficiencies and unintended consequences into the health system. Preventive care occupies a distinct space within consultations: it frequently relies on opportunistic initiation, rapport, nuanced communication, and negotiation around behaviour change. There has been limited research on how clinicians and patients navigate preventive care for smoking, excess weight, excess alcohol, and physical inactivity in remote consultations leaving uncertainty about how consultation mode shapes this important component of preventive practice.

1.5.3 Social determinants of health and preventive healthcare

Tobacco addiction and obesity are related to poverty. The prevalence of obesity increases from 23% to 41% from the least to the most deprived areas for women and from 28% to 34% for men.[21] Similarly, 17% of adults in the most deprived areas smoke compared to 9% in the least deprived.[107] Prevalence of physical inactivity also follows a social gradient.[108 109] The gradient is more complex for alcohol consumption however as despite higher alcohol consumption by individuals with higher socioeconomic status, on average they suffer lower alcohol related harms than those from those from lower socioeconomic groups.[110] This is potentially due to differences in drinking patterns, clustering of other risk factors and wider determinants of health.[111]

People's social circumstances strongly influence their ability to adopt and maintain healthy behaviours. The reasons for this are multifaceted but likely to include economic, educational, environmental (both social and physical), institutional and political factors.[112] There are also systemic factors at play, including the relatively low price of ultra-processed and high fat, sugar and salt foods per calorie compared to healthy alternatives and irresponsible marketing practices by the food, alcohol and tobacco industries that promote unhealthy consumption patterns.[113] These factors have been coined commercial determinants of health.[114]

In 2010, Michael Marmot published the Marmot review which highlighted that a social gradient exists where greater deprivation is directly correlated with poorer health. He called for a 'proportionate universalism' approach, whereby action on all social determinants of health is taken but with scale and intensity proportional to needs of the local population.[115] In 2020, the Marmot Review 10 Years On was published. The report showed that health inequalities over the past decade had widened, life expectancy had stalled and fallen for the poorest 10% of women, and the time spent in poor health had increased.[116] The impact of social determinants on health outcomes was bought to public attention during the COVID-19 pandemic when those from lower socioeconomic groups, those from minority ethnic backgrounds, people living with disability and people living with obesity were more likely to experience severe disease or death. [117] More needs to be done to address the social determinants of health, including through policies that reduce poverty, improve housing, education and employment opportunities and ensure equitable access to healthcare and preventive services.

Some argue that interventions targeting diet, smoking, physical activity and alcohol do not go far enough to address wider determinants of health, that have a substantial impact on individual health outcomes. Furthermore, there are concerns that behaviour change interventions may be more accessible or achievable for individuals with greater resources, therefore widening health inequalities.[118] However, action on social determinants of health and interventions targeting diet, smoking, physical activity and alcohol should not be viewed as mutually exclusive. The social determinants of health can and should be addressed alongside offering advice and support for key behavioural risk factors for ill health. If support is not offered, people must go it alone, which is the most individualised approach. Moreover, population level policies do not treat an individual's current tobacco addiction or excess weight. At the same time, others argue that interventions targeting smoking, diet and physical activity may undermine personal choice and represent an example of health system overreach. Although these critiques arise from different perspective, both can act as barriers to implementation by reducing support for preventive interventions within healthcare systems.

Primary care, and in particular GPs, should be cognisant and curious about their patients' social context. Throughout general practice training, I was taught to enquire about and understand someone's social context. This knowledge may help with understanding the challenges individual patients may face when thinking about key behavioural risk factors and consider these social factors when offering advice and support. Some GP surgeries have taken further steps to address this within the health system, for example in Greenwich, Live Well coaches work alongside GPs to help patients with housing, finances and employment.[119] Across the UK, social prescribing (where individuals are referred to non-clinical services that can support their health and wellbeing) is being promoted to address the wider social determinants of health, whilst freeing healthcare professional time to manage clinical care.[120] There is evidence that social prescribing is associated with a small improvement in patient experience but it is currently unclear whether this translates into better clinical outcomes.[121] The transition to Integrated Care Systems (ICS) has also been posited as a potential solution to greater commissioning of services with in-depth place knowledge and hence targeted action on social determinants.[122] However, acting on these key preventive health areas is likely to reduce health inequalities too. Over half of the difference in risk of premature death between different socio-economic groups can be accounted for by smoking, for example.[123] There is a need for a strong healthcare system role to these key preventive health areas, ideally in parallel with a robust and consistent government policy response to tackle the wider social determinants.

The expansion of remote consulting has also prompted concern about equity. Access to, and comfort with, digital and telephone consultations is socially patterned, intersecting with age, socioeconomic deprivation, language, and ethnicity. At the same time, behavioural risk factors targeted through preventive interventions are themselves unequally distributed, clustering among more deprived populations. Any systematic difference in how preventive care is delivered across consultation modes therefore has the potential to reinforce or mitigate existing inequalities. There is some evidence to suggest that individuals living in more deprived areas may be less likely to access face-to-face consultations with a GP.[102] However, the evidence base remains limited regarding whether remote consultation modes influence the likelihood of preventive intervention delivery, and whether such effects vary between patient groups. Without this understanding, it is difficult to determine whether the reorganisation of primary care consulting represents a neutral shift in delivery mode or a change with important distributional consequences.

1.5.4 Implementation of prevention

1.5.4.1.1 Availability of services

One of the limiting factors in the implementation of preventive care in primary care is the availability and accessibility of appropriate services to signpost or refer patients into. One part of the complexity is that many services are locally commissioned often by integrated care boards (ICBs) in England. These replaced clinical commissioning groups (CCGs) from 1st of July 2024. This means there is geographical variability across the country as to whether and what form services take. Proponents of this system organisation say that it enables services to be commissioned that respond health needs at a more local level; however, an unintended consequence is that there are fewer national programmes that can be uniformly run and evaluated at scale. Services can be commissioned, then decommissioned, adding to confusion and complexity in primary care about what is available and for whom.

In the context of smoking cessation, commissioning arrangements in the UK can result in fragmented access to support across different parts of the healthcare system. In some areas, nicotine replacement therapy (NRT) is no longer routinely funded or prescribed within primary care, limiting the role of GPs in directly delivering pharmacological support. Instead, patients are often referred to locally commissioned, council-run stop smoking services, which may be restructured or rebranded over time as commissioning priorities change. Additional pathways may exist for specific patient groups, such as those recently discharged from hospital, who can access smoking cessation support through participating community pharmacies.[124] While these services provide important support, such arrangements can mean that patients are unable to access smoking cessation treatment directly through their

GP practice, highlighting a shift away from primary care based provision and raising concerns about continuity, accessibility, and equity of care.

In the case of treatment options for obesity, in the UK there is a four-tier model of care, although this structure is becoming increasingly blurred, with more treatment options available in the community and digital provision. Tier 1 consists of universal primary prevention interventions that include promotion of healthy eating and physical activity guidance and is usually delivered by local authorities. These interventions can be understood as primary prevention; they aim to prevent weight gain rather than treat excess weight. Tier 2 services are intended for people with BMI ≥25 kg/m^2 and can be delivered by local teams or private providers such as Weight Watchers depending on the local commissioning arrangements. A recent cohort study found that, out of the approximately 1.8 million eligible people in the UK population, only 3.13% of these were referred for tier 2 weight management services.[125] Tiers 3 and 4 are specialist weight management services, usually delivered in secondary care in a multi-disciplinary team. They are aimed at people with a BMI ≥35 kg/m^2 with a major co-morbidity such as type 2 diabetes or BMI ≥40 kg/m^2. Tier 3 typically involves non-surgical intensive medical management including pharmacotherapy, whereas Tier 4 includes bariatric surgery. However, Glucagon-like peptide-1 (GLP-1) receptor agonists are now being rolled out in primary care as part of a 12 year phased implementation plan by NHS England.[126] There are also significant regional differences in the availability of services, with only 83% of ICBs reporting commissioning specialist weight management services and only 69% providing NICE compliant eligibility criteria for bariatric surgery.[127] Another study found that as of April 2024, only 838 patients had received and NHS prescription of semaglutide, and 22% of ICBs did not fund semaglutide.[128] There is concern that limited NHS access to GLP-1 RA medications will increase health inequalities as those who can pay privately can access these medications more readily.[129]

In the case of physical activity and exercise, again there is significant regional variation as to what is available and for whom. Current NICE guidance suggests that referral to a physical activity programme should only be funded for people who have an additional risk factor or health condition. A recent large cohort study found a ubiquitous low use of physical activity intervention referrals in primary care.[130] This was consistent across all ethnicities and levels of deprivation. Another study highlighted the variation in types of programmes offered, e.g., swimming, gym memberships, community exercise groups with a wide variety of stated aims.[131]

Managing excess alcohol use is grounded in early identification, assessment and evidence-based intervention, with services tailored to levels of drinking risk and local needs. GPs are encouraged to routinely assess alcohol consumption using validated screening tools such as the Alcohol Use Disorders Identification Test (AUDIT) alongside brief interventions. NICE suggest that these interventions should be accompanied by referral to specialist alcohol treatment and recovery service*s* for individuals with more severe dependence or complex needs, including psychological support and medically assisted withdrawal where appropriate.[132] In England and the wider UK, commissioning of these services occurs at a local level at ICBs, again leading to substantial variation in the availability, scope and intensity of alcohol interventions and specialist pathways across regions. Studies have reported that services are reactive, not proactive and that people had to navigate several steps to access care.[133]

Overall, these examples illustrate how the fragmented and locally commissioned nature of preventive care services in England creates substantial barriers to consistent delivery in primary care. Variation in service availability, eligibility criteria, referral pathways and funding mechanisms increases cognitive and administrative burden for GPs, contributes to uncertainty about what support patients can access, and risks undermining the routine integration of preventive care into everyday practice. While local commissioning may enable responsiveness to population needs, the absence of stable, nationally coordinated preventive programmes limits scalability, continuity and evaluability, and may exacerbate geographical inequalities in access to care. Addressing these structural constraints is likely to be as important as influencing clinician behaviour in improving the delivery of preventive care in primary care.

1.5.4.2 Workforce pressures and continuity of care

UK general practice is under considerable strain because the workload demands are outstripping the workforce's ability to provide care and this may affect the delivery of preventive healthcare. Recent consultation figures show that primary care is undertaking record numbers of consultations, 30.5 million standard GP appointments were recorded in November 2021, the highest on record.[134] One study found that the overall consultation rate increased by 15% between 2018-2019 and 2021-2022.[102] This is accompanied by a current shortfall of 4200 full time equivalent GPs. The number of fully qualified, permanently employed GPs has fallen from 47 to 44 per 100,000 patients between December 2017 and December 2021.[135] The Additional Roles Reimbursement Scheme (ARRS) has attempted to offset this, by incentivising primary care networks to employ allied healthcare professionals including paramedics, pharmacists and physician associates.[136] Furthermore, there is evidence that this workload strain is reducing the continuity of care (seeing the same regular GP) that patients experience.[137] This is despite evidence that higher continuity is associated with reduced mortality rates and fewer acute hospital admissions.[138] This may be relevant for preventive healthcare delivery too, as understanding the patient's socioeconomic context (understood more deeply over a number of consultations) may impact if, when and how effectively brief interventions are delivered.

The Health Foundation estimates, that under current policy, by 2030/31 the NHS faces a shortfall of over 1 in 4 GP posts. In a pessimistic scenario, this rises to 1 in 2 GP and nurse posts.[139] This is coupled with record waiting times for hospital and outpatient specialist care, resulting in patients understandably seeking further advice in primary care. Hospital systems are also trying to cope with record demand by transferring some of their work in to primary care, for example by increasing the availability of advice and guidance services prior to referral.[140] The concern here is that taking on work traditionally done in secondary care with no further resource results in other primary care work that is not done. The type of preventive care described in this thesis is particularly vulnerable to being neglected because it is not imminently problematic.

Of concern, these workforce and demand pressures have led to the greatest decline in patient satisfaction seen in recent years. The annual patient satisfaction survey showed patients who had a good experience of making an appointment reduced from 71% in 2021 to 56% in 2022.[141] When patients have an appointment with their GP, 85% felt listened to (89% in 2021) and 83% felt their GP treated them with care and concern (88% in 2021).

Understanding the healthcare system context is vital to thinking about how preventive healthcare is effectively implemented.

1.5.4.3 The status of preventive care

Healthcare professionals often do not offer appropriate support for patients even when they present with a symptom directly related to smoking, excess weight, physical inactivity or excess alcohol.[142] This is illogical based on the strength of evidence for intervention outlined earlier in this thesis. Where discussion of prevention occurs, healthcare professionals often give advice rather than practical support, even when support is financially incentivised.[143] Observation of healthcare professionals indicates a bias towards care that involves *'active, specialized, biomedical, and highly-technological … practiced on organs in the upper part of the bodies of young or middle-aged people*'.[144] The preventive care examined in this thesis does not typically conform to this model of practice and, despite often being delivered to young and middle-aged adults, is frequently afforded lower status and priority within consultation. However, this type of care has the same detailed and in-depth evidence base and complexity as other high status fields. Additionally, implementation is challenging in that it requires often high-level communication techniques such as motivational interviewing or coaching, often in the context of a longitudinal relationship in which the socio-economic context of the patient is understood. There have been calls for physicians to reflect on these internal biases they hold to why they prioritise some types of care (prescribing a tablet) over other types of often more efficacious interventions (e.g., brief interventions for smoking cessation).[145]

1.5.4.4 The role of the Quality Outcomes Framework

Whilst prevention should be addressed by all healthcare professionals, general practitioners are often specifically tasked with this due to their long term relationship with a patient and understanding of their social context. The Quality and Outcomes Framework (QOF) explicitly tasks primary care with this work. QOF is an incentive scheme introduced in the UK in 2004 with the aim of improving the quality of care in general practice; it financially rewards practices for meeting specific indicators relating to clinical care, public health and patient experience.[146] QOF has played a role in embedding preventive care into routine primary care by encouraging systematic recording and management of risk factors such as smoking status, alcohol use, and obesity. There is evidence that these financial incentives have improved risk factor identification (e.g., recording of smoking status and weight) but it is unclear whether this translates into beneficial clinical outcomes for the patient.[40 147]

The evidence on the effects of incentives on clinical activity is complex and context specific. A recent systematic review found that QOF incentives consistently improved the quality of care at one year across all indicators, but by three years the impact was inconsistent, with no evidence that care was better than pre-incentivisation trend.[148] Care needs to be taken if incentives are removed, for example, in Scotland, discontinuation of the QOF showed that removing incentives was associated with a decrease in associated clinical activities.[149] This evidence suggests that both the implementation and discontinuation of QOF financial indicators are important health system level factors to consider when trying to gain a deeper understanding of the implementation of prevention in primary care.

Overall, the implementation of preventive interventions in primary care has long been recognised as suboptimal despite strong evidence of effectiveness. Barriers identified in the literature include health system-level challenges; adequate referral pathway, a sufficient workforce with clear roles and responsibilities and time and continuity with patients. There is also the role of status; this type of work is often deprioritised despite its relevance and efficacy. The QOF is the most used health system level policy lever for financially incentivizing aspects of preventive care and UK primary care. However, it remains uncertain whether financial incentives or other system-level and clinician-level interventions are effective in increasing the delivery of this type of care, and whether any such strategies remain applicable within a hybrid consultation landscape.

1.6 Gaps in the literature

Despite the well-documented benefits of preventive care described above, there is limited research on how these discussions occur in modern primary care settings, specifically with the increased use of technology mediated (typically telephone) consultations. Gaps in the literature and how this thesis addresses these are outlined below:

1. How did the COVID-19 pandemic affect the delivery of preventive interventions in primary care?

   The COVID-19 pandemic accelerated the transition to remote consulting, both in the UK and internationally. However, it is unclear what effect this rapid transition had on the delivery of interventions for smoking, excess weight, physical inactivity, and excess alcohol in primary care. In **Chapter 2**, I use data from the Oxford Clinical Informatics Digital Hub (ORCHID) database to understand both the immediate step change and subsequent rate change in brief intervention delivery in primary care for the four main behavioural risk factors after the onset of the COVID-19 pandemic.

2. How does consulting with a patient remotely, typically by telephone, shape how prevention is discussed in a primary care consultation?

Existing studies have largely focused on the overall impact and safety of remote consultations, clinical outcomes and patient satisfaction, but few have explored how GPs navigate lifestyle counselling and behaviour change interventions in these settings. In **Chapter 3** I used a mixed methods analysis of recorded consultations and subsequent GP interviews to explore whether and how prevention is discussed both remotely and face-to-face.

3. Do remote consultations make preventive interventions more or less likely to be delivered?

There is a lack of evidence on whether remote modalities influence likelihood of support offered for preventive care. GPs now routinely use telephone consultations and communicate via text message. It is unclear where preventive interventions fit in this more diverse consultation mode landscape and whether they are more or less likely to be delivered via a specific consultation mode. In **Chapter 4**, I develop a novel method to count and code consultations, including text messages, email, video and telephone consultations in the Clinical Practice Research Data Link (CPRD) database of primary care electronic health records. I then use this new method in **Chapter 5** to understand the likelihood of brief intervention delivery between different consultation modes. If this is understood, strategies to optimise delivery could be developed specifically for each technology.

4. Does this new way of consulting introduce any new disparities between different patient groups in terms of who receives a preventive intervention?

New remote and digital technologies for consulting may have the unintended consequences of creating barriers to some groups of people accessing care. Understanding who is affected by these new consultation modes and by how much, strategies can be developed to overcome this and ensure that primary care remains accessible to all. This is particularly important for prevention, as behavioural risk factors are often clustered amongst those with higher deprivation. In **Chapter 2**, I explore how different subgroups of the population were affected by the COVID-19 pandemic on the delivery of preventive care. In **Chapter 5**, I analyse whether the likelihood of preventive intervention delivery for different consultation mode differs for specific population subgroups. A secondary aim of the systematic review and meta-analysis in **Chapter 6** was whether any of the strategies to increase implementation of preventive care in primary care had been evaluated by socio-economic status, ethnicity, age, or sex.

5. What strategies are effective at increasing the implementation of preventive interventions in primary care and are different strategies needed to increase the delivery of preventive interventions in the context of remote consultations?

The implementation of preventive care in primary care is sub-optimal. As outlined earlier in this chapter, there is good evidence for the efficacy of these types of interventions, but health care professionals rarely do them in consultation. There are several health system level and healthcare professional level levers that could be used to try to increase the delivery of this type of care. It is unclear whether these levers would be the same for traditional face-to-face consultations or remote consultations. In **Chapter 6**, I describe a systematic review and meta-analysis looking at the evidence behind various strategies to increase this type of care in primary care.

1.7 Patient and Public Involvement

Patient and public involvement (PPI) was embedded throughout this thesis using a structured before, during, and after approach to ensure that the research was grounded in patient perspectives. A small, dedicated PPI budget from the Wellcome Trust supported this activity. Before the studies were undertaken, the overall outline, research questions, and proposed methods for the thesis were presented to a Patient Participation Group at a local GP surgery. Feedback from this session informed the refinement of the research aims and the design of the individual studies included in this thesis. During the study period, regular PPI input was obtained approximately every three months from an experienced PPI contributor. This involvement helped shape study conduct, interpretation of findings, and presentation of results, with specific contributions described within the relevant chapters. After completion of the studies, a PPI roundtable discussion was held to reflect on the findings and consider priorities for future research and implementation. The outcomes of this roundtable are incorporated into Chapter 7.

1.8 Aims of this thesis and overview

This thesis aims to address the above research gap with the following research questions:

Chapter 2: How has the COVID-19 pandemic affected the delivery of preventive healthcare? An interrupted time series analysis of adults in English primary care from 2018-2022.

I conducted an interrupted time series analysis with primary care data from the ORCHID database to understand how the COVID-19 pandemic affected the delivery of brief interventions in English primary care.

Chapter 3: How does remote consultation shape how prevention is approached in primary care consultations?

This question is answered with a mixed-methods study using a data-informed coding system to quantify the different types of talk that occur in face-to-face versus remote audio recorded consultations followed by GP interviews and thematic analysis to explore GP's reflections on these consultations.

Chapter 4: Quantifying primary care activity in electronic health records: development and comparative cross-sectional analysis of a new categorisation system

Chapter 3 provided insights into preventive intervention delivery in three GP practices and 66 recorded consultations with 12 GPs. In response to the degree of uncertainty in this smaller sample size, I decided to investigate the delivery of preventive interventions in primary care in a larger data set. To do this, I needed to establish a reliable way of categorising consultation mode. This chapter describes a new method of categorising this type of data in the CPRD database.

Chapter 5: What is the rate of occurrence of brief interventions in face-to-face versus remote consultations for adults in English primary care?

This chapter uses the method to identify primary care clinical activity and consultations developed in **Chapter 4** to quantify more precisely how consultation mode affects delivery of preventive care in a sample of over 10 million people in the UK population. This project involved a logistic regression analysis of routinely collected primary healthcare data from the CPRD database.

Chapter 6: Strategies to increase the delivery of preventive care in primary care: Systematic review and meta-analysis

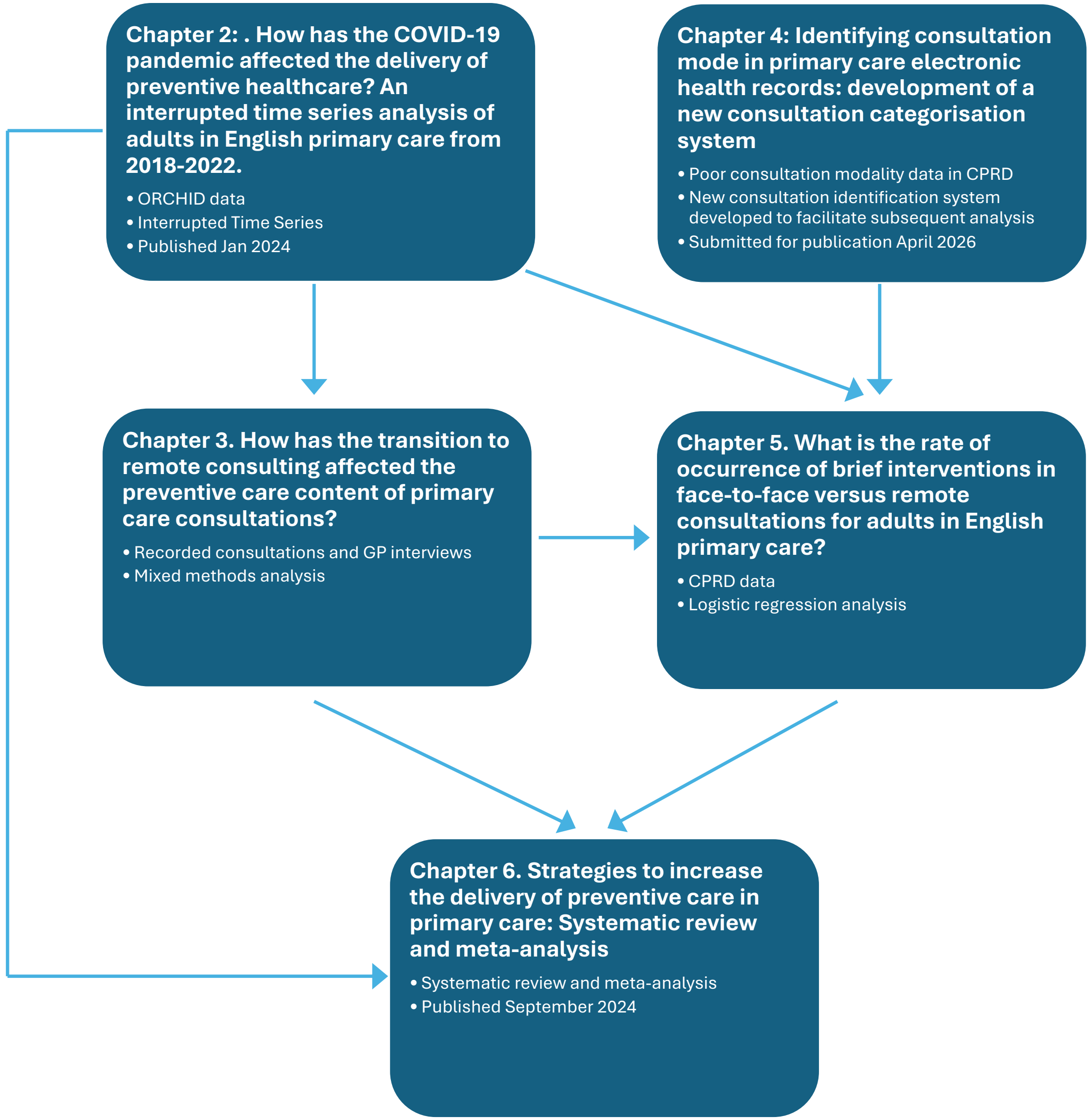
Results from **Chapters 2, 3, and 5** suggested that preventive interventions were being delivered less frequently than the prevalence of their targeted health behaviour in the population would suggest. Therefore, this study investigates health system and health professional level strategies that aim increase implementation of brief interventions in primary care assesses their effectiveness.

Chapter 7: Discussion.

This chapter summarises the results from the above chapters and aligns these results in the current clinical and policy context as well as suggesting opportunities for future research.

Together, this package of studies provides an overall evaluation of preventive healthcare in modern primary care and explores potential strategies to increase implementation. The integration of these research questions into this thesis is shown in Figure 1.1 below:

Figure 1.1 Structure of this thesis



2 How has the COVID-19 pandemic affected the delivery of preventive healthcare?

2.1 Summary

In this study, I examined the impact of the COVID-19 pandemic on the delivery of preventive advice and referrals for four major behavioural risk factors in primary care: smoking, excess weight, excess alcohol consumption, and physical inactivity. Using a retrospective cohort design, I analysed data from over 21 million patients across 1,847 general practices in England, accessed via the Oxford Clinical Informatics Digital Hub. I applied interrupted time series (ITS) analysis to data spanning January 2018 to June 2022, with March 2020 marking the onset of the pandemic. The analysis showed a sharp reduction in the provision of advice and referrals for all four risk factors at the start of the pandemic. By June 2022, advice on smoking (slope change -0.02 events per hundred patient years/month (EPH/month); 95% confidence interval (CI) -0.17, 0.21), excess weight (0.06 EPH/month; 95% CI 0.01, 0.12), alcohol (0.02 EPH/month; 95% CI -0.01, 0.05) and physical inactivity (0.05 EPH/month; 95% CI 0.01, 0.09) had not returned to pre-pandemic levels. Similarly, smoking cessation referral remained lower (0.01 EPH/month; 95% CI -0.01, 0.09), excess alcohol referral returned to similar levels (0.0005 EPH/month; 95% CI 0.0002, 0.0008), while referral for excess weight (0.14 EPH/month; 95% CI 0.10, 0.19) and physical inactivity (0.01 EPH/month; 95% CI 0.01, 0.02) increased relative to pre-pandemic rates. These findings suggest that preventive care delivery in primary care remains disrupted and highlight the need to prioritise behavioural risk factor interventions in pandemic recovery planning.

NOTE: This study has been published as a peer-reviewed journal article:

- **Heath L** et al. How has the COVID-19 pandemic affected the delivery of preventive healthcare? An interrupted time series analysis of adults in English primary care from 2018 to 2022. Prev Med. 2024 https://doi.org/10.1016/j.ypmed.2024.107923

2.2 Introduction

As outlined in Chapter 1, brief interventions in primary care for smoking, weight management, excess alcohol and physical activity are efficacious and are recommended in international medical guidelines as part of comprehensive primary care.[1 150] An understanding of how this care is delivered in hybrid, modern general practice would not be complete without consideration of the effect of the COVID-19 pandemic on general practice and delivery of this type of care.

Interventions for smoking, excess weight, alcohol and physical activity are often delivered opportunistically in primary care. Unlike screening programmes or chronic disease reviews, they are rarely scheduled, often clinician-initiated, and dependent on available consultation time and relational continuity. As such, they may be particularly vulnerable to disruption when health systems face acute pressure, such as during the COVID-19 pandemic. Periods of system shock provide insight into how primary care prioritises competing demands and which forms of care are preserved, postponed, or displaced. While existing analyses of the COVID-19 pandemic have documented substantial changes in consultation volume and chronic disease management, little is known about how behavioural preventive interventions were affected. Understanding these patterns is important not only for evaluating the resilience of primary care during crisis, but also for anticipating longer-term consequences for population health.

Additionally, the onset of the COVID-19 pandemic coincided not only with reduced primary care activity, but also with an unprecedented and rapid shift towards remote consulting. This transformation fundamentally altered how clinicians and patients interacted, reshaping consultations and potentially changing the conditions under which opportunistic preventive care is delivered. Any observed change in brief intervention delivery during this period may therefore reflect not only increased system pressure, but also the consequences of consultation mode itself. Distinguishing between these possibilities is important: if reductions in preventive care are primarily attributable to remote consulting, this has implications beyond the pandemic context, given the sustained integration of telephone and digital consultations into routine practice. The pandemic thus provides a natural experiment through which broader questions about consultation mode and preventive care can begin to be explored.

Therefore, the aim of this study was to quantify the rate of preventive interventions delivered (advice or referral for the four main behavioural risk factors: smoking, excess weight, excess alcohol and physical inactivity) delivered before and after the start of the COVID-19 pandemic in March 2020. Secondarily to understand whether different population subgroups (sex, age, socioeconomic status, ethnicity or geographical area) were differentially affected.

2.3 Methods

2.3.1 Design

This was a retrospective cohort study using routinely collected primary care data from practices in England contributing to the Oxford Clinical Informatics Digital Hub (ORCHID).[151] Practices contributing to the dataset were representative of English primary care in terms of deprivation, rurality, size of practice and ethnicity.[152] This study met the institution's guidelines for protection of participants concerning safety and privacy. Ethical approval for this study was given by an independent approval committee and the University of Oxford, Medical Sciences Interdivisional Research Ethics Committee (ref: R69874/RE001). Data was analysed on RStudio (version 4.3.1) on secure ORCHID servers. The protocol for this study was published on Open Science Framework in January 2023. [153] The ORCHID database was chosen for this research as it had the patient population required to answer the research question, and ethical approval had already been granted for COVID-19 related studies using this cohort.

2.3.2 Study population

I included all active patients aged ≥18 years and who were registered with a selected practice for at least 1 day during the study period from 1st January 2018- 30th June 2022. All patients contributed to the dataset until death, moving out of an ORCHID practice, or censoring at study end.

2.3.3 Exposure

The exposure was the first UK wide lockdown due to the COVID-19 pandemic on 23rd March 2020.

2.3.4 Outcomes

The outcomes were advice on smoking, alcohol, physical activity, or excess weight and referral to services to support behaviour change for these risk factors. I present these as events/hundred-patient years (EPH) of observation for step change and events/hundred patient years/month (EPH/month) for slope change, before and after the first UK lockdown on the 23rd March 2020. Preventive care code lists, covering smoking cessation advice, smoking cessation referral, weight management advice, weight management referral, alcohol advice, alcohol referral, physical activity advice and physical activity referral were developed. Outcome codes were based on clinician entries into the electronic healthcare record. I developed these code lists in SNOMED CT, and they were reviewed for completeness by another academic GP. The full list of outcome codes is given in Appendix 1.

2.3.5 Covariates

Main analyses were repeated by subgroups of sex (male or female); age (<35, 35-65, >65); ethnicity (White, Asian, Black, Mixed, other, unknown); socioeconomic status (index of multiple deprivation (IMD) quintiles), or location (urban or rural). [154]

2.3.6 Statistical analysis

Descriptive statistics were calculated for the characteristics of the study population. Rates of each preventive care intervention delivered expressed as events/hundred person-years and plotted for each week from the start of the study period (1st January 2018) to visualise the change in preventive activity over time.

Interrupted time series analysis (ITS) was selected as an appropriate quasi-experimental approach for evaluating the impact of a system-wide, time specific disruption when randomisation is not possible. By modelling pre-existing trends and seasonal variation, ITS enables separation of abrupt level changes from changes in longer-term trends, thereby strengthening causal inference relative to simpler pre-post comparisons. While ITS cannot fully exclude the influence of concurrent external factors, it provides a robust framework for assessing temporal associations between the COVID-19 pandemic and changes in preventive care delivery.

An ITS analysis was undertaken with a single change point of the 23rd March 2020 (week 13). I modelled the monthly trends from 1st January 2018 using segmented linear regression models. The asymptotic normality of Poisson distributed data enabled my data to be treated as normally distributed continuous data.[155] The models controlled for seasonality using indicator terms for months. Residual plots were used to graphically check for autocorrelation, and the partial auto-correlation function was assessed. I did not adjust for auto-correlation of residuals as, like in most epidemiological studies, auto-correlation was largely explained by seasonality and auto-correlation was not significant after controlling for this.[156] As the population demographics were relatively stable over time, I did not control for any demographic variables.

For each outcome, I used the likelihood ratio test to compare the joint (omnibus) null hypothesis, that neither step nor slope changed, with the composite alternate hypothesis that either or both changed.[157] To investigate whether specific groups were differentially affected by the COVID-19 pandemic lockdown and recovery, each covariate was sequentially added to the ITS model. The step change, slope change and 95% confidence intervals (CI) of each type of preventive care delivery were calculated for each subgroup. All analyses were conducted in RStudio on secure ORCHID servers.

2.3.7 Patient and public involvement

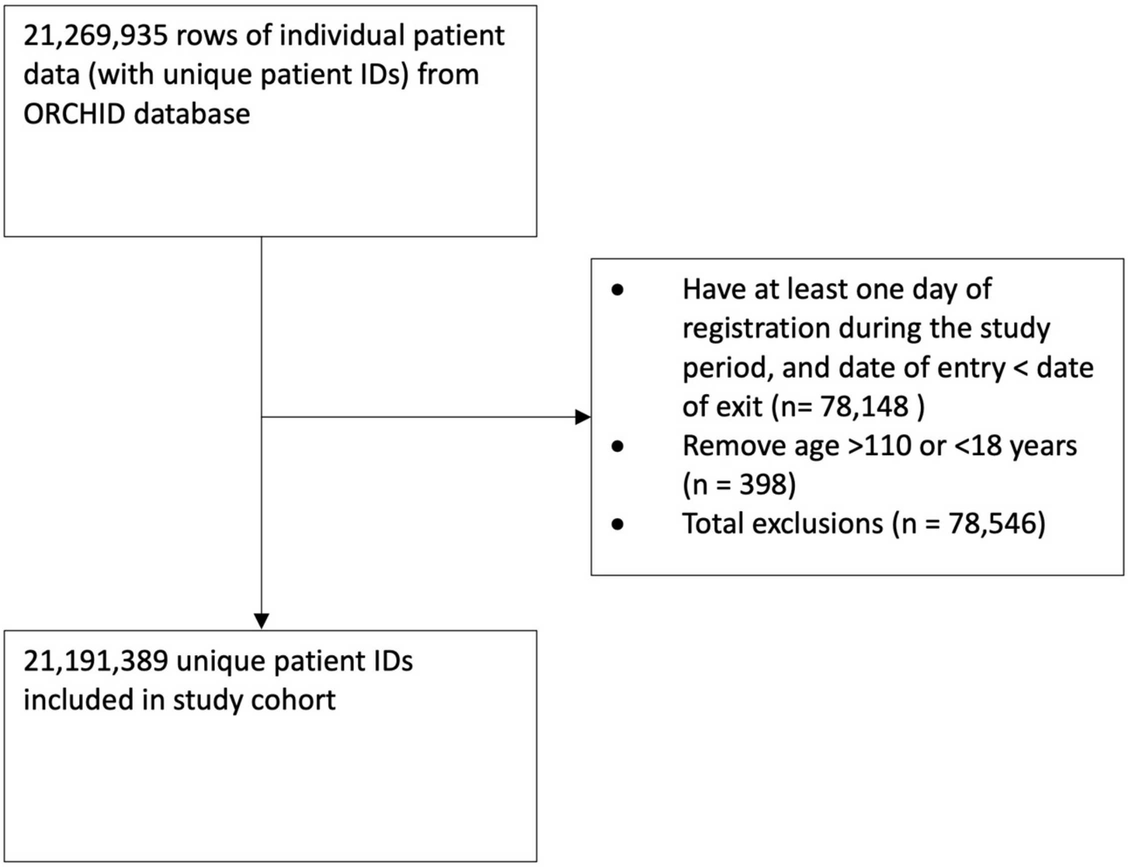
My patient and public involvement contributor was involved in shaping the aims of the study and the protocol. In particular, she provided feedback on the different population subgroups I should investigate in this study, to understand the potential differential impact of the COVID-19 pandemic and the delivery of preventive care to potentially disadvantaged groups.

2.4 Results

2.4.1 Cohort description

A total of 21,191,389 active patients contributed to the dataset from 1847 practices, with a mean age of 37.9 years (Standard Deviation (SD) 23.5). The flow chart of patients through the study is shown below.

Figure 2.1 Flow chart of patients through the study



Overall, 50.2% were female, 67.6% were of white ethnicity and 46.2% lived in cities or towns (Table 2.1). The mean amount of time each patient contributed to the data was 2.92 years and there was a total of 61,957,779 years of follow up.

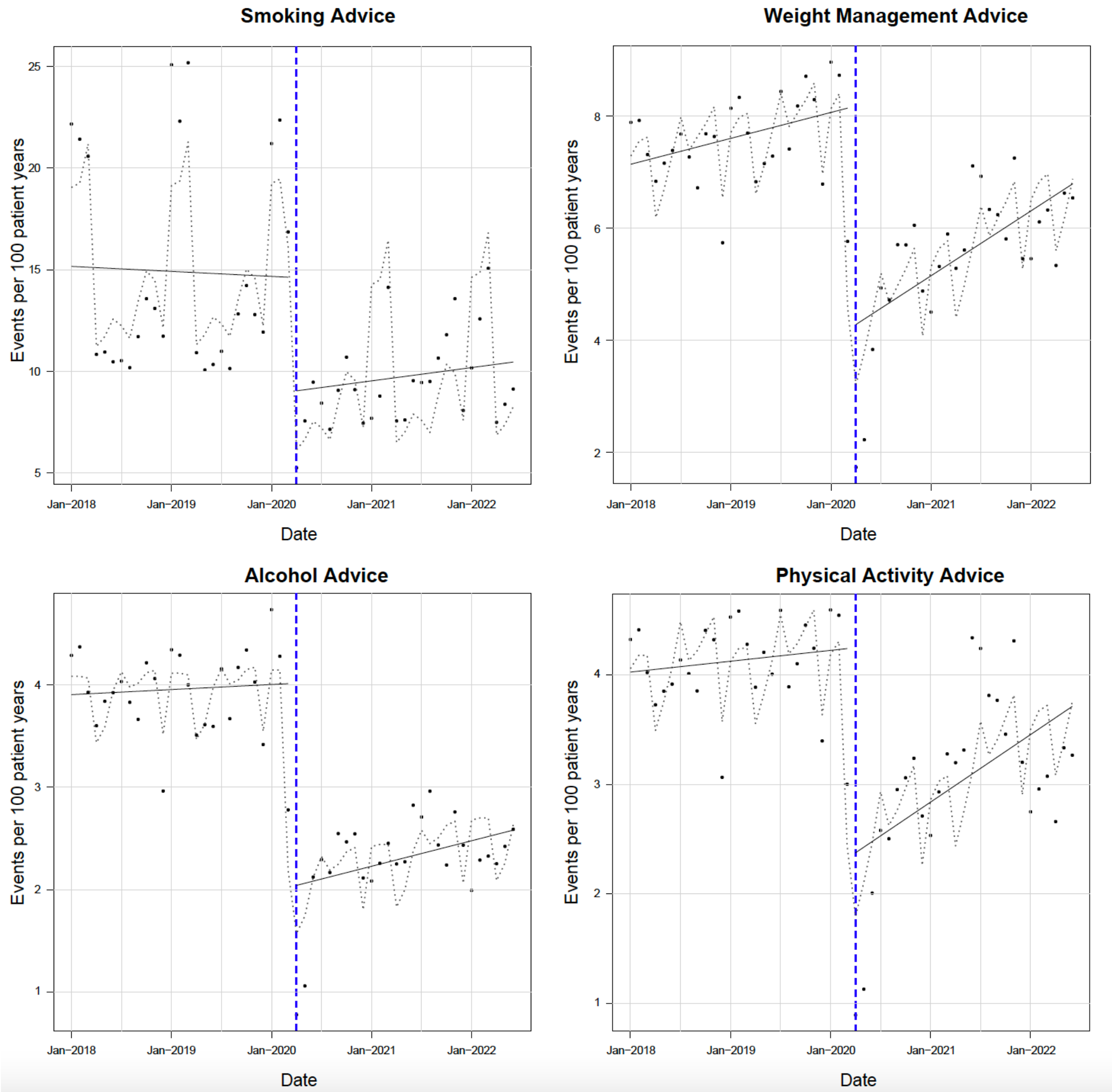
Table 2.1 Characteristics of adult patients in the ORCHID database from January 2018 to June 2022 included in the analysis

	Total population (n= 21,191,389)	
Patient characteristic	**N**	**%**
Female	10,645,150	50.2
Age (years)		
18-35	10,152,221	47.9
35-60	6,708,473	31.7
>60	4,330,695	20.4
Ethnic group		
White	14,325,035	67.6
Asian	1,804,572	8.5
Black	758,974	3.6
Mixed	420,590	2.0
Other	366,797	1.7
Unknown	3,515,421	16.6
Index of multiple deprivation (IMD) quintile		
1 (most deprived)	4,186,256	19.8
2	4,271,266	20.2
3	4,142,496	19.5
4	4,192,723	19.8
5 (least deprived)	4,398,648	20.8
Location		
Urban	17,596,984	83.0
Rural	3,594,405	17.0

2.4.2 Change in advice and referrals

For each health behaviour advice and referral analysed, there was an immediate reduction in delivery at the onset of the COVID-19 pandemic, followed by a gradual recovery. After adjusting for calendar month, there was evidence of a statistically significant negative step change for smoking cessation advice (-5.89 EPH; 95% CI -11.57, -0.21) but not for slope change (-0.02 EPH/month; 95% CI -0.17, 0.21). There was a significant step (-5.63 EPH; 95% CI -7.19, -4.06) and slope change (0.06 EPH/month; 95% CI 0.01, 0.12) for weight management advice. Similarly, there was a significant step (-3.17 EPH; 95% CI -4.27, -2.07) and slope change (0.05 EPH/month; 95% CI 0.01, 0.09) for physical activity advice given. For alcohol advice, there was a significant step (-2.45 EPH; 95% CI -3.24, -1.67) but not slope change (0.02 EPH/month; 95% CI -0.01, 0.05). Taken together, these step and slope changes were jointly significant for each health behaviour analysed (omnibus test; $p < 0.001$) for smoking cessation advice, weight management advice, alcohol advice and physical activity advice.

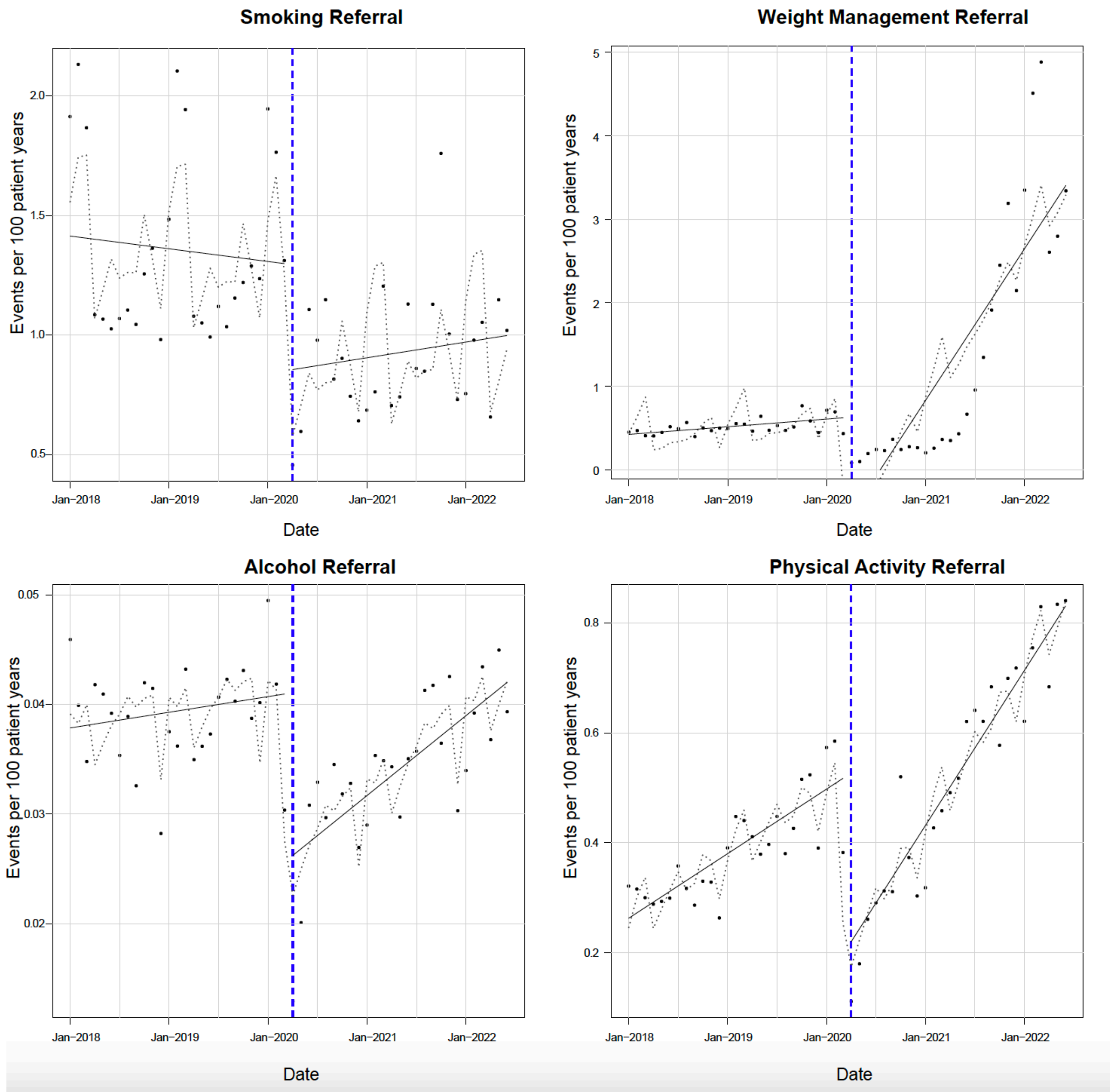
Figure 2.2 Interrupted time series (ITS) model fitted to monthly events/100 patient years from January 2018 to June 2022 of smoking cessation, weight management, alcohol intake and physical activity advice for adults in the ORCHID database



* The dashed line represents the calendar month adjusted model; the solid line represents the model without month effect adjustment.

After adjustment for calendar month, there was evidence of a statistically significant negative step (-0.62 EPH; 95% CI -1.22, -0.02) but not slope change (0.01 EPH/month; 95% CI -0.01, 0.09) for smoking cessation referral (omnibus test; $p=0.006$). For weight management referral, there was a significant step (-5.14 EPH; 95% CI -6.44, -3.85) and slope (0.14 EPH/month; 95% CI 0.10, 0.19) change (omnibus test; $p<0.001$). Similarly, there was a significant step (-0.03 EPH; 95% CI -0.04, -0.02) and slope (0.0005 EPH/month; 95% CI 0.0002, 0.0008) change for alcohol referral (omnibus test; $p<0.001$), although the absolute numbers of referrals were small. For physical activity referral, there was a significant step (-0.70 EPH; 95% CI -0.82, -0.56) and slope change (0.01 EPH/month; 95% CI 0.01, 0.02) when comparing the periods before and after the onset of the COVID-19 pandemic (omnibus test; $p<0.001$)

Figure 2.3 Interrupted time series (ITS) model fitted to monthly events/100 patient years from January 2018 to June 2022 of smoking cessation, weight management, alcohol intake and physical activity referral for adults in the ORCHID database.



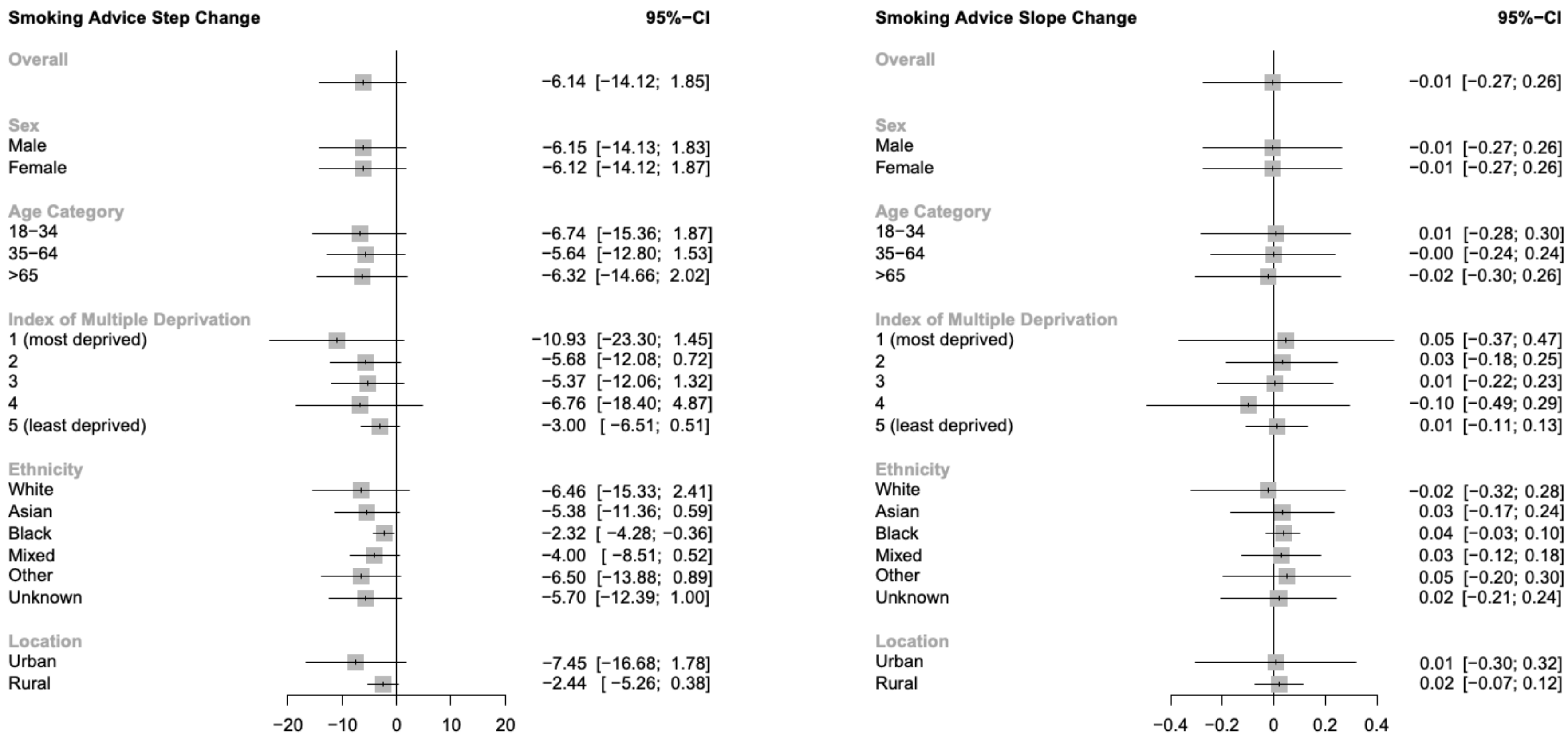
*The dashed line represents the calendar month adjusted model; the solid line represents the model without month adjustment.

2.4.3 Population subgroups

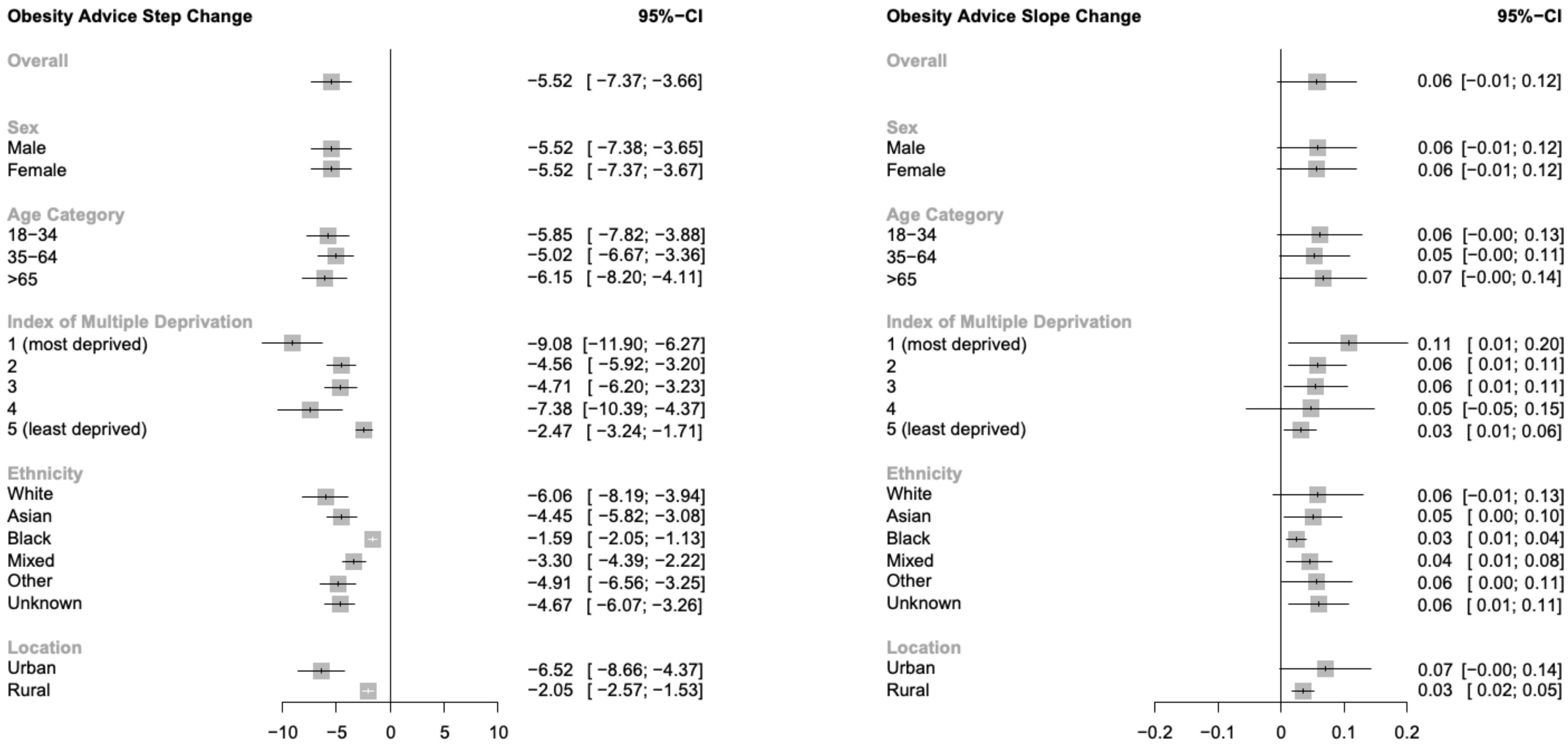
Overall, the pattern of advice and referrals across population subgroups was similar and observed differences were small. Confidence intervals suggest a greater reduction in initial step change between the most deprived quintiles compared to the least; between people of White ethnicity compared to those of Black ethnicity; and people in urban compared to rural locations for obesity, alcohol and physical activity advice. There was no suggestion of a significant difference for either step or slope change between any of the other population subgroups and advice.

Figure 2.4 Forest plots of step change and slope change for smoking, weight management, excess alcohol and physical inactivity advice by population subgroups for a) smoking b) obesity c) alcohol and d) physical activity

a)

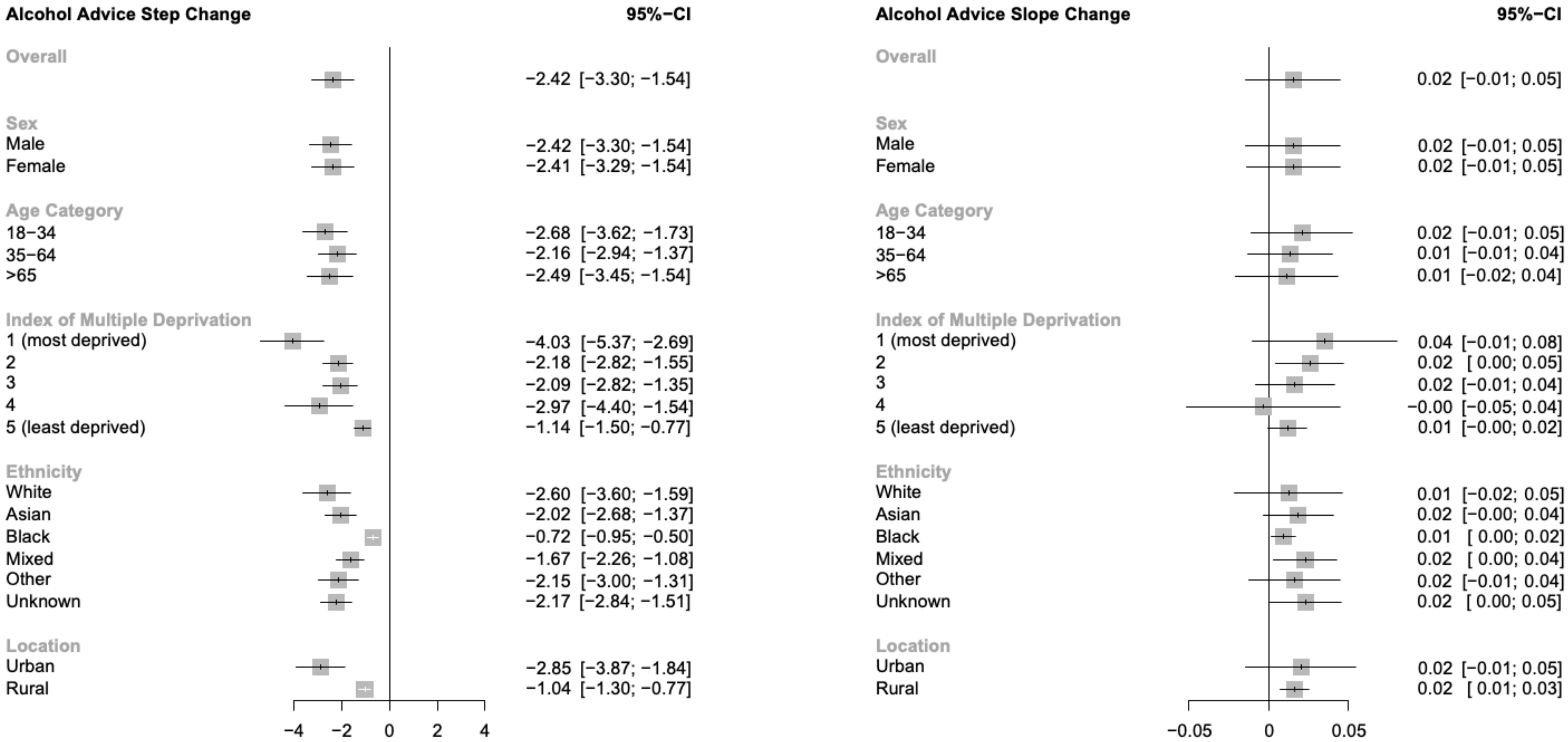


b)

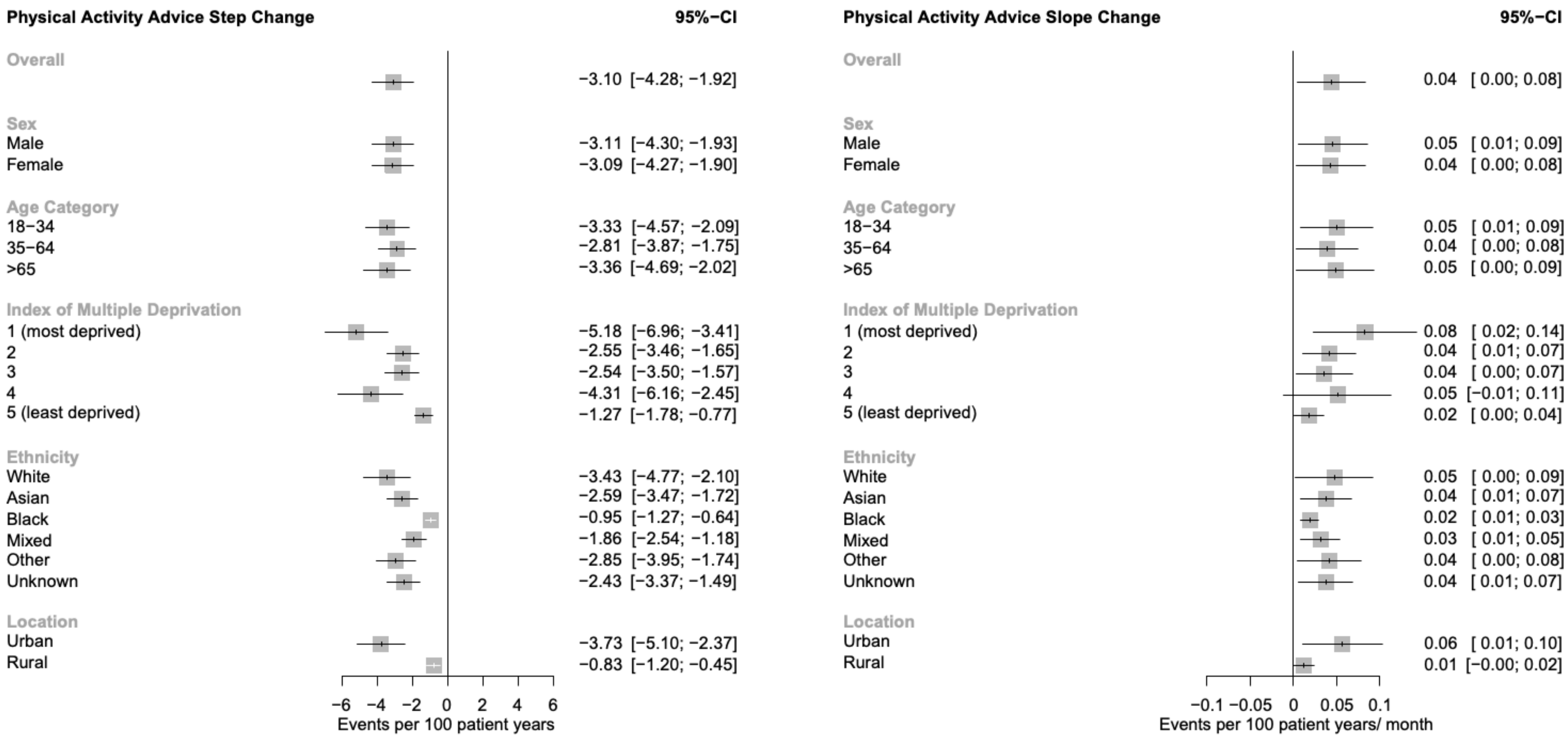


Obesity Advice Step Change
95%−CI
Overall
−5.52 [−7.37; −3.66]
Sex
Male −5.52 [−7.38; −3.65]
Female −5.52 [−7.37; −3.67]
Age Category
18−34 −5.85 [−7.82; −3.88]
35−64 −5.02 [−6.67; −3.36]
>65 −6.15 [−8.20; −4.11]
Index of Multiple Deprivation
1 (most deprived) −9.08 [−11.90; −6.27]
2 −4.56 [−5.92; −3.20]
3 −4.71 [−6.20; −3.23]
4 −7.38 [−10.39; −4.37]
5 (least deprived) −2.47 [−3.24; −1.71]
Ethnicity
White −6.06 [−8.19; −3.94]
Asian −4.45 [−5.82; −3.08]
Black −1.59 [−2.05; −1.13]
Mixed −3.30 [−4.39; −2.22]
Other −4.91 [−6.56; −3.25]
Unknown −4.67 [−6.07; −3.26]
Location
Urban −6.52 [−8.66; −4.37]
Rural −2.05 [−2.57; −1.53]
−10 −5 0 5 10
Obesity Advice Slope Change
95%−CI
Overall
0.06 [−0.01; 0.12]
Sex
Male 0.06 [−0.01; 0.12]
Female 0.06 [−0.01; 0.12]
Age Category
18−34 0.06 [−0.00; 0.13]
35−64 0.05 [−0.00; 0.11]
>65 0.07 [−0.00; 0.14]
Index of Multiple Deprivation
1 (most deprived) 0.11 [0.01; 0.20]
2 0.06 [0.01; 0.11]
3 0.06 [0.01; 0.11]
4 0.05 [−0.05; 0.15]
5 (least deprived) 0.03 [0.01; 0.06]
Ethnicity
White 0.06 [−0.01; 0.13]
Asian 0.05 [0.00; 0.10]
Black 0.03 [0.01; 0.04]
Mixed 0.04 [0.01; 0.08]
Other 0.06 [0.00; 0.11]
Unknown 0.06 [0.01; 0.11]
Location
Urban 0.07 [−0.00; 0.14]
Rural 0.03 [0.02; 0.05]
−0.2 −0.1 0 0.1 0.2

c)


Alcohol Advice Step Change
95%−CI
Overall
−2.42 [−3.30; −1.54]
Sex
Male −2.42 [−3.30; −1.54]
Female −2.41 [−3.29; −1.54]
Age Category
18−34 −2.68 [−3.62; −1.73]
35−64 −2.16 [−2.94; −1.37]
>65 −2.49 [−3.45; −1.54]
Index of Multiple Deprivation
1 (most deprived) −4.03 [−5.37; −2.69]
2 −2.18 [−2.82; −1.55]
3 −2.09 [−2.82; −1.35]
4 −2.97 [−4.40; −1.54]
5 (least deprived) −1.14 [−1.50; −0.77]
Ethnicity
White −2.60 [−3.60; −1.59]
Asian −2.02 [−2.68; −1.37]
Black −0.72 [−0.95; −0.50]
Mixed −1.67 [−2.26; −1.08]
Other −2.15 [−3.00; −1.31]
Unknown −2.17 [−2.84; −1.51]
Location
Urban −2.85 [−3.87; −1.84]
Rural −1.04 [−1.30; −0.77]
−4 −2 0 2 4
Alcohol Advice Slope Change
95%−CI
Overall
0.02 [−0.01; 0.05]
Sex
Male 0.02 [−0.01; 0.05]
Female 0.02 [−0.01; 0.05]
Age Category
18−34 0.02 [−0.01; 0.05]
35−64 0.01 [−0.01; 0.04]
>65 0.01 [−0.02; 0.04]
Index of Multiple Deprivation
1 (most deprived) 0.04 [−0.01; 0.08]
2 0.02 [0.00; 0.05]
3 0.02 [−0.01; 0.04]
4 −0.00 [−0.05; 0.04]
5 (least deprived) 0.01 [−0.00; 0.02]
Ethnicity
White 0.01 [−0.02; 0.05]
Asian 0.02 [−0.00; 0.04]
Black 0.01 [0.00; 0.02]
Mixed 0.02 [0.00; 0.04]
Other 0.02 [−0.01; 0.04]
Unknown 0.02 [0.00; 0.05]
Location
Urban 0.02 [−0.01; 0.05]
Rural 0.02 [0.01; 0.03]
−0.05 0 0.05

d)

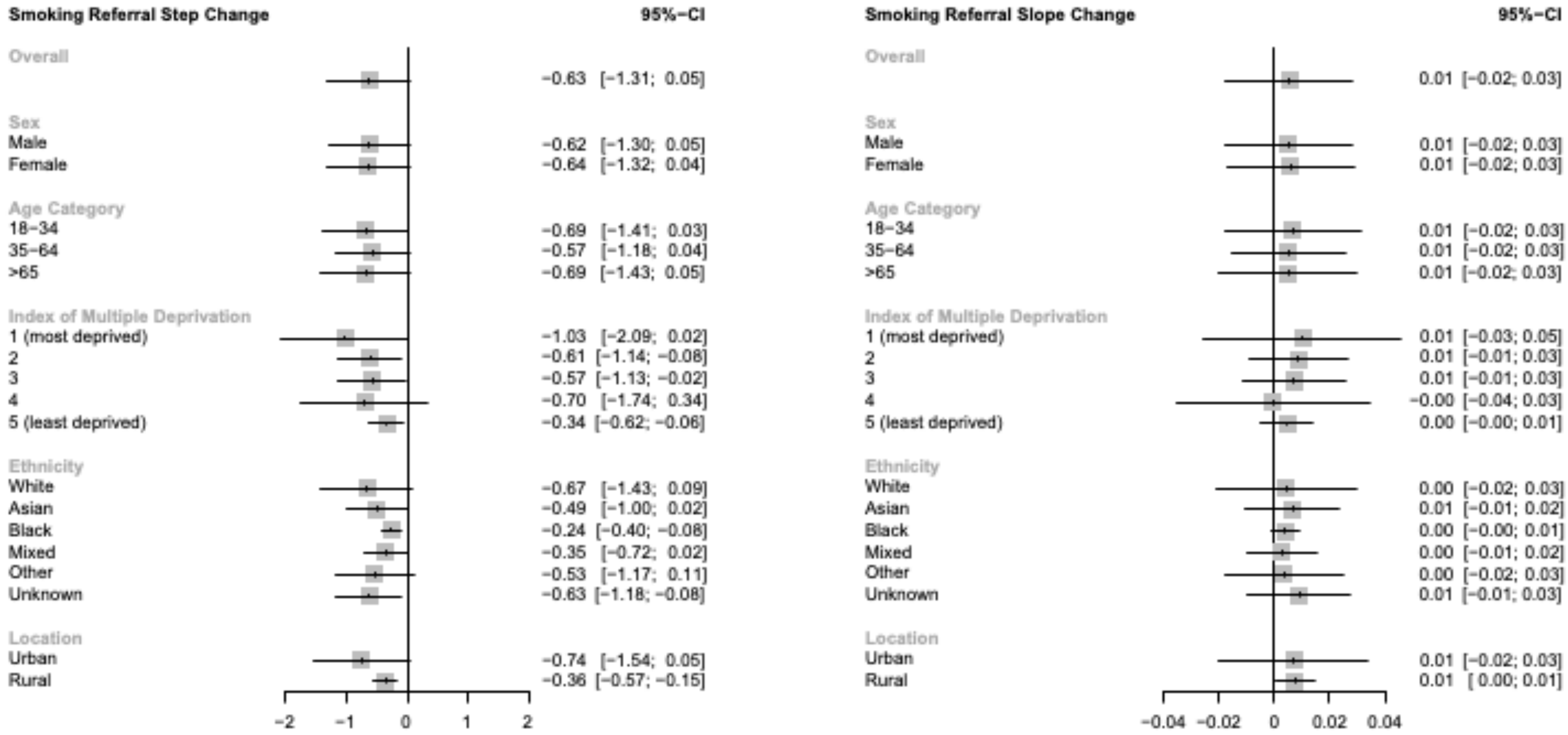


Physical Activity Advice Step Change
95%−CI
Overall
−3.10 [−4.28; −1.92]
Sex
Male −3.11 [−4.30; −1.93]
Female −3.09 [−4.27; −1.90]
Age Category
18−34 −3.33 [−4.57; −2.09]
35−64 −2.81 [−3.87; −1.75]
>65 −3.36 [−4.69; −2.02]
Index of Multiple Deprivation
1 (most deprived) −5.18 [−6.96; −3.41]
2 −2.55 [−3.46; −1.65]
3 −2.54 [−3.50; −1.57]
4 −4.31 [−6.16; −2.45]
5 (least deprived) −1.27 [−1.78; −0.77]
Ethnicity
White −3.43 [−4.77; −2.10]
Asian −2.59 [−3.47; −1.72]
Black −0.95 [−1.27; −0.64]
Mixed −1.86 [−2.54; −1.18]
Other −2.85 [−3.95; −1.74]
Unknown −2.43 [−3.37; −1.49]
Location
Urban −3.73 [−5.10; −2.37]
Rural −0.83 [−1.20; −0.45]
−6 −4 −2 0 2 4 6
Events per 100 patient years
Physical Activity Advice Slope Change
95%−CI
Overall
0.04 [0.00; 0.08]
Sex
Male 0.05 [0.01; 0.09]
Female 0.04 [0.00; 0.08]
Age Category
18−34 0.05 [0.01; 0.09]
35−64 0.04 [0.00; 0.08]
>65 0.05 [0.00; 0.09]
Index of Multiple Deprivation
1 (most deprived) 0.08 [0.02; 0.14]
2 0.04 [0.01; 0.07]
3 0.04 [0.00; 0.07]
4 0.05 [−0.01; 0.11]
5 (least deprived) 0.02 [0.00; 0.04]
Ethnicity
White 0.05 [0.00; 0.09]
Asian 0.04 [0.01; 0.07]
Black 0.02 [0.01; 0.03]
Mixed 0.03 [0.01; 0.05]
Other 0.04 [0.00; 0.08]
Unknown 0.04 [0.01; 0.07]
Location
Urban 0.06 [0.01; 0.10]
Rural 0.01 [−0.00; 0.02]
−0.1 −0.05 0 0.05 0.1
Events per 100 patient years/ month

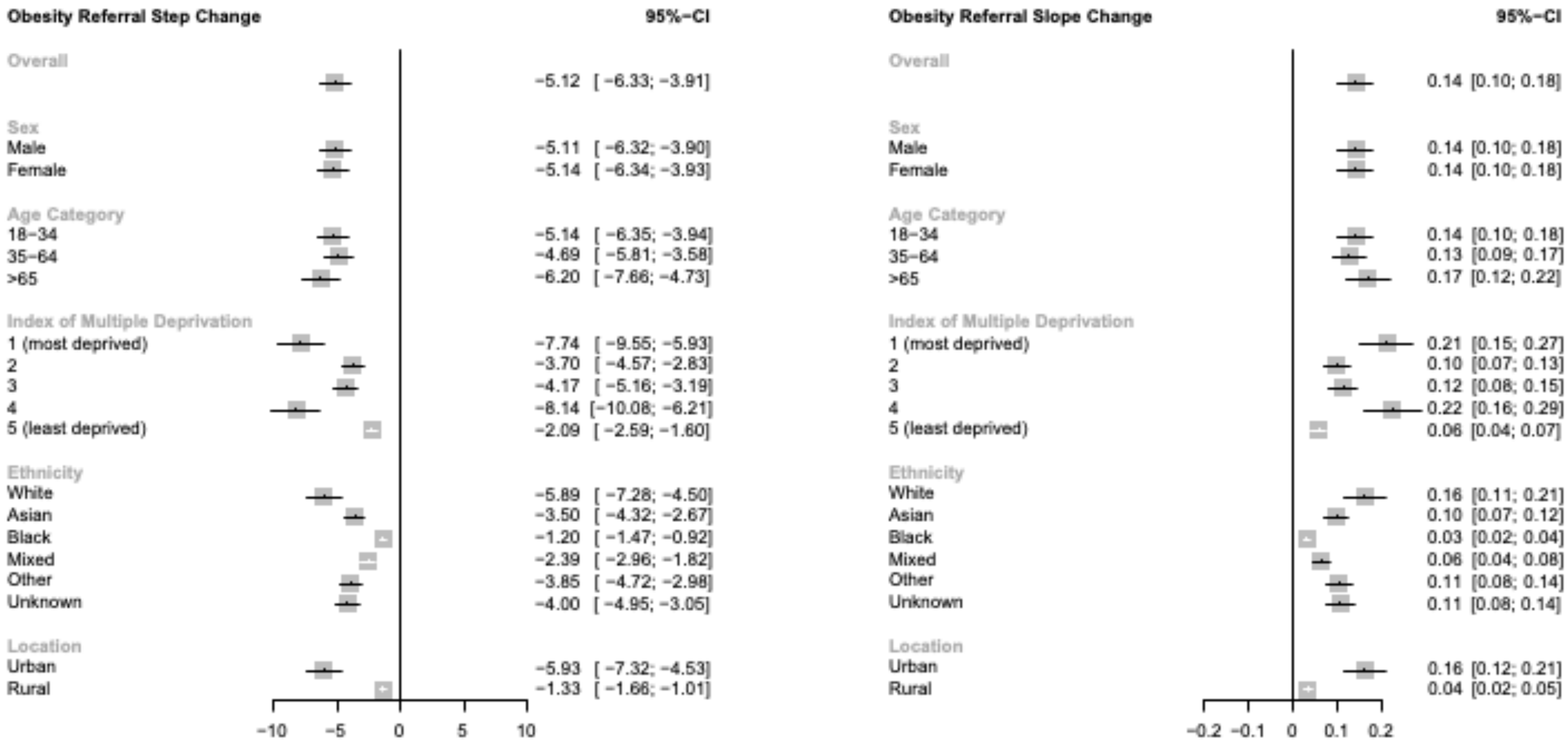
Similarly, for weight management and physical activity referral there was greater reduction in initial step change between the most deprived (first) quintile compared to the second, third and fifth quintiles; between people of White ethnicity compared to people of Black, Asian and Mixed ethnicities and between people in urban compared to rural locations. For weight management referral only, there was a greater increase in slope change between the first compared to second and fifth quintiles; those from White ethnicities compared to those of Black and mixed ethnicities; and people from urban compared to rural areas. For alcohol referral there was a greater reduction in initial step change between people of White compared to people of Black ethnicities. There was no suggestion of a significant difference for either step or slope change between any of the other population subgroups and referral.

Figure 2.5 Forest plots of step change and slope change for smoking, weight management, excess alcohol and physical inactivity referral by population subgroups for a) smoking b) obesity c) alcohol and d) physical activity

a)

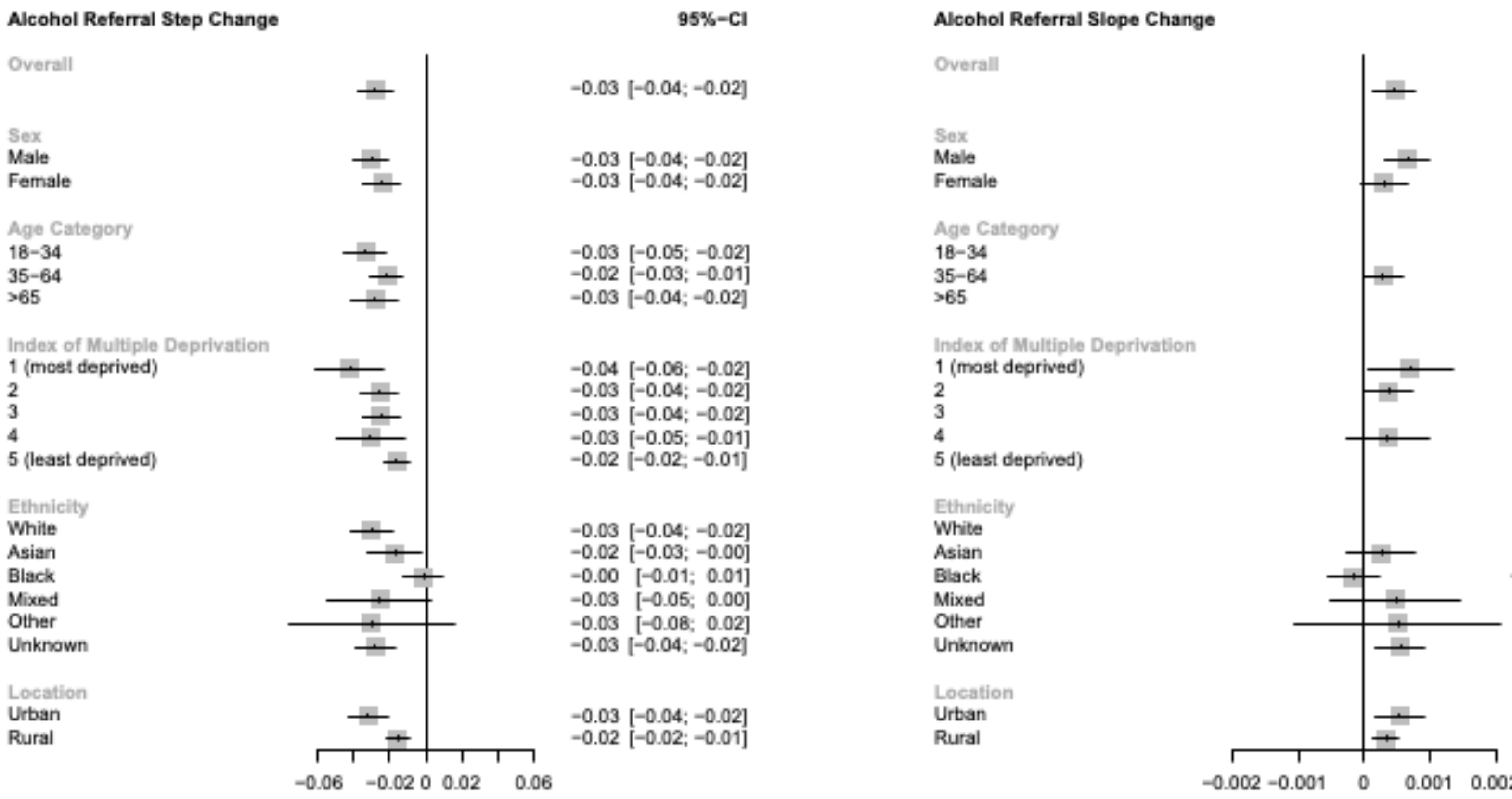


b)



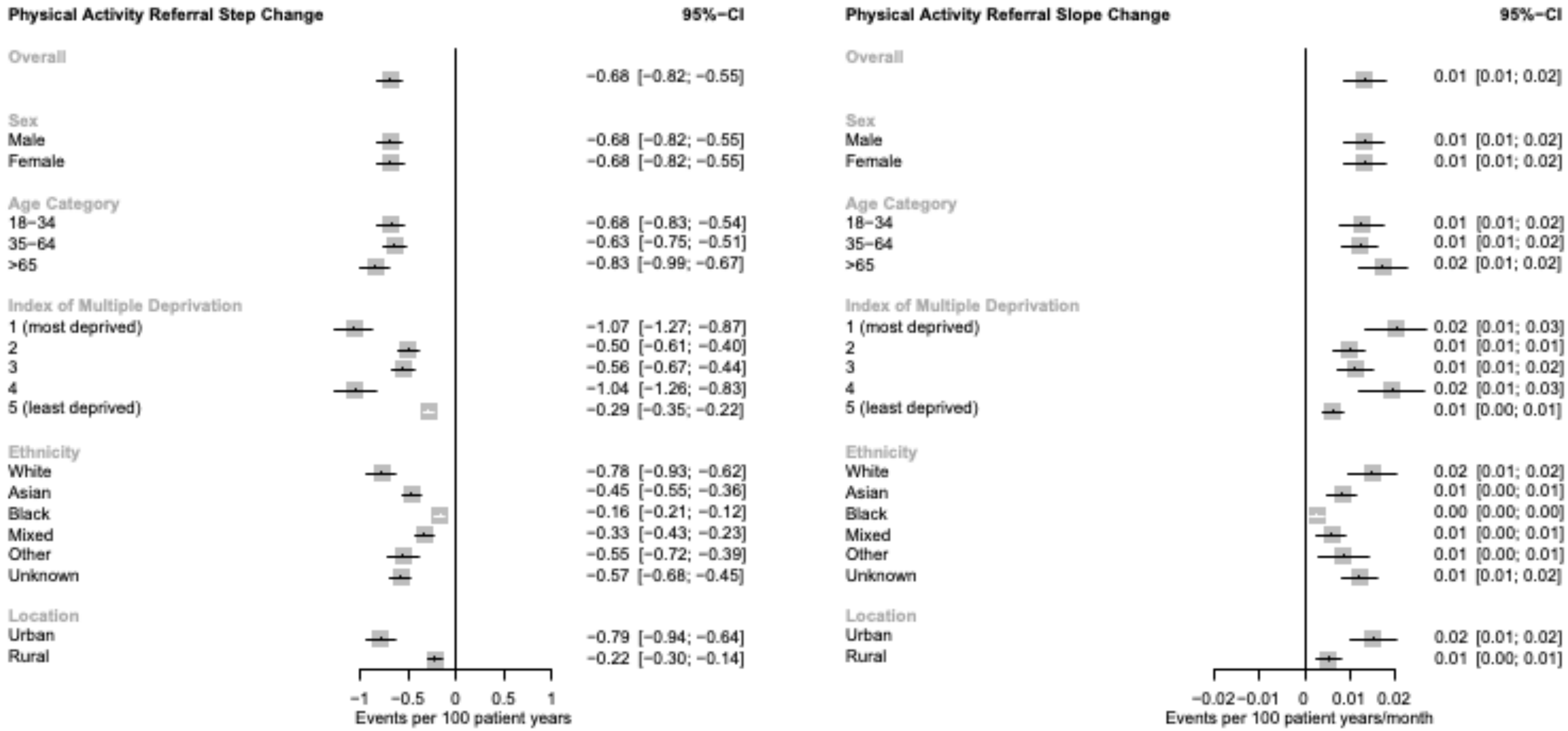
Obesity Referral Step Change
95%−CI
Overall
−5.12 [−6.33; −3.91]
Sex
Male −5.11 [−6.32; −3.90]
Female −5.14 [−6.34; −3.93]
Age Category
18−34 −5.14 [−6.35; −3.94]
35−64 −4.69 [−5.81; −3.58]
>65 −6.20 [−7.66; −4.73]
Index of Multiple Deprivation
1 (most deprived) −7.74 [−9.55; −5.93]
2 −3.70 [−4.57; −2.83]
3 −4.17 [−5.16; −3.19]
4 −8.14 [−10.08; −6.21]
5 (least deprived) −2.09 [−2.59; −1.60]
Ethnicity
White −5.89 [−7.28; −4.50]
Asian −3.50 [−4.32; −2.67]
Black −1.20 [−1.47; −0.92]
Mixed −2.39 [−2.96; −1.82]
Other −3.85 [−4.72; −2.98]
Unknown −4.00 [−4.95; −3.05]
Location
Urban −5.93 [−7.32; −4.53]
Rural −1.33 [−1.66; −1.01]
−10 −5 0 5 10
Obesity Referral Slope Change
95%−CI
Overall
0.14 [0.10; 0.18]
Sex
Male 0.14 [0.10; 0.18]
Female 0.14 [0.10; 0.18]
Age Category
18−34 0.14 [0.10; 0.18]
35−64 0.13 [0.09; 0.17]
>65 0.17 [0.12; 0.22]
Index of Multiple Deprivation
1 (most deprived) 0.21 [0.15; 0.27]
2 0.10 [0.07; 0.13]
3 0.12 [0.08; 0.15]
4 0.22 [0.16; 0.29]
5 (least deprived) 0.06 [0.04; 0.07]
Ethnicity
White 0.16 [0.11; 0.21]
Asian 0.10 [0.07; 0.12]
Black 0.03 [0.02; 0.04]
Mixed 0.06 [0.04; 0.08]
Other 0.11 [0.08; 0.14]
Unknown 0.11 [0.08; 0.14]
Location
Urban 0.16 [0.12; 0.21]
Rural 0.04 [0.02; 0.05]
−0.2 −0.1 0 0.1 0.2

c)



Alcohol Referral Step Change
95%−CI
Overall
−0.03 [−0.04; −0.02]
Sex
Male
−0.03 [−0.04; −0.02]
Female
−0.03 [−0.04; −0.02]
Age Category
18−34
−0.03 [−0.05; −0.02]
35−64
−0.02 [−0.03; −0.01]
>65
−0.03 [−0.04; −0.02]
Index of Multiple Deprivation
1 (most deprived)
−0.04 [−0.06; −0.02]
2
−0.03 [−0.04; −0.02]
3
−0.03 [−0.04; −0.02]
4
−0.03 [−0.05; −0.01]
5 (least deprived)
−0.02 [−0.02; −0.01]
Ethnicity
White
−0.03 [−0.04; −0.02]
Asian
−0.02 [−0.03; −0.00]
Black
−0.00 [−0.01; 0.01]
Mixed
−0.03 [−0.05; 0.00]
Other
−0.03 [−0.08; 0.02]
Unknown
−0.03 [−0.04; −0.02]
Location
Urban
−0.03 [−0.04; −0.02]
Rural
−0.02 [−0.02; −0.01]
−0.06 −0.02 0 0.02 0.06
Alcohol Referral Slope Change
95%−CI
Overall
0.00 [0.00; 0.00]
Sex
Male
0.00 [0.00; 0.00]
Female
0.00 [−0.00; 0.00]
Age Category
18−34
0.00 [0.00; 0.00]
35−64
0.00 [−0.00; 0.00]
>65
0.00 [0.00; 0.00]
Index of Multiple Deprivation
1 (most deprived)
0.00 [0.00; 0.00]
2
0.00 [0.00; 0.00]
3
0.00 [0.00; 0.00]
4
0.00 [−0.00; 0.00]
5 (least deprived)
0.00 [0.00; 0.00]
Ethnicity
White
0.00 [0.00; 0.00]
Asian
0.00 [−0.00; 0.00]
Black
−0.00 [−0.00; 0.00]
Mixed
0.00 [−0.00; 0.00]
Other
0.00 [−0.00; 0.00]
Unknown
0.00 [0.00; 0.00]
Location
Urban
0.00 [0.00; 0.00]
Rural
0.00 [0.00; 0.00]
−0.002 −0.001 0 0.001 0.002

d)


Physical Activity Referral Step Change
95%−CI
Overall
−0.68 [−0.82; −0.55]
Sex
Male −0.68 [−0.82; −0.55]
Female −0.68 [−0.82; −0.55]
Age Category
18−34 −0.68 [−0.83; −0.54]
35−64 −0.63 [−0.75; −0.51]
>65 −0.83 [−0.99; −0.67]
Index of Multiple Deprivation
1 (most deprived) −1.07 [−1.27; −0.87]
2 −0.50 [−0.61; −0.40]
3 −0.56 [−0.67; −0.44]
4 −1.04 [−1.26; −0.83]
5 (least deprived) −0.29 [−0.35; −0.22]
Ethnicity
White −0.78 [−0.93; −0.62]
Asian −0.45 [−0.55; −0.36]
Black −0.16 [−0.21; −0.12]
Mixed −0.33 [−0.43; −0.23]
Other −0.55 [−0.72; −0.39]
Unknown −0.57 [−0.68; −0.45]
Location
Urban −0.79 [−0.94; −0.64]
Rural −0.22 [−0.30; −0.14]
−1 −0.5 0 0.5 1
Events per 100 patient years
Physical Activity Referral Slope Change
95%−CI
Overall
0.01 [0.01; 0.02]
Sex
Male 0.01 [0.01; 0.02]
Female 0.01 [0.01; 0.02]
Age Category
18−34 0.01 [0.01; 0.02]
35−64 0.01 [0.01; 0.02]
>65 0.02 [0.01; 0.02]
Index of Multiple Deprivation
1 (most deprived) 0.02 [0.01; 0.03]
2 0.01 [0.01; 0.01]
3 0.01 [0.01; 0.02]
4 0.02 [0.01; 0.03]
5 (least deprived) 0.01 [0.00; 0.01]
Ethnicity
White 0.02 [0.01; 0.02]
Asian 0.01 [0.00; 0.01]
Black 0.00 [0.00; 0.00]
Mixed 0.01 [0.00; 0.01]
Other 0.01 [0.00; 0.01]
Unknown 0.01 [0.01; 0.02]
Location
Urban 0.02 [0.01; 0.02]
Rural 0.01 [0.00; 0.01]
−0.02 −0.01 0 0.01 0.02
Events per 100 patient years/month

2.5 Discussion

With the onset of the pandemic, rates of advice approximately halved (Figure 2.2) and rates of referral dropped by varying amounts (Figure 2.3). Rates of smoking, weight, alcohol, and physical activity advice have not yet recovered to their pre-pandemic levels. Nor have rates of smoking referral. Rates of referral for weight, alcohol or physical activity have recovered to pre-pandemic levels or even higher but remain low in comparison to the prevalence of the corresponding risk factors.

Approximately 13% of the UK adult population smoke.[158] Prior to the pandemic, they received regular, approximately annual, smoking advice (15 events per hundred patients per year), but with the onset of the pandemic this dropped by 6 per hundred patients per year (Figure 1). The pre-pandemic rate of weight advice (8 events per hundred patients per year), of physical activity advice (4 events per hundred patients per year) and of alcohol advice (4 events per hundred patients per year) were already low compared to the prevalence of overweight/obesity (approximately 60%), of physical inactivity (approximately 30%) and of alcohol consumption associated with higher rate of harm (approximately 20%). [159 160] The pre-pandemic rates of referral to support behaviour change were even lower: approximately one tenth the pre-pandemic rates of advice for smoking, weight management and physical activity, and one hundred times less frequent in the case of alcohol.

This is clinically important as not acting on key behavioural risk factors for cardiovascular disease and cancer may increase the incidence of these conditions in the future. The initial reduction and slow recovery of advice and referral for smoking cessation is a cause for concern as risk for smoking-related diseases is associated with smoking duration.[161] The mechanisms underlying this finding are unclear. Potential explanations include the ongoing shift of smoking cessation services from primary care to local authority commissioned provision, the cumulative impact of austerity related reductions in smoking cessation services, and the furlough of staff during the COVID-19 pandemic, all of which may have reduced availability of smoking cessation support.[162] The increase in referral for weight management and physical activity is welcomed and is likely due to the introduction of a new financial incentive described below. Policy makers and clinicians should aim to sustain and expand the reach of these programmes to maximise benefit.

2.5.1 Comparison with existing literature

As discussed in Chapter 1, other ITS analyses to assess the pandemic effect in primary care have focussed on acute conditions,[73] referral to cancer services,[74-76] asthma diagnoses, [77] and cardiovascular disease, [78] and most of these studies do not analyse data beyond the last quarter of 2020, so comparison of care recovery trajectories is challenging. However, one US based study reported that breast cancer screening rates, after initially decreasing were above expected levels in May 2020.[75] This rapid recovery suggests some aspects of preventive care may have been prioritised for recovery over others. Furthermore, the magnitude of reduction in preventive care observed in this study is towards the upper end of reductions in acute care activity reported elsewhere in the literature. Previous studies have documented decreases in acute care delivery ranging from 5% to 50% at the onset of the

COVID-19 pandemic. [73] This suggests that preventive care may have been particularly deprioritised in comparison to acute care for other conditions during the early stages of the pandemic.

Other preventive activities have been investigated in primary care during the pandemic, for example one US study looked at the impact of the COVID-19 pandemic on non-COVID-19 vaccinations. They found that the number of vaccinated individuals decreased by 9.6% among children and 4.2% among adults during the first year of the pandemic, this decline persisted and worsened during the second year of the pandemic.[163] They found that these decreased vaccination rates were highest amongst females, those living in rural areas, and those living in areas with the highest social risk of infection highlighting the disproportionate impact on disadvantaged groups. In contrast, in this analysis, larger initial reductions in some forms of preventive care were observed among individuals living in urban areas, and there was no evidence of a difference in the initial step change of any type of preventive care analysed between men and women. These findings suggest that the impact of the pandemic on preventive care delivery varied according to the type of preventive care activity being examined and the healthcare system context. Another study found that the pandemic exacerbated inequalities in consultation rates for vulnerable groups such as migrants, those whose first language was not English, and people from Black African/Caribbean/Black British ethnicities.[164] My study supports these findings, with the largest reduction in some types of preventive care being experienced by the most deprived quintile. I also found that people from White ethnicities tended to experience larger initial reductions in some areas of preventive care than those from minority ethnic groups. However, care tended to recover quicker for those from White ethnicity compared to those from minority ethnic groups. It is important to note that observed differences in this study between population subgroups were small.

The marked increase in weight management referrals seen in this analysis is unusual and warrants more detailed consideration. It seems likely that this may be a result of the enhanced service incentive scheme that started in April 2021. This scheme offered a payment to the GP practice of £11.50 per referral to an appropriate weight management programme. [165] It was introduced as a specific COVID-19 pandemic response and part of a wider obesity strategy. I was co-author on a related piece of work evaluating the real world impact of the enhanced service incentive. This study found that the onset of the national enhanced service incentive in April 2021 was associated with a fourfold increase in the number of coded referrals for weight management.[166] This study supports these findings, with weight management referral demonstrating the largest positive slope change observed in the analysis (0.14 EPH per month; 95% CI 0.10 to 0.19).

The low implementation of advice and support across the whole of the time period studied, in comparison to the prevalence of risk factors in the population may in part be due to incomplete recording of behavioural risk factors in the medical record. Existing literature suggests approximately 84% have smoking status recorded,[167] less than half have any information on physical activity or exercise; [168] one third have weight recorded each year;[40] and a quarter of patients have units per week of alcohol recorded in the past 5 years. [169] This incomplete recording of behavioural risk factors may reduce opportunities for clinicians to identify patients who could benefit from preventive advice or referral and may also contribute to underestimation of preventive care activity within routine electronic health record data.

2.5.2 Implications for future research and practice

During the COVID-19 pandemic government advice was to stay home and protect the NHS. Fear of contracting COVID-19 in healthcare settings and advice to shield vulnerable people may have led to fewer opportunities for preventive care to be delivered. Additionally, NHS England and NHS Improvement in agreement with the British Medical Association's General Practitioners Committee simplified and reduced the Quality and Outcomes Framework (QOF) requirements for 2020/21, which rewarded doctors for giving smoking cessation advice and offering referral to cessation services.[72] It is likely these factors reduced the focus on preventive care delivery and redirected attention towards acute care. In the future, policy makers should consider and plan for the unintended consequences of extreme stressors on healthcare systems, and how the prioritisation of acute care impacts preventive care. Increasing the delivery of smoking cessation advice and referral, which had not returned to pre-pandemic levels in this analysis, should be a health system priority given that smoking is estimated to account for approximately 50% of the difference in health outcomes between the most and least deprived populations. [123] In addition, efforts should be made to ensure that the increases observed in weight management referrals are sustained over time.

An important confounder to consider in this study is that, simultaneously to the COVID-19 pandemic, the way that general practice was consulting also changed. As outlined in Chapter 1, the pandemic accelerated a transition to remote consulting, which was already happening albeit at a much slower pace before the onset of the pandemic. It is difficult to infer from an ITS whether the reduction in preventive care delivery was a result of the pandemic and prioritisation of acute services, or whether it was due to the shift to remote consulting, or whether it was a combination of the two factors. Therefore, future research should explore the impact of remote consulting on the delivery of preventive care. Furthermore, as remote consulting is now embedded within routine primary care, strategies to optimise preventive care delivery, including staff training and digital tools, should be considered further. These approaches are discussed in Chapter 7.

2.5.3 Strengths and Limitations

The strength of this study includes the use of the large ORCHID database, which is updated regularly, allowing access to up to date data. Practices across England were equally represented in terms of deprivation, rurality, size of practice and ethnicity, and so findings are likely generalisable to the wider population. A broad range of preventive healthcare codes were considered, so the impact of COVID-19 on different aspects of preventive healthcare could be explored. As this analysis was done 2 years after the first lockdown, there is sufficient post point change data available, allowing a more robust pre and post lockdown comparison. The pattern of initial reduction in step change and then recovery in advice and referral was consistent across multiple health behaviours and both advice and referral code categories. This consistency in findings across different outcomes strengthens the reliability and internal validity of the analysis.

This analysis is subject to the usual limitations of routine electronic health record data, including only preventive interventions accurately coded in the patient electronic health record were considered and so potentially subject to recording bias. Data in free text was not analysed, and so preventive care may have occurred but not be captured in this analysis. However, there is no clear reason why coding practices for preventive care would have systematically changed before or after the onset of the COVID-19 pandemic, suggesting that the validity of the analysis is likely to be preserved. Although I developed the code list in collaboration with a team of clinicians and data scientists, some clinical codes may have been missed or some codes incorrectly included, though these errors should not explain changes in trends. As this is an observational study, causality cannot be inferred, and it may be that other changes at this time may be contributing to the changes seen in the data. This study period finished in June 2022, since this time, there have been some changes to preventive care delivery, including a policy focus on prevention in the NHS 10 year plan and the introduction of the national enhanced service incentive for weight management referrals in primary care. Therefore, there could have been subsequent changes in preventive care delivery that were not detected in this study.

2.5.4 Conclusions

The COVID-19 pandemic was associated with a marked reduction in preventive healthcare interventions. By 30th June 2022, preventive care delivery, including advice and support for smoking, and advice for weight, excess alcohol, and physical inactivity, has not returned to pre-pandemic levels in English primary care. Whilst this chapter demonstrates that preventive care delivery had not returned to pre-pandemic levels by June 2022, it does not disentangle the mechanisms underlying this reduction. It remains uncertain whether the observed decline was primarily driven by the pandemic itself, by the rapid transition to remote consulting, or by an interaction between the two.

3 How does remote consultation shape how prevention is approached in primary care consultations?

3.1 Summary

Evidence suggests that brief interventions (advice and referral for further support) are effective for smoking cessation, weight management, reducing alcohol use and improving physical activity, yet they are not routinely delivered in primary care, and the adoption of remote consulting could be making this worse. The NHS Long Term Plan emphasised a shift from treatment to prevention, but the influence of remote consultations on brief intervention implementation remains unclear. The previous chapter showed a reduction in interventions for smoking, weight management, alcohol excess and physical activity associated with the start of the pandemic, but this analysis could not separate the pandemic effect from the rise of remote consultations. There is reason to believe that remote consultations could reduce the delivery of these types of interventions as they have been shown to be more transactional and more often single issue consultations. This study aims to understand whether and why consultation mode impacts the delivery of brief interventions in primary care.

A mixed methods approach was used. Routine general practice consultations were audio recorded and analysed with a data-informed coding system to quantify preventive content. Segments were defined as the start of preventive talk, initiated by either party, until the end of preventive talk. Number of segments, length of segments and type of segment (patient volunteered; response (meets guidance); response (does not meet guidance); advice; or support/ referral was captured and categorised into health behaviour discussed (smoking,

excess weight, alcohol, physical activity and multiple behaviours). Semi-structured interviews with the same GPs were conducted remotely and analysed thematically using an inductive approach. Data captured from the two sources was triangulated to gain a deeper understanding of the implementation of prevention in real-world English primary care.

Sixty-six consultations were recorded and 12 GPs were interviewed from three GP practices across England. Sixty-two per cent (95% CI; 49-74%) of consultations contained at least one preventive segment, with comparable proportions in face-to-face (60%; 95%CI 42-76%) and telephone (65%; 95% CI 45-81%) consultations. Weight related segments were most frequent (n=45 segments), followed by alcohol (n=22), smoking (n=20) and physical activity (n=22). GPs more often gave advice (24% of segments) than referral (7% of segments) across all health behaviours and consultations modes. Interview analysis generated five themes: Assessing receptivity through visual and relation cues supports preventive care discussions; discussing stigmatised behaviours remotely involves managing changes in the interpersonal dynamic; technology mediated pathways shape variation in preventive care; professional and system level factors influence preventive care delivery across all consultation modes; and prevention occurs within collaborative, longitudinal care developed over multiple consultations.

Overall, the quantitative and qualitative findings provide complementary insights into how preventive care is enacted in routine GP consultation. The quantitative findings suggest that, while preventive care discussions occur relatively frequently in both face-to-face and remote consultations in this sample of GPs and practices, they are often limited in depth. The interviews highlight the nuanced interpersonal and systemic factors that shape when and how these conversations occur. GPs' accounts help to contextualise the observed patterns, demonstrating that decisions to initiate or pursue preventive care are shaped by multiple, interrelated factors operating at the patient, healthcare professional and system level.

In conclusion, although policy encourages an increased focus on prevention, delivery remains challenging and dependent on professional, social, technical and organisational context. Simplifying referral pathways to reduce referral friction; improving training for remote consultations; re-examining the use of text messaging to promote behaviour change and addressing the potential inequities that digital delivery may introduce, may support more consistent and equitable preventive practice in primary care.

3.2 Introduction

In the previous chapter, I explored the effect of the pandemic on the delivery of preventive care (action on smoking, weight management, alcohol use and physical inactivity) in UK primary care, and found that the pandemic did reduce the frequency of preventive care, and that it was already at a level below what would be expected given the prevalence of these behavioural risk factors in the population.[170] Other studies support this conclusion and suggest that clinicians give evidence-based brief interventions far less commonly than guidelines recommend.[55 142 143 169] Optimising the implementation of these evidence-based interventions is an NHS priority; two of the three key 2025 NHS 10 year health plan aims were to move care from treatment to prevention and from hospital to community.[171]

In addition to the implementation gap, the way GPs are consulting has changed and this may be exacerbating the challenge. During the COVID-19 pandemic, 47% of consultations with GPs were via telephone, and 3% online (email and video).[172] The Royal College of General Practitioners (RCGP) called for research to investigate how consultation modality affects care.[82] As discussed in Chapter 1, a 2019 UK study of primary care consultations reported that behavioural advice was less frequent during a telephone consultation (24%) or video consultation (14%) than a face-to-face consultation (44%).[87] Studies have reported that telephone consultations are more transactional, involve less discussion of other reasons for seeking healthcare, and elicit less psychosocial context.[87-89] (See Chapter 1 for a more detailed discussion of the remote consulting literature).

Discussing patient health behaviours and delivering Interventions in primary care consultations have been well explored in the literature.[173] Conversation analysis studies from the UK and US have found that when doctors link the health behaviour to a specific health problem there was less conversational disruption.[174 175] Furthermore, when doctors framed advice as a treatment option for a specific medical problem, it was more likely to be verbally accepted by patients than advice alone, as this is interactionally rooted in a doctor's authority to treat illness.[176] However, a recent systematic review highlighted initiating conversations by linking a person's health concern with their health behaviour can increase advice resistance.[177 178] There is a moral component to these discussions too. A Danish study found that to avoid potential moral judgement from doctors for their health behaviours, patients would give anticipatory correct answers. GPs typically responded to this by adding support for their current habits.[179] Another study highlighted how another strategy that patients use to avoid moral judgements would be to offer obstacles for behaviour change, for example, work commitments, so as to morally position them as willing to make behaviour change but practically unable to do so at the present time.[180] The authors highlighted that this could also be used as an opportunity for health care professionals to personalise advice and offers of further support by addressing the specific concerns of their patients.

Studies have highlighted that sensitivity around this topic can be in part understood because of the asymmetry of knowledge; advice givers position themselves as more knowledgeable than the advice recipient, despite the patient having first-hand knowledge of their health behaviours and social context.[181] Another aspect that has been identified to contribute to the sensitivity of these topics is whether the advice was supplementary to the purpose of the consultation advice to an unprepared recipient.[176] Strategies identified in the literature to overcome these sensitivities include capitalising on patient-initiated discussions and collaborating with the patient through question and answer sequences.[177] These insights are useful to understand the challenges associated with lifestyle and preventive care talk in traditional face-to-face consultations; however, none of these studies explored whether or how consultation mode e.g., remote (typically telephone) consultations affected these conversational dynamics.

This study addressed the research question: how does remote consultation shape the delivery of preventive care in primary care? The study focussed on routine primary care clinics across England. The study aimed to examine both the occurrence of brief preventive interventions for smoking, weight management, excess alcohol and physical activity and GPs' perceptions, attitudes, and experiences of delivering these interventions across consultation modes. Specifically, the aim was to quantify the frequency, duration, and type of brief interventions delivered for key behavioural risk factors in remote compared with face-to-face consultations, and to explore how GPs experienced and approached prevention across these settings. These strands were developed iteratively, with emerging findings from each informing and refining the other, to generate a richer understanding of how consultation mode shapes preventive care delivery.

3.3 Methods

3.3.1 Overview of study design

This is a mixed methods study involving the recording of routine primary care consultations and subsequent interviews with GPs. Twelve GPs from three recruited general practices consented to record routine clinic appointments, with between 10 – 28 patients at each participating practice in the 12 month period between January 2025 – December 2025. Initially, I listened to the recordings, to familiarise myself with the consultation and to identify parts of the consultation where prevention was discussed to inform some of the question prompts for the subsequent GP interview (see Appendix 2 for full interview guide and where information from the recorded consultations was integrated into the GP interviews). After I listened to these recordings, I conducted a virtual interview with each participating GP over Microsoft Teams. Once all the consultations were recorded and interviews complete, I then analysed the data. The recorded consultations were analysed using a data informed coding system and the interviews were analysed using thematic analysis. Coding of the recorded consultations was conducted iteratively alongside thematic analysis, allowing each process to inform and refine the other.

3.3.2 Methodology

Ontology and epistemology are two interconnected concepts that address the nature of reality and the nature of knowledge (how we come to know and understand that reality).[182] This mixed methods study was underpinned by a pragmatic ontological position, which recognises that both objective and subjective realities can be useful in understanding complex social interactions (the clinical consultation).[183] A mixed methods approach allowed me to develop a rich and nuanced understanding of prevention in real-world clinical practice. [184]

This is particularly relevant in the case of discussions around health behaviours, as recent research has highlighted the complexity of clinical coding of GP consultations in relation to lifestyle or preventive care talk. Challenges found included definition of codes, interactional barriers and clinical and systemic barriers to these discussions.[185] The authors of a recent study concluded that research in this area required methodological flexibility to understand the full scope of communication complexities in this area and avoid reductionism. They suggested more contextually situated multi-method study designs that manage the complexity of healthcare communication along with the inherent variability of general practice would have the potential to generate evidence transferable to real-world practice.[185] This supports the use of a mixed methods approach for this research question, so quantitative and qualitative data can be integrated to capture both measurable patterns and the nuanced, context dependent aspects of clinical communication in real world general practice.

Previous studies have also highlighted missed opportunities of preventive interventions.[186] [187] However these approaches have been criticised for not considering the longitudinal aspect of care and social and societal contexts in the community and therefore overestimating missingness.[185] This mixed method approach addresses these concerns by using quantitative and qualitative methods that mutually inform one another. GP interviews, incorporating the playback of consultation recordings, enable exploration of both data inclusion and apparent missingness within the quantitative dataset. This allows for consideration of factors not readily captured through quantitative coding alone, such as availability of referral pathways, patient social circumstances, system level constraints, and technological limitations, thereby providing essential contextual depth. Conversely, the quantitative data offers concrete prompts and real-world clinical scenarios to structure and enrich the interviews. Taken together, this integrative approach facilitates a more comprehensive understanding of preventive care than either method could achieve in isolation.

3.3.3 Data Collection

3.3.3.1 Sample size considerations

I expected that not all consultations would contain preventive care. A recent UK study of primary care consultations reported that behavioural advice was less frequent during a telephone consultation (24%) or video consultation (14%) than a face-to-face consultation (44%).[87] To detect an absolute difference of 20 percentage points in preventive care delivery between face-to-face preventive care delivery (44%) and telephone preventive care delivery (24%) a two-sided comparison of proportions (α= 0.05) requires approximately 87 consultations per group for 80% power. Therefore, I initially aimed to record up to 180 GP consultations (90 face-to-face; 90 telephone). As the study progressed, it became clear that a higher proportion of consultations contained prevention than anticipated and so the target sample size was adjusted down accordingly to 66 recorded consultations. From experience with similar research projects, I expected 12 GPs to be sufficient for data saturation in the interview component of the study. At this point I expected the themes to be rich, with no new information coming to light. [188]

3.3.3.2 Sampling and recruitment strategy

I worked with three geographically diverse Clinical Research Networks (CRNs) in the Northwest, West Midlands and Southeast to recruit three general practices each with demographically varied patient populations. The Southeast site served an urban population, including patients from both affluent and deprived areas. The West Midlands site had a more ethnically diverse patient population, while the Northwest practice served a community from a more deprived suburban area. The patients at each practice were then sampled by convenience i.e., by being booked into a clinical session with a participating GP.[189] This enabled me to explore the delivery of preventive care in different primary care settings, whilst reducing the administrative burden on the participating busy GP practices. The flow diagram in Appendix 3 illustrates the activities associated with the study.

I contacted interested GPs at participating practices via email, informing them that the study focused prevention across different consultation modes (without detailing specifically what I meant by prevention). The approved content of this email is in Appendix 4. Patients were recruited via the practice appointment booking system. A member of staff at the practice screened the session lists to ensure that booked patients met the inclusion criteria. If eligible, research staff at the practice contacted patients to invite them to take part by sending the patient an Accurx text message with the participant information leaflet attached. The content of this text message is detailed in Appendix 4. The promotional poster that was displayed in practices is shown in Appendix 5.

Participants were eligible for inclusion if they met the following criteria: GPs participating in recorded consultations and interviews were required to be adults (≥18 years), willing and able to provide informed consent, and currently working in general practice in England as a partner, salaried, or locum GP, with at least one year of post-qualification experience. Patient participants involved in recorded consultations were also required to be adults (≥18 years) and willing and able to provide informed consent. Patients were excluded if they were unable to understand or communicate in English, were receiving palliative care (where discussions of prevention may be inappropriate), or if the patient or any accompanying individual present during the consultation was under 18 years of age.

3.3.3.3 Recorded consultations

Recorded consultations were used as the data collection method for the quantitative component of this mixed-methods study. This approach enabled the systematic analysis of GP patient communication using a structured data informed coding framework. Audio recordings provided a reliable and replicable means of capturing the real time content and structure of clinical interactions as they occurred in routine practice, minimising recall bias and observer effects. This method allowed for the quantification of talk relevant to the research question, such as the delivery of advice or referral for behavioural risk factors. This real time data capture complements and informs the subsequent GP interview, which facilitated reflection on the content of the consultation.

Consultations were recorded by GPs either via telephone or face-to-face during routine clinical sessions. Prior to each consultation, the healthcare professional verbally confirmed that the patient and any accompanying adult still consented to the consultation being audio recorded. An external audio recorder was used for the recordings. If any children were present, the recording did not proceed. For telephone consultations, the call was placed on speaker mode to enable recording. After each session, the recordings were downloaded from the device and transferred securely to the University of Oxford OneDrive. The original files were then deleted from the recording device once I had received them and confirmed this with the research site.

3.3.3.4 Semi-structured interviews

Semi-structured interviews were used as the primary data collection method for the qualitative component of this study.[190] This approach was selected to allow for an in-depth exploration of GPs' experiences, perspectives, and interpretations in relation to the research questions. Semi-structured interviews provided a flexible yet focused framework, enabling me to probe key topics while allowing participants the space to introduce issues of personal relevance. This method was particularly well-suited to understanding the contextual and relational aspects of clinical communication, which may not be fully accessible through observation or quantitative coding alone. The use of interviews also supported the interpretivist epistemological stance underpinning the qualitative strand of this mixed-methods study, recognising the co-construction of meaning between researcher and participant. Interviews were audio-recorded with consent and transcribed via Microsoft Teams transcription function. Any inaccuracies in the Microsoft Teams transcription were checked and corrected with the audio recording to ensure accuracy in the subsequent thematic analysis.

I conducted individual semi-structured interviews with GPs via the university approved videoconferencing platform, Microsoft Teams. Each interview lasted approximately 30 minutes. Before each interview, I explained the purpose of the interview again, confirmed that the participant still consented to the audio recording, and provided an opportunity for any further questions. I used a topic guide (Appendix 2) to support the interviews, but participants were encouraged to discuss their perceptions and experiences freely and in depth. The questions on the topic guide were used as prompts and were iteratively developed over the course of the interviews.

I conducted the interviews from a private, secure environment to ensure participant confidentiality. Audio recordings and transcriptions were securely stored on the University of Oxford OneDrive and accessible only to members of the research team. The original recordings were deleted from the audio recorder once they had been successfully uploaded.

3.3.4 Data Analysis

3.3.4.1 Developing the coding framework

During the protocol stage of this study, I planned to use the Roter Interactional Analysis System (RIAS) to analyse the recorded consultations.[191] I initially chose this method RIAS is an established approach for understanding how technology (e.g., remote consultation) shapes communication. This method has been used successfully for coding medical dialogue in a variety of clinical settings, including studies investigating consultation modality.[192-194] RIAS is derived from social theories relating to problem solving, reciprocity and interpersonal influence.[195 196] Both the healthcare professional and the patient are treated as experts in the consultation.

This method allows researchers to systematically analyse interactional patterns between patient and provider by coding different types of talk in a consultation:[191] However, as the study progressed, I realised that there were significant limitations and challenges to using

RIAS within the context of this study. Firstly, the primary outcomes of my study did not rely on RIAS being applied to every utterance in the consultation (including those parts of the consultation that are unrelated to prevention). However, there is no flexibility with the RIAS method to only analyse part of the consultation. I questioned whether coding every utterance in the consultation, regardless of whether it was related to prevention, was a good use of research time. Therefore, I searched the literature to understand other strategies that had been used and found a flexible and pragmatic literature that had used descriptive statistics of recorded consultations, often triangulated with qualitative methods such as interviews or focus groups.

One study analysed the content and structure of lifestyle focused calls by counting number of utterances and then calculating topic ratio (topic utterance count/ total utterance count in consultation) in the context of telehealth conversations in patients with Heart Failure. An utterance was defined as a meaningful unit of speech delimited by clear pauses. They identified consultations with "heightened" lifestyle management content and then looked at the content and structure of these calls, and the association of lifestyle focussed calls with frequency and length of hospital admissions[197]

Another study used qualitative thematic analysis of transcribed scripts of video recorded primary care consultations alongside an Observation Tool (recommended in the USA Agency for Healthcare Research and Quality's Health Literacy Universal Precautions Toolkit),[198] where the researchers quantitatively evaluated physicians' attempts to be understood. This tool has not been validated, but the author's explained that no validated health literacy assessment tool existed at the time of writing. The authors described that a limitation to the study was the lack of standardised approached to mixed methods research.[199]

Another study developed their own coding scheme for categorising speech in the context of consultations that required an interpreter and those that did not in diabetes care. They conducted a quantitative analysis of the number of words coded under each coding theme in the interpreted vs English consultations.[200] They developed their coding scheme iteratively, comparing codes, discussing any discrepancies until an acceptable Cohen's kappa statistic (0.84) was reached. Codes were applied to whole paragraphs only, with each paragraph representing a speaking turn.

A further study in English primary care using recorded consultation data applied the Global Consultation Rating scale, an observer-assessed instrument to measure the effectiveness of communication across a doctor-patient consultation in the context of physical activity discussions in primary care.[201 202] Each of the 12 domains (e.g., problem identification, problem exploration) is scored from 0-2 where 0= not done or poor, 1= adequate and 2=good. The authors then iteratively developed their own coding strategy to identify whether the physical activity advice offered was relevant to existing clinical guidance, and where it was given the depth of discussion around physical activity. The discussion was categorised as meaningful if at least one of: importance of physical activity to the presenting complaint; tailored advice; onward referral or specific advice on how to improve physical activity, was discussed.[187]

I therefore developed an iterative data informed coding system that was tailored to my dataset and research question. This was a data-informed approach that is similar to the pragmatic coding systems described above. Specifically, RIAS provided an initial conceptual foundation, demonstrating that lifestyle related communication within clinical consultations can be systematically identified and categorised through distinctions such as open questions, closed questions, and advice-giving. Other studies extended this basic categorisation to include lifestyle talk relevance and alignment with clinical guidelines. Therefore, in this study I built upon this conceptual foundation and created a coding system that moved beyond basic coding and captured the detail of lifestyle talk that was relevant to my research question. In the absence of an existing validated tool tailored to the specific research question, my approach was also informed by prior studies that have developed bespoke coding frameworks. These established reliability through iterative double coding and the achievement of acceptable inter-rater agreement (e.g. kappa statistics). Consistent with more pragmatic approaches described in the literature, the unit of analysis was not restricted to individual utterances. Instead, coding was conducted at the level of 'segments', defined as episodes of preventive talk initiated by either participant and continuing until the topic shifted. This approach was selected to preserve the coherence and contextual integrity of preventive discussions, which often unfold across multiple conversational turns and would be fragmented if analysed at the level of isolated utterances, thereby enabling a more meaningful analysis. A procedural flow diagram for the coding development process can be found in Appendix 6.

3.3.4.2 Recorded consultations

Using the above methodological justification and real world clinical guidelines in terms of the importance of not only advice but also offer of further support or referral, I developed the below coding system to quantify different types of preventive talk in the recorded consultations.

Table 3.1 Codes used to analyse the recorded consultation data

Category	Description	Example	Relevance to outcomes
Prevention categorisation	I categorised each consultation into binary categories: 1. Prevention mentioned (yes/no) – was there any preventive talk about the four health behaviours of interest (smoking, obesity, alcohol, physical activity) 2. Was prevention relevant to the consultation (yes/no). This was a clinical judgement. Was there a clinical rationale for these topics to be discussed in this consultation? This meant that consultations could contain non-opportunistic preventive interventions (if related to presenting complaint) or opportunistic preventive interventions (if a health behaviour not related to presenting complaint was mentioned).	*1. Prevention mentioned.* A consultation that asked a patient whether they smoked, or a consultation where a weight management referral was discussed would both be categorised as 'yes', prevention mentioned. *2. Prevention relevant*. A consultation about knee pain in a patient with obesity, it is clinically relevant to discuss weight management. This was categorised as 'yes', prevention is relevant to this consultation. In contrast, in a straightforward consultation about a vasectomy request, discussing health behaviours is less clinically relevant. This was categorised as 'no' prevention is not indicated in this consultation.	These categories informed the consultation denominator so I could calculate the proportion of consultations that contained preventive care out of the total number of consultations where prevention was relevant. Only consultations with preventive talk were included in the subsequent analysis of segment coding.

Brief Intervention (BI) segment component 1. Patient volunteered 2. Response (meets guidance) 3. Response (does not meet guidance) 4. Advice 5. Support/ referral	Each of these codes represents a stage on a continuum of BI delivery. Each segment of preventive talk was assigned one of these categories. 1. *Patient volunteered*. in these instances, there was no contribution from the GP, the patient gave some information about their health behaviours in the consultation that was not responded to during the consultation. 2. *Response (meets guidance).* In these instances, the GP asked a question related to health behaviours and the patient responded with information that their health behaviour already met clinical guidance. This typically ended the conversation. 3. *Response (does not meet guidance).* Here, the GP asks a question related to health behaviours and the patient responded that their existing health behaviour does not meet clinical guidance. However, despite not meeting clinical guidance, the discussion ended at this point. *4.* *Advice.* The GP gives advice about a health behaviour. This may be in response to a question posed to the patient or given independently. The	1. Patient volunteered (Cons 54) *Patient: "I've lost a stone of weight in 4 weeks, I'm eating fine"* 2. Response (meets guidance) (Cons 60): *GP: "Do you smoke at all?"* *Patient "No"* *GP "Good."* 3. Response (does not meet guidance) (Cons 55) *GP: "Do you try and eat healthily?" ….* *Patient: "I know I am eating more than I should at the moment, because I am sort of eating through my feelings, but it's just the energy, I want my life back" …* *GP: "Can I check your back?"* 4. Advice (Cons 22): GP: *"So I think if you are able to bring it down* (alcohol) *it is likely to be of benefit for a lot of reasons"* 5. Support/ Referral (Cons 17): GP: *"In terms of the*	This addresses outcome 1b and 1c: 1. Descriptive statistics for brief interventions for the four main behavioural risk factors overall and individually in remote vs face-to-face consultations: a. Length of talk **b. Total number of occurrences** **c. Type of prevention/ brief intervention delivered e.g., question, advice or support/ referral**

	quality of advice was not rated on quality, rather the presence of advice was coded in the data. 5. *Support/ referral*. The GP responds to information about health behaviours in consultation with signposting or referral to further support. This was the most developed and sophisticated form of preventive intervention.	*help that's available in terms of weight loss on the NHS, there are some services available on the NHS, I don't know whether that's anything of interest at all… there's a 12 week programme where you can have access to a health coach who goes into a bit more detail about the sorts of things you are eating…further advice about how to lose weight… online things that can be a bit more flexible with your working hours… I can refer you if you would like"*	

Length of segment	I timed from when the segment of preventive talk started to when it finished. This was one distinct segment of prevention and was used to calculate the median and interquartile range of length of segments.	*Time: 00:02:00* GP: “Do you smoke?” Patient: “No”. *Time: 00:02:03* Segment coded as: smoking, response meets guidance and *00:00:03 duration*	This addresses outcome 1a: 1. Descriptive statistics for brief interventions for the four main behavioural risk factors overall and individually in remote vs face-to-face consultations: **a. Length of talk** b. Total number of occurrences c. Type of prevention/ brief intervention delivered e.g., question, advice or support/ referral

Additional quantitative data captured included total length of time of consultation, presenting complaint and the consultation mode (face-to-face or remote).

3.3.4.2.1 Inter-rater reliability

To ensure the coding system was valid and reliable, two further researchers used the coding system to independently code 10% of the recorded consultations each so a total of 20% of the consultations were coded twice. Ten percent is the typical percentage of recordings that are double coded using the RIAS method and so twenty percent was chosen as a robust assessment of inter-rater reliability.[191] An intraclass correlation coefficient (ICC) was used to compare the number of preventive segments identified between the two coders. With the matching segments, a quadratic weighted kappa was used to understand the agreement in type of brief intervention component between the coders.[203] A weighted kappa was used because the categories of brief intervention had a defined hierarchical order and this measure gives more weight to larger discrepancies.[204] An ICC was used where the segments matched, to compare the length of segment between the coders in seconds.

3.3.4.2.2 Descriptive statistics

With the quantitative data I captured from the 66 recorded consultations I then calculated the number and percentage of consultations that were:

1. Face-to-face and remote
2. Contained prevention, both overall and where prevention was relevant
3. Number of distinct segments of health behaviour talk both overall, by consultation modality, and for each health behaviour

The number of times that there was discussion of each brief intervention component:

1. Overall, by consultation mode, and for each health behaviour

The median, upper and lower quartiles for:

1. The length of consultation (overall and by consultation modality)
2. The length of talk for each health behaviour overall and by consultation mode
3. The length of talk for each brief intervention component overall, by consultation mode and for each health behaviour

Where appropriate, 95% confidence intervals were calculated to provide an indication of the precision of estimates derived from the coded data.

3.3.4.3 Interviews

The subsequent interviews were conducted to interpret the analysis of the recorded consultations within the context of the GP's experiences and practices. For example, the GP's perspective on how the technology affected how, when, and why prevention was (or was not) discussed. The interviews were done after the recorded consultations so I could play back recorded consultations to the GPs as prompts in the interview. The semi-structured interview guide was designed to be flexible so that if a theme was identified in the recorded consultation, this could be addressed during the interview.[205] I analysed the interviews using Braun and Clarke's reflexive thematic analysis, to identify and understand GP experiences.[206] This method complemented and informed the quantitative findings by providing contextual and interpretive insights into patterns observed in the coded consultation data.

Initially, I used open coding, where I iteratively coded an interview based on my interpretations of the discussion. To ensure credibility, another independent academic GP open-coded two interviews, and we compared our codes to minimise reflexive or biased interpretation. After discussing the results, we resolved any inconsistencies and met again to reflect on the development of the coding framework and held theme development sessions to share different perspectives on theme development.[207] I also worked on theme development with members of my supervisory team, who offered unique perspectives from different academic and public policy backgrounds. This was an iterative process aimed at capturing the richness of the data in a thoughtful and creative way, and it allowed me to engage deeply with the dataset over time.

I used an iterative approach to coding, moving back and forth between conceptual, contextual, and inductive codes to develop broader categories and, ultimately, themes. Throughout I followed Lincoln and Guba's approach to quality and rigour.[208]

3.3.4.4 Data triangulation

Triangulation is the process of 'using more than one method to gain a more complete picture',[209] and underpinned this mixed methods design, whereby both data collection and analytical approaches were integrated to inform and complement one another. This enabled me to explore the research questions from different methodological angles, strengthening the richness of the findings. The consultation data provided insight into what objectively happened in consultation, while the interviews offered contextual understanding and reflections from GPs on their behaviours, decisions, and constraints. By integrating these two data sources, I was able to identify themes and develop a more comprehensive understanding of how preventive care is delivered and perceived in primary care. This approach also allowed me to cross-check findings and to generate richer, more nuanced interpretations than would have been possible using a single method alone.

3.3.5 Patient and public involvement

My PPI contributor contributed to the documents for ethical approval, including the lay summary, the participant consent forms and the participant information sheets. Her insights also helped shape the recruitment strategy, including the selection of study sites to capture a diverse range of patient populations.

3.3.6 Ethics and governance

Written versions of the participant information leaflet were given to all participants. The patients received these via text message and the GPs via NHS email. These documents explained the nature of the study, what participation involved, the implications and constraints of the protocol, and any known side effects or risks (none were anticipated). I made it clear that they were free to withdraw from the study at any time.

I obtained written electronic consent from GPs when they were invited to participate in the study. After reviewing the participant information, GPs completed the electronic consent form, which was stored securely on the protected University of Oxford server. The GP also received an email copy of their consent form.

Verbal consent was obtained from patients for the audio-recorded sessions by the practice research team over the telephone, and this was recorded using an electronic consent form created in Microsoft Forms. A copy of the completed form was texted to the patient using the secure Accurx primary care messaging system, and the practice securely sent a copy of the form to the research team via NHS email. In the small number of cases where a patient was non-digital, paper copies of the same consent form were used. These were handled in the same way in terms of a copy being provided to the patients and a scanned copy added to their medical records. All research staff received training on how to take patient consent during the site initiation visit to ensure the study protocol was followed.

If a patient brought a companion to their appointment, the companion received a printed copy of the companion participant information sheet. Written informed consent was then obtained from the companion by the practice research staff. All research staff taking informed consent were Good Clinical Practice (GCP) trained.

This study was approved by HRA and Health and Care Research Wales on 23rd January 2024. (IRAS protocol ID: 327578; REC reference: 23/PR/1533).

3.4 Results

3.4.1 Sample Characteristics

Baseline demographics of the patients was broadly representative of the English population in terms of ethnicity, and in line with established consulting patterns in primary care with more women (70%) than men (30%) in the study and the average age of participants was above the population average at 61 [IQR 44-70 years]. The GPs were slightly more likely to be men (66%) than women (33%), had an average of 13 years [IQR 5-10 years] since they completed training and were White (66%) or Asian or Asian British (33%). A participant demographic summary is given in Table 3.2.

Table 3.2 Baseline data for patients and GPs

		n (%) or median [IQR]
Patients		66 (100)
	Sex	
	Male	20 (30)
	Female	46 (70)
	Age	61 [44-70]
	Ethnicity	
	White	50 (76)
	Asian or Asian British	6 (9)
	Black or Black British	2 (3)
	Unknown	8 (12)
	Region	
	Southeast	28 (42)
	West Midlands	29 (44)
	Northwest	9 (14)
GPs		12(100)
	Sex	
	Male	8(66)
	Female	4(33)
	Age	44 [37-58]
	Ethnicity	
	White	8 (66)
	Asian or Asian British	4 (33)
	Years since CCT	13 [5-30]
	Region	
	Southeast	5(42)
	West Midlands	4 (33)
	Northwest	3 (25)

3.4.2 Quantitative data

Data was collected from 66 audio recorded consultations and analysed with the data-informed coding framework described in the methods section.

3.4.2.1 Inter-rater reliability score

Twenty-nine segments across fourteen consultations were double coded. Overall, 29/ 34 (85%) of the segments were captured by both coders. Of the 29 segments that matched, the inter-rater reliability scores for brief intervention component and length of segment were calculated (Table 3.3). A kappa score of above 0.8 is categorised as substantial agreement and an intraclasss correlation coefficient (ICC) of above 0.9 as excellent agreement.[210 211]

Table 3.3 Inter-rater reliability scores for coding of recorded consultations

Code	**Variables**	**ICC or weighted kappa [95% CI]**
Number of segments	Numerical	ICC = 0.92 [0.75 – 0.97]
Brief intervention component	Hierarchical: Patient volunteered; Response (meets guidance); Response (does not meet guidance); Advice; Referral or further support	Weighted kappa = 0.93 [0.82-1.00]
Length of segment	Time (seconds)	ICC = 0.96 [0.91-0.98]

3.4.2.2 Overall consultation data

There was an approximate even split of face-to-face (53%) and telephone (47%) consultations discussing a range of primary care presentations from diverse body systems, reflecting the reality of general practice. Face-to-face consultations (median, 12:30 [IQR 10:22 -16:06]) were slightly longer than telephone consultations (11:25 [08:35-15:29]) but prevention was discussed in approximately similar proportions of consultations (60% and 65% of consultations respectively). Table 3.4 shows the overall consultation data.

Table 3.4 Overall consultation data

		n(%)* or median (IQR)
Consultation mode		
	Overall	66 (100)
	Face-to-face	35 (53)
	Telephone	31 (47)
Consultation length		
	Overall	12:11 [09:14-15:42]
	Face-to-face	12:30 [10:22-16:06]
	Telephone	11:25 [08:35- 15:29
Presenting complaint system		
	Musculoskeletal	16 (24)
	Women's health	5 (8)
	Urinary	5 (8)
	Dermatology	5 (8)
	Abdominal	4 (6)
	Neurology	3 (5)
	Ear, nose and throat	3 (5)
	Mental Health	2 (3)
	Respiratory	2 (3)
	Social issue	2 (3)
	Non-specific symptoms	5 (8)
	Test results	14 (21)

**Percentages may not total 100 due to rounding*

3.4.2.3 Preventive segments in consultation

Overall, a similar proportion of face-to-face (60%; 95%CI 42-76%) and telephone (65%; 95% CI 45-81%) consultations contained any preventive care. However, the pattern was more nuanced when looking at each individual health behaviours. Weight, for example was slightly more likely to be discussed face-to-face (58%; 95% CI 42-72%) versus the telephone (42%; 95% CI 28-58%) as was smoking (55% face-to-face; 95% CI 32-77%) and physical activity (55% face-to-face ; 95% CI 32-76), whereas alcohol was more likely to be discussed via the telephone (63%; 95% CI 41-83%) than face-to-face (36%; 95% CI 17-59%). Confidence intervals were wide across estimates indicating limited precision.

Table 3.5 Quantifying prevention and preventive segments present in consultation

	Consultation mode	n/ N	% (95% CI)
Consultations containing preventive care			
	Face-to-face	21/35	60 (42-76)
	Telephone	20/31	65 (45-81)
	Overall	41/66	62 (49-74)
Preventive segments in consultation			
Overall	Face-to-face	59/117	50 (41-60)
	Telephone	58/117	50 (40-59)
Smoking	Face-to-face	11/20	55 (32-77)
	Telephone	9/20	45 (23-68)
Weight management	Face-to-face	26/45	58 (42-72)
	Telephone	19/45	42 (28-58)
Alcohol	Face-to-face	8 /22	36 (17-59)
	Telephone	14/22	63 (41-83)
Physical activity	Face-to-face	12/22	55 (32-76)
	Telephone	10/22	45 (24-68)
Combined prevention	Face-to-face	2/8	25 (3-65)
	Telephone	6/8	75 (35-97)

In terms of the type of segment, there were small numbers of referrals or offers of further support for all health behaviours (7% of preventive segments were for referrals or offers of further support, and this did not differ based on consultation mode). More commonly than an offer of referral or further support, the patient volunteered the information themselves (23% overall), the patient responded to a question from the GP saying they met a recommendation e.g., they were a non-smoker (36% overall), or the GP gave advice (24% overall). Again, results were similar between face-to-face and telephone consultations.

Weight management had a higher proportion of consultations where a patient response did not meet guidance (20%) than for other health behaviours.

Table 3.6 Type of segment overall, by health behaviour and by consultation mode

		Type of segment					
		Patient volunteered n(%)	**Response (meets guidance) n(%)**	**Response (does not meet guidance) n(%)**	**Advice n(%)**	**Referral/ Further support n(%)**	**Total (n)**
Total							
	Overall	27 (23)	42 (36)	12 (10)	28 (24)	8 (7)	117
	Face-to-face	16 (27)	18 (31)	10 (17)	11 (19)	4 (7)	59
	Telephone	11 (19)	24 (41)	2 (3)	17 (29)	4 (7)	58
Smoking							
	Overall	1 (5)	16 (80)	1 (5)	1 (5)	1 (5)	20
	Face-to-face	0 (0)	8 (73)	1 (9)	1 (9)	1 (9)	11
	Telephone	1 (11)	8 (89)	0 (0)	0 (0)	0 (0)	9
Weight							
	Overall	11 (24)	7 (16)	9 (20)	14 (31)	4 (9)	45
	Face-to-face	6 (23)	4 (15)	8 (31)	7 (27)	1 (4)	26
	Telephone	5 (26)	3 (16)	1 (5)	7 (37)	3 (16)	19
Alcohol							
	Overall	1(5)	12 (55)	2 (9)	4 (18)	3 (14)	22
	Face-to-face	0 (0)	4 (50)	1 (13)	1 (13)	2 (25)	8
	Telephone	1 (7)	8 (57)	1 (7)	3 (21)	1 (7)	14
Physical activity							

	Overall	12 (55)	5 (23)	0 (0)	5 (23)	0 (0)	22
	Face-to-face	9 (75)	2 (17)	0 (0)	1 (8)	0 (0)	12
	Telephone	3(30)	3 (30)	0 (0)	4 (40)	0 (0)	10
Combined prevention							
	Overall	2 (25)	2 (25)	0 (0)	4 (50)	0 (0)	8
	Face-to-face	1 (50)	0 (0)	0 (0)	1 (50)	0 (0)	2
	Telephone	1 (17)	2 (33)	0 (0)	3 (50)	0 (0)	6

3.4.2.4 Preventive segment length

The length of preventive talk segment did not appear to differ between face-to-face (median 00:20 [IQR, 00:08-00:44]) and telephone (00:17 [00:08-00:44]) consultations. Length of segment was shortest for smoking, where most people confirmed that they did not smoke, (00:05, [00:04-00:13]) and longest for weight management (00:30, [00:10, 01:00]). Length of segment was similar across face-to-face and telephone consultations for all health behaviours.

The longest type of preventive segment was for referral or further support (01:45 [00:45–03:02]), which was longer than advice alone, (00:36 [00:13–01:35]), response which does not meet guidance, (00:49 [00:29–01:11]), response which does meet guidance, (00:10 [00:05–00:20]), and patient volunteering the information, (00:10 [00:05–00:21]). Referral or further support segments often included advice. Where there was sufficient data to compare face-to-face and telephone consultation segment length, they appeared similar.

Table 3.7 Length of segment by health behaviour and consultation mode

		Length of segment (mm:ss)		
		Median	**Lower quartile**	**Upper Quartile**
Total				
	Overall	00:20	00:08	00:44
	Face-to-face	00:17	00:07	00:44
	Telephone	00:17	00:08	00:44
Smoking				
	Overall	00:05	00:04	00:13
	Face-to-face	00:06	00:04	00:21
	Telephone	00:05	00:04	00:12
Weight				
	Overall	00:30	00:10	01:00
	Face-to-face	00:28	00:11	00:55
	Telephone	00:30	00:10	01:20
Alcohol				
	Overall	00:15	00:07	00:47
	Face-to-face	00:15	00:09	00:36
	Telephone	00:16	00:10	01:29
Physical activity				
	Overall	00:23	00:09	00:31
	Face-to-face	00:14	00:08	00:20
	Telephone	00:27	00:11	00:38
Combined 'lifestyle'*				
	Overall	00:37	00:10	00:58

*Insufficient data to provide a breakdown into consultation modes.

Table 3.8 Length of segment by type of preventive talk and consultation mode

	Type of preventive talk, median [IQR], s				
	Patient volunteered	**Response (meets guidance)**	**Response (does not meet guidance)**	**Advice**	**Referral/ Further support**
Overall	10 [5–21]	10 [5–20]	49 [29–71]	36 [13–95]	105 [42–182]
Face-to-face	10 [7–17]	7 [4–17]	*	50 [16–75]	*
Telephone	10 [4–29]	11 [5–25]	*	33 [10–100]	*

*Rare outcome and insufficient data to calculate

3.4.3 Qualitative data and triangulation

3.4.3.1 Theme 1: Visual and relational cues help clinicians assess receptivity to preventive care discussions

GPs described how preventive discussions are often supported by relational and contextual cues within face-to-face consultations. Visual cues, body language and informal conversations were seen as helping clinicians gauge patient receptivity and introduce brief interventions for key risk factors for chronic disease. In the absence of these cues during telephone consultations, GPs adapted their interaction styles, for example by relying more on tone of voice, and emphasised the importance of establishing whether it was an appropriate moment to engage the patient in a more reflective discussion about behaviour change.

These cues were also described as shaping GPs' confidence in how to proceed. Rapport, alongside visual and behavioural feedback, enabled GPs to judge patient understanding and decide whether to continue, adapt or discontinue preventive discussions.

> *"I do have these conversations over the phone. The difference being you don't have the body language in terms of whether they are receptive, you have to listen carefully to changes in tone as to whether they might be switched off. Whereas in a face-to-face consultation you have body language, sometimes you could see whether they're sort of losing interest quickly, turning away you know, breaking off eye contact et cetera and that maybe this message isn't working." (GP 1)*

GP 1 is describing how the absence of visual cues such as body language, eye contact, and physical orientation reduced the sense of interpersonal connection, requiring the clinician to rely heavily on vocal cues alone over the telephone. The GP highlights how tone becomes a proxy for engagement, change in tone indicating an adaptive strategy to compensate for reduced cue availability. In contrast, face-to-face consultations are described as enabling continuous monitoring of attentional and relational signals (e.g., turning away or breaking eye contact). These cues support immediate feedback on whether a message is being received as intended, allowing the GP to adjust their communication accordingly. One GP highlighted specific importance of this for behaviour change.

> *"If you're going to make any difference or you're going to try and motivate a change in behaviour that cannot happen just on by a voice really. So, I think it's trying to establish that continuity. If you have spoken to them a couple of times (via the telephone), I'd probably try and see if I can get to see them (face-to-face)" (GP 4)*

GP 4 recognises that interactions that involve prevention and behaviour change can be complex, requiring communication tools beyond potentially one-dimensional voice tools such as pitch, tone and pauses. In addition, another GP described how the clinic environment or the patient's environment during a remote consultation can affect the opportunity for preventive interventions.

> *"Just by the nature of our telephone consultations as well, you don't actually know what the patient's doing. So, I tend to say at the beginning of the consultation is now a good time to talk? And often they say yes, but you can hear that they're out and about. You know, they might be walking around, shopping or something like that and*

> *they tend to want to talk about the thing that they booked the appointment for, and then they want to get on with what they're doing. You know, they might be at work and they've stepped out of the office for three or four minutes specifically to ask about a medication for a headache, and they don't really want to be getting into a longer conversation (about prevention)… Whereas when someone's in the client room face-to-face , you've got that undivided attention for the length of time that you want to keep them in the room. And you know, you're in that medical setting. It's a lot easier to talk about anything" (GP 6)*

The lack of wider chit-chat or general conversation seen in telephone consultations may explain why discussion of wider health issues such as prevention is perceived by this GP to be less feasible over the telephone. GPs described communication as feeling more effective when the other person seemed attentive and engaged, something that could be conveyed through informal talk such as brief personal comments, everyday conversation, or shared humour. These could signal relational availability, reduce interactional asymmetry, and establish a safe conversational setting to explore topics that require reflexion or future orientation, for example, prevention. Despite these interactional differences, there was no evidence that the length of segment or type of segment differed significantly between face-to-face or telephone consultations. However, it may be that different health behaviours are differentially affected by consultation mode. This will be explored in subsequent themes.

3.4.3.2 Theme 2: Telephone consultations alter interpersonal dynamics in ways that can both impede or enable discussion of stigmatised behaviours

GPs described discussions of weight, smoking and alcohol as requiring careful interpersonal work because these behaviours can carry stigma. Many participants felt that telephone consultations made such conversations more difficult, as the absence of facial expressions and other relational cues reduced opportunities to convey empathy and reassurance. However, some also described situations in which the relative distance created by telephone consultations made these discussions easier. Hence, telephone consultations were described as both constraining and enabling conversations about stigmatised behaviours.

GPs described how telephone consultations impaired their ability to have preventive discussions on the telephone, an issue that was exacerbated for topics which were associated with stigma, such as weight. This may be due to GPs being less able to perform the 'emotional labour' that is required when addressing preventive care topics that are stigmatised remotely. Emotional labour describes the effort required to regulate feelings and emotional expressions during professional interactions, particularly to convey empathy, reassurance, or authority in line with role expectations.[212] This led to the feeling that telephone consultations were formulaic rather than bi-directional, meaningful exchanges.

> *"But obviously on the phone. It's impossible. I don't know, it just all becomes transactional doesn't it so I find it's really hard on the phone to make it natural and to look like you can ask about like weight and smoking. Like there's a lot of stigma around them and a lot of people get wound up because it's not the first time and they have tried" (GP 10)*

"It does sound a bit like an inquisition, and it's just when you're on the phone, you're firing questions a bit rather than having a conversation." (GP 10)

During telephone consultations, there is limited access to relational cues such as facial expressions or eye contact that can make stigmatising topics feel more transactional or abrupt and reduce opportunities for reassurance. There is also the potential for increased ambiguity about how messages are received, which may heighten perceptions of judgement or disapproval. There may also be less opportunity to perform clinical empathy during remote consultations. The empathetic process has been shown to involve non-cognitive processes such as motor mimicry and interpretation of patient facial expressions that may remind the physician of the GP of similar emotions he or she has experienced previously.[213] Telephone consultations would prevent these visual empathy building processes from occurring. The quantitative data reflects this with weight management (with associated obesity stigma) being more frequently discussed face-to-face (58% of segments occurred face-to-face).

However, other GPs described how being more detached from the patient in a telephone consultation facilitated conversations that may be more challenging face-to-face, as the GP could be more objective with measurements such as weight.

"…when you can kind of slightly separate that out and it (weight management) *becomes a little less emotional perhaps over the phone, or that if there is emotion it's more contained and therefore you can perhaps have a bit more of an objective take on it together, but I think that that's my feeling about it"* (GP 3)

Such variation in participants' accounts reflect how the ways in which consultation modality influences preventive care is contingent upon the purpose or clinical context of the consultation. Greater distance and reduced visual cues may, in some situations, lessen the sense of being judged, for example when raising weight management, and can create space for patients to disclose sensitive information more comfortably. At the same time, the absence of these cues may make it more difficult for GPs to gauge receptivity and navigate potentially stigmatising topics. Overall, these findings suggest that telephone consultations can both mitigate and intensify experiences of stigma, depending on the interaction. There may be additional factors beyond the scope of this study contributing to these differing interpretations, such as the sex of the patient and GP, the GP's own body weight and appearance, and prior experiences of weight management among both patients and GPs.

3.4.3.3 Theme 3: Technology mediated pathways shape variation in preventive care

GPs described how the wider IT infrastructure both enabled and constrained elements of the preventive care pathway, further shaping interactions during remote consultations. This highlighted the need to understand the occurrence of preventive talk within the context of the wider technical systems and care pathways.

GPs described how technology had led to new patterns of working. For example, discussing alcohol during a telephone consultation (in response to liver function test results) was seen as an opportune moment for discussing alcohol use.

"And alcohol again sometimes they bring that up with liver tests if they've got either raised ferritin or something like that. And I ask them about their alcohol then we'll normally we discuss that then." (GP 7)

The quantitative data supported GP7's insights, that alcohol was more frequently discussed during a telephone consultation (64% of segments occurred remotely). Such test results provided a medically framed and situationally relevant prompt to raise the topic. Interestingly, no GPs described using text messaging to offer advice or referral for alcohol use. Text messaging for alcohol use was not present in the recorded consultations, in contrast to smoking cessation where this was frequently discussed in the interviews. The fact that excess alcohol use produces measurable biochemical changes in traditional laboratory tests, brings this behaviour under the medical gaze and hence clinical consultation in a way that smoking cessation does not. Smoking cessation could often be managed through more indirect or asynchronous forms of communication, whereas excess alcohol use typically required more direct interaction, such as a telephone or face-to-face consultation, to address the complexity of investigation results.

There may also be some practical challenges in discussing some health behaviours remotely. For example, the GP can ask how much alcohol someone drinks, remotely or face-to-face whereas, to calculate an accurate up-to-date weight, the GP needs to see the patient face-to-face. The telephone consultation can therefore be understood as a distinct setting, that suits some medical topics over others, that requires a different set of tools, training, and communicative expertise, that may suit some areas of prevention more than others.

In contrast to the telephone potentially facilitating alcohol discussions, there was concern that progress that had historically been made with smoking cessation e.g., of accessibility of services, had been reversed in terms because technology (text messaging) was now an additional step in the pathway. The median length of a smoking segment was 5s (IQR 4-13s), partly reflecting that most people responded "no" to the question, "do you smoke?", but also because if they did smoke, the subsequent advice or referral was outsourced to a text message.

> *"I don't think anything's quite as good over the phone, but you can still give advice, and you can still signpost and then it's ultimately down to individuals whether they take that advice or not, isn't it? So, with smoking, I mean, I think smoking cessation has gone backwards really because we used to have smoking cessation advisors and we can't do that now. It's just a phone number" (GP 9)*

> *"I think we still get quite a lot of patients who come in expecting us to prescribe things like nicotine replacement patches or inhalers and things like that. And I mean I was used to doing that previously. So, it's something I'm comfortable with. It's just now we're sending them a text message to go and speak to somebody else about it, and I almost see it as another opportunity where you could lose the patient. You know, they've already come to the GP and spoken about wanting to do something like that, but then we're almost passing the buck to a different organisation and that's another opportunity almost where the patient could be lost due to low motivation." (GP 6)*

This was a pattern observed by multiple GPs across different regions of England. Text messages were described as offering limited scope for conveying interpersonal support and shared accountability. The absence of vocal tone, facial expression and immediacy was seen to reduce opportunities to communicate empathy, encouragement and clinician engagement, which participants suggested were particularly important when addressing stigmatised and behaviourally challenging issues such as smoking. As a result, referrals delivered in this way were sometimes experienced as impersonal or easily overlooked, with some GPs perceiving this as potentially reducing motivation and follow through compared with more direct forms of interaction where support and commitment could be more clearly conveyed. GPs also observed this issue with the pathway was also most likely to affect those who would struggle the most with digital signposting.

> *"I think it's, you know, interesting that the sort of cohort of patients that are increasingly going to be left smoking are going to probably be the ones that are less able to, you know, respond to these more digital ways of accessing care. So, yeah, I think it's just, it's very interesting the way we've kind of ended up doing this." (GP 1)*

Given that smoking prevalence is higher in more socioeconomically disadvantaged groups, reliance on low social presence interventions such as text message referral links risks reinforcing the inverse care law, whereby those with greater need receive less relationally rich and potentially less effective support.[214]

3.4.3.4 Theme 4: Professional and system constraints influence preventive care delivery across all consultation modes

GPs described how their professional roles and the constraints of the healthcare system shaped their delivery of preventive care in both face-to-face and remote consultations. While many viewed prevention as central to their role, time pressures and competing demands of their role often limited their ability to raise preventive care effectively. GPs described how they viewed prevention as a core part of their role in primary care.

> *"Yes, I usually generally ask about their lifestyle whenever I can, and particularly smoking and alcohol they are the ones I frequently ask about. And exercise sometimes. I usually try and get those in and particularly smoking. I would encourage them with smoking cessation if they are keen for it."* (GP 2)

> *"Yes, I try and do it whenever it's relevant basically. And I find that if you don't, then you're just going to end up seeing the same people you know, time and time again about the same issue."* (GP 4)

Another GP highlighted that, given time constraints, their role was often to initiate the discussion and then signpost or refer patients to another clinician or service able to address the issue in more depth.

> *"Yeah, we're, we're doing the checking in, but we're not, we don't have the time to do all of the then how can you take this forward. So, I think having somebody who could*

do that a bit better dedicated would be brilliant, but it doesn't mean I don't want to do it because I think it's really important that we're doing this first part." (GP 3)

However, the quantitative data suggested the signposting or referral took place infrequently for all health behaviours (7% of preventive segments were for referral or signposting for further care). Furthermore, this was similar for both telephone and face-to-face consultations, implying that this pattern of offering advice rather than referral is not affected by consultation mode.

Within the surgery, GPs navigated uncertainty about staff roles, access routes, and the division of preventive responsibilities; who does what? Questions such as whether a dietician or specialist nurse was available, what they could offer, and what services they could refer the patient to added to this professional complexity.

> *"We could always refer to the dietitians in the hospitals or secondary care, but that was no use to be quite honest because they bounced everything back and it's not a good use for their skills either…. so, a primary care dietitian I think has been invaluable. And when I heard she was leaving I thought, oh, that's a shame." (GP 6)*

GPs frequently provided advice (24% of all preventive segments) rather than making referrals across all health behaviours and both face-to-face and remote consultations, perhaps reflecting the increased fragmentation of care and lack of clarity about whose responsibility it was to provide or refer to ongoing support. Advice can be contained in the consultation without knowledge of services available or referral pathways and does not generate any additional workload.

GPs described how they worked with Additional Roles Reimbursement Scheme (ARRS) staff to do this and reflected that this has resulted in them doing less than perhaps they would have done prior to implementation of ARRS.

> *"Maybe before we had the dietitian and the health and well-being coach, I would go more in depth at how that person might be able to lose weight. So, for example, talking about the dietary changes they can do, how they can work physical activity into their daily routine, you know, are they hitting the 30 minutes of moderate activity five times a week? You know, I'd probably talk about this a bit more, but actually, now that we've got the dietitian and health and well-being coach who specifically trained do that through motivational interviewing I'm probably a lot more surface level on weight management advice and it's more about introducing who these people are and then referring them onwards because they have 30 to 45 minutes specifically to talk about that."* (GP 6)

Despite this use of ARRS staff, there was a sense that continuity with a single member of staff was important for these conversations, that often conversations happened over a series of interactions and that this was important for behaviour change. Without this continuity with the patient, these discussions were seen as more challenging.

> *"I would perhaps just try and do it in bite sized chunks (*for older patients*) because I know I'm more likely, although our current model of GP doesn't necessarily always allow for continuity, to have I suppose more than one opportunity to have that conversation" (GP 11)*

> *"And we also don't see them as much face-to-face (as we used to). And so when you sense that the patient's getting a bit defensive when you bring up lifestyle stuff, as is often the case, you then feel like maybe you didn't have the same rapport or you weren't viewed as the family doctor anymore, you just seem to be someone who's just nagging them. And again, because of that, I think the second I hit some resistance unless it's someone I've known for a long time or someone that I've seen a few times, I find it a little bit trickier to bring it up without causing offence"* (GP 11)

The interpersonal dimension of care was described as cumulative across consultations rather than tied to a single encounter. Ongoing contact enabled familiarity, trust and shared understanding to develop over time. Early consultations, often face-to-face, were seen as important for establishing rapport and signalling investment, with subsequent shorter or remote interactions able to rely on this relational foundation. This may explain why preventive interventions may require continuity of care from a single clinician, as GPs can calibrate communication, respond to emerging cues over time, and progressively address emotional, motivational, and practical barriers. Availability of ARRS staff may enable a single, more in-depth consultation, but reduce the likelihood of relational based continuity of care with a single GP that may be conducive to implementation of prevention.

GPs described increasingly complex patients that required continuity of care to successfully manage. Consultations involved managing chronic conditions alongside discussions of preventive care, often with limited time (median [IQR] 12:11 [09:14-15:42] overall, with no evidence of a difference between face-to-face and remote consultations). Preventive care was therefore not a discrete act but part of an ongoing, multifaceted discussion requiring continuity and rapport, in the context of medical complexity.

GPs described how referral pathways and system constraints restricted what they were able to offer patients in terms of prevention. These impacted both face-to-face and remote consultations.

> "*So again, going to sound quite negative here, we used to be able to refer to Weight Watchers and things like that, but we can't do that anymore either."* (GP 9)

Beyond the GP practice, the wider health system represented an additional layer of complexity characterised by inconsistent commissioning arrangements, changing service eligibility criteria, and uneven accessibility of services. There was also lack of clarity about criteria for accessing medications for weight management and frustration from GPs that they could not provide this to patients who they thought could significantly benefit from this intervention.

> *"This is a problem for Ozempic. The criteria are literally changing daily and I wasn't sure, you can probably hear the uncertainty in my voice as I was talking, thinking, gosh, actually this would be actually really good for this woman. And then I wasn't quite sure about the criteria because well, as you know, we can give it to people without diabetes, but they have to have four out of four comorbidities. It's nonsense really."* (GP 5)

The inability to deliver this care was associated with a relational cost, and patients becoming cross with their GP.

> *"They can be very cross that they can't get it. A lot of people are paying for it themselves, but they you take them, you know, and they do it personally. Even if I refer them on to sort of tier three weight management. That's on the other day; he said you're not going to give me. I've got to make my BMI over 40 before you give it me so they can be very cross."* (GP 7)

The interaction between a complex patient and complex referral arrangements may explain why prevention was often limited to advice or questioning rather than referral, or further support; the health system navigation complexity increased friction in intervention delivery, and intervention delivery may have felt inconvenient in the face of medical complexity. Taken collectively, the data suggest that these externalities (system complexity, patient complexity, professional role) may have at least a similar, if not greater impact on preventive care than consultation mode.

3.4.3.5 Theme 5: Prevention occurs within collaborative, longitudinal care developed over multiple consultations

GPs described preventive care as a dynamic, collaborative process that is responsive to patients' readiness and priorities. Rather than following a rigid protocol, preventive discussions were tailored to each patient, often unfolding over multiple consultations, through which patients were encouraged to contribute information and take an active role in the discussion.

GPs described how they worked collaboratively with a patient to meet them where they were at in terms of behaviour change and offer an intervention at an appropriate time, regardless of consultation mode. They also described taking a long-term perspective and plant an idea that can be revisited when the patient is more ready for change.

> *"I pick the opportune times really to introduce discussions or to remind them of something or come back to it, knowing that that there will be occasion when they are ready to go and they're more engaged to make change in their life."* (GP 1)

> *"And then sometimes I think people aren't necessarily quite there yet. And then that might be more of a prod to kind of say, look, you know I'm going to say this"* (GP 3)

This suggests a dynamic and ongoing interaction between GP and patient that influences when this type of care is delivered, that is determined by protocol but is relational and reliant on continuity of care to build upon previous discussions. There was evidence GPs also encouraged patients to contribute to the conversation and volunteer information so that the conversation was more patient led. There was the feeling that open questions where patients reflected on their health behaviours, facilitated successful discussions and reduced stigma, again regardless of consultation mode.

> *"I'd ask them is there anything you think could be contributing to how you're feeling and then just explore instead of going, what about you smoking? So how is everything at home and you know, like just more open questions because most people then just bring up. I know I shouldn't be doing this and then you can explore that with less stigma and less judgement."* (GP 10)

GPs also described how prevention could be used as a useful starting point for engaging people in their health. One GP described how prevention could be used as a tool in joint decision making, whereby the GP addresses the patient priorities, whilst encouraging them to consider additional preventive options in return.

> *"And sometimes it's (prevention) the entry point where you know they need something. You say, OK, we can do that for you, but then consider this as well, so to speak. You know, so there's a little bit of I would I say bargaining and joint decision making that needs to come into it"* (GP 1)

One GP described how the digital interaction with the patient to signpost or refer to preventive care services (e.g. smoking cessation services), most commonly via text message, was limited in its scope because of the asynchronous nature of that type of communication.

> *"It's probably more personal if you were to sort of almost do a chat sort of a format in terms of digital interaction really isn't it? But again, that is much more time consuming and much more fragmented. You know you are sat doing 20 different things and you'll send a message and then they might send message back and then the next day and then we might somebody else might respond" (GP 12)*

The GP recognised that it could be more efficacious if she was able to respond in real time to that specific patient's questions or concerns. Here, prevention is limited by the reality of the text messaging platform this doesn't behave like a chat bot, rather enables patients to respond once to a message that is filed within the text messaging platform. Prevention collaboration is also limited by the reality of GP working, where colleagues often pick up on text messages from patients the next day, especially if they are non-urgent. This GP's observation highlights how different communication formats may shape patient engagement. Text messaging was described as offering limited immediacy and opportunity for interaction, with minimal feedback and a more one directional mode of communication. In contrast, a chatbot was seen as enabling a more conversational and responsive exchange, giving a greater sense of interaction. This GP suggested that this more interactive format could support attention, trust and a sense of support, which were considered important for encouraging behaviour change in preventive contexts.

Prevention, in particular weight management with the most frequent number of segments (n=43 segments) was discussed often in consultation, suggesting an understanding that this is a topic that is appropriate to address in primary care consultations. Personal preference for face-to-face consultations for prevention and in particular, weight management was described by one GP:

> *"I definitely prefer having conversations about altering people's lifestyle face-to-face. And the reason for that a lot of how the person is perceiving what you're saying is through body language. So, you know, if you're telling somebody that they should lose weight, that can be quite a difficult conversation. I mean, people can be quite offended sometimes And I think if you can't see how the person is reacting or behaving then it's really difficult to know what the next thing you should say is. You know you want to almost have that feedback of what they're perceiving, what you're saying. And that's a lot easier in a face-to-face setting. And additionally, some of the information that we have on the health record might be a couple of years out of date. So, a weight that*

we've got from somebody might be within the normal range, but they may have put on weight, or conversely, they may have lost weight. So, you're talking to somebody about weight loss with an out of date reading… I mean I still speak about things like alcohol and smoking and weight on the phone, but I just prefer it face-to-face" (GP 6)

This GP's preference for more direct forms of interaction appeared to reflect not only convenience but also a desire for greater relational control and a sense of emotional safety. By allowing GPs to monitor and respond to patient reactions more effectively in face-to-face consultations, these interactions could reduce the emotional labour associated with prevention discussions, increase confidence in message delivery, and support collaboration with the patient.

Despite this, the quantitative data showed an approximately even split between preventive discussions conducted remotely and face-to-face, suggesting that GPs enacted prevention across both consultation modes and adapted their interactional approaches accordingly. Rather than representing a loss of interpersonal connection, remote consultations appeared to involve a reworking of how these interactions were achieved. These adaptations appeared to be sufficient in the quantitative data to support the relational conditions needed to discussed preventive care.

3.5 Discussion

3.5.1 Summary

In this mixed methods study with 66 consultations involving 12 GPs from 3 practices across England, there was no evidence that the number and length of preventive care segments differed between remote and face-to-face consultations. GPs typically gave advice rather than signposting for further support or referral for all behaviours and for both telephone and face-to-face consultations. Weight was the most frequently recorded preventive segment (n=45), and alcohol (n=22), smoking (n=20), and physical activity (n=22) with comparable frequencies. Evidence from the qualitative interviews suggests that preventive care cannot be studied in isolation but is highly context dependent, is socially and temporally situated and constrained by broader system factors. Remote consultations bought new interpersonal dynamics that required additional consultation skills to manage. Technology was integrated with prevention to differing extents between health behaviours and this additionally shaped how, when and to whom preventive care was delivered.

3.5.2 Comparison with existing literature

Research to date investigating preventive care delivery in primary care consultations has used predominantly qualitative or mixed methods. One 2019 study reported that behavioural advice was less frequent during a telephone consultation (24%) or video consultation (14%) than a face-to-face consultation (44%).[87] These results suggest that preventive care (smoking, weight management, alcohol and physical activity) is delivered more frequently than this, 62% (95% CI 49-74%) contained some preventive talk, and that there were a similar number of preventive segments between telephone and face-to-face consultations. This could be because this study looked at routine consultations, and so data from acute lists or telephone triage consultations, where preventive care may not be a priority, was not analysed. Prevention could be defined differently, or alternatively, as telephone consultations have become more established, GPs may have become more skilled at delivering prevention remotely. The possibility of the Hawthorne effect cannot be excluded, where GPs knew that the study was about prevention, so prioritised this type of talk more than they would typically do.

One study found that between 2014-2019, consultations in English primary care lasted 10.9 minutes on average, which was slightly shorter than the median length of consultation in this study, 12:11 [IQR 09:14-15:42]. [101] The longer length could be accounted for by trends to increasing patient complexity that are well documented in the literature,[215] or because I sampled routine consultations and not acute consultations where single, well-defined problems may be discussed. Similarly, a 2010 conversation analysis study found that telephone consultations were shorter and included less problem disclosure than face-to-face consultations.[89] Whilst I didn't specifically analyse problem disclosure, preventive talk was evenly distributed between the consultation modes suggesting that where telephone is used for routine consultations, asking questions and giving advice for health behaviours is done in practice. However, subsequent GP interviews did highlight that some GPs found the lack of visual cues and opportunity for rapport building made these conversations more challenging.

One established theory in the literature that could help explain this phenomenon is Social Presence Theory. This refers to the "sense of being with another" and the extent to which an individual perceives the "intelligence, intentions and sensory impressions of another". The theory was first described by Short, Williams and Christie in 1976 and posits that digital media differ in their ability for participant to give and receive social cues, and therefore that there is a variety of effect on social connectedness.[216] The original paper described intimacy and immediacy as the two core components of Social Presence Theory. Intimacy is the feeling of connectedness the two communicators have during their interaction; immediacy refers to the psychological difference between participants. For example, synchronous telephone and video calls are likely to transmit more subtle social cues that aid understanding and connectedness, compared to asynchronous modalities with less social presence, for example text messaging or email. In the context of this study, GPs described face-to-face consultations as characterised by a higher degree of social presence compared to telephone consultations, enabling continuous monitoring of attentional and relational signals, for example, turning away or breaking eye contact. These cues support immediate feedback on whether a message is being received as intended, allowing the GP to adjust their communication accordingly. This is particularly relevant for discussions around health behaviours, topics that can be sensitive or stigmatising, and so having a richer apparatus of interactional tools, available in high social presence consultation modes, was felt to aid communication. GPs described adapting their consultation approach in remote consultations to draw on limited indicators of social presence, including tone of voice and pauses, to facilitate discussions in relation to behaviour change.

In my dataset, approximately 50% of the consultations were conducted remotely (via telephone). This is a greater proportion than is seen nationally, with NHS Digital estimating that 62.9% of all appointments were carried out face-to-face in general practice in September 2025.[217] This could be because one of the practices in this study was a practice that used a notably higher proportion of telephone consultations than is typical seen, and the majority of the recordings this GP practice provided were telephone consultations.

Studies looking more broadly at remote consultations found that remote and online consultations in primary care often presented with operational challenges that needed to be recognised and solutions resourced sufficiently.[218 219] The text messaging for smoking cessation referral identified in this study may be an example of this. This type of intervention disadvantages digitally excluded patients, which is likely to overlap with those who are most likely to need the intervention. One study found that the increased fragmentation of care and diversity of roles has added confusion and inefficiency into delivery of care.[100] These results provide specific examples of this; referral for further support for all health behaviours occurred rarely in the recorded consultations, which GPs attributed to lack of pathway clarity, and confusion about who does what. Another study investigated how remote and digital working could risk 'technostress' and relational strain within and between teams.[220] My study supports this as some GPs expressed significant frustration at how telephone consultations eroded their ability to develop rapport with patients and that this negatively impacted their ability to meaningfully engage patients' in behaviour change.

Previous research has advocated for specific training for healthcare professionals delivering remote consultations, recognising that that delivering high quality consultations to diverse patient groups is complex.[105] This study supports this and identifies specific training areas identified in this area including training on delivering referral or further support via a telephone consultation. Previous studies have looked at conversational patterns that are associated with higher acceptance and take up of weight management programmes in face-to-face consultations.[221 222] Similar techniques could be used to identify whether these associations are the same or different for telephone consultations, or for other health behaviours.

Other studies have identified specific opportunities and barriers for remote preventive care. For example, one study found that video or telephone consultations may enable GPs to provide physical activity promotion to a broader number of patients, but that this would reduce the ability of GPs to do visual assessments.[92] My study partly supports this conclusion; GPs similarly expressed concern about the lack of visual cues in remote consultations, but the telephone consultations captured were of similar length to face-to-face consultations, challenged the conclusion that these could enable a greater number of consultations. One US study found that primary care physicians described education on local treatment resources, and having support peers trained in obesity medicine and dieticians would be an opportunity to improve obesity care.[223] There is evidence from my data that complex referral pathways and eligibility criteria could limit implementation, however there are trade-offs when considering additional staff members including increased fragmentation of care and lack of clarity around who does what. Similarly, a study looking at GPs perceptions of weight management in Scotland found that GPs perceived their role in weight management as awareness raising and signposting.[224] Findings from my study also found that GPs also viewed this as there role, and the data suggested that the ARRS roles in primary care may have reinforced this view. However, the quantitative data suggested that despite GPs more often raising awareness (give advice) than signpost in practice.

One in depth ethnographic analysis of telecare (telephone consultations) for older people living at home challenged the perception that telecare is perceived as a loss of care and a dehumanisation.[225] The authors described how use of tone of voice, knowledge sharing and emotional labour associated with telecare is in itself a form of care. They found that telecare works best when situated among robust networks of what the authors called, 'co-present caring' including people and embodied (face-to-face) caring from the wider healthcare system. Results from this study support these conclusions; GPs described how they relied more on audiological cues, pauses in conversation and thought carefully about their own voice when discussing prevention in a telephone consultation. In addition, evidence from the qualitative interviews situated preventive care in the professional and system level reality of English primary care; implementation was limited by wider system level factors across consultation mode.

3.5.3 Strengths and limitations

This study has several strengths. It was a multi-centre study including three general practices from different areas of England, encompassing patients from diverse backgrounds and broadly representative of those who use general practice services. A total of 66 consultations were recorded, covering a wide range of typical presentations encountered in primary care. The use of an objective coding system allowed quantitative analysis that was less susceptible to researcher bias. There was a good balance between telephone and face-to-face consultations, enabling meaningful comparisons between these modes of delivery. The majority of participants who consented to take part completed the study, with fewer than 20% of patients withdrawing, and only one GP unable to participate due to a change in role. The coding system was pragmatic, as it was specifically designed to answer the research question, and showed high inter-rater reliability in the domains tested, specifically number of segments, type of brief intervention segment, and length of brief intervention segment.

The inclusion of follow-up interviews with GPs, incorporating playback of selected segments from recorded consultations, provided valuable opportunities for reflection on preventive content without influencing the consultations themselves. While a common critique of coding preventive care talk is that it cannot capture longitudinal aspects of care or system-level constraints, the subsequent GP interviews offered a novel approach to addressing these challenges and capture reflections that would otherwise be lost. These mutually informing methods generated insights into the delivery of preventive care in everyday practice that would not have been apparent with a single method approach.

There are also limitations to consider. The findings may in part reflect a Hawthorne effect: although care was taken not to disclose exactly what was being measured during the recorded consultations, both GPs and patients were aware that the study related to prevention. This awareness may have prompted more preventive care discussions than would otherwise have occurred, potentially leading to an overestimation of their frequency. Furthermore, participation was voluntary and it could be that practices with a greater interest in prevention chose to participate and are more motivated to deliver this type of care. However, it is unlikely to have influenced the type of preventive care delivered (for example, advice being more common than referral or further support) or to have affected telephone and face-to-face consultations differently. In addition, although this was a multi-centre study, all three practices were located in England. Consequently, findings may not be generalisable to health systems in the devolved nations, where service availability and organisational constraints differ.

Another limitation is that, while GP perspectives were captured through both the recorded consultations and subsequent interviews, patient perspectives were explored as they emerged within the context of recorded consultations. In designing the study, additional patient interviews would have been ideal, but this study had to be feasible to complete as part of a DPhil with a single researcher working on this and the other studies in this thesis. Therefore, recorded consultations and GP interviews were planned. Exploring patient perspectives of prevention in primary care is another significant body of work, which I have started to develop in the PPI prevention round table event described in Chapter 7.

Many of the GPs mentioned ARRS staff being involved in prevention. Capturing consultations with these health care professionals and understanding how prevention is discussed in these contexts would provide additional helpful data on the reality of prevention implementation in primary care. The sample only included GPs, as this is often the first point of contact for prevention, with patients then being referred on to see other members of the multidisciplinary team. The limitation of this study is that these consultations and perspectives of these healthcare professionals were not captured. Further work could specifically look at how prevention is delivered in these contexts and how that compares with what is delivered in a typical GP consultation.

Finally, the coding system used to analyse the recorded consultations was developed specifically for this research question and has not yet been independently validated. As such, while the resulting quantitative data are applied and data-informed, the coding framework would require further validation before being used in other research contexts.

3.5.4 Reflexions on analysis

As a practising GP, my professional background and experience inevitably shaped both the analytic lens applied to the recorded consultations and GP interviews and the interpretations drawn from them. My familiarity with the structure, constraints, and expectations of a UK general practice consultation may have facilitated a nuanced understanding of clinical context and the tacit rules governing consultation flow. However, this same familiarity may also introduce potential sources of bias.

First, there is a risk of normative bias, whereby practises that align with my own clinical training or values, particularly regarding prevention, may be implicitly judged as more appropriate or desirable. This could lead to over-interpretation of missed prevention opportunities or insufficient attention given to the legitimacy of GPs' prioritisation decisions within constrained consultations. Conversely, practises that diverge from my own may be correctly problematised rather than understood on their own terms. Secondly, I may have assumptive understanding of GP communication patterns. I may have taken certain interactional features for granted, potentially obscuring alternative interpretations that may be more salient to non-GP analysts, such as patient's perspectives or the interactional significance of apparently routine exchanges. Thirdly, there is the possibility of identification bias with participating GPs. As a peer, I may be more inclined to empathise with GP participants, particularly interpreting absences of prevention because of systemic pressures rather than individual choice. While this perspective is important, it may inadvertently downplay other explanatory factors or constrain critical interrogation of professional norms.

To mitigate these influences reflective practises were employed throughout the analytic process, and any analytical claims were grounded closely in the data. There were two independent coders for the quantitative analysis and thematic analysis of the interviews. Themes from the thematic analysis were discussed iteratively with the wider supervisory team, including two non-clinical supervisors, who had unique perspectives from their own professional backgrounds. A GP leading this research can be seen both as a resource and a constraint. Acknowledging and critically examining this role duality strengthens the transparency and credibility of the analysis.

3.5.5 Implications for policy and practice

This study reveals the complexity behind policy statements that encourage doing more prevention in primary care. Each individual health behaviour had its own prevention implementation challenges and opportunities, and each used digital or remote technology in distinct ways. Acknowledging the challenges at the clinical, GP practice and health system levels, and understanding the role of technology in either supporting or constraining implementation efforts, is an important first step toward meaningful positive change.

In this study, preventive care was delivered approximately equally through remote and face-to-face consultations. However, most of the available training for discussing smoking, weight management, alcohol use and physical activity assumes a face-to-face setting. There are clear opportunities to develop training resources that help GPs make the most of remote consultations for prevention. For example, although in my data, referrals or discussion of further support took the longest amount of time, previous studies have found that these interventions can be delivered in under 30 seconds.[27] Given that GPs frequently identified lack of time as a major constraint, improving confidence and efficiency around these discussions in different consultation modes should be a priority. There were specific opportunities identified for alcohol prevention in primary care. Previous studies have raised the need for supportive resources to facilitate discussion about alcohol use and strategies to reduce intake face-to-face consultations.[226] Developing training and protocols for delivering brief interventions about alcohol use by telephone, especially in response to abnormal liver function test results, could strengthen implementation in this area.

GP consultation models provide structure to clinical consultations in primary care. Although not specifically in face-to-face consultations, many of these were developed before remote technology was routinely used in practice. Some of these models, such as Stott and Davis, specifically identify preventive care as an area that should be discussed and explored each time a patient consults with a healthcare professional. In the case of Stott and Davis, this is area number four, “opportunistic health promotion”.[227] Another consultation model is the Calgary-Cambridge model does not specifically mention prevention, but during the gathering information stage, clinicians are encouraged to explore patients' ideas, concerns, expectations, and social context, which helps to identify health behaviours that can then be explored further in the explanation and planning phase of the consultation.[228] Some GPs expressed frustration that telephone consultations resulted in patients’ being distracted for example, being out of the house doing their shopping and this resulted in an abridged consultation (and prevention omitted). This also introduces an additional inequity in preventive care delivery, those with more unstable or crowded housing may be less ideally positioned to tackle more challenging conversations remotely. New consultation models, that consider the environmental realities of remote consultations, could be developed to aid clinicians have meaningful encounters in these situations.

One broader framework for remote consultations that is relevant to this study is the Planning and Evaluating Remote Consultation Services (PERCS) framework.[229] This framework highlights the interdependent influences of individual, organisational, and system level factors on the delivery of remote care. Applying the framework to the present study, within the clinical relationship domain, GPs emphasised the importance of face-to-face interactions in building rapport and supporting preventive discussions, particularly for sensitive or potentially stigmatising health behaviours. In the technology domain, GPs expressed concerns regarding the effectiveness of text messaging for smoking cessation, yet this approach remained embedded within routine practice. This reflects how the relative ease and availability of technological solutions can shape care pathways, at times preceding considerations of clinical effectiveness and equity. Finally, the staff domain was also salient, with tensions evident in how responsibility for prevention was conceptualised. GPs described prevention as a core component of their role, while simultaneously positioning it as an activity that could be delegated to other members of the multidisciplinary team, often justified by the opportunity for longer face-to-face consultations to address these issues in greater depth. Overall, the PERCS framework provides a useful lens through which to situate remote preventive care in the broader remote consultation policy landscape and highlights shared implementation challenges.

Across the GP interviews, there was a consistent view that smoking cessation interventions had gone backwards. Text message signposting was described as being least accessible to those most likely to smoke, suggesting that technology could be exacerbating the inverse care law.[214] One way to counteract this could be to enable practices to employ smoking cessation support workers through ARRS, this could be particularly relevant in more deprived areas where smoking rates are highest. Smoking accounts for approximately half of the difference in health outcomes between the richest and poorest in the UK, so enabling targeted preventive support in people's communities could be impactful. Weight management services continued to face traditional bureaucratic barriers, including frequent changes in eligibility criteria and the commissioning and decommissioning of services, which created friction within referral pathways. Simplifying eligibility and referral processes should be a priority to support easier clinical implementation and more equitable access for patients.

3.5.6 Conclusions

Overall, this study demonstrates that while the policy ambition to increase preventive activity in general practice is clear, its implementation remains complex, highly context dependent and shaped by the relational and communicative dynamics of consultation mode. Preventive care is shaped by the interplay of clinical priorities, GP practice and system level constraints and the evolving role of digital technology. By examining real-world consultations and subsequent GP reflections, this research highlights both the potential and the limitations of current approaches to delivering prevention in routine care. Strengthening training for remote consultations, simplifying referral processes and addressing the inequities created by digital delivery could help translate policy goals into sustainable practice. Continued attention to the organisational and contextual realities of primary care will be essential if prevention is to become a consistent and achievable part of everyday consultations.

4 Quantifying primary care activity in electronic health records: development and comparative cross-sectional analysis of a new categorisation system

4.1 Summary

The aim of this chapter was to develop a primary care activity categorisation system (the Oxford Primary Care Activity Categorisation, OPCAC) to be more accurate and complete than the two existing Clinical Practice Research Datalink (CPRD) Aurum categorisation systems (conssourceid and consmedcodeid), to enable better specification of primary care activity and to enable me to carry out the Chapter 5 analysis.

Codes were included denoting primary care activity if entered into the electronic health record for 16.6 million people, from 1,828 GP practices, in the CPRD Aurum database between 1st September 2022 and 31st August 2023. Codes were assigned to one of 14 primary care activity categories (home visit; face-to-face; video; telephone; text; email; unclear consultation; vaccination; investigations; emergency department; secondary care; documents; administration; unclear other) by me and another academic general practitioner in collaboration with database and statistical experts. Percent agreement and positive predictive values (PPV) were calculated between OPCAC and Aurum's systems.

Of the 1.2 billion rows of primary care activity codes, 96.6% were able to be assigned an OPCAC, compared to 61.5% classified using Aurum's systems. The percent agreement for any consultation between OPCAC and Aurum's conssourceid was 52.5%, and between OPCAC and Aurum's consmedcodeid was 61.9%. The PPV for any consultation between OPCAC and conssourceid was 54.8%, and between OPCAC and consmedcodeid was 74.7%,

which shows that the categories assigned by conssourceid and consmedcodeid are poor predictors for the OPCAC categorisation. The OPCAC identified 178.1 (one consultation per patient per day) to 260.7 (one unique consultation mode per patient per day) million consultations, compared to the 163.5 to 238.2 million consultations identified by Aurum's systems over the one year period. Face-to-face, text message, and unclear consultation modes were most frequently identified in both OPCAC and Aurum systems. The distribution of consultation mode across categorisation systems was similar, but the OPCAC was more complete.

Overall, the OPCAC captures approximately 10% more consultations in UK primary care than previous analyses using Aurum's categorisation systems and also captures non-consultation activity. This has significant implications for existing and future national primary care workload estimation and workforce planning. This method can identify remote (telephone, video, email and text message) and face-to-face consultations in UK primary care electronic health record data and this new system will enable me to complete the planned analysis in Chapter 5.

4.2 Introduction

In the previous chapter, I used mixed methods to explore how remote consultation shapes how prevention is approached in consultation. The quantitative element of the study used data from 66 recorded consultations to give estimates about the frequency of preventive care delivery. Whilst this data informed the qualitative analysis of this study, precision was limited by sample size, indicated by the wide confidence intervals around these estimates. In Chapter 5, I aim to examine the likelihood of a brief intervention occurring according to consultation mode using primary care electronic health record data. To complete this analysis, I need a method which reliably identifies consultation mode from the electronic health record data.

However, categorising primary care activity, including consultation mode is more complex than analysing other routinely collected data such as test results or prescriptions in electronic health record data. This complexity arises because there is no universally accepted approach to clinical coding, training for clinical staff is limited, and recording of consultation mode is not considered essential for patient care.[230] In addition, there are many different electronic health record systems in general practice, each with their own unique way of recording consultation mode.[217] Previous studies have described the inaccuracies of consultation mode in electronic health record data: telephone triage sessions are recorded as a block rather than individual consultations; modality labels do not reflect the activity taking place, for example, online/ video consultations often do not having a video component; and telephone appointments are often recorded as face-to-face.[231]

The existing publicly available data on primary care activity and consultation mode in the UK includes the General Practice Appointments Data from NHS England.[232] These data have been described as experimental due to the variation on data entry between different healthcare professionals and practices.[233] There have been efforts to standardise data entry such as the Investment and Impact fund (IIF) for primary care networks (PCNs) which incentivises PCNs to map their appointments to standard appointment types.[234] However, the reality of data available for research from large primary care databases is that data on consultation modes is often missing or erroneous, making data analysis challenging.[235]

A 2025 British Journal of General Practice editorial described how the limitations to the coding of consultation mode is holding back the evaluation of remote and digital technologies in NHS primary care.[236] This editorial suggested that current estimates likely underestimate the volume of remote consultations in UK general practice. One 2025 cross-sectional study using data from the UK's largest eConsult provider found that the number of online consultations from this provider alone significantly outnumbered the numbers of online consultations estimated by NHS Digital.[237] There have been calls to increase the accuracy of recording of consultation mode to enable data-driven analyses into modern primary care delivery.[238 239]

In this Chapter I developed a clinician-generated primary care activity categorisation system, using the Clinical Practice Research Datalink (CPRD) Aurum database of routinely collected healthcare data from UK primary care.[240] When planning this thesis, I initially planned to use the ORCHID database, as in Chapter 2. However, expert opinion from the ORCHID data team experts indicated that consultation mode data were not suitable for research purposes.

Consequently, I explored alternative primary care databases. The CPRD Aurum team advised that, because of the poor quality of the underlying data, the existing consultation categorisation systems were not currently suitable for research use, but they could be used to support the development of a new consultation categorisation system. Therefore, the objective of this chapter was to create a categorisation system in the CPRD Aurum database that was firstly comprehensive, so that the majority of primary care activity codes entered into the electronic health record were assigned a category. Secondly, representative of primary care activity, so that the full range of primary care workload was considered, not just consultations but also administrative activity. Lastly, flexible so that the categorisation system could be used for a range of research questions, including Chapter 5 of this thesis.

4.3 Methods

4.3.1 Study design and data source

This consultation classification development exercise and comparative cross-sectional study aims to create the Oxford Primary Care Activity Categorisation (OPCAC) system to improve upon the existing CPRD Aurum consultation categorisation systems (conssourceid and consmedcodeid). I did this by assigning an OPCAC category to the primary care activity codes entered into the electronic health record and then analysing how well this represented the data compared to the existing Aurum systems.

The Clinical Practice Research Datalink (CPRD) Aurum database is one of the world's largest longitudinal electronic health record databases and supplies anonymised patient data (diagnoses, symptoms, observations, tests, referrals and prescriptions) from general practices that use the EMIS Web® clinical computer system.[241] The database comprises the electronic health data of 50.1 million people of whom 16.6 million are currently actively registered patients, from 1,828 general practices in the United Kingdom (UK), and is approximately representative of the UK population.[240 242 243] This study follows a protocol approved by CPRD on 13th November 2023 (Study ID: 23_003466).

4.3.2 Structure of CPRD data

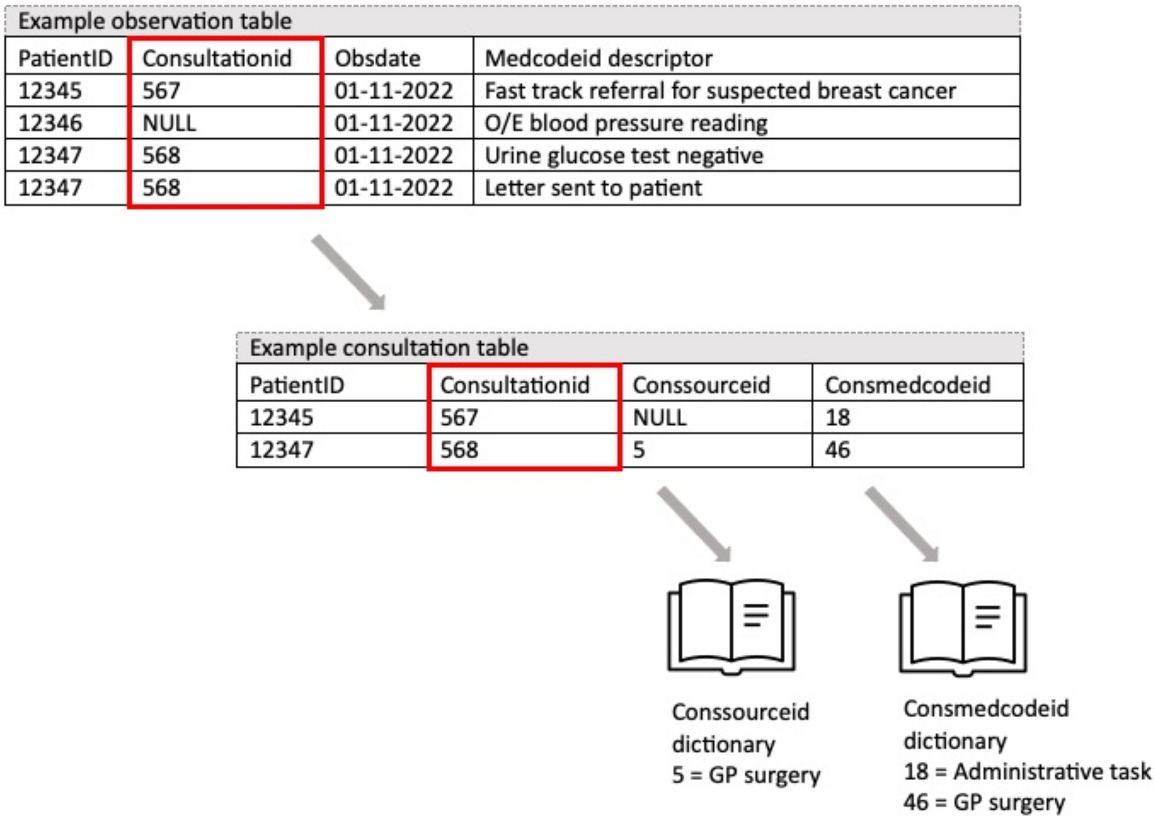
Consultations most commonly include at least one primary care activity code (medcodeid), often selected by the consulting clinician, to indicate the wide variety of clinical and administrative actions including history taking, symptom elicitation, clinical examination, measurements, investigations, referrals, diagnoses, medications, vaccinations, and allergies. These primary care activity codes are recorded in the observation table in CPRD Aurum.

Rows in the observation table can be linked to rows in the consultation table by a consultationid. In the consultation table, consultation mode is recorded in CPRD Aurum as a conssourceid or consmedcodeid (Table 1). However, as illustrated in Figure 1, there may be missing data as it is not mandatory to record anything in the consultation table with most data recorded in the observation table.

Table 4.1 Format of CPRD Aurum categorisation systems (Aurum systems).

Aurum system[244]	**Description**
Consmedcodeid	This is set (by the GP or other user) in the EMIS Web software and is context-sensitive and configurable to some extent. The practice can generate a prebooked appointment list for a face-to-face clinic for example. The GP can select the next patient from the list and click 'Start' to begin the consultation; the EMIS Web software (the electronic health record platform) will create a consultation record and set the default consultation type ([consmedcodeid]). However, patient-related activity can be recorded without initiating a new appointment, and therefore the consmedcodeid may not provide a complete record. CPRD does not modify this information once it is received.
Conssourceid	The conssourceid is often used to describe the physical location or other information relating to the source of a consultation. It is entered as free text or selected from a pre-existing list. This field can contain identifiable information such as a doctor's name, or clinic address. For that reason, CPRD redact the free text, and generate a lookup file containing a record for every unique text string. The redaction process is very resource intensive therefore only the most used strings have been converted.

Figure 4.1 Example structure of CPRD data



In my data extraction, 4663 different conssourceids mapped to 148 textual descriptions of conssourceid, and 99 different consmedcodeids mapped to 98 different textual descriptions of consmedcodeids.

4.3.3 Developing a new consultation categorisation system (OPCAC)

A GP colleague and I categorised the primary care activity codes in collaboration with statisticians and database experts into 14 categories (see Table 2) describing the modality in which they were most likely to have been recorded. For example, a code that referred to an examination finding was classified as a face-to-face consultation. The classification system was designed to be hierarchical such that when two or more codes occurred contemporaneously the category appearing higher up in Table 2 (and therefore of lower numerical value) would be the assigned consultation mode. This can happen because several codes can be entered in one consultation or one administrative entry. Discrepancies were then resolved by discussion with electronic health records researchers and clinical colleagues.

Table 4.2 The Oxford Primary Care Activity Categorisation (OPCAC) system

OPCAC Classification		Description	Example primary care activity code term	May indicate a:		
				GP consultation	face-to-face GP consultation	remote GP consultation
1	Home Visit	A consultation took place in a patient's home	-Acute home visit -Care home visit	✓	✓	
2	Face-to-face consultation	A face-to-face consultation occurred, typically at the GP practice	-Diabetic foot examination -O/E - temperature normal	✓	✓	
3	Video consultation	A synchronous remote consultation with video	-Consultation via video conference -Video consultation	✓		✓
4	Telephone consultation	A synchronous remote consultation via the telephone	-Telephone consultation -Telephone triage encounter	✓		✓
5	Text message consultation	A clinical exchange via text messaging	-Short message text message sent -SMS text message sent to patient	✓		✓
6	Email consultation	A clinical exchange via email	-Email encounter -Email consultation	✓		✓
7	Unclear – consultation	It is likely a consultation occurred, but consultation mode is unclear	-QRISK cardiovascular disease 10-year risk calculator score -GAD 7 score	✓		
8	Vaccination*	Primary care activity related to vaccination	-Influenza vaccine -First MMR (measles mumps and rubella) vaccination	(✓)	(✓)	
9	Investigations	Requests or information relating to clinical tests	-Platelet count -US Kidneys			
10	Emergency Department	Emergency department attendance	-Seen in accident and emergency department -Attended A&E			
11	Secondary Care	Secondary care activity	-Anticoagulation monitoring in secondary care -Reviewed in hospital			
12	Document	Documents or letters	-Test result by letter to patient -Do not attempt CPR (DNACPR) in place			
13	Administration	System organisation or patient details	-Shared care - specialist and GP -Awaiting clinical code migration to EMIS web			
14	Unclear -other*	Primary care activity codes not covered elsewhere	-Examination for population survey -Referral to GP			

*Vaccination refers to the act of administering a vaccine. Within OPCAC, there is flexibility regarding whether this activity is counted as a consultation to give researchers choice as to whether they count vaccinations with all consultations, or separately. In this analysis, vaccination was not included in the consultation counts.

**The 'unclear other' category was excluded from our analysis due to the very small number of activity codes in this category (0.02%)

4.3.4 Data analysis

I initially described the distribution of primary care activity in the Aurum database. We then compared the distribution of clinical activity and consultations captured by the Aurum systems and the OPCAC.

4.3.4.1 Percentage agreement and positive predictive values

I compared the percentage agreement and positive predictive values (PPV) between the OPCAC and the Aurum systems for face-to-face consultations (home visit or face-to-face categories), remote consultations (video, text, and email categories) and any consultation (home visit, face-to-face, video, text, email or unclear consultation categories). Higher PPV values indicate greater agreement between Aurum systems and OPCAC for that consultation category and suggest lower levels of false positive classification within the Aurum system. To allow meaningful comparisons, the Aurum system consultation codes were grouped into the same categories as the OPCAC using text descriptors in the data dictionary. Full details of these pairing to the Aurum system data can be found in the Appendix 7.

Percentage agreement was calculated as the number of activity codes where the OPCAC and Aurum systems had the same assigned consultation category (face-to-face, remote or any consultation), out of the total number of consultation activity codes. The PPV was calculated as: true positives / (true positives + false positives), where true positives were consultations classified as face-to-face in both OPCAC and the Aurum system, and false positives were consultations classified as face-to-face in the Aurum system but not in OPCAC (see table 1 for definitions of face-to-face, remote and any consultation). The OPCAC was assumed to be the true categorisation as this was the best available categorisation approach. Both comparisons were restricted to activity codes that had both an Aurum system categorisation and an OPCAC categorisation (approximately 60% of activity codes).

4.3.4.2 Discrepancies between OPCAC and Aurum categorisation

I tabulated the most common discrepancies between the OPCAC and Aurum systems. I then looked at the most frequent code descriptors associated with these discrepancies and described the results.

4.3.4.3 Quantifying clinical activity and consultations

Finally, I calculated how much extra clinical activity was captured by the OPCAC versus the Aurum systems. I did this by investigating where a clinical code was assigned an OPCAC 1 – 7 (and hence categorised as a consultation). I compared the total number of these rows with an OPCAC to those with a consultationid to calculate a crude estimate of clinical activity captured between both systems. Those rows without a consultationid would be missed by the existing Aurum systems.

I then restricted these activity codes to a. one for each unique OPCAC category (1-7) per patient per day and b. one per patient per day (keeping the highest ranking OPCAC code). I restricted the number of activity codes because multiple activity codes could be entered in a single consultation. I restricted in this way to have both an upper estimate of number of consultations (where we allow multiple consultations on the same day e.g., a telephone consultation followed by a face-to-face consultation) and then a lower estimate of the number of consultations where we assume only one consultation per patient per day. I used the highest ranking OPCAC category when assigning one OPCAC per person per day so we could make use of the hierarchical nature of the OPCAC and describe the distribution of consultation modes in our dataset e.g., 1 = home visit and 7 = unclear. Finally, I calculated the consultations per month and week by dividing the total number of consultations by 12 and 52 respectively.

4.4 Results

4.4.1 Characteristics and distribution of data

In the CPRD database, 96.6% of rows of primary care activity data are associated with the 7,934 most frequently occurring primary care activity codes (out of 247,118 total unique activity codes). I selected these 7,934 codes to develop a new classification system. Ninety-six percent was chosen as a pragmatic threshold covering most of the codes entered, whilst making efficient use of research resource. Figure 4.2 provides an overview of the data characteristics.

The 14 OPCAC consultation categories described in Table 4.2 classified over 96% of the approximately 1.2 billion rows of observation data in the CPRD database. Of the rows with an associated OPCAC, 61.5% had a corresponding consultationid. Sixty percent had a corresponding consmedcodeid and 60.4% had a corresponding conssourceid.

Figure 4.2 Flow of data through the study

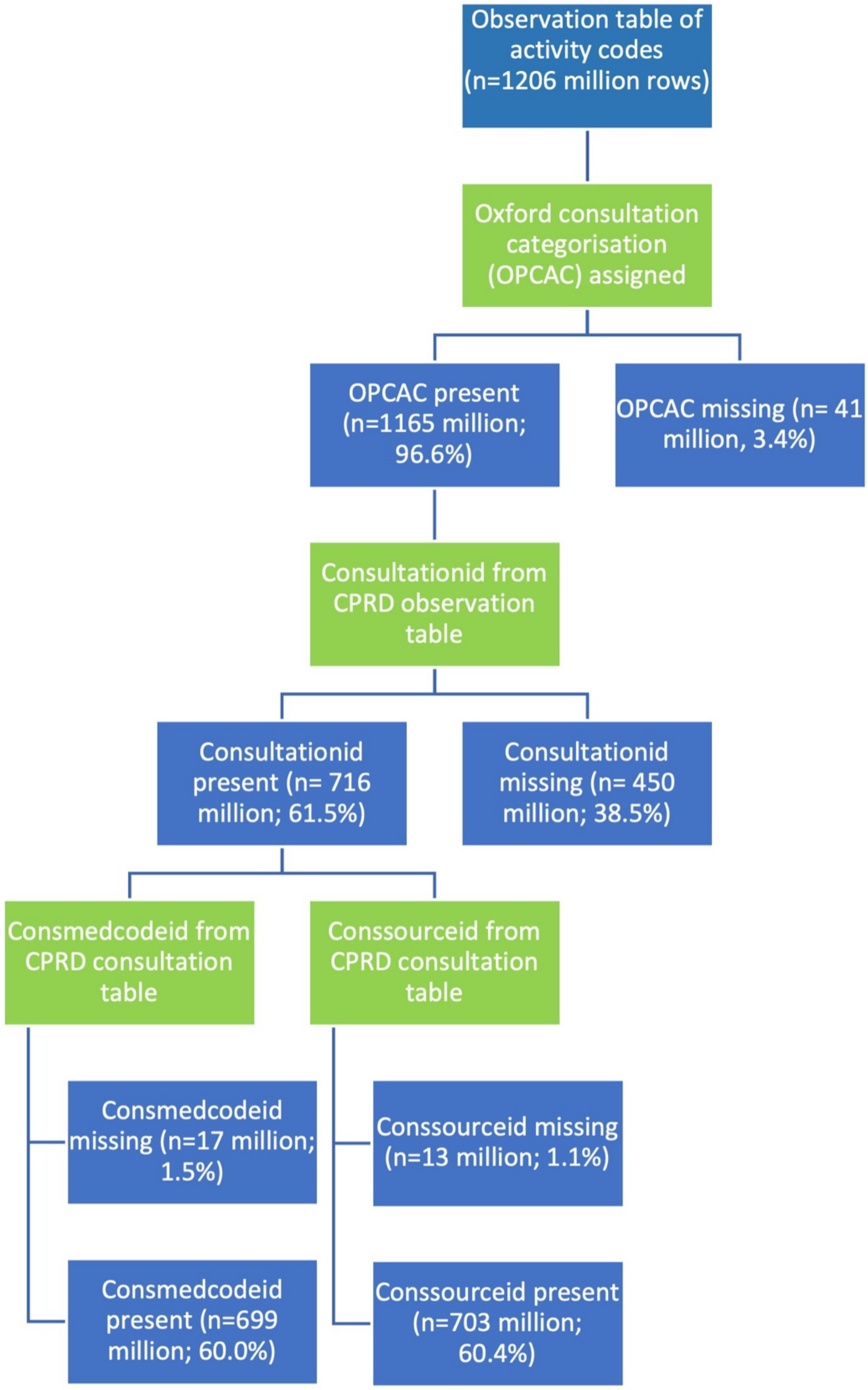


Table 4.3 Distribution of OPCAC in the CPRD consultation table by presence or absence of consultationid and consultation table data.

	Consultationid present n, millions (%)		**Missing consultationid n, millions (%)**
OPCAC	***Conssourceid***	***Consmedcodeid***	
Home Visit	0.92 (0.13%)	0.92 (0.13%)	0.28 (0.06%)
Face-to-face	134 (19.1%)	134 (19.2%)	6.9 (1.54%)
Video	0.09 (0.01%)	0.09 (0.01%)	0.004 (0.001%)
Telephone	7.1 (1.01%)	7.1 (1.02%)	0.68 (0.15%)
Text Message	116 (16.5%)	116 (16.5%)	14.8 (3.29%)
Email	5.9 (0.84%)	5.9 (0.85%)	2.2 (0.50%)
Unclear consultation	133 (18.9%)	132 (18.8%)	9.0 (2.01%)
Vaccination	22.6 (3.21%)	22.6 (3.23%)	0.68 (0.15%)
Investigations	10.7 (1.53%)	10.7 (1.54%)	294 (65.50%)
Emergency Department	3.4 (0.49%)	3.4 (0.49%)	0.08 (0.02%)
Secondary Care	19.6 (2.80%)	19.6 (2.80%)	0.42 (0.09%)
Document	62.9 (8.95%)	61.0 (8.72%)	3.3 (0.73%)
Administration	187 (26.50%)	187 (26.70%)	117 (26.00%)
Other unclear	0.06 (0.009%)	0.06 (0.009%)	0.01 (0.003%)
Total	703 (100%)	699 (100%)	450 (100%)

Table 4.3 shows the distribution of activity codes with an OPCAC to those primary care activity codes missing a consultationid, and those with either a consmedcodeid or conssourceid. Approximately one third of activity codes did not have an associated consultationid. Activity codes without a consultationid were more likely to be data related to non-consultation primary care activity. For example, there were 294 million rows of primary care activity codes assigned to investigations when no associated consultationid was present, compared with 10.7 million rows of codes assigned to investigations when an associated consultationid was present. Similarly, codes with a missing consultationid were less likely to be associated with categories that imply a consultation took place. For example, there were 6.9 million codes categorised as a face-to-face consultation when no associated consultationid was present, compared to 134 million when a consultationid was recorded. In

addition, the distribution of primary care activity between the two Aurum systems was comparable, indicating these two Aurum systems are categorising clinical data in similar ways.

4.4.2 Percent agreement and positive predictive values

Table 4.4 shows the percent agreement and positive predictive value between relevant groups of the OPCAC and the Aurum system (consmedcodeid and conssourceid descriptions). Overall agreement was broadly similar between the two Aurum systems and the OPCAC. Remote consultations had the greatest percent agreement (79.43% for conssourceid and 70.17% for consmedcodeid) and any consultation had the lowest percentage agreement (52.48% for conssourceid and 61.92% for consmedcodeid).

Table 4.4 ***a)*** *Percentage agreement* ***b****) Positive predictive value for classification of consultation mode between the OPCAC and the two existing Aurum systems. Rows without a consultationid were excluded from this analysis*

a) *Percentage agreement on presence or absence of a consultation*

OPCAC group	**conssourceid agreement(%)**	**consmedcodeid agreement (%)**
Any consultation	52.48	61.92
Face-to-face	67.99	67.04
Remote	79.43	70.17

b) *Positive predictive value (PPV) for consultation mode*

OPCAC group	**conssourceid PPV**	**consmedcodeid PPV**
Any consultation	54.82	74.66
Face-to-face	37.98	30.77
Remote	0.76	0.77
No consultation	47.26	30.24

PPV values show that the categories assigned by conssourceid and consmedcodeid are poor predictors for the OPCAC categorisation. For example, if the conssourceid categorisation indicates that a face-to-face consultation has taken place, the OPCAC categorisation will only be face-to-face in 37.98% of cases and if a consmedcodeid indicates a face-to-face consultation, this will be a face-to-face consultation in the OPCAC in 30.77% of cases.

4.4.3 Discrepancies between OPCAC and Aurum categorisation

I then tabulated discrepancies for each OPCAC category the Aurum systems. The three most frequent discrepancies between the OPCAC and the Aurum classifications are shown in Table 4.5.

Table 4.5 The three most frequent discrepancies between the OPCAC and the existing Aurum systems.

OPCAC	**Aurum system description**	**Consourceid frequency (millions)**	**Consmedcodeid frequency (millions)**
Administration	GP Surgery	26.7	24.9
Face-to-face	Administration	7.0	6.4
Document	GP Surgery	4.7	4.3

To understand these discrepancies further, I then tabulated the three most frequent descriptors (EMIS terms) for the associated primary care activity codes for each category for both the Aurum systems (Table 4.6). The discrepancies between the two Aurum systems and the OPCAC are similar, the descriptions are identical, and they share comparable frequencies. The differences between OPCAC and the Aurum systems illustrate variations in how code descriptors were mapped to different primary care activity categories.

Table 4.6 The three most frequent primary care activity code descriptors for each of the three most frequent discrepancies between the Aurum systems and OPCAC.

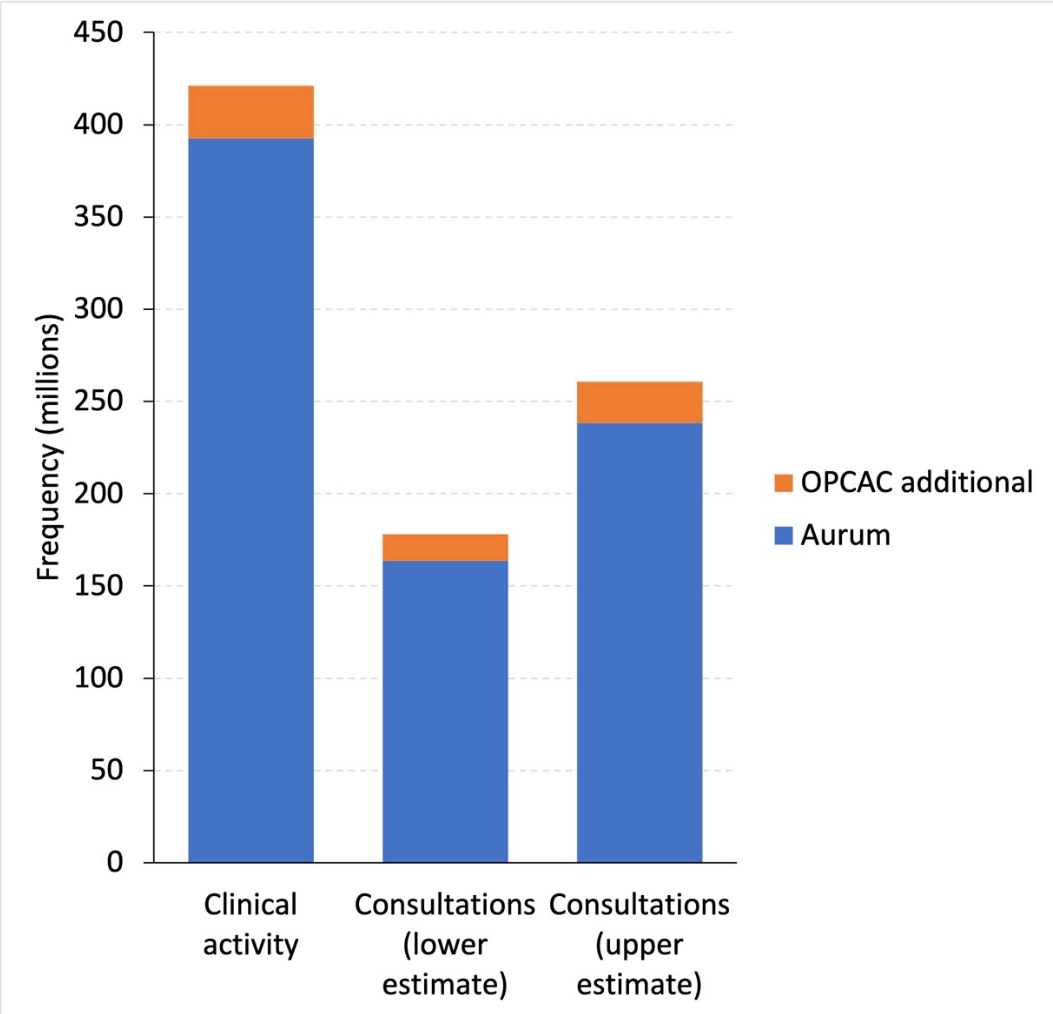
Code descriptor (EMIS term)	OPCAC	Aurum system description	Consourceid frequency	Consmedcodeid frequency
Template entry - EHR composition type	Administration	GP Surgery	7,333,708	7,184,633
Protocol entry	Administration	GP Surgery	969,137	946,664
Informing patient of named accountable general practitioner	Administration	GP Surgery	597,163	562,005
Body mass index	Face-to-face	Administration	766,364	719,680
Systolic arterial pressure	Face-to-face	Administration	670,673	624,184
Diastolic arterial pressure	Face-to-face	Administration	670,403	624,149
Referral letter	Document	GP Surgery	1,507,411	1,554,535
eMED3 (2010) new statement issued, not fit for work	Document	GP Surgery	742,166	735,779
Attachment	Document	GP Surgery	698,045	731,837

4.4.4 Quantifying clinical activity and consultations

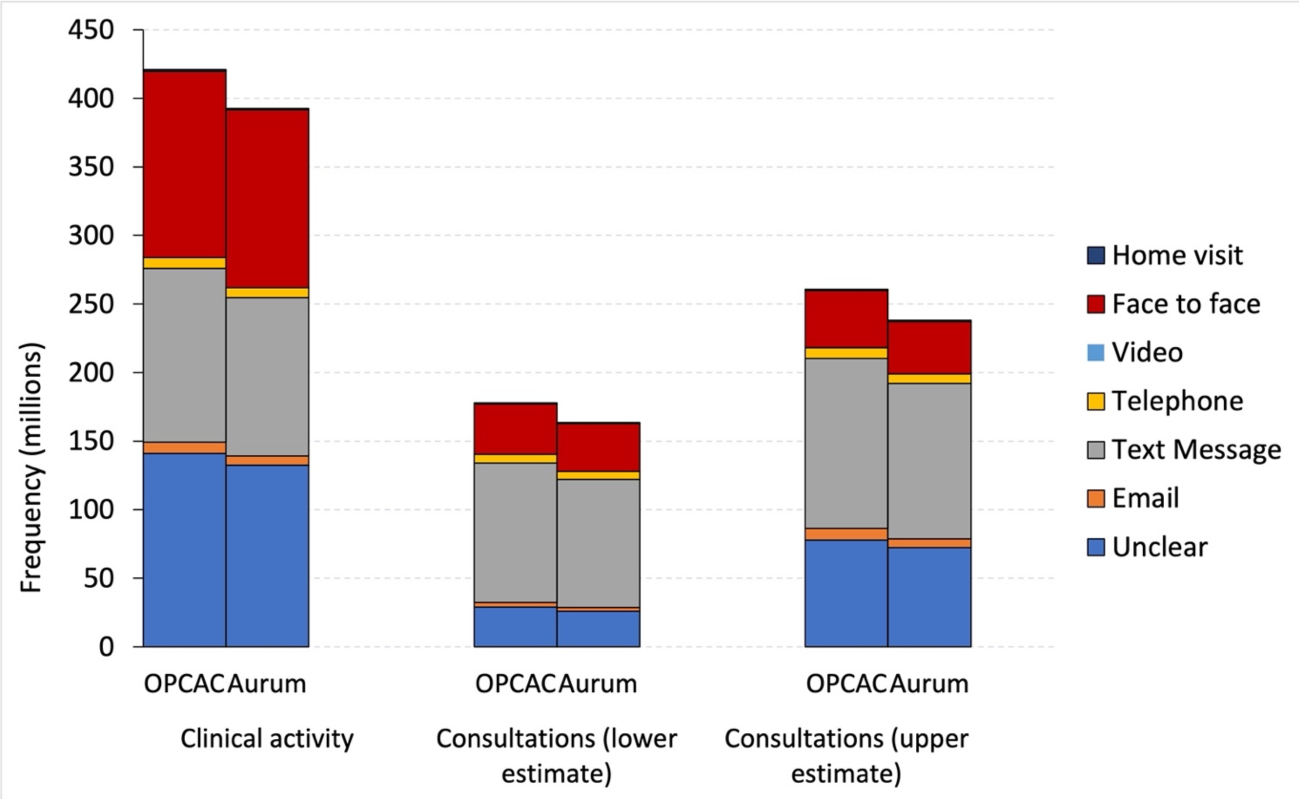
The quantity of clinical activity and lower and upper estimate of consultations between 1st September 2022 – 31st August 2023 is shown in Figure 4.3a. The distribution (OPCAC categories 1 – 7) of these clinical activities and consultations is shown in Figure 4.3b

*Figure 4.3 Quantity **(a)** and distribution **(b)** of clinical activity, lower estimate of consultations and higher estimate of consultations for the OPCAC and Aurum systems.*

a)



b)



The OPCAC captured an additional 28.4 million rows of clinical activity, corresponding to between 14.2 and 22.6 million consultations between 1st September 2022 – 31st August 2023. This is approximately 10% more than the Aurum systems which captured 392.6 million rows of clinical activity and between 163.5 million (lower estimate, one consultation/patient/day)– and 238.2 million (upper estimate, one unique consultation/ patient/day) consultations. This equates to approximately an additional 1.2 – 1.9 million consultations per month or 280,000 – 434,000 consultations a week that have not been counted in existing Aurum systems.

The distribution of categories for these clinical activities and consultations was similar between the OPCAC and Aurum systems. For clinical activity, the most frequently assigned category was unclear consultation (33.5%, OPCAC; 33.8%, Aurum), followed by face-to-face (32.3% OPCAC; 33.0% Aurum) and text message (30.1% OPCAC, 29.4% Aurum). For the lower estimate of consultations, the most frequently assigned category was text message (57.2% OPCAC; 57.2% Aurum), followed by face-to-face (20.7% OPCAC; 21.3% Aurum) and unclear consultation (16.2% OPCAC; 16.0% Aurum). For the upper estimate of consultations, the most frequently assigned category was text message (47.6% OPCAC; 47.5% Aurum) followed by unclear consultation (29.9% OPCAC; 30.4% Aurum) and face-to-face (15.9% OPCAC; 16.0% Aurum). Across all estimates, the number of home visit and video consultations were small. The number of home visits accounted for between 0.24 and 0.54% of the total clinical activity and consultations, and the number of video consultations accounted for 0.02 to 0.04% of the total clinical activity and consultations.

4.5 Discussion

4.5.1 Summary of findings

I have developed OPCAC, a primary care activity categorisation system that covers 96.6% of primary care activity codes (medcodeids) in the primary care electronic health record. This compares to 61.5% covered by the Aurum systems and translates into there being between 178.1 – 260.7 million consultations categorised with the OPCAC compared to 163.5 – 238.2 million consultations with the Aurum system between 1st September 2022 and 31st August 2023. This shows the Aurum system may have been underestimating the number of consultations taking place in UK primary care by approximately 10%. This has significant implications for workforce planning, general practice funding and overall health system policy.

Furthermore, the observed differences between OPCAC and the Aurum systems suggest systematic variation in how primary care activity is conceptualised across classification systems. As illustrated in table 4.5, OPCAC categorisations appear to align more closely with the apparent clinical context of the code descriptors. For example, classifying body mass index as face-to-face activity reflects the requirement for direct patient interaction, whereas classification as administrative activity, as the Aurum systems do, may underrepresent clinical contact. Conversely, the Aurum systems categorise informing patient of a named accountable general practitioner under GP surgery may imply a consultation where none occurred. The increase in activity classified as unclear consultation in OPCAC may reflect improved capture of primary care activity that could not be confidently assigned to a consultation mode using the Aurum systems. Importantly, the remaining consultation categories were similar to, or larger than, those identified using the Aurum systems, suggesting this did not occur at the expense of resolution within other consultation modes.

I anticipate this consultation categorisation system may be helpful for a broad range of researchers. I designed the OPCAC to be a flexible research tool for a range of research questions and associated methods: researchers can make use of the hierarchical nature of the OPCAC, collapse categories (e.g., combine video, text and email to a single remote category) or explore clinical activity data in association with clinical staff data to understand who does what in primary care. I will use this method in the subsequent chapter, to categorise consultation to understand what the rate of occurrence of brief intervention in face-to-face versus remote consultations for adults in English primary care, illustrating how this new method can be used to answer research questions.

4.5.2 Strengths and limitations

A strength of this study is the use of the large CPRD Aurum database, including all 1.2 billion rows of primary care activity data from 1st September 2022 – 31st August 2023. The OPCAC also categorises primary care administrative activity more completely than the Aurum systems, enabling the full range of primary care workload to be captured. The consultation categorisation system also has a hierarchical structure enabling more flexible use by researchers. For example, if more than one primary care activity code is entered for the same patient on the same day at the same time, then the higher (outcome number 1 to 14) consultation category could be used for that encounter. This is a pragmatic solution to a complex coding problem in a large real world dataset. In addition, I developed two ways of counting the number of consultations that reflect the reality of modern primary care, one that restricts the number of consultations to one/day/patient (a lower estimate) and another which counts unique consultation type, such as a telephone consultation followed by a face-to-face consultation, which may better reflect the reality of telephone triage and subsequent face-to-face consultation in modern digital first primary care. Whilst not necessary for my subsequent analysis, this gives future researchers flexibility with how to count consultations for their specific research question.

My analysis is limited to codes that were accurately recorded into the patient electronic health record, and so is potentially subject to recording bias. I could only analyse documented clinical codes and so potentially useful information in free text was not included. I aimed to categorise 96% of activity codes. In the end, 7,934 (96.6%) of activity codes were categorised and this was a pragmatic decision covering the most common clinical codes in the knowledge that most consultations include more than one code. The remaining 239,184 primary care activity codes that were not assigned an OPCAC accounted for only 3.4% of the data. These remaining activity codes were rarely used and would not meaningfully change the estimates of clinical activity or consultation numbers. Although the primary care activity codes were independently categorised by me and another academic GP, with discrepancies discussed with the wider team, there is the potential for misclassification of codes and incorrect consultation mode assignment. However, because of the quality control procedures, I expect this number to be small. A significant proportion of codes categorised by the OPCAC system were unclear consultation. Although these codes did not allow more detailed classification, they will still enable researchers to determine whether a consultation took place. In addition, because of the hierarchical nature of the OPCAC, many of these unclear consultation codes could be assigned a consultation mode through an accompanying activity code with a more specific consultation mode. This will enable me to have the best chance of identifying consultation mode when a brief intervention is recorded in the electronic health record in Chapter 6. There were also duplicate entries into the electronic health record that had different consultationids. Understanding what these rows represented was beyond the scope of this project, but it is likely that some incorrect data entry occurred. Finally, in the absence of a definitive truth for consultation mode classification within CPRD Aurum, it is not possible to confirm that all activity was categorised correctly. However, OPCAC was developed iteratively by practising GPs alongside database experts and aimed to improve the validity and completeness of consultation categorisation, making it likely to approximate real world clinical activity more closely than existing approaches.

4.5.3 Comparison to existing literature

The Royal College of General Practitioners (RCGP) online appointment data estimates that there were 349 million consultations in England in 2023, excluding COVID-19 vaccination appointments.[245] Extrapolating the results from this study population of 16.6 million people, gives a total of approximately 611.6– 895.3 million consultations (assuming an English population of 57 million).[246] Some of this increase is likely to represent true increased consultations captured, but may also represent different methods for counting text message consultations.[247] If text messages were excluded from this analysis, the OPCAC estimates 261.7-468.9 consultations, comparable with the RCGP estimate.

A study using CPRD Gold data found that in 2018-2019, the median total number of GP consultations per patient was 8.3 (IQR 7.0-9.7), of which 3.1 (2.5-3.9) were face-to-face consultations. The estimates in this study are slightly higher, which may reflect the additional data captured or differences in the mechanism by which data are entered into the electronic health record; 11.0 (lower estimate)- 15.7 (upper estimate) GP consultations per patient between 1st September 2022 – 31st August 2023. Excluding text message consultations results in 4.6 (lower estimate) -8.2 consultations (upper estimate) per patient. Of these, 2.2-2.5 are face-to-face consultations, which is lower than the CPRD Gold estimate. However, the OPCAC also includes several consultations for which the mode cannot be identified from the activity codes used, and it is likely that a number of these are also face-to-face consultations. Another study in the CPRD Gold database found that GP telephone consultation rates increased by 11.1% (95% CI 7.8-14.5) per year from 2007 to 2014, whereas GP home visits decreased steadily by 1.8% (95% CI 2.5 to 1.1) per year, but that these represented only 2% of consultations.[248] My results show a lower proportion (0.06%) of consultations as home visits which may reflect the requirement for the presence of a clinical code explicitly indicating that the consultation occurred as a home visit.

Categorising text messages is problematic in consultation categorisation systems. One study found that half of the increase in consultation rates seen in CPRD Aurum was due to the introduction of a single new code ‘Accurx consultations’, which is a text messaging communication service for patients.[247] I similarly found that a significant proportion of clinical activity was accounted for by text messaging consultations. The OPCAC has a specific consultation category for text messaging, so researchers have the option of including this category of consultation mode or not in their analysis. It is unclear how existing published data on consultation numbers manages this; whether they are excluded from analysis or counted in the same way as other remote consultation modes, both of which do not represent the reality of this consultation mode. Other studies have relied on the consultation and staff data given in the consultation table in CPRD Aurum to determine whether or not a consultation occurred.[249-251] However, these consultation categorisations have significant limitations, as our analysis shows that approximately 10% of consultations were probably excluded from the analysis, and over a third of administrative activity not included in workload estimates.

Similar challenges in the classification of routine primary care data have been reported elsewhere. The development of a research ready primary care data asset for Wales required substantial reclassification of electronic health record data to generate meaningful measures of service use, highlighting how data processing decisions can materially influence estimates of primary care activity.[252] Likewise, an analysis using the OpenSAFELY platform, identified Systematized Nomenclature of Medicine – Clinical Terms (SNOMED-CT) codes most relevant to online or remote consultations and used these code lists to quantify and examine patterns in consultation activity, they observed considerable variation in how online consultations were recorded between GP practices.[235] Similarly to my analysis, they found some of the most frequent codes used by practices were ambiguous in terms of consultation mode, for example ‘Encounter by computer link’ was found in 22.7% of practices in their cohort. Overall, these findings emphasise the need for transparent and consistent approaches to primary care activity categorisation in primary care research.

4.5.4 Implications for policy and practice

There are some future possibilities to increase accurate consultation mode recording. Firstly, digital scribes, if they can accurately use SNOMED CT clinical coding, could improve data entry and reduce GP documentation burden. There is some evidence that ambient voice to text artificial intelligence systems may improve data entry for clinical and research purposes in primary care.[253] Secondly, electronic health record templates have been shown to increase the accuracy of clinical coding and these could be adapted to include information about consultation mode.[230] Lastly, at the national level, efforts to reduce duplicate codes and make consultation codes clear would help to increase clinician confidence with integrating this type of coding into routine practice.[236] These changes at the clinician, practice and national level would reinforce each to other, acting to increase the accurate recording of consultation mode.

Understanding the number of consultations taking place and what modes are being used is important when planning health service delivery. Consultation data are analysed by NHS Digital to produce the NHS Digital GP appointment database, which is updated monthly.[232] However, this analysis uses predominantly data from the EMIS platform, with only 61.5% of activity codes being assigned an Aurum system consultation categorisation. Our results show firstly that the Aurum system categorisation may not accurately reflect the activity code entered into the electronic health record. For example, if the conssourceid categorisation indicates that a face-to-face consultation has taken place, the OPCAC categorisation will only be face-to-face in 37.98% of cases and if a consmedcodeid indicates a face-to-face consultation, this will be a face-to-face consultation in the OPCAC in 30.77% of cases. Secondly, this approach misses approximately 10% of consultations due to consultations being present in the 38.5% of data that lack an assigned consultationid. Finally, it does not account for the administrative workload in primary care. However, this existing consultation system has been used by thinktanks and medical institutions to advocate for greater investment into primary care.[245] My analysis suggests that these arguments could be made more compelling when the full dataset is used to calculate consultation numbers and non-consultation data considered, as in the OPCAC. For example, the Health Foundation found that there were record numbers of GP appointments in October 2024 (41.3 million), 3 million more than the year before.[254] They called on the government for greater investment in primary care to support the shift from hospital to community care. OPCAC suggests that the number of appointments delivered is likely to be higher and additionally captures additional non-consultation work that may further support investment arguments.

4.5.5 Conclusions

The complexity of this study has shown that information on primary care activity and consultation mode in routinely collected healthcare data should be a standardised metric, like prescriptions or laboratory results, that is reliably captured on clinical computer systems. Software companies should endeavour to standardise this type of data collection and ensure that it is straightforward to use in clinical practice, research, and policymaking. In the absence of such standardisation, the clinician coded system developed in this chapter is a more comprehensive method for categorising primary care activity than pre-existing approaches. The method I developed in this Chapter enabled me to conduct the analysis in Chapter 5.

5 What is the rate of occurrence of brief interventions in face-to-face versus remote consultations for adults in English primary care? An open cohort study of routinely collected healthcare data.

5.1 Summary

Brief interventions for smoking, excess weight, excess alcohol and physical activity have historically been delivered opportunistically in face-to-face consultations. However, today GPs deliver a hybrid mix of face-to-face and remote consultations. It is unclear how this has affected the amount of these types of interventions delivered in primary care. The aim of this chapter was to examine the likelihood of a brief intervention occurring according to consultation mode.

I conducted a mixed model logistic regression analysis of the electronic health record data of 10,630,465 people in Clinical Practice Research Datalink (CPRD) Aurum database from 1st January 2019- 31st December 2022. Patients were included if they were 18 years or older and registered with a GP practice during the study period. The number of brief intervention codes were tabulated by health behaviour, advice or referral and consultation mode. The primary analysis compared face-to-face consultations (face-to-face and home visits) to remote consultations (telephone, video, text, email combined). Secondary analysis further subdivided remote consultations into synchronous (telephone and video) and remote (text message and email) categories.

Out of a study population of approximately 10 million people, there were approximately 1 million weight management intervention codes per year; 500,000 alcohol intervention codes per year; and 900,000 physical activity codes per year. This is low compared to the prevalence of these risk factors in the population English population. The rates of smoking intervention (2 million codes per year) were at the level expected the prevalence of smoking in England. However, across all health behaviours advice was given much more frequently than referral. During the four year study period, out of the total number of brief intervention codes for each health behaviour, approximately 5% of smoking cessation codes; 15% of weight management codes; 0.3% of alcohol codes; and 6% of physical activity codes were for referral for further support.

Key preventive care interventions (smoking cessation, weight management, excess alcohol and physical activity) are significantly less likely to occur in remote consultations compared to face-to-face consultations (OR 0.10; 95% CI 0.10, 0.11) after adjusting for key patient demographics, staff type and comorbidity score. This pattern was consistent for both synchronous telephone or video consultations (OR 0.21; 95% CI 0.21, 0.21) as well as asynchronous text and email consultations (OR 0.09; 95% CI 0.09, 0.09).

Interventions for weight management, excess alcohol and physical activity occur at lower levels in primary care than their prevalence in the population would suggest. Referrals for support with all behavioural risk factors occur significantly less frequently than advice. Brief interventions are significantly less likely to occur in remote consultations compared to face-to-face consultations after adjusting for key patient demographics, staff type and comorbidity score. This pattern was consistent for both synchronous telephone or video consultations as well as asynchronous text and email consultations. If the NHS is to deliver on the aim of the 10 year plan to prioritise prevention, greater attention must be given to how preventive care can be effectively integrated into remote and digitally mediated consultations in the community.

5.2 Introduction

In Chapter 3, quantitative findings suggested broadly similar levels of preventive care activity in telephone and face-to-face consultations, whereas qualitative data highlighted constraints and some opportunities associated with delivering this type of care generally across all consultation modes and specifically during a remote consultation. However, the quantitative component was based on a small sample of practices and consultations, limiting statistical power and resulting in imprecise estimates. As such, uncertainty remains about whether preventive care delivery truly differs by consultation modality, particularly when accounting for patient characteristics and the type of staff member they consult with.

This chapter builds directly on Chapter 3 by leveraging a substantially larger dataset to provide more precise estimates of preventive care delivery across consultation types. The analysis is enabled by the consultation categorisation system developed in Chapter 4, which allows routine primary care data to be classified into meaningful consultation modes, including home visit, face-to-face, video, telephone, email, text message and unclear consultation. By applying this system at scale, this analysis can examine preventive care delivery with greater granularity than has previously been possible.

Therefore, the objectives in this chapter were to examine the likelihood of a brief intervention occurring according to consultation mode. The primary analysis compared face-to-face consultations (face-to-face and home visits) to remote consultations (telephone, video, text, email combined) and the secondary analysis further subdivided remote consultations into synchronous (telephone and video consultations) and asynchronous (email and text message) modes. In addition, this chapter explored whether occurrence of brief intervention delivery by consultation mode differed according to patient age, sex, ethnicity, socioeconomic status, number of comorbidities, or type of staff member they consulted with.

5.3 Methods

5.3.1 Study population

Patients were included in the study if they were adults aged 18 or above, registered with a general practice in England from the 1st of January 2019 to the 31st of December 2022. Patients entered the study on the latest date of either the date the study started, the date their GP practice's data was assessed to be at the required standard, or the date of registration with their GP practice. Patients were excluded at that point they received a palliative code, because patients who were actively dying were not considered suitable for preventive interventions. Patients left the study on the earliest date of their date of death; the date they deregistered with their GP practice; the last date of their GP practice's data download to CPRD or the study end date.

5.3.2 Consultation mode codes

All eligible patients' CPRD records were assessed to determine whether they had a consultation, and if so, what the mode of consultation was. I used the method I developed in Chapter 4, the Oxford Primary Care Clinical Activity Categorisation system (OPCAC) to determine consultation mode. The OPCAC describes seven consultation modes where 1 = Home visit; 2 = Face-to-face; 3= Video; 4 = Telephone; 5 = Text message; 6 = Email and 7 = Unclear consultation. Category 7 (unclear consultation) was included in frequency tables but was not included in this analysis, as I only included consultations where I was confident of the consultation mode.

Where more than one consultation-related observation occurred for the same individual on the same day, a single observation was retained and classified according to a predefined hierarchy. Each observation was assigned the lowest-ranked category (from 1 to 6 as defined in OPCAC), such that higher-priority consultation types took precedence. This approach accounted for instances in which multiple modes of contact occurred on the same day for the same clinical problem. For example, a telephone consultation followed by a face-to-face consultation on the same day was classified as a face-to-face consultation. Similarly, where both investigations (such as blood tests) and a telephone consultation occurred on the same day, the clinical encounter where preventive action was most likely to occur was classified as a consultation, in this case the telephone consultation.

5.3.3 Brief intervention codes

Outcomes of interest included the offer of advice or referral for further support for the four main behavioural risk factors that can feasibly be addressed in primary care. These are:

Table 5.1 Categories of outcome brief intervention codes used for CPRD analysis

Outcome	Definition
Smoking cessation advice	Codes for smoking advice, brief intervention, offer of support, written information
Smoking cessation referral	Codes for referral to smoking cessation nurse/ counsellor/ service
Weight management advice	Codes for weight management advice or dietary advice for weight loss
Weight management referral	Codes for referral to weight management programme/ service/ clinic
Alcohol advice	Codes for advice about alcohol intake, problem drinking
Alcohol referral	Codes for referral to alcohol misuse service/ clinic/ nurse
Physical activity advice	Codes for advice about physical activity or exercise
Physical activity referral	Codes for exercise/ gym/ physical activity referral

I developed these code lists in collaboration with two other academic GPs who checked them for completeness. All occurrences of these brief intervention codes were extracted from the eligible patient cohort for the duration of the study. Full details of these code lists are given in Appendix 8.

5.3.4 Covariates

Data were extracted on a range of factors that could independently influence whether a consultation occurred face-to-face or remotely based on my clinical knowledge of consulting patterns and the wider literature.[81] Sociodemographic characteristics included age (modelled as a continuous variable in years), sex (binary variable: women or men), ethnicity (categorical variable: Asian, Black, White, Mixed, Other, or Unknown), area-level deprivation measured by the Index of Multiple Deprivation (IMD) and classified into quintiles, Office for National Statistics (ONS) region (categorical variable of nine regions of England) and staff type (categorical variable: GP or doctor, nurse or allied healthcare professional, administrative or managerial, and missing or unknown). Multimorbidity was accounted for using the Cambridge multimorbidity score, a validated measure in UK primary care datasets that predicts hospital admission and mortality.[255] The score is calculated based on the presence of 20 predefined long-term conditions: hypertension; anxiety or depression; chronic pain; hearing loss; irritable bowel syndrome; asthma; diabetes mellitus; coronary heart disease; chronic kidney disease; atrial fibrillation; constipation; stroke or transient ischaemic attack; chronic obstructive pulmonary disease; connective tissue disorders; cancer; alcohol problems; heart failure; dementia; psychosis or bipolar disorder and epilepsy.

5.3.5 Statistical analysis

I first generated descriptive statistics to characterise the study cohort and consultation activity during the study period (1 January 2019 to 31 December 2022). These included the total number of individuals in the cohort, baseline demographic characteristics (age, sex, ethnicity, region and IMD score), the total number of consultations, the number and percentage of consultations by consultation mode (home visit, face-to-face, telephone, video, text message and email), and the total number and the percentage of consultations that contain brief interventions (advice and referral) delivered overall and for each health behaviour over the study period.

5.3.5.1 Primary analysis

The primary analysis examined the association between consultation mode, face-to-face vs remote and the likelihood of a brief intervention being delivered. I initially intended to use a mixed model logistic regression analysis with a patient level random intercept to model the occurrence of a brief intervention (advice or referral) according to whether the consultation was conducted face-to-face or remotely. I planned to use the random intercept to account for the fact that people in the cohort could contribute more than one consultation (non-independence). However, due to the very large size of the dataset (444 million consultations) this was computationally infeasible with models requiring extremely long run times, potentially extending to weeks or months for individual analyses. I therefore used logistic regression models with robust standard errors clustered at the patient level, which provide valid inference when there is patient level correlation and can be used as an alternative to mixed-effects models in large-scale datasets.[256] These two modelling approaches were compared in a sensitivity analysis using a subset of the data (see 5.3.5.4 Sensitivity analysis).

The primary adjusted model additionally included age, sex, ethnicity, IMD score, ONS region, staff type, and the baseline Cambridge multimorbidity score. This fully adjusted model constituted the main analysis.

5.3.5.2 Missing data

Missing covariate data (ethnicity, age, sex, IMD, staff group and ONS region) were handled using the missing indicator method in the primary analysis, with missing values coded as a separate category.[257] The validity of the missing indicator method is hard to assess.[258] This is an evolving field and this method was chosen in part due to the infeasibility of multiple imputation for this analysis (due to quantity of data and computing power required as described above). Complete case analysis was performed as a sensitivity analysis to assess the robustness of this method.

5.3.5.3 Secondary analyses

Four secondary analyses were specified a priori. Firstly, to explore whether associations differed by type of remote consultation (contemporaneous vs non-contemporaneous), I conducted an analysis in which consultation mode was reclassified from a binary variable to a categorical variable: face-to-face and home visits; telephone and video consultations; and email and text message consultations.

Secondly, I repeated primary analysis after excluding home visits from the in-person consultation category, such that the reference group consisted of face-to-face consultations only. This was done to account for the possibility that clinician behaviour differs between face-to-face consultations conducted in surgery settings and those conducted as home visits.

Thirdly, to examine whether the association between consultation mode and brief intervention delivery was similar for different outcomes, the primary analysis was repeated for each outcome (smoking cessation advice; smoking cessation referral; weight management advice: weight management referral; alcohol advice: alcohol referral; physical activity advice and physical activity referral).

Lastly, I examined heterogeneity in the association between consultation mode and brief intervention delivery by fitting interaction terms within the fully adjusted logistic regression models. Interaction terms were assessed to determine whether the association between consultation mode and brief intervention delivery differed across population subgroups. Interactions were assessed for age, sex, ethnicity, IMD score, staff group and the Cambridge multimorbidity score. Where there was evidence of interaction ($p<0.05$), I conducted stratified subgroup analyses to aid interpretation. For example, to assess whether the association between consultation mode and brief intervention delivery varied by age, an interaction term between consultation mode and age was included in the adjusted model alongside all main effects.

5.3.5.4 Sensitivity analyses

I performed four prespecified sensitivity analyses to assess the robustness of the findings. Firstly, I repeated the primary analysis using complete case data only, including records with no missing covariate information. Secondly, I repeated the primary analysis using only the first consultation per patient to evaluate the robustness of the findings to non-independence of observations arising from multiple consultations contributed by the same individual. Thirdly, I conducted a stratified analysis in which patients were categorised by consultation frequency into low (first quartile), medium (second quartile), high (third quartile), and very high (fourth quartile) groups, to explore whether the primary analysis was confounded by the frequency of consultation. Lastly, I compared estimates from mixed-effects logistic regression and clustered logistic regression using a random subsample of 100,000 patients to assess whether the choice of modelling approach for within patient clustering affected the magnitude of the association.

5.3.5.5 Multiple testing

No formal adjustment for multiple testing was undertaken; therefore, findings were interpreted cautiously, with consideration given to the number of statistical comparisons performed. Emphasis was placed on effect sizes and confidence intervals rather than statistical significance alone.

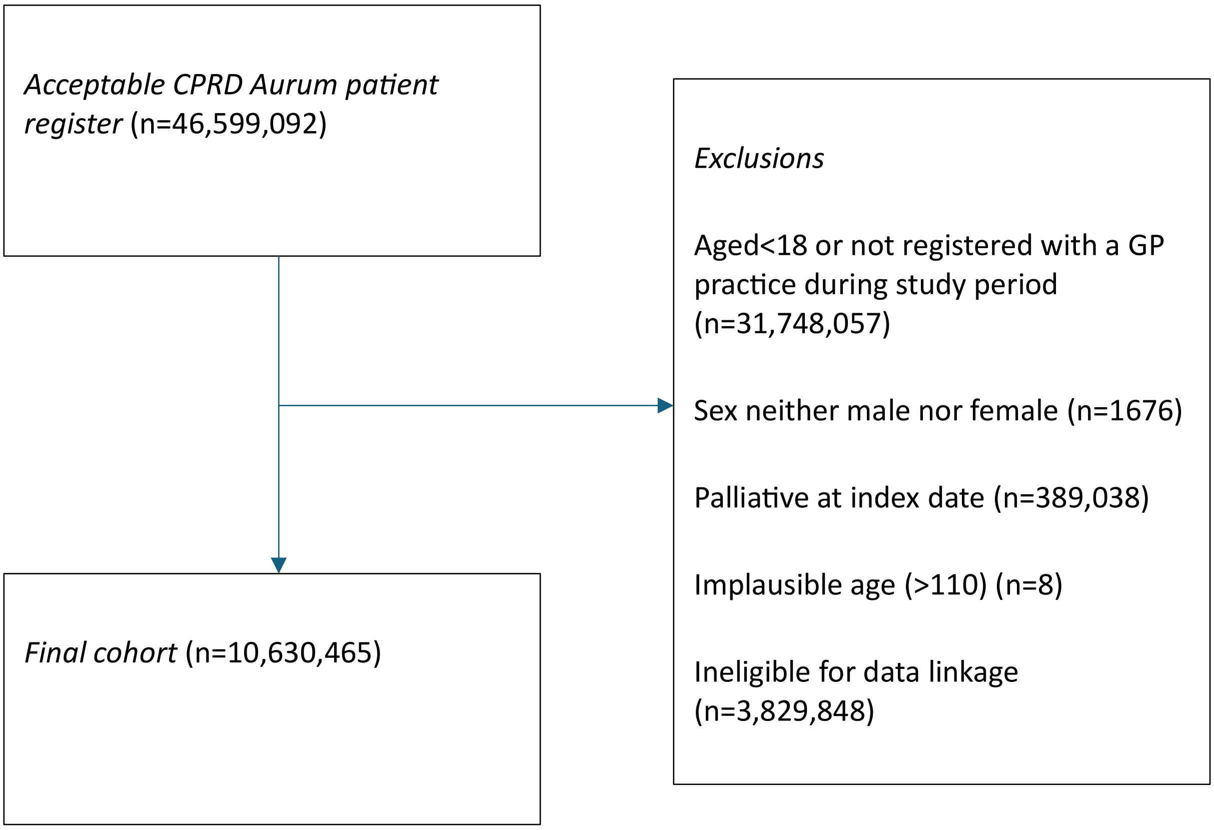
5.3.6 Ethical approval

The protocol for this study was approved by CPRD on 7/12/2023, ID: 23_003466.

5.4 Results

From a total of 46,599,092 patients in the CPRD Aurum database, a total of 10,630,465 patients were eligible for inclusion in the study. Details of how this cohort was defined are detailed in Figure 5.1. Attrition across the cohort selection process primarily related to restrictions necessary for valid linkage and analysis, including eligibility for linked datasets, registration requirements and data quality standards applied within CPRD Aurum.

Figure 5.1 Flow chart through the study



5.4.1 Baseline characteristics

The 10,630,465 people in the cohort contributed 42.8 million patient-years of electronic health record data for a median follow up of 5.0 years (IQR 3.23-5.00 years) between 1st January 2018 and 31st December 2022. Baseline demographic data are shown in Table 5.2.

Table 5.2 Baseline demographic information of study cohort

	n (%)
Age (years)	
18–34	3,715,294 (34.9%)
35–60	4,562,588 (42.9%)
>60	2,352,583 (22.1%)
Sex	
Women	5,378,738 (50.6%)
Men	5,251,727 (49.4%)
Region	
Northeast	325,888 (3.1%)
Northwest	1,914,922 (18.0%)
Yorkshire and The Humber	405,638 (3.8%)
East Midlands	280,412 (2.6%)
West Midlands	1,646,998 (15.5%)
East of England	464,727 (4.4%)
London	2,185,562 (20.6%)
Southeast	2,122,254 (20.0%)
Southwest	1,284,064 (12.1%)
Ethnic group	
Asian	1,073,189 (10.1%)
Black	480,058 (4.5%)
Mixed/Multiple	179,831 (1.7%)
White	8,320,847 (78.3%)
Other	93,705 (0.9%)
Unknown	482,835 (4.5%)
Index of multiple deprivation (IMD) quintile	
1 (most deprived)	2,000,433 (18.9%)
2	2,238,844 (21.1%)
3	2,093,592 (19.8%)
4	2,130,507 (20.1%)
5 (least deprived)	2,129,995 (20.1%)

The cohort was broadly reflective of the English population, with 50.6% women and 78.3% of White ethnicity. Participants were distributed approximately evenly across IMD quintiles, with each quintile comprising around one fifth of the cohort (ranging from 18.9% in the most deprived to 21.1% in quintile 2). The distribution of ethnic groups in the study population was similar to that observed in the wider English population.[259] Small differences between the regional distribution observed in this study and ONS population estimates are expected because CPRD Aurum does not sample practices uniformly across England and regional population coverage varies.[242]

During the five year period of this study, the cohort experienced 443,639,757 consultations. 17,646,792 (4.0%) of these consultations contained any of the pre-specified brief intervention codes for smoking cessation, weight management, alcohol or physical activity. The distribution of consultation modes is given in Table 5.3

Table 5.3 Distribution of consultation modes for study cohort between 1st January 2018 – 31st December 2022

Consultation mode	**Total consultation numbers, n (%)**	**Any brief intervention code, n (% of total)**
Home visit	940,375 (0.2)	25,491 (2.7)
Face-to-face	116,368,265 (26.2)	11,576,471 (10.0)
Video	226,682 (0.1)	2095 (0.9)
Telephone	18,219,393 (4.1)	354,783 (2.0)
Text message	200,369,399 (45.2)	1,627,387 (0.8)
Email	4,816,127 (1.1)	34,386 (0.7)
Unclear	102,699,516 (23.1)	4,026,179 (3.9)
Total	443,639,757	17,646,792 (4.0)

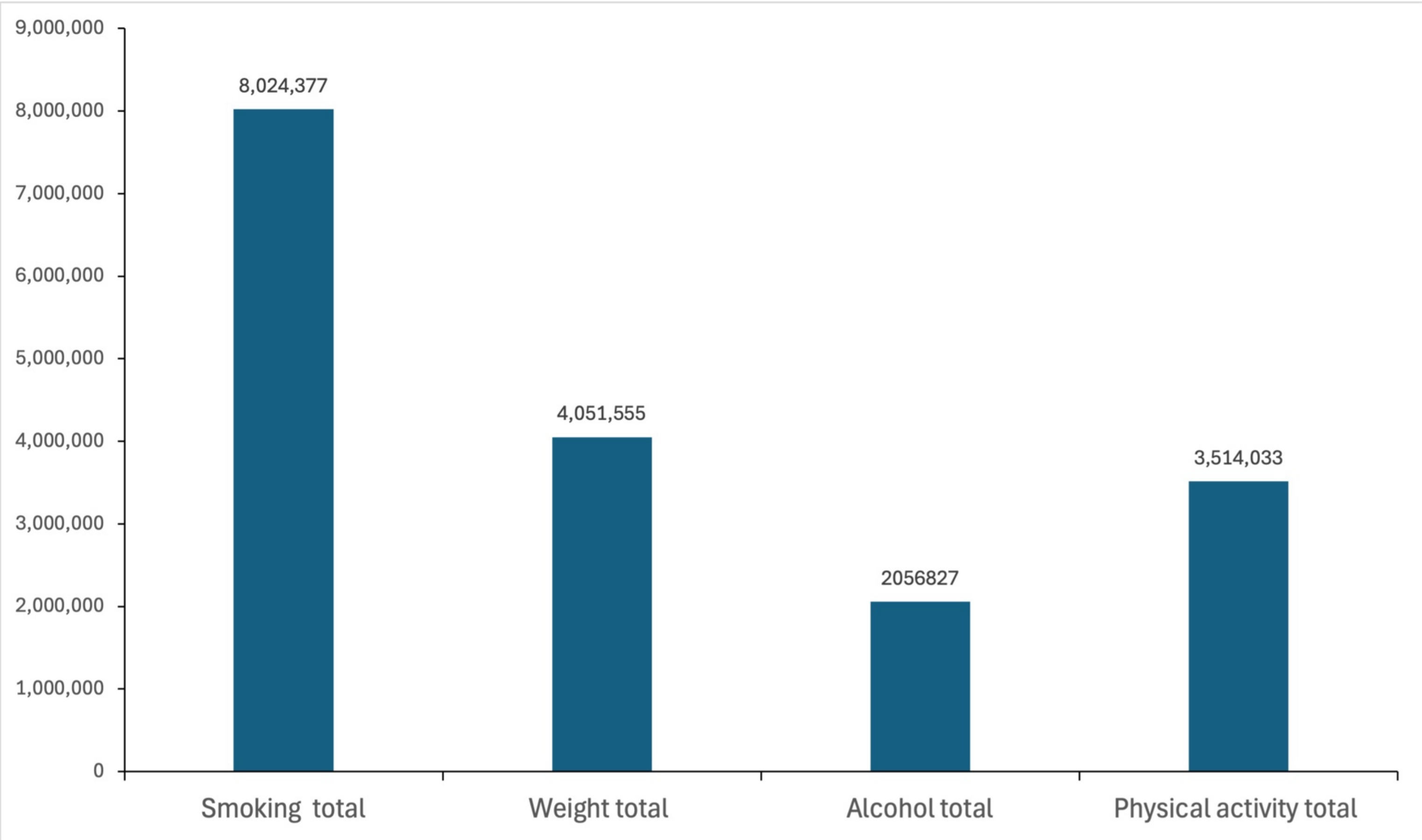
Out of the total 443 million consultations captured, 45% of these were text message encounters, 26% were face-to-face consultations and 4% were telephone. It was not possible to determine consultation mode for 23% of consultations. Ten percent of face-to-face consultations had a brief intervention code, 2% of telephone consultations had a brief intervention code and 0.7% of text message encounters had a brief intervention code. Of consultations with an unclear mode, approximately 4% had a recorded brief intervention code.

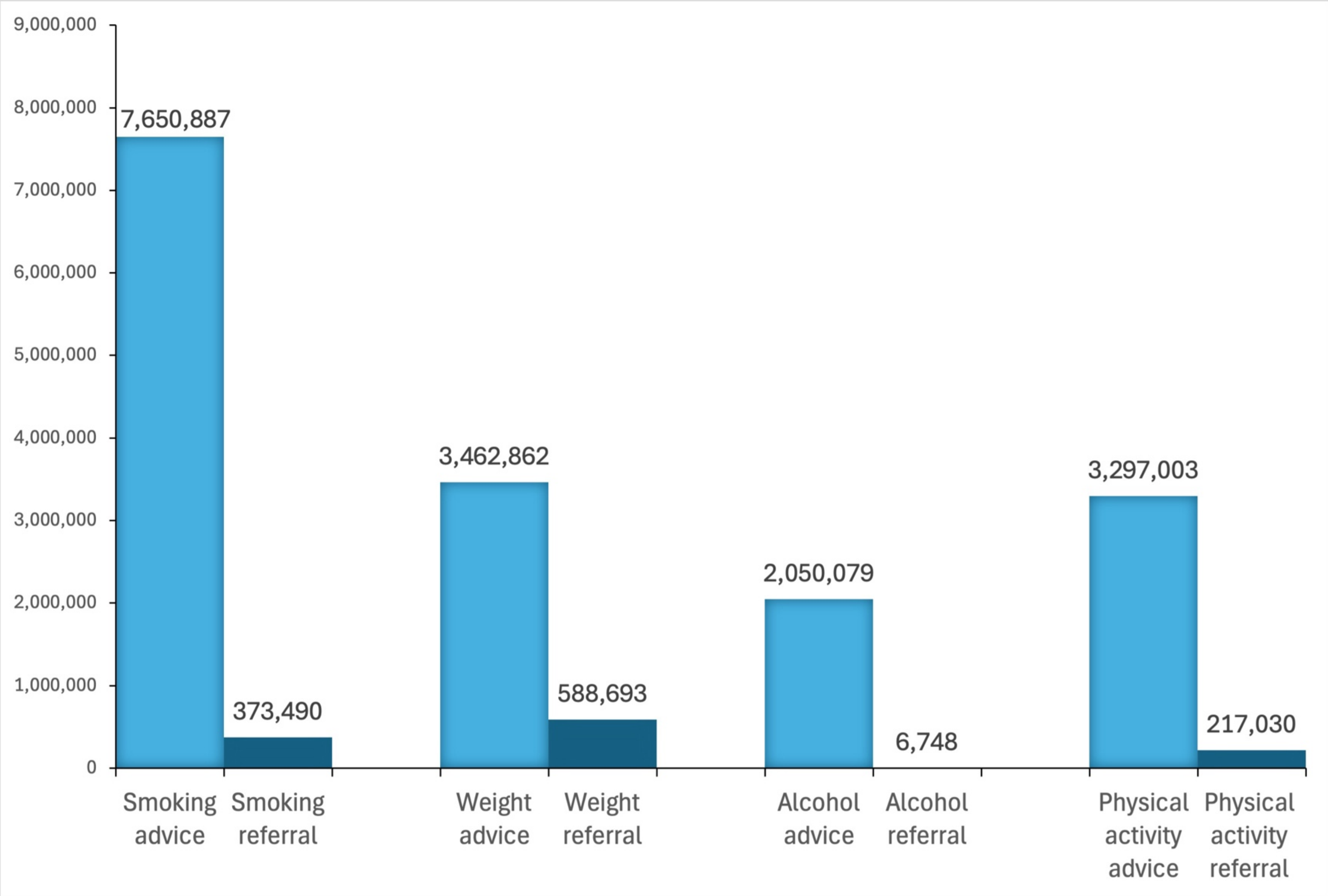
5.4.2 Distribution of brief interventions by health behaviour and consultation mode

I then tabulated the number of brief interventions, overall and then for advice and referral for each health behaviour. Then I tabulated the number of brief interventions for advice and referral for each health behaviour by consultation mode separately. The full tables can be found in the Appendix 9. Figures 5.2 and 5.3 illustrate these distributions graphically.

Figure 5.2 Frequency of brief intervention codes for smoking cessation, weight management, excess alcohol and physical activity a) overall and b) by advice and referral during all coded consultations (n= 443,639,757) during the study period 1st January 2019 – 31st December 2022

a)

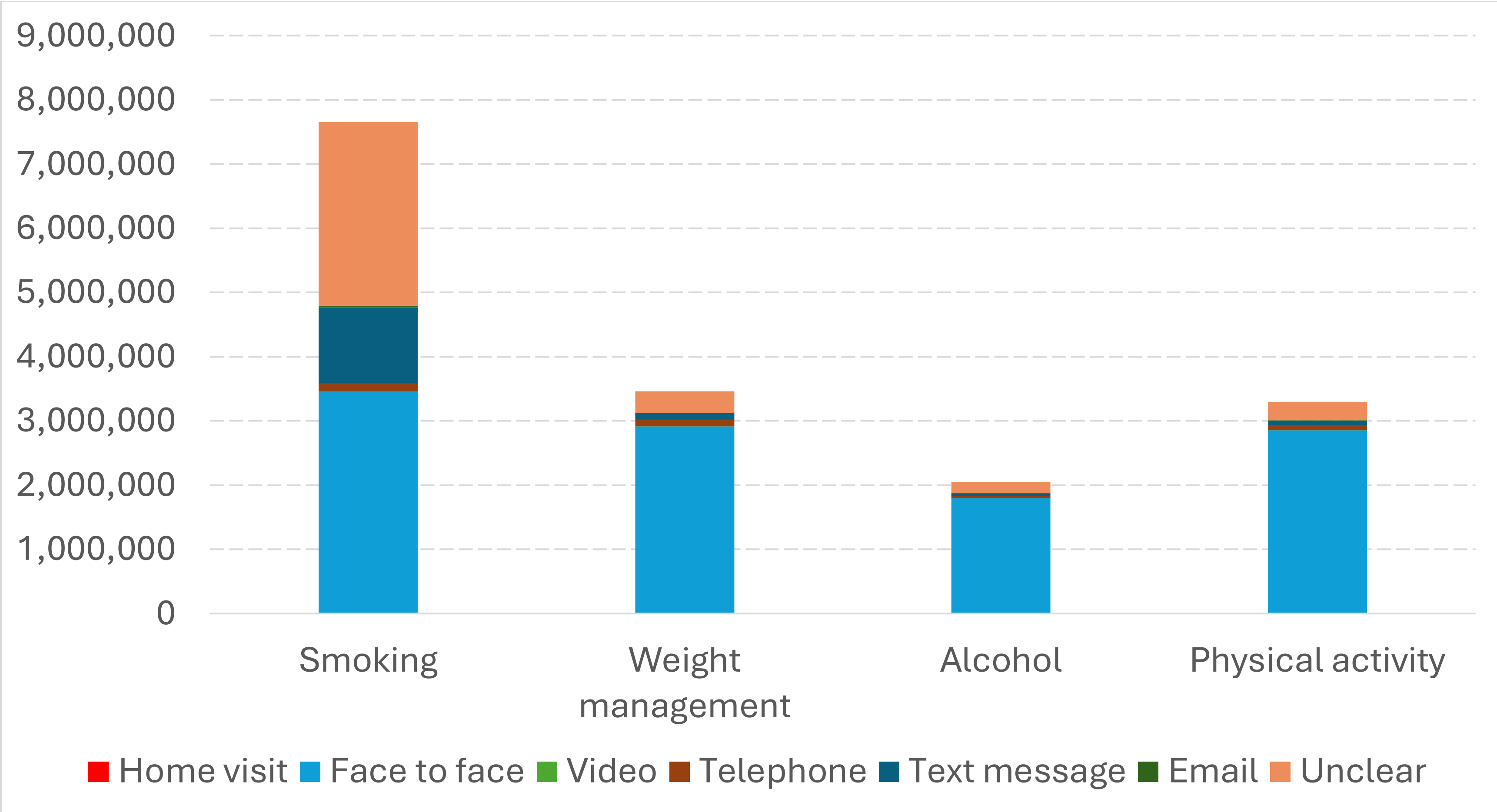



9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
7,650,887
373,490
3,462,862
588,693
2,050,079
6,748
3,297,003
217,030
Smoking advice
Smoking referral
Weight advice
Weight referral
Alcohol advice
Alcohol referral
Physical activity advice
Physical activity referral

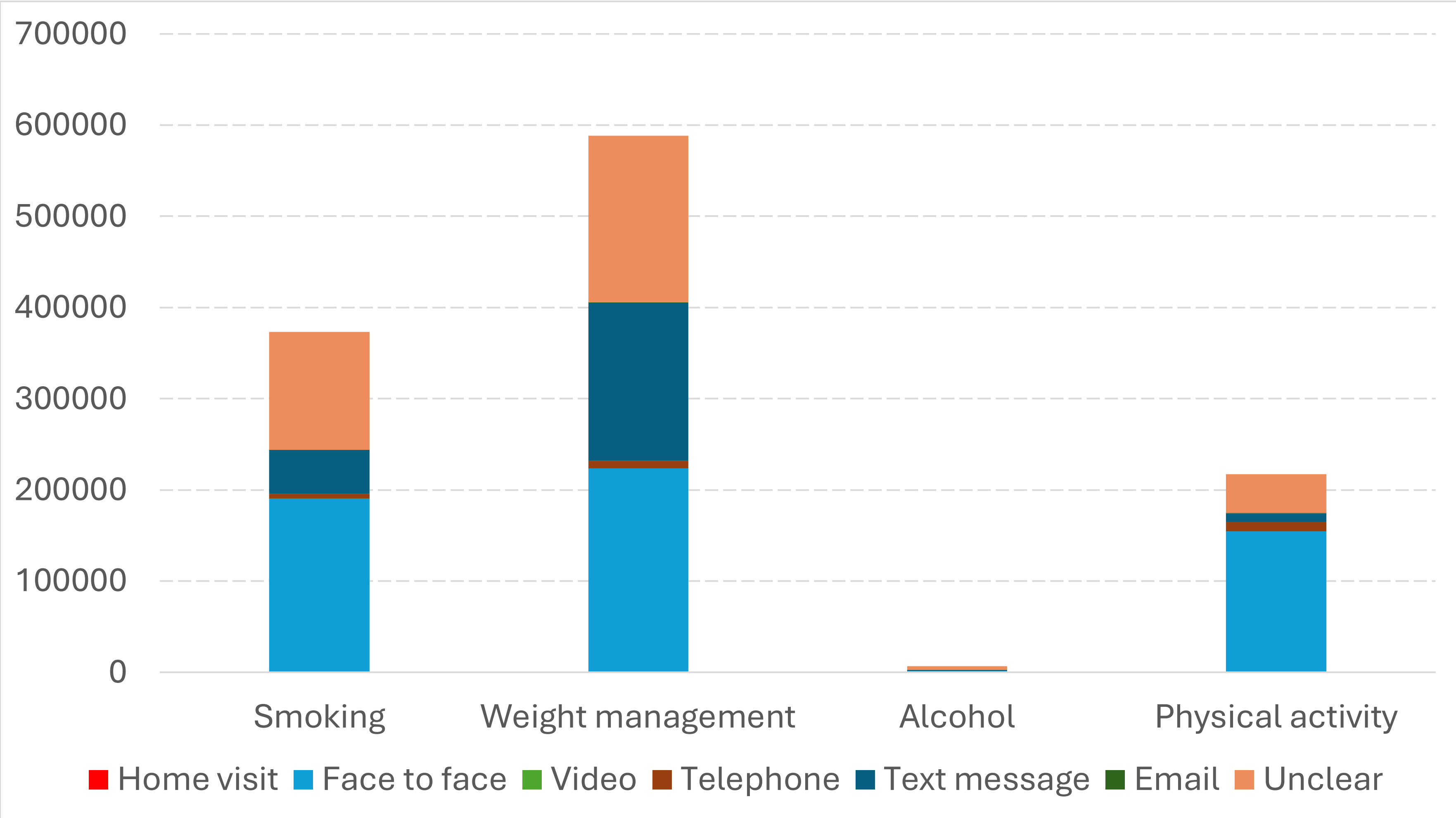
b)

Figure 5.3 Frequency of brief intervention codes by target health behaviour and consultation mode for a) advice and b) referral during all coded consultations (n= 443,639,757), during the study period 1st January 2019 – 31st December 2022

a)



b)


700000
600000
500000
400000
300000
200000
100000
0
Smoking
Weight management
Alcohol
Physical activity
Home visit
Face to face
Video
Telephone
Text message
Email
Unclear

5.4.2.1 Overall distribution of brief intervention codes

Over the five-year period, the number of recorded advice and referral codes varied across health behaviours. Smoking cessation advice and referral was the most frequently recorded (7.65 million advice; 0.73 million referral), whereas lower numbers were observed for weight management (3.46 million advice; 0.59 million referral), physical activity (3.30 million advice; 0.22 million referral) and alcohol (2.05 million advice; 6,748 referral), and. Across all health behaviours, advice was recorded more frequently than referral for further support.

5.4.2.2 Distribution of brief intervention advice codes by consultation mode

Of all recorded advice codes for each health behaviour, the majority of weight management (84%), alcohol (88%) and physical activity (86%) advice codes were delivered during face-to-face consultations. In contrast, smoking cessation advice was less frequently recorded face-to-face (45%), with 15% delivered via text message and 37% recorded under unclear consultation modes.

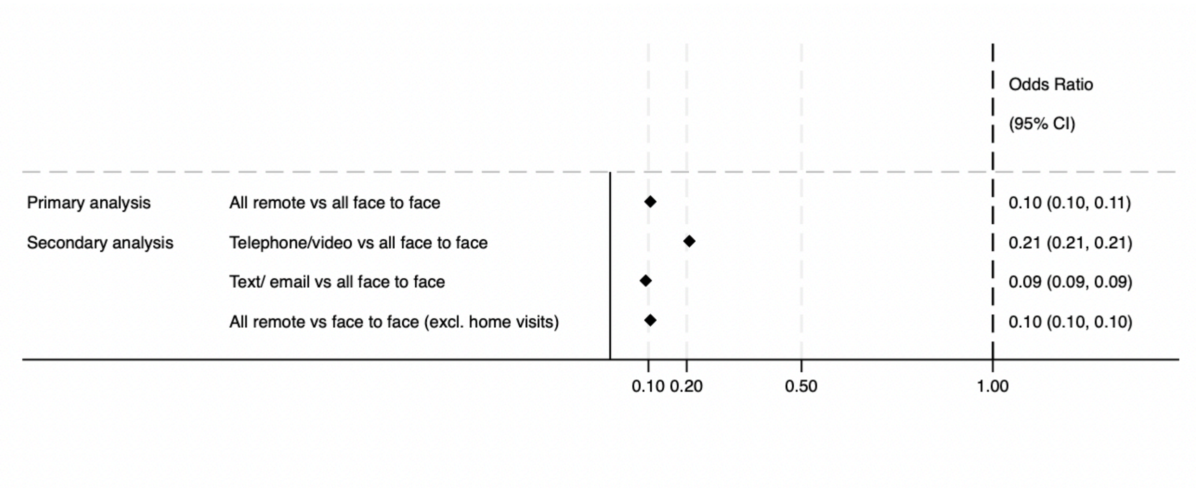
5.4.2.3 Distribution of brief intervention referral codes by consultation more

Consultation modes varied across referral for different health behaviours. For smoking cessation referrals, 51% occurred face-to-face, 13% via text message, and 35% were recorded as unclear. For weight management referrals, 38% occurred face-to-face, 29% via text message, and 31% were unclear. Physical activity referrals were mostly face-to-face (71%), with 5% via telephone, 4% via text message, and 19% unclear. The number of alcohol referral codes was low (n = 6,748), limiting interpretation of consultation mode distribution for this category.

5.4.3 Likelihood of brief intervention delivery by consultation mode

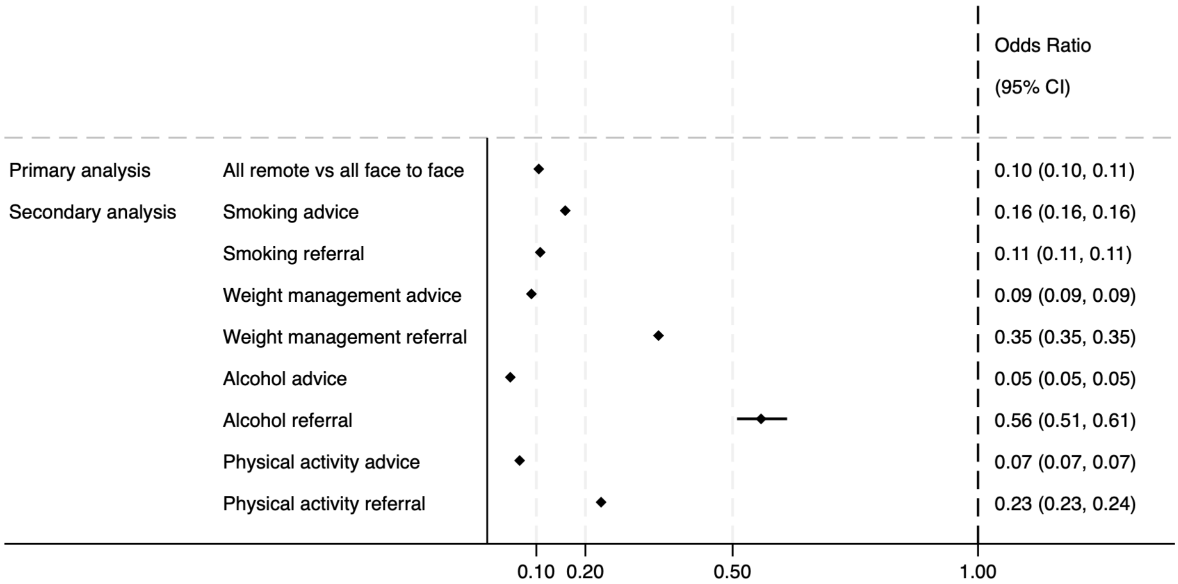
The fully adjusted primary analysis showed that preventive care was significantly less likely to occur in a remote consultation than a face-to-face consultation (OR 0.10; 95% CI 0.10, 0.11). This association was seen for both synchronous telephone/video consultations compared to face-to-face consultations (OR 0.21; 95% CI 0.21, 0.21) and more extreme for asynchronous text/email consultations compared to face-to-face consultations (OR 0.09; 95% CI 0.09, 0.09), and when home visits were excluded from the face-to-face consultation category (OR 0.10; 95% CI 0.10, 0.10). These results are displayed in the Forest plot in Figure 5.4.

Figure 5.4 Forest plot of adjusted odds ratios (95% confidence intervals) from the primary and secondary logistic regression analyses examining the association between consultation mode and brief intervention delivery using all available data from the study population (n= 10,630,465), 1st January 2019 – 31st December 2022



I then ran the primary analysis for each of the health behaviour subgroups. Results of this analysis are displayed in Figure 5.5.

Figure 5.5 Forest plot of adjusted odds ratios (95% confidence intervals) from the secondary logistic regression analyses examining the association between consultation mode and brief intervention advice or referral delivery for each health behaviour using all available data from the study population (n= 10,630,465), 1st January 2019 – 31st December 2022

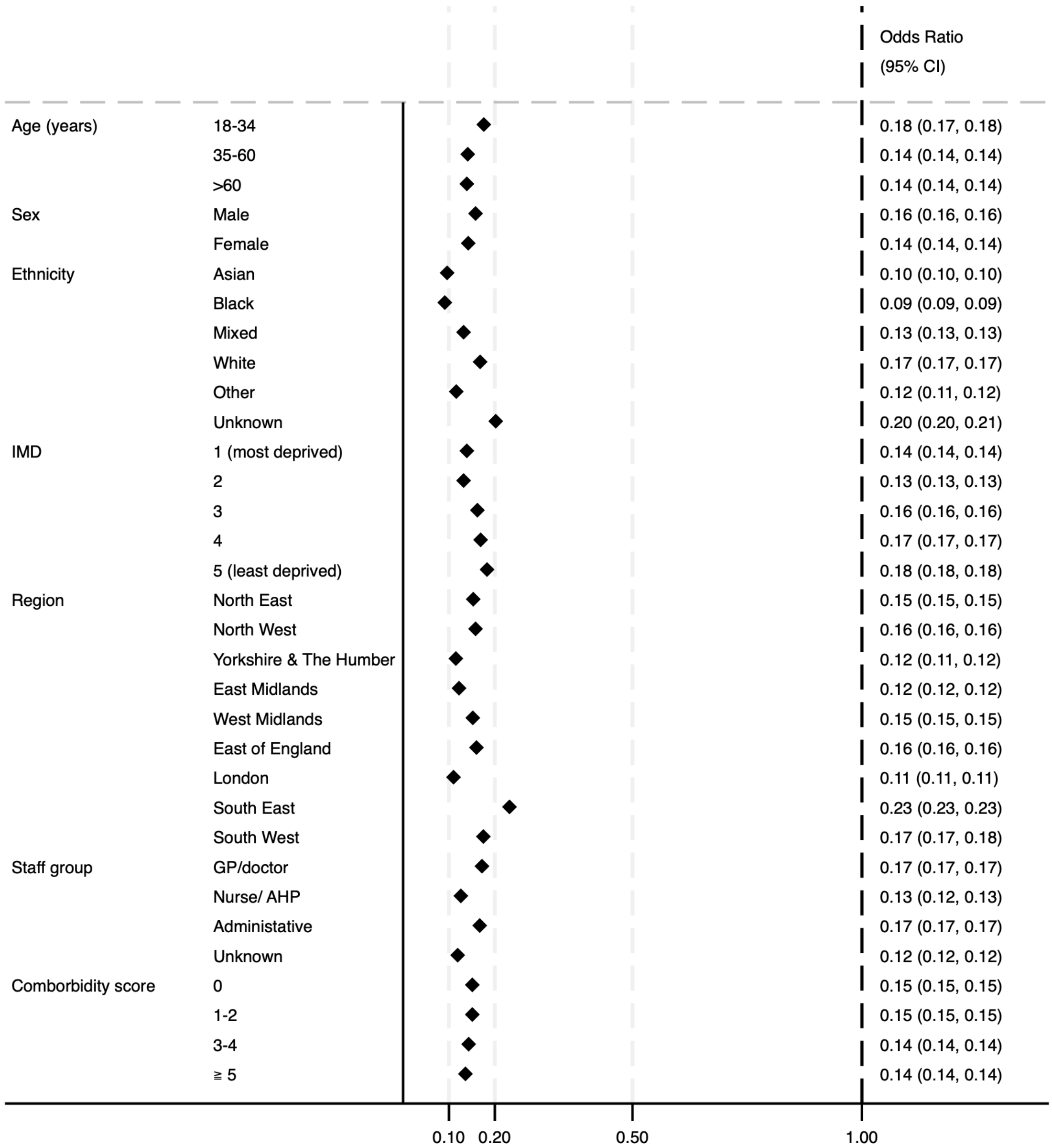


Across all health behaviour categories, preventive interventions involving advice or referral were less likely to be delivered during remote consultations compared with face-to-face consultations. The magnitude of this association varied by health behaviour. The smallest odds ratios were observed for alcohol advice (OR 0.05; 95% CI 0.05, 0.05) and physical activity advice (OR 0.07; 95% CI 0.07, 0.07). In contrast, higher odds ratios were observed for alcohol referral (OR 0.56; 95% CI 0.51, 0.61) and weight management referral (OR 0.35; 95% CI 0.35, 0.35). Across all health behaviours except smoking, referral had a higher odds ratio implying that a referral is relatively more likely to be made remotely compared to advice.

5.4.4 Subgroup analysis

Initially, I assessed potential effect modification by key covariates (age, sex, ethnicity, IMD, comorbidity score, staff group and region) by including interaction terms with consultation mode (remote vs face-to-face). There was statistical evidence of interaction for all covariates ($p<0.001$). This was explored further in subgroup specific models (Figure 5.6)

Figure 5.6 Forest plot of adjusted odds ratios (95% confidence intervals) from the subgroup logistic regression analyses examining the association between consultation mode and brief intervention delivery according to age, sex, ethnicity, deprivation, region, staff type and number of comorbidities, using all available data from the study population (n= 10,630,465), 1st January 2019 – 31st December 2022



Across all subgroups, preventive interventions involving advice or referral were less likely to be delivered during remote consultations than during face-to-face consultations. However, there was evidence of heterogeneity in the magnitude of association across patient level, clinician level and practice level factors. Comparatively attenuated associations were observed among adults aged 18 to 34 years (OR 0.18; 95% CI 0.17,0.18), men (OR 0.16; 95% CI 0.16,0.16), individuals of White (OR 0.17; 95% CI 0.17,0.17) or Unknown (OR 0.20; 95% CI 0.20,0.21) ethnicity, those living in the least deprived areas (OR 0.18; 95% CI 0.18,0.18) and those in the South East region (OR 0.23; 95% CI 0.23,0.23), suggesting these groups were relatively more likely to receive brief interventions remotely. In contrast, Asian (OR 0.10; 95% CI 0.10,0.10) and Black (OR 0.09; 95% CI 0.09,0.09) ethnic groups and those from London (OR 0.11; 95% CI 0.11, 0.11) showed the lowest odds ratios, indicating the greatest relative reductions in remote brief intervention delivery. GPs/doctors (OR 0.17; 95% CI 0.17,0.17) and administrative staff (OR 0.17; 95% CI 0.17,0.17) were slightly more likely to deliver brief interventions remotely than nurses/allied healthcare professionals (OR 0.13; 95% CI 0.12,0.13) or unknown (OR 0.12; 95% CI 0.12,0.12) staff type. There was little variation according to comorbidity score. Despite subgroup variation, the direction of association was highly consistent across all groups, with all confidence intervals remaining below the null value.

5.4.5 Sensitivity analysis

Complete case analysis included 85.3% of the study population(n=382,902,699). Results were similar, with an odds ratio of 0.15 (95% CI 0.15-0.15). When the population was divided into quartiles of consultation volume over the study period, there was evidence of marginal reduced likelihood of preventive care delivery remotely compared to face-to-face as consultation volume increased. The odds ratio for Q1 (low consultation volume) was 0.27 (95% CI 0.26,0.27); for Q2 (medium consultation volume) was 0.19 (95% CI 0.19, 0.19); for

Q3 (high consultation volume) was 0.16 (95% CI 0.16, 0.16); and for Q4 (very high consultation volume) was 0.13 (95% CI 0.13, 0.13). When consultations were restricted to first consultation only (n= 10,362,972), the effect size was similar to the primary analysis (OR 0.13; 95% CI 0.13,0.13).

Using a random subsample of patients (n=100,000) with 4,320,642 consultations, results from mixed-effects logistic regression and clustered logistic regression were consistent in direction and magnitude. The robust standard errors approach gave an odds ratio of 0.11, 95% CI 0.10, 0.11; SE 0.0015) compared with 0.09 for the mixed-effects model (95% CI 0.09, 0.09; SE 0.0008) with no material difference in interpretation, supporting the use of the clustered model in the primary analysis.

5.5 Discussion

5.5.1 Summary of findings

Key preventive care interventions to reduce risk of chronic disease (smoking cessation, weight management, excess alcohol and physical activity) are significantly less likely to occur in remote consultations compared to face-to-face consultations (OR 0.10; 95% CI 0.10, 0.11) after adjusting for key patient demographics, staff type and comorbidity score. This pattern was consistent for both synchronous telephone or video consultations (OR 0.21; 95% CI 0.21, 0.21) as well as asynchronous text and email consultations (OR 0.09; 95% CI 0.09, 0.09). There was some evidence that this effect varied by type of brief intervention code, whether advice or referral. Alcohol advice and physical activity advice showed the strongest associations with consultation mode, with substantially lower odds of delivery during remote consultations compared with face-to-face consultations (OR 0.05; 95% CI 0.05,0.05 and OR 0.07; 95% CI 0.07, 0.07 respectively). In contrast, associations were less pronounced for referral codes, especially alcohol referral (OR 0.56; 95% CI 0.51, 0.61) and weight management referral (OR 0.35; 95% CI 0.35, 0.35). This may reflect differences in how advice and referral interventions are delivered in practice. Referral pathways are often standardised and may be more easily facilitated through remote systems such as electronic templates, text messaging or online signposting, whereas advice based interventions may depend more on conversational flow and interpersonal interaction. In the case of smoking, smoking cessation advice appeared comparatively more likely to occur remotely than smoking referral. One possible explanation is that smoking advice has been strongly embedded within routine primary care through Quality and Outcomes Framework (QOF) incentives and standardised electronic templates, which may facilitate delivery and recording of advice during remote consultations.[147]

There was also some evidence that the effect varied by type of health behaviour being discussed. Smoking advice (OR 0.16; 95%CI 0.16,0.16) and referral (OR 0.11; 95%CI 0.11,0.11) were the most comparable, suggesting these types of interventions are similarly approached in remote consultations. In contrast, there was a wider discrepancy between alcohol advice (OR 0.05; 95% CI 0.05, 0.05) and alcohol referral (OR 0.56; 95%CI 0.51,0.61), suggesting these are treated differently, with alcohol referral comparatively more likely to be delivered remotely. This may reflect a similar pattern to that observed in Chapter 3, where alcohol related interventions were associated with follow up telephone consultations to discuss abnormal liver function tests.

Across all demographic, socioeconomic, and staff subgroups, preventive interventions involving advice or referral were consistently less likely to be delivered during remote consultations than during face-to-face consultations. Although there was evidence of heterogeneity in the magnitude of association between subgroups, the overall differences in effect size were relatively modest, suggesting limited clinical significance at the individual level despite statistical evidence of interaction. However, comparatively greater reductions in remote brief intervention delivery among Black and Asian ethnic groups and those living in the most deprived areas remain concerning from a population health perspective. These groups experience a disproportionate burden of behavioural risk factors and poorer health outcomes, and there is evidence that people living in more deprived areas may also face greater barriers to accessing face-to-face primary care. Consequently, even relatively small differences in preventive care delivery may contribute to widening health inequalities when applied across large populations.

There was limited variation in effect size according to comorbidity score, which was unexpected given that patients with greater multimorbidity may be anticipated to have more frequent healthcare contact and therefore greater opportunity for preventive intervention delivery. One possible explanation is that preventive discussions in patients with higher comorbidity burden may be deprioritised in favour of managing acute or competing clinical concerns. Alternatively, remote consultations may constrain preventive care delivery similarly across levels of clinical complexity, regardless of consultation frequency.

5.5.2 Strengths and limitations

This study has several important strengths. Firstly, it draws on a very large, nationally representative dataset, comprising over 10 million patients and more than 400 million consultations recorded from a four year period from 1st January 2019 – 31st December 2022. This includes a period when consulting was not disrupted by the pandemic. The CPRD Aurum database is widely recognised as broadly representative of the UK population, enhancing the generalisability of the findings to routine primary care practice.[242]

Secondly, this is, to my knowledge, the first study to quantify the delivery of key preventive activities to reduce the risks of chronic disease in UK primary care in the context of increasing use of remote consultations. Given the growing policy emphasis on prevention and the desire to transition to more digital delivery of care within the NHS 10 year plan, this analysis is both timely and highly relevant to current health system priorities.[171]

Thirdly, the analysis accounts for a wide range of potential confounders, including patient level, clinician level, and practice level characteristics known to be associated with the delivery of brief interventions. This strengthens the internal validity of the findings. Finally, the categorisation of consultation mode was developed through clinician led input in collaboration with database experts. This approach ensures that the classification is grounded in real world clinical practice and improves the validity of the exposure definition.

This study also has several limitations. As with all observational analyses using routinely collected data, there is potential for unmeasured confounding. Variables not captured within the CPRD, such as consultation complexity, clinician workload, or patient preferences, may influence both consultation mode and the likelihood of delivering brief interventions. There is also the potential for reverse causality in the observed association between consultation mode and delivery of preventive activities. Consultations conducted remotely may differ systematically in their purpose or clinical complexity, such that encounters less conducive to preventive discussions are more likely to be undertaken remotely. In this scenario, lower rates of preventive activity in remote consultations would reflect differences in consultation case mix rather than an effect of consultation mode itself. As such, residual confounding by indication cannot be excluded, and the findings must be interpreted as associations rather than causal effects and should prompt further scrutiny.

There may also be differences in the accuracy and completeness of coding between remote and face-to-face consultations. If coding practices vary systematically by consultation mode, this could introduce bias. For example, if brief interventions are less consistently recorded in one consultation type, the observed differences may reflect coding practices rather than true differences in care delivery. Furthermore, as with most studies using electronic health record data, it was not possible to analyse free text data within the electronic health record. This is particularly relevant for text message encounters, where a lot of the content of text messages is hidden inside the message and not formally coded. Preventive discussions may have been recorded in free text rather than through structured coding and would therefore not be captured in this analysis. However, there is no evidence to indicate that the use of free text recording differs systematically between remote and face-to-face consultations.

Consultations were also restricted to one per patient per day. While some patients may have had multiple consultations on the same day, it was not possible within the coding structure to reliably link specific brief interventions to individual consultation modes. Therefore, only the intervention associated with the highest ranking consultation mode was included, which may have led to misclassification. Finally, a proportion of consultations could not be categorised by mode and were excluded from the analysis. The impact of this exclusion is uncertain. If the likelihood of missing consultation mode is associated with specific patient, clinician, or consultation characteristics, this could introduce selection bias.

5.5.3 Comparison to existing literature

As described in Chapter 1, the literature addressing differences between remote and face-to-face consultations in primary care has been predominantly qualitative or mixed method, focussing on overall safety, issues of access and continuity of care. There have been a small number of quantitative studies focussing on remote cardiovascular secondary prevention. One US study looked at the impact of remote consulting (telemedicine), on specific clinical assessments, specifically blood pressure or cholesterol measurement. They found that blood pressure assessment was less common during remote consultation than a face-to-face consultation (9.6% vs 69.7% for blood pressure; $p<0.01$) and that this pattern was also observed in cholesterol level assessment (13.5% vs 21.6% for cholesterol; $p < .001$).[85] A smaller Spanish study also found reductions in the recorded incidence rate of hypercholesterolaemia (IRR 2020 vs 2019 0.61; 95% CI (0.54-0.68)) and hypertension (IRR 2020 vs 2019 0.62; 95% CI (0.54-0.70)) amongst many other diseases in a remote versus a face-to-face appointment.[260] The results from this study support and extend these results with more a more significant effect size (primary analysis: OR 0.10; 95% CI 0.10, 0.11) seen for behavioural preventive interventions compared to cardiovascular secondary prevention. This may be because discussing this type of care requires greater reliance on visual and relational cues when discussing potentially stigmatising health behaviours, as discussed in Chapter 3.

Evidence from consultation level interaction analyses also supports this interpretation. One study using the Roter Interactional Analysis System (RIAS) to conduct an analysis of 34 consultations in different healthcare settings found that, although the overall types of talk between the two consultation modes were broadly the same, face-to-face consultations contained a higher proportion of pauses and mutual silences, suggesting potentially important differences in conversational dynamics that warrant further investigation..[261] The authors suggested that these pauses may play an important role in enabling opportunities for the patient to raise concerns. As I found in Chapter 3, patients often volunteer information about their health behaviours. It could be that pauses in the consultation are important for both patient raising of preventive topics that are important to them and act as an opportunity for clinicians to deliver opportunistic preventive care to reduce the risk of chronic diseases. When these conversational pauses are absent or reduced as in remote consultations, the interactional opportunity to deliver this type of care is less easily found.

In contrast to the findings of the present study, a systematic review reported that remote or virtual consultations were as effective as face-to-face care for outcomes including alcohol use, smoking cessation, and weight management.[239] The authors concluded that remote consultations may represent an effective alternative to face-to-face care in primary care settings. However, the studies included in this review were predominantly intervention trials in which participants were pre-screened and randomised to receive either remote or face-to-face management and were conducted in healthcare systems that differ from that of England. For example, individuals with alcohol use problems were randomised to receive mobile phone based or in person support in Kenya;[262] smokers in Japan were randomised to receive internet based or face-to-face smoking cessation support in primary care;[263] and patients in rural United States primary care settings were pre-selected and randomised to receive clinic based or telephone delivered behavioural interventions for weight management.[264] These studies therefore evaluate the efficacy of interventions once delivered, rather than how such interventions are accessed and implemented in routine clinical practice. As a result, they do not address the implementation challenge identified in this study: that patients were substantially less likely to receive preventive advice or referral during remote consultations than during face-to-face consultations. The findings from this study therefore extend the existing literature by demonstrating that, although preventive interventions may retain effectiveness across consultation modes once initiated, the opportunity for these interventions to occur appears to differ markedly in routine primary care. This distinction is particularly important in the context of opportunistic prevention, where behavioural interventions are frequently embedded within consultations conducted for unrelated healthcare concerns.

In other contexts, electronic health record data has been used to examine variation in care delivery by consultation mode. For example, one study looked at the rates of antibiotic prescribing for common infections face-to-face vs remotely in the CPRD database. They found that adults had a 23% greater chance of being prescribed antibiotics remotely than face-to-face, suggesting that consultation mode may influence clinical decision making and the content of care delivered. [265] The findings from this study similarly demonstrate that consultation mode shapes the type of care delivered in routine primary care, although in this case for behavioural preventive interventions rather than prescribing decisions. Prescribing decisions for acute infections may be protocol driven and require rapid resolution, whereas preventive care to reduce the risk of chronic diseases may rely on rapport building and contextual cues. Therefore, this study extends the existing literature by demonstrating that the impact of consultation mode on care delivery is likely to differ according to the type of care being delivered and the interactional work required within the consultation.

5.5.4 Implications for policy and practice

The number of interventions for weight management, excess alcohol and physical activity delivered in English primary care is disproportionately low for the prevalence of these risk factors in the population. Out of a study population of approximately 10 million people, there were approximately 1 million weight management intervention codes per year; 500,000 alcohol intervention codes per year; and 900,000 physical activity codes per year.

This is low compared to the prevalence of overweight/obesity (approximately 60%), of physical inactivity (approximately 30%) and of alcohol consumption associated with higher rate of harm (approximately 20%). [159 160] The rates of smoking intervention (2 million codes per year) were at the level expected for a smoking prevalence of 13% in the English population.[158] However, across all health behaviours advice was given much more frequently than referral. During the four year study period, out of the total number of intervention codes for each health behaviour, approximately 5% of smoking cessation codes; 15% of weight management codes; 0.3% of alcohol codes; and 6% of physical activity codes were for referral for further support. This is concerning given that referral to structured support services is recognised as one of the more effective components of behavioural brief interventions. [4 5] These findings suggest that primary care systems may currently be more effective at identifying behavioural risk factors and providing brief advice than at connecting patients with sustained behavioural support.

The findings have important implications for both policy and practice. If prevention is to become a central function of primary care, as outlined in successive NHS policy documents, greater attention and training is required not only to encourage clinicians to raise behavioural risk factors, but also to strengthen the infrastructure, pathways, and capacity required to support onward referral and long term behaviour change support. This may include improving integration between primary care and community services, simplifying referral pathways, and ensuring equitable local provision of accessible services. The comparatively higher rate of smoking intervention delivery may reflect the longstanding integration of smoking cessation into primary care through financial incentives, established referral pathways, and national infrastructure, highlighting the potential importance of system level investment and implementation support for other behavioural risk factors. Chapter 3 discusses several of the consultation and health system barriers to effective referral identified by GPs, while Chapter 6 examines implementation strategies that may support improved integration of preventive care into routine practice.

Furthermore, the findings from this study suggest that preventive care remains disproportionately concentrated within face-to-face consultations, despite the widespread adoption of hybrid models of primary care combining face-to-face and remote delivery and the stated direction of travel, from analogue to digital, of the NHS 10 year plan.[171] This raises important questions regarding how preventive care can be more effectively integrated into remote and digitally mediated consultations. Telephone consultations are often structured as shorter and more time constrained interactions, which may be less conducive to discussions around smoking, weight management, alcohol use, and physical activity. Clinicians may perceive telephone consultations as a less appropriate setting for initiating potentially sensitive behavioural discussions. However, there is also a risk that assumptions regarding the suitability of consultation mode for preventive care may contribute to missed opportunities for intervention during remote consultations that might otherwise have occurred in face-to-face encounters. Consideration should therefore be given to how digital technologies could be used more proactively to support the delivery of preventive care. For example, the continued development of the NHS App presents an opportunity to facilitate targeted access to preventive services, potentially using routinely recorded data such as smoking status or BMI to prompt engagement with relevant interventions.[266] In Chapter 7, I discuss in more detail options for greater integration of preventive interventions into primary care.

The use of text messaging as a modality for delivering aspects of preventive care warrants careful consideration. On the one hand, follow up messages, such as providing details of local smoking cessation services after a consultation, may offer a practical means of supporting patients. On the other hand, the observation that text messaging is most frequently used for activities that are financially incentivised, such as smoking cessation advice and weight management referral, raises the possibility that care delivery may become reduced to minimal actions required to meet incentive thresholds. There is therefore a risk that the use of digital tools could inadvertently facilitate a more transactional, tick box approach to preventive care. Policy frameworks and incentive structures should be designed to ensure that the use of technology supports meaningful patient engagement, rather than enabling superficial compliance with performance indicators.

As demonstrated in Chapter 2 and again in this study, the overall level of coded evidence of referral for smoking cessation, weight management, excess alcohol and physical activity across primary care is low, given their prevalence in the population. If the NHS is to achieve its stated aim of increasing preventive care activity, improving the delivery of such interventions within routine practice will be essential. Chapter 6 examines the evidence for a range of implementation strategies that may support improvements in the delivery of preventive care in primary care.

5.5.5 Conclusions

Interventions for smoking cessation, weight management, excess alcohol and physical activity are significantly less likely to occur in remote consultations compared to face-to-face consultations after adjusting for key patient demographics, staff group and comorbidity score. This pattern was consistent for both synchronous telephone or video consultations as well as asynchronous text and email consultations. Most GP practices in England now operate a hybrid face-to-face and remote model of care. If the NHS is to deliver on its ambition to prioritise prevention, greater attention must be given to how preventive care can be effectively integrated into remote and digitally mediated consultations.

6 Strategies to improve the implementation of preventive care in primary care: A systematic review and meta-analysis

6.1 Summary

Action on smoking, obesity, excess alcohol, and physical inactivity in primary care is effective and cost effective, but as shown in the previous chapter, implementation is low. The aim of this chapter was to examine the effectiveness of strategies to increase the implementation of preventive healthcare in primary care.

Eight databases were searched from inception through 5 October 2023 with no date of publication or language limits. Randomised trials, non-randomised trials, controlled before-after studies and interrupted time series studies comparing implementation strategies (team changes; changes to the electronic patient registry; facilitated relay of information; continuous quality improvement; clinician education; clinical reminders; financial incentives or multicomponent interventions) to usual care were included. Two reviewers screened studies, extracted data, and assessed bias with an adapted Cochrane risk of bias tool for Effective Practice and Organisation of Care reviews. Meta-analysis was conducted with random-effects models. Narrative synthesis was conducted where meta-analysis was not possible. Outcome measures included process and behavioural outcomes at the closest point to 12 months for each implementation strategy.

85 studies were included comprising of 4,210,946 participants from 3,713 clusters in 71 cluster trials, 6,748 participants in 5 randomised trials, 5,966,552 participants in 8 interrupted time series, and 176,061 participants in 1 controlled before after study. There

was evidence that clinical reminders (OR 3.46; 95% CI 1.72-6.96; I^2=89.4%), clinician education (OR 1.97; 95% CI 1.50-2.59; I^2=81.1%), facilitated relay of information (OR 1.95, 95% CI 1.10 – 3.46, I^2=88.2%), and multicomponent interventions (OR 3.10; 95% CI 1.60 – 5.99, I^2=96.1%) increased processes of care. Multicomponent intervention results were robust to sensitivity analysis. There was no evidence that other implementation strategies (team changes; changes to the electronic patient registry; continuous quality improvement; or financial incentives) affected processes of care or that any of the implementation strategies improved behavioural outcomes. No studies reported on interventions specifically designed for remote consultations. Limitations included high statistical heterogeneity, and many studies did not account for clustering.

Multicomponent interventions and clinical reminders may be the most effective implementation strategy. There was no evidence that implementation interventions improved behavioural outcomes.

NOTE: This study has been published as a peer-reviewed journal article:

- **Heath L** et al. Strategies to improve the implementation of preventive care in primary care: a systematic review and meta-analysis. BMC Medicine. 2024. https://doi.org/10.1186/s12916-024-03588

6.2 Introduction

Primary healthcare professionals are well placed to deliver brief interventions for smoking, weight management, excess alcohol and physical inactivity. Yet, as shown in Chapter 2 and Chapter 5 and the wider literature, they rarely do.[142 267 268] For example, in the UK in 2020, the rate of advice for weight management (8 events per hundred patients per year), physical inactivity (4 events per hundred patients per year) and excessive alcohol intake (4 events per hundred patients per year) was low compared to the prevalence of overweight or obesity (approximately 60%), of physical inactivity (approximately 30%) and of harmful alcohol consumption (approximately 20%) [159 160 170].

Given their clinical and cost-effectiveness, governments and health systems have attempted to increase the implementation of this type of preventive healthcare.[269 270]. Numerous health strategies, most recently the NHS 10 year plan, have highlighted the need for the health system to transition away from focussing on treatment of established disease to prevention of disease to improve quality of life and reduce healthcare expenditure.[271] This systematic review addresses this policy objective.

I conducted a systematic review and meta-analysis to examine the effectiveness of different health system and health professional level implementation strategies compared to usual care, in adults in a primary healthcare setting to increase both process and behavioural outcomes for smoking, obesity, excessive alcohol consumption and physical inactivity to inform future health policy action. The way primary health care is being delivered is also changing as more consultations are being delivered remotely (via telephone, video, email or text message), and this may affect implementation efforts as discussed in Chapter 3.[272 273]

Therefore, I also aimed to examine the effectiveness of implementation strategies in both remote and face-to-face consultations.

6.3 Methods

A full protocol was prospectively published on the International Prospective Register of Systematic Reviews (PROSPERO).[274] This followed the Cochrane Effective Practice and Organisation of Care (EPOC) guidelines for an implementation systematic review and is reported according to the preferred reporting items for systematic reviews and meta-analysis (PRISMA) statement.[275 276]

6.3.1 Data sources and searches

I searched Cumulative Index to Nursing and Allied Health Literature (CINAHL), The Cochrane Central Register of Controlled Trials (CENTRAL), The Cochrane Database of Systematic Reviews, Dissertations & Theses – Global, Excerpta Medica Database (Embase), Europe PubMed Central (Europe PMC), Medical Literature Analysis and Retrieval System Online (MEDLINE) and Psychological Information Database (PsycINFO) for studies until 5th October 2023. The references of included studies were manually searched for studies missed in the database search. An example search strategy is included in Appendix 10.

6.3.2 Study selection

The population considered for inclusion were adult patients seeking primary health care, where interventions for behaviour change happen opportunistically. If adolescents were also included in the study population, I only analysed the participants over the age of 18. If it was not possible to separate those under 18 from adult participants, I only included the study if the average age of participants was over 18 years. In this review I used the NHS England definition of primary care, including the general practice multidisciplinary team, community pharmacy, dental and optometry services .[277] When it was unclear whether a study was conducted in primary care, a decision was made in consultation with my supervisory team, considering whether this was the first point of contact for the patient in the healthcare system. I included cluster randomised trials (cRT), cluster non-randomised trials (cNRT), randomised trials (RT), controlled before-after studies (CBA) and interrupted time series (ITS) studies.

Exclusion criteria were adults seeking care for established disease e.g., weight loss as a treatment for type 2 diabetes, and people who were receiving palliative care. There were no date or language restrictions.

Interventions included were those both at the health system and health professional level and these were compared to usual care. I categorised implementation strategies in a comprehensive (in that all strategies could be included) and well-defined (in that it was clear which strategy went in which category) way. This study uses an adapted taxonomy from the EPOC group.[278 279] This approach has a precedent for use in implementation systematic reviews; the strategy was used in another study looking at implementation strategies to optimise care for type 2 diabetes.[280] The implementation categories used in this review are described in Table 6.1.

Table 6.1 Taxonomy for implementation strategies

Implementation strategies targeting the healthcare system. 1. *Preventive care management*. The implementation of a system for organising preventive care, with a person/organisation responsible for monitoring delivery or performance. 2. *Team changes*. An additional team member/s or role added with responsibility to increase the delivery of preventive care. 3. *Electronic patient registry*. Beyond collection of routine data, the electronic health record must be used specifically as an intervention to target individuals and to enable the delivery of preventive care.

4. *Facilitated relay of information to clinicians*. Information collected, separately to the main clinical record which is relayed to clinicians to facilitate preventive care. 5. *Continuous quality improvement (QI)*. Systems level QI is an iterative process, with defined methods for identifying inefficiencies in preventive care system wide, with a plan for action and recollection of data on performance.
Implementation strategies targeting healthcare professionals. 6. *Audit and feedback*. A summary of the preventive care delivered by a clinic or healthcare professional over time, which is then relayed back to the clinic or individual for reflection. 7. *Clinician education*. An educational programme for preventive care delivered to all fully qualified healthcare professionals in primary care. 8. *Clinical reminders*. In-consultation reminders to deliver any aspect of preventive care. 9. *Financial incentives*. Pay for performance schemes where payment was given to deliver a specific aspect of preventive care.
Other 10. *Multi-component interventions*. Interventions that combined two or more of the above strategies.

After deduplication, one other reviewer and I independently screened title and abstracts and then full-text records against prespecified eligibility criteria using a decision flowchart. Covidence screening software (Veritas Health Innovation) was used for deduplication and title, abstract, and full-text screening.[281]

6.3.3 Data extraction and quality assessment

Data were extracted independently by me and one other reviewer using a piloted Microsoft Excel spreadsheet. Extracted information included baseline characteristics, study design, intervention characteristics and outcome measures. Risk of bias was independently assessed by two authors using the Cochrane EPOC risk of bias tool for the appropriate study design. Disagreements were resolved by the wider supervisory team for review.

6.3.4 Data synthesis and analysis

In line with Donabedian's three component approach for measuring the quality of care, the main outcomes were measures that record changes in, process (e.g., referral to further support) and behavioural outcome (e.g., smoking cessation or weight loss) of preventive care.[282] Outcomes were grouped by predominant mode of intervention e.g., clinician education or team changes. Outcomes were extracted at 1 year, or the closest measurement to this. Secondary outcomes included patient acceptability and satisfaction with the intervention; healthcare professional acceptability and satisfaction with the intervention; resource use; equity impact, and adverse effects.

Where more than one health behaviour was reported I prioritised a summary statistic of the effect of the intervention on combined health behaviours, the primary outcome of the study, or if neither of these were present, the first reported health behaviour. If more than one process outcome was reported, I took the most distal outcome e.g., if advice given and referral made were both reported, I used the referral data. I included studies that reported changes in health behaviours (e.g., reduction in alcohol consumption) and outcomes of health behaviours (e.g., alcohol dependence score) and grouped these together for the behavioural outcomes meta-analysis.

I extracted continuous and dichotomous outcomes, converting these where required from a standardised effect measure to an odds ratio (OR) using an adapted Chinn's method.[283] Where a study did not correct for clustering, I adjusted the width of the confidence interval as described in the Cochrane handbook.[284] The upper quartile intracluster correlation coefficient (ICC) was selected from the included studies. This conservative approach also reduces the influence of outlier values. When the number of cases in the intervention or control group was zero, the Peto method was used to calculate an OR. Calculation details can be found in Appendix 11.

Where an adjusted hazard ratio, incident rate ratio or risk ratio was given by the study, this was taken as a conservative estimate of the odds ratio. If two or more intervention groups existed, I selected the intervention group that most closely represented the implementation strategy of interest. For example, I used the training workshop and usual care arms, and not the free patient education material arm in the Kottke et al study.[285] Where there were intervention arms of different intensity, these were combined into a single intervention arm. Some studies provided insufficient information to calculate a standardised effect measure. In these cases, the authors were contacted and if no further information was provided, these results were synthesised narratively.

I used random effects meta-analysis to pool study outcomes, given that the true effect of preventive interventions is likely to differ across contexts and health behaviours. Sensitivity analysis used two further models to pool the study outcomes. Firstly, the Hartung-Knapp-Sidik-Jonkman (HKSJ) model variance correction applied to the standard DerSimonian-Laird model; optionally without truncation of correction factor at 1, to reduce the risk of poor coverage of 95% confidence intervals (CI). Secondly, the inverse variance heterogeneity (ivhet) model, for meta-analysis of heterogenous studies.[286 287] Meta-analysis was conducted in Stata, version 14.2 (StataCorp) using the admetan command. Forest plots were used to display the results of meta-analysis. The I^2 statistic and 95% prediction intervals were calculated to assess heterogeneity. Details of these prediction intervals and their interpretation is given in Appendix 12.

Additional sensitivity analyses were conducted where possible, excluding firstly studies at high risk of bias and secondly studies where data had to be imputed. Subgroup analysis considered each health behaviour separately. These analyses were completed where there was more than one study able to be meta-analysed in each subgroup.

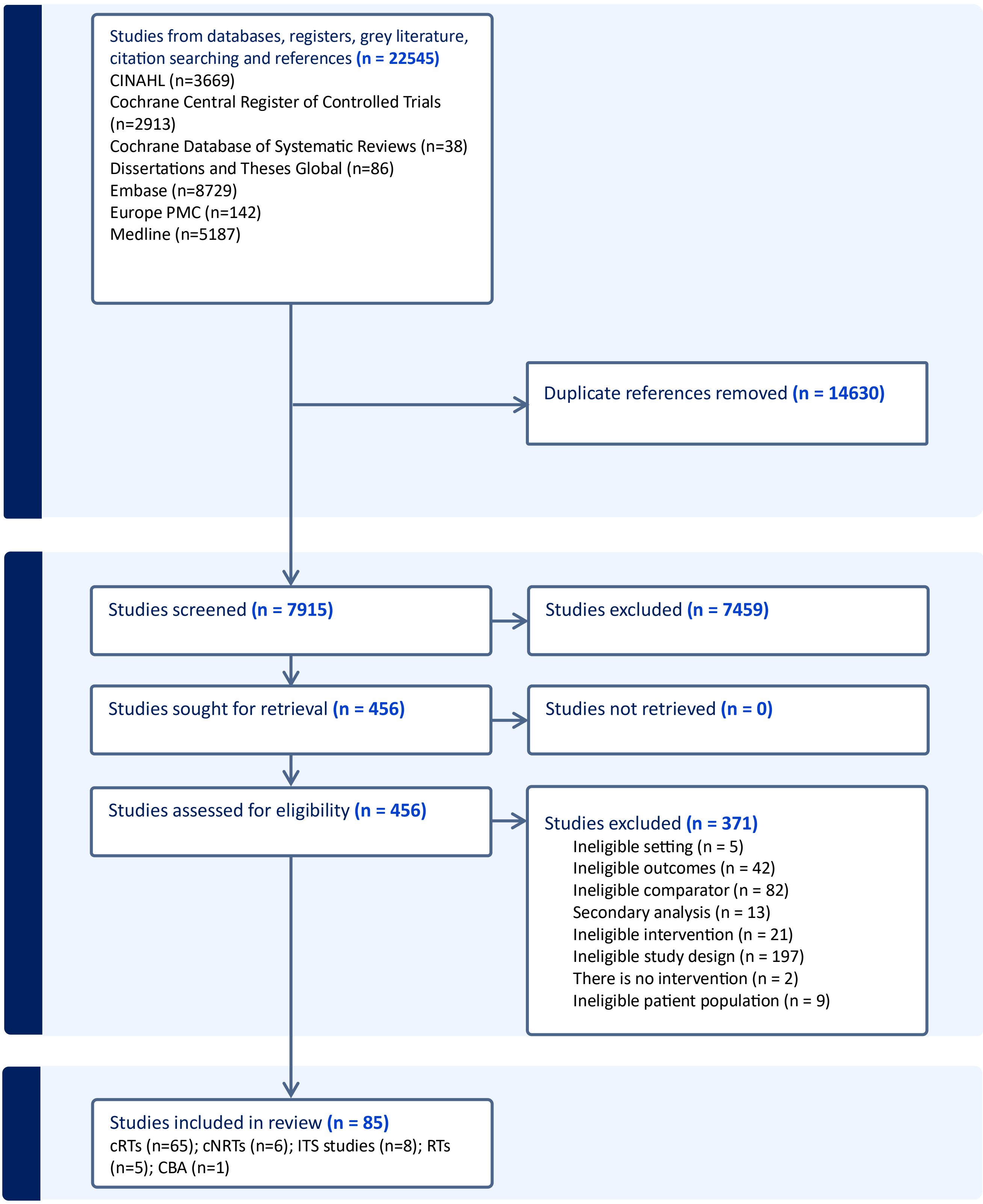
6.3.5 Patient and public involvement

Regular meetings were held with our PPI contributor. These meeting covered aims, study design and discussion of results. My PPI contributor is passionate about ensuring the voices of those from deprived areas are considered within research. She suggested including the secondary outcome for health equity impact of implementation strategies.

6.4 Results

The figure below shows the flow through the study. The search identified 22,545 unique study titles. After screening, 456 full texts were assessed for eligibility and 85 studies were included.

Figure 6.1 Prisma flow diagram



6.4.1 Study characteristics

Of the 85 included studies, 65 were cRTs, 6 were cNRTs, 8 were ITS studies, 5 were RTs and 1 was a CBA study. Details of the included studies are given in Appendix 13. The 71 cluster trials had a total of 3,713 clusters and 4,210,946 participants. The randomised trials had a total of 6,748 participants, the interrupted time series studies used data from 5,966,552 participants 176,061 participants in 1 CBA study. Forty-two studies focussed on smoking, 19 on alcohol, 7 on obesity (poor diet), 2 on physical activity and 15 on multiple health behaviours. The average age of patients and healthcare professionals was 49 and 43 years respectively. 48% of patients and 45% of healthcare professionals were male. Of the small number of studies that reported ethnicity, 67% of patients and 69% of healthcare professionals were White. The most common countries were the USA (n=42), Europe (n=15) the UK (n=13). The mean (standard deviation) follow-up time for ITS studies was 44 (42) months and for the other study types was 10 (6) months.

No studies examined the impact of preventive care management interventions or audit and feedback interventions. Three studies investigated the impact of team changes; 5 studies investigated the electronic patient registry; 5 studies investigated the facilitated relay of information; 1 study investigated continuous quality improvement; 37 studies investigated clinician education interventions; 9 investigated clinical reminders; 7 investigated financial incentives and 18 investigated multi-component interventions. Of the studies, 68 were included in meta-analyses and 17 studies were synthesised narratively. No studies examined implementation strategies specifically for remote consultations in primary care.

6.4.2 Risk of bias

Risk of bias was assessed to be low in 25 studies, unclear in 24 studies, and high in 36 studies. Removing studies at high risk of bias in sensitivity analysis did not significantly change the meta-analysis results (see sensitivity analysis).

Table 6.2 Risk of bias assessment for cluster-randomised, cluster non-randomised, and controlled pre-post studies

Intervention category	**Study ID**	Random sequence generation	Baseline outcome measures similar	Baseline characteristics	Incomplete outcome data	Protection against contamination	Selective reporting	**Overall***
Team changes	Flocke 2020	3	1	1	1	3	1	3
	Schwartz 2014	1	2	1	1	1	1	2
Electronic Patient Registry	Boston 2023	1	1	1	1	1	1	1
	Fiore 2019	1	1	1	1	1	1	1
	Houston 2015	1	2	1	1	1	1	2
	Minian 2002	1	1	1	3	2	3	3
	Rindal 2022	1	3	3	3	1	1	3
Facilitated relay of information	Bentz 2007	2	1	1	3	1	1	3
	Grant 2014	3	1	1	1	1	1	3
	Saitz 2003	1	1	1	1	1	1	1
	Unrod 2007	1	3	1	1	1	1	3
	Wadland 2007	1	1	1	3	1	3	3
Continuous QI	Yano 2008	1	1	1	1	1	1	1
Clinician education	Adams 1998	3	2	1	1	1	1	3
	Anderson 2021	1	1	1	1	1	1	1
	Babor 2004	1	2	2	3	1	2	3
	Baldeon 2018	2	2	3	1	1	3	3
	Butler 2013	1	1	1	1	1	1	1
	Campbell-Scherer 2019	1	1	1	1	1	1	1
	Corelli 2022	2	2	1	1	1	1	2
	Cummings 1989	1	1	1	1	1	1	1
	Evins 2002	1	1	1	1	1	1	1
	Flocke 2021	1	1	3	1	1	1	3
	Funk 2005	2	2	2	3	2	3	3
	Girvalaki 2018	3	1	1	1	2	1	3
	Haller 2014	1	1	2	1	1	1	2
	Haskard 2008	1	2	2	3	2	3	3
	Hilbink 2012	1	3	3	3	2	3	3
	Houston 2013	1	2	1	3	1	3	3
	Hudmon 2018	2	2	2	3	3	2	3
	Joseph 2004	1	1	1	1	1	1	1
	Jumbe 2022	1	2	1	1	1	1	2

	Kaner 2003	1	2	2	1	1	1	2
	Keller 2000	2	3	1	3	2	3	3
	Kottke 1989	3	2	1	1	2	1	3
	Lennox 1998	2	2	2	1	1	1	2
	Malta 2016	3	2	3	2	1	2	3
	McRobbie 2008	1	3	3	1	2	1	3
	Mejia 2016	2	1	1	1	1	1	2
	Moore 2003	1	1	1	1	1	1	2
	Olano-Espinosa 2013	1	2	1	3	1	1	3
	Ornstein 2013	1	2	2	2	1	1	2
	Prokhorov 2010	2	1	1	1	2	1	2
	Ribeiro 2011	2	2	2	3	2	3	3
	Rosario 2022	1	2	1	1	1	1	2
	Ruf 2010	1	3	1	2	1	1	3
	Sinclair 1998	3	1	1	1	1	1	3
	VanLieshout 2016	1	1	1	1	1	1	1
	Verbiest 2014	1	1	1	3	1	3	3
	Welzel 2021	1	1	1	1	1	1	1
Clinical reminders	Baer 2016	1	2	3	2	1	2	3
	Banerjee 2013	1	1	1	1	1	1	1
	Dubey 2006	1	1	1	1	1	1	1
	Linder 2009	2	1	1	1	1	1	2
	Milch 2004	3	2	1	1	3	2	3
	Minian 2019	1	1	1	3	1	1	3
	Rossom 2022	1	1	1	1	1	1	1
	Rothemich 2008	1	1	1	1	1	1	1
	Wadlin 2022	1	1	2	1	1	1	2
Financial incentives	Bardach 2013	2	1	1	1	1	1	2
	Roski 2003	1	1	2	1	1	1	2
Multi-component	Ackermann 2005	1	1	1	1	2	1	2
	Anderson 2016	1	1	2	1	1	1	2
	Asadi-Aliabadi 2023	1	3	3	2	1	2	3
	Bailey 2023	3	1	1	2	1	1	3
	Goodfellow 2016	1	1	1	1	1	1	1
	Harris 2017	1	2	1	3	1	3	3
	Kowitt 2022	3	2	2	1	3	1	3
	Lee 2023	1	2	1	1	2	1	2
	Little 2009	2	2	2	1	1	1	2
	McElwaine 2014	3	1	1	1	1	1	3
	Patwardan 2012	1	1	1	1	1	1	1
	Rose 2008	1	2	2	1	1	1	2
	Twardella 2007	1	1	1	1	1	1	1
	van Beurden 2012	1	1	2	2	1	1	2

	Wiggers 2017	**2**	**2**	**2**	**1**	**3**	**1**	**3**
	Young 2002	**1**	**1**	**1**	**3**	**1**	**3**	**3**

Table 6.3 Risk of bias assessment for interrupted time series (ITS) studies

Intervention category	**Study ID**	Intervention independent of other changes	Shape of the intervention effect pre-specified	Intervention unlikely to affect data collection	Knowledge of allocated interventions adequately prevented	Incomplete outcome reporting	Selective reporting	**Overall***
Team changes	Alageel 2019	1	1	2	1	1	1	2
Financial incentives	Coleman 2007	1	1	1	1	1	1	1
	Fichera 2016	1	1	1	1	1	1	1
	O'Donnell 2020	1	1	1	1	1	1	1
	Rieckmann 2018	1	1	1	1	1	1	1
	Szatkowski 2016	1	1	1	1	1	1	1
Multi-component	Balasubramanian 2022	1	1	1	1	1	1	1
	Sturgiss 2023	2	1	1	1	1	1	2

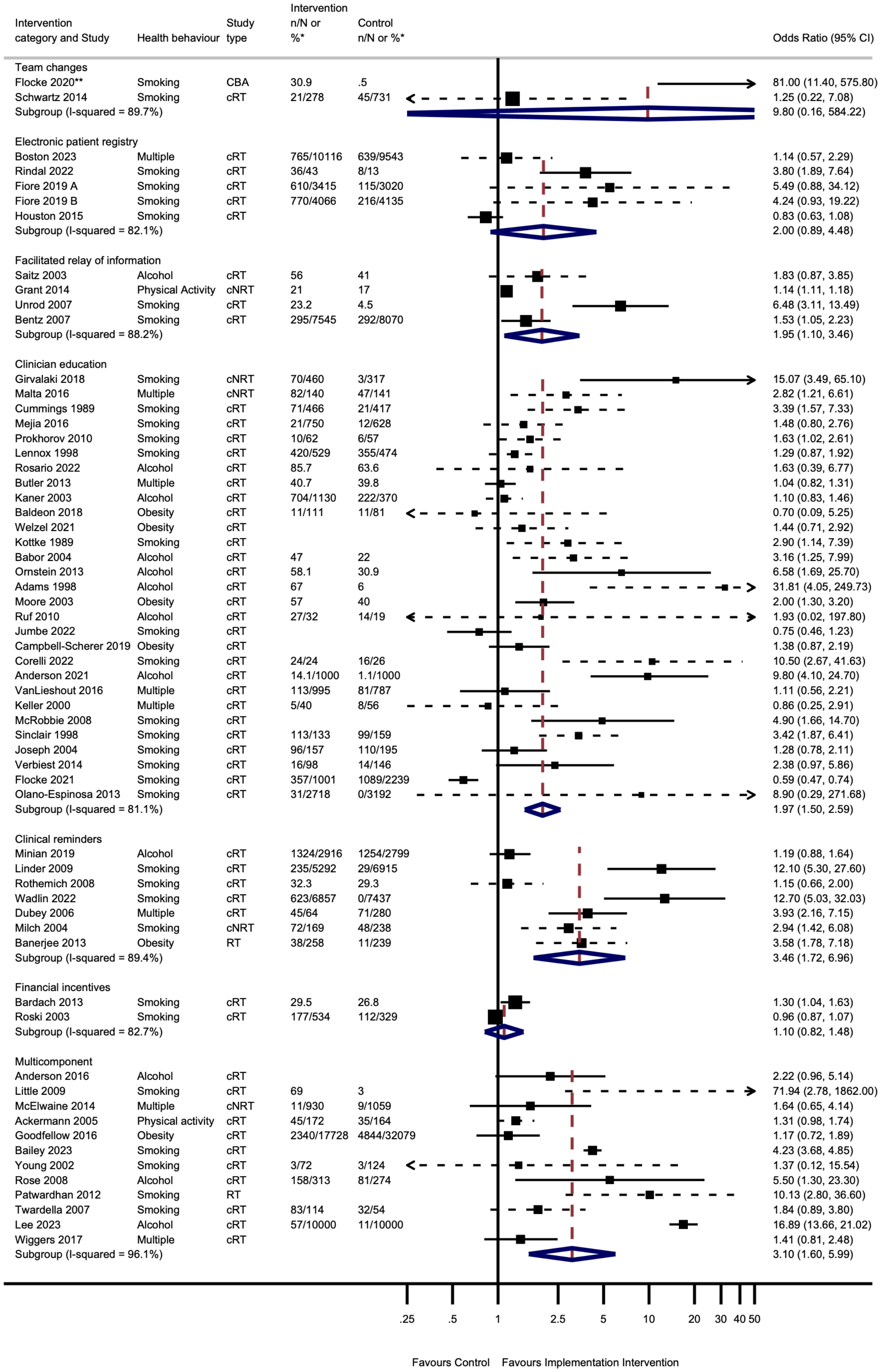
Note: 1 = low risk of bias; 2 = unclear risk of bias; 3 = high risk of bias

*Overall score is the highest risk of bias score assigned to the study

6.4.3 Process outcomes

Sixty studies were included in the process outcome meta-analysis from 7 intervention groups: 7 clinical reminder studies; 29 clinician education studies, 4 electronic patient registry studies, 4 facilitated relay of information studies, 2 financial incentive studies, 12 multi-component studies and 2 team change studies (Figure 6.2).

Figure 6.2 Odds of improving process outcomes between implementation interventions and control groups using random effects meta-analysis.



*n/N or % given where available in the paper

** Flocke study estimate not visible for reasons of scale

Note: Dashed line indicates studies for which approximate data had to be used.

Three studies reported the effect of team changes on process outcomes. One ITS study was not included in the meta-analysis. This study found team changes resulted in a significant increase in the number of people receiving an appropriate weight management referral or smoking cessation intervention.[288] The meta-analysis of the remaining 2 studies reported imprecise results (OR 9.80, 95% CI 0.16 – 584.22, I^2 =89.7%, 95% CI 62%-97%).

Four studies examined the effect of changing the patient record. One of the 4 electronic patient registry studies had 2 separate analyses for 2 different healthcare systems.[289] There was no evidence that amending the electronic patient registry increased preventive processes (OR 2.00; 95% CI 0.89 – 4.48, I^2 =82.1%, 95% CI 59%-92%).

Five studies reported the effect of the facilitated relay of information on preventive care, with 4 included in the meta-analysis. One study was unable to complete clinician and practice level analyses because the sample was too small.[290] There was evidence that facilitated relay of information interventions significantly increased preventive processes (OR 1.95, 95% CI 1.10 – 3.46, I^2 = 88.2%, 95% CI 72%-95%).

Thirty-one studies examined the effects on process outcomes of clinician education interventions. Two studies were unable to be included in the analysis.[291 292] One study showed no evidence of a significant difference between intervention and control groups being signposted to quit line services by pharmacy staff.[291] The second study found that training and support for GPs significantly increased the rate of implementation of brief interventions for alcohol.[292] Meta-analysis of the remaining 29 studies showed a significant increase in preventive process outcomes (OR 1.97, 95% CI 1.50-2.59, I^2 = 81.1%, 95% CI 74%-86%).

Seven of the 8 clinical reminder studies with process outcomes were able to be meta-analysed. These showed a statistically significant increase in health process outcomes (OR 3.46, 95% CI 1.72-6.96, I^2 =89.4%, 95% CI 81%-94%). One study not included in the meta-analysis reported that there were no significant differences between groups in changes in the percentages of patients who had a nutrition counselling visit when reminders and alerts were added to the records of patients with overweight or obesity.[293]

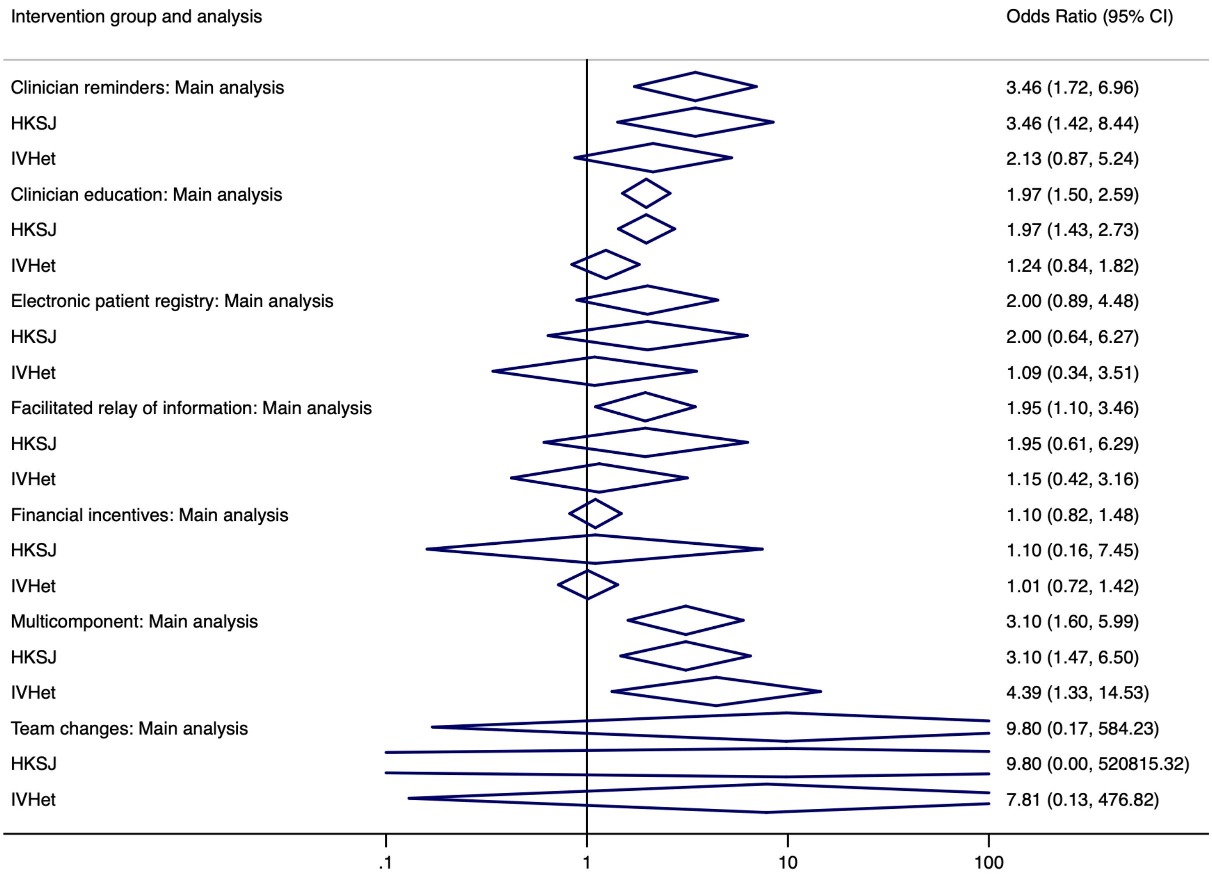
Six studies reported the effect of financial incentives on process outcomes. There were differences in the way that results were reported for four ITS studies, precluding meta-analysis. Three reported statistically significant positive associations between financial incentives and greater alcohol and smoking advice/interventions,[143 294 295] and one reported a positive association between the financial incentive and clinicians' alcohol advice or intervention without commenting on statistical significance.[296] Two cRTs reported process outcomes.[297 298] There was no evidence from the meta-analysis of these studies that financial incentives increased the delivery of preventive processes (OR 1.10, 95% CI 0.82 – 1.48, I^2 =82.7%, 95% CI 27%-96%).

Seventeen multicomponent intervention studies reported process outcomes, of which 12 were included in the meta-analysis. Two ITS studies not included in the meta-analysis found that multicomponent interventions were associated with an increase in the number of people screened for tobacco use or receiving a smoking cessation intervention,[299] and an increase in alcohol recording.[300] One study not included in the meta-analysis found a statistically increase in the percentage of tobacco users who received a cessation intervention.[301] However, another study not included in the meta-analysis reported no evidence that patients were more likely to receive behavioural advice or referral at follow up for any health behaviour,[302] and another found no evidence for a change in alcohol screening after implementing a multicomponent intervention.[300] Of the 12 studies included in the meta-analysis, there was evidence that multicomponent interventions increased the process outcomes (OR 3.10, 95% CI 1.60 – 5.99, I^2 =96.1%, 95% CI 95%-97%).

6.4.4 Sensitivity and subgroup analysis

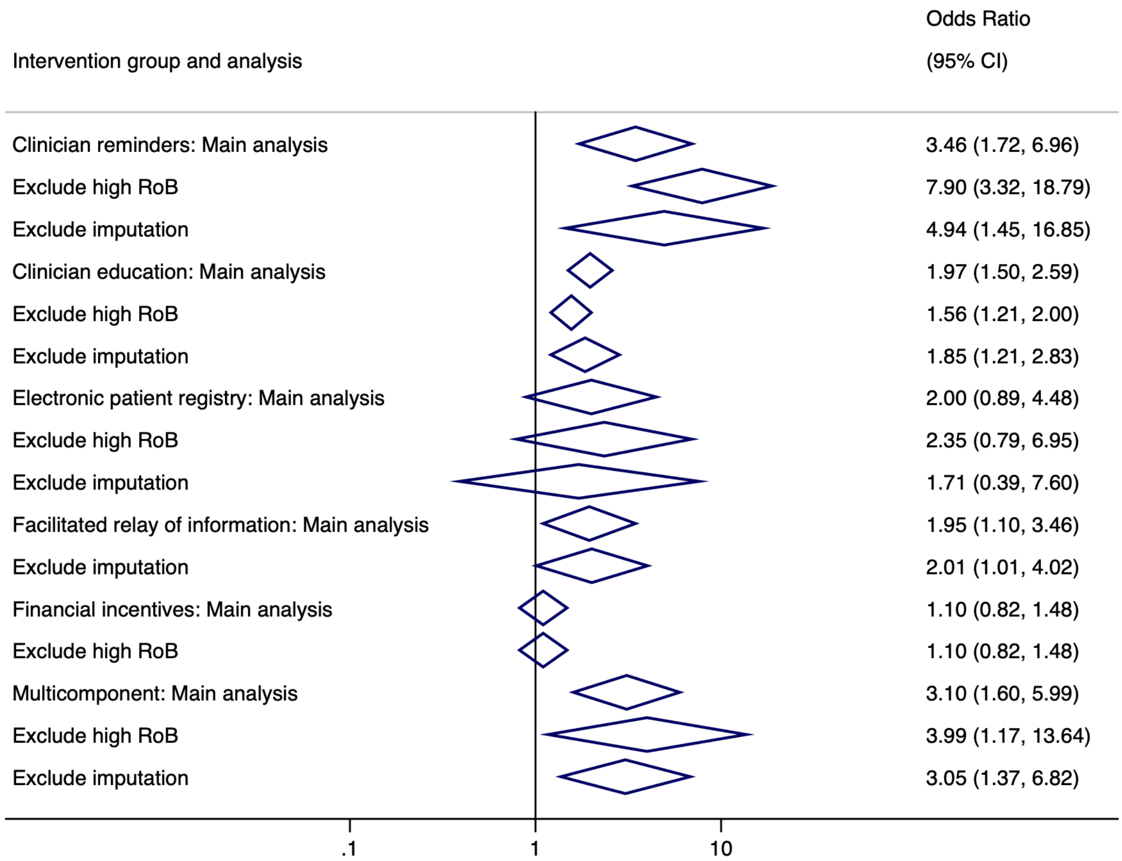
Sensitivity analysis showed that multicomponent interventions were the only category of intervention that showed evidence of increased process outcomes in all 3 meta-analysis models (random effects, HKSJ, and IVHet) (Figure 6.3).

Figure 6.3 Meta-analysis summary diamonds as random effects (main analysis), Hartung-Knapp-Sidik-Jonkman (HKSJ) and inverse variance heterogeneity (IVHet) models for process outcomes.



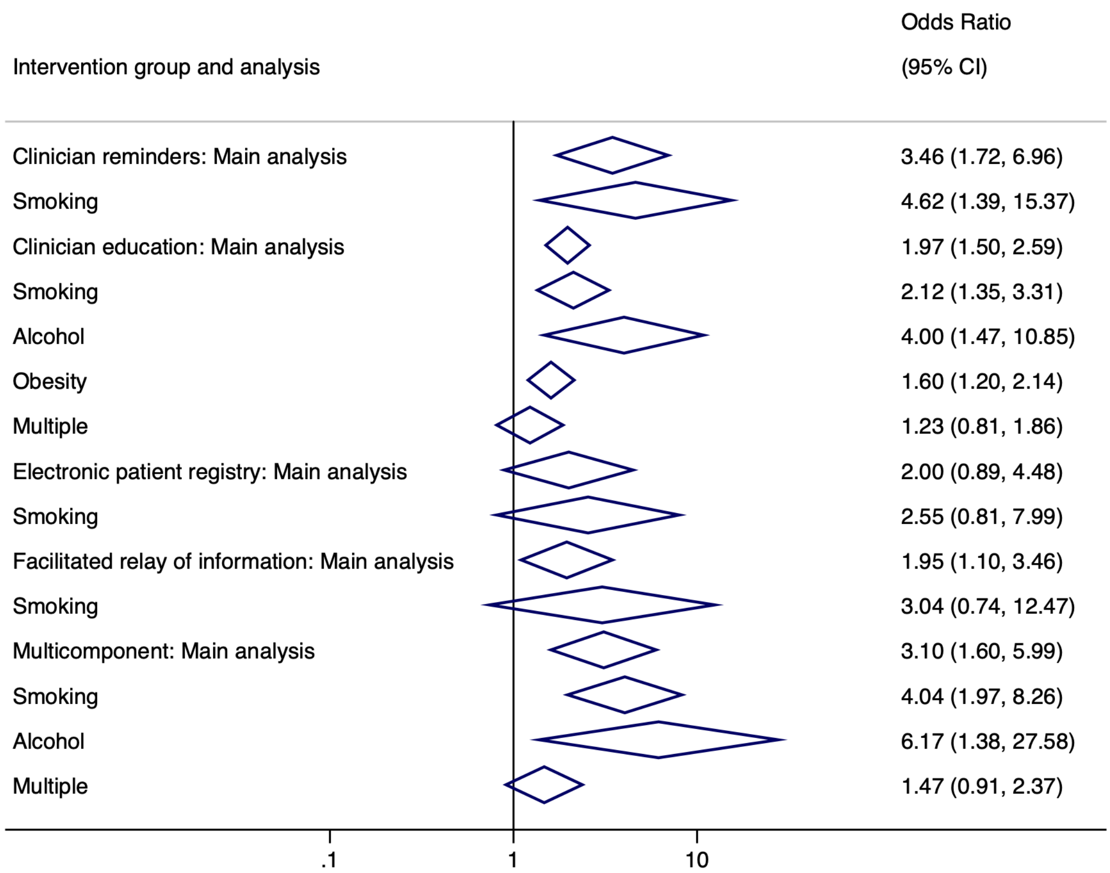
Removing studies at high risk of bias or studies that required imputed data did not significantly change the results (Figure 6.4).

Figure 6.4 Random effects meta-analysis summary diamonds excluding studies at high risk of bias and those that required data imputation for process outcomes.



Subgroup analysis showed that there was no evidence that clinician education or multicomponent interventions that targeted multiple health behaviours improved process outcomes (Figure 6.5).

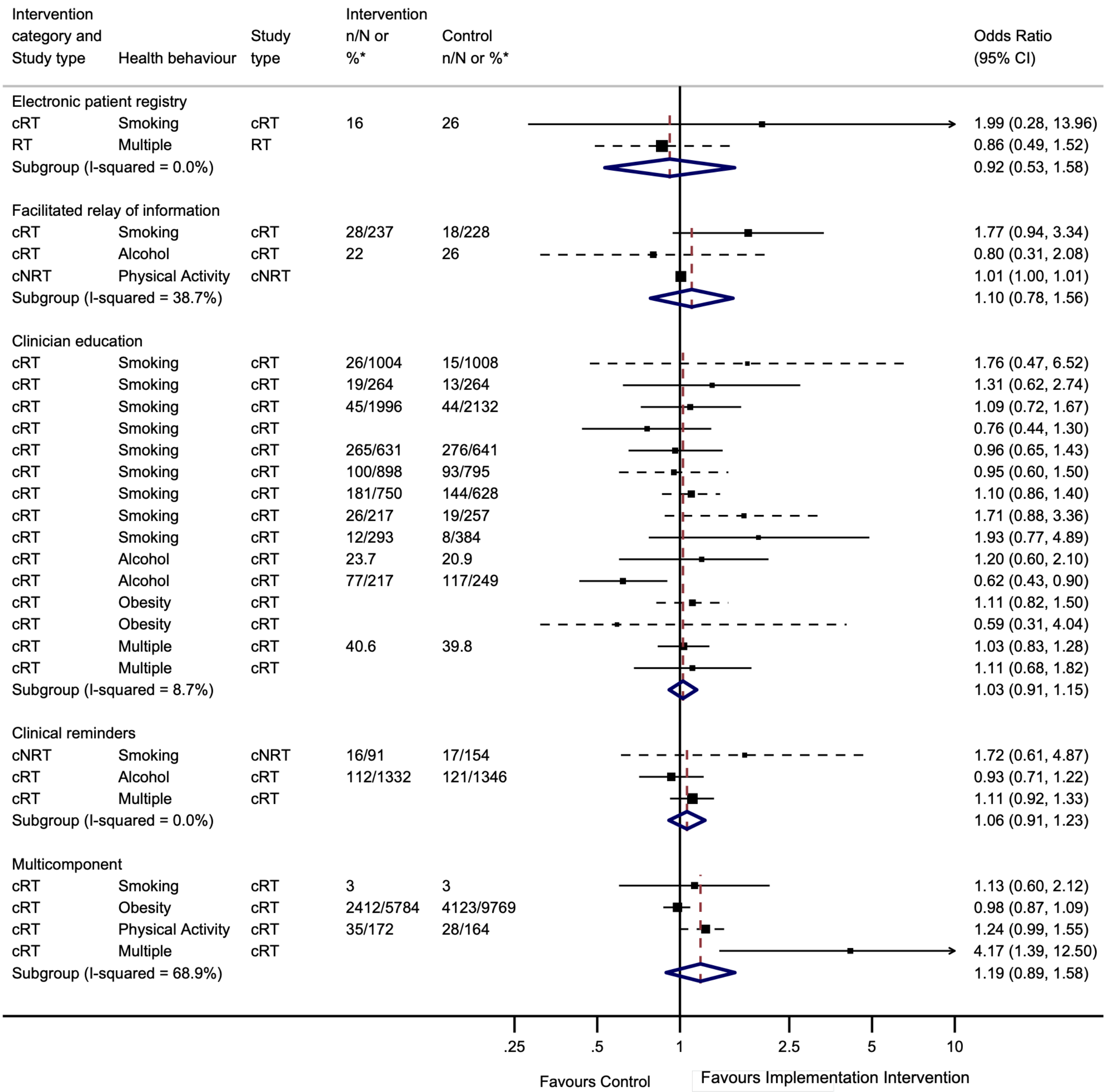
Figure 6.5 Random effects meta-analysis summary diamonds of health behaviour subgroups for process outcomes



6.4.5 Behavioural outcomes

Thirty-nine studies out of 85 reported behavioural outcomes and were able to be meta-analysed, assessing the effect of 5 intervention modes. This included 15 studies of clinician education; 3 studies of clinical reminders; 2 electronic patient registry studies; 3 facilitated relay of information studies, and 4 studies of multicomponent interventions (Figure 6.6).

Figure 6.6 Odds of improving behavioural outcomes between implementation interventions and control groups using random effects meta-analysis.



*n/N or % given where available in the paper

Note: Dashed line indicates studies for which approximate data had to be used.

Two studies reported the effect of team changes on behavioural outcomes. These were unable to be meta-analysed due to differences in the reporting of data. One found that individuals who were in the intervention group were significantly more likely than controls to have a lower BMI and to have quit smoking at the end of the follow up period,[288] the other found no evidence of a difference in self-reported smoking cessation at 8 months.[303]

Two studies investigated the effect of changes to the electronic patient registry on behavioural outcomes and were meta-analysed. There was no evidence that changes to the electronic patient registry improved behavioural outcomes (OR 0.92, 95% CI 0.53 – 1.58, I^2= 0.0%, 95% CI 0%-100%).

Four studies reported the effect of facilitated relay of information on beneficial behavioural outcomes. One study was unable to complete clinician and practice level analyses because the sample was too small.[290] Three studies included in the meta-analysis found no evidence that facilitated relay of information improved behavioural outcomes (OR 1.10, 95% CI 0.78 – 1.56, I^2=38.7%, 95% CI 0%-81%).

One study investigated the effect of continuous quality improvement on smoking outcomes.[304] There was no evidence of a difference in smoking cessation between the intervention and the control groups (OR 0.90, 95% CI 0.58 – 1.39).

Twenty studies reported the effect of clinician education on behavioural outcomes. Five were unable to be included in the meta-analysis due to insufficient information. One study showed a significant increase in smoking cessation in the intervention group compared to controls at one year.[305] Another study found the intervention group had a greater reduction in alcohol dependence score during follow up compared to the control group.[306] However, three studies found no evidence of a difference in rates of smoking cessation, alcohol dependence score or difference or BMI/ weight between intervention and control groups during follow-up.[285 307 308] The meta-analysis showed there was no evidence that clinician education (OR 1.03, 95% CI 0.91 – 1.15, I^2 =8.7%, 95% CI 0%-46%) improved behavioural outcomes.

Four studies reported the effect of clinical reminders on beneficial behavioural outcomes. One study not included in the meta-analysis due to insufficient data showed no evidence of a difference in weight loss between intervention and control groups.[309] The remaining 3 studies included in the meta-analysis showed no evidence that clinical reminders improved behavioural outcomes (OR 1.06, 95% CI 0.91 – 1.23, I^2=0.0%, 95% CI 0%-11%).

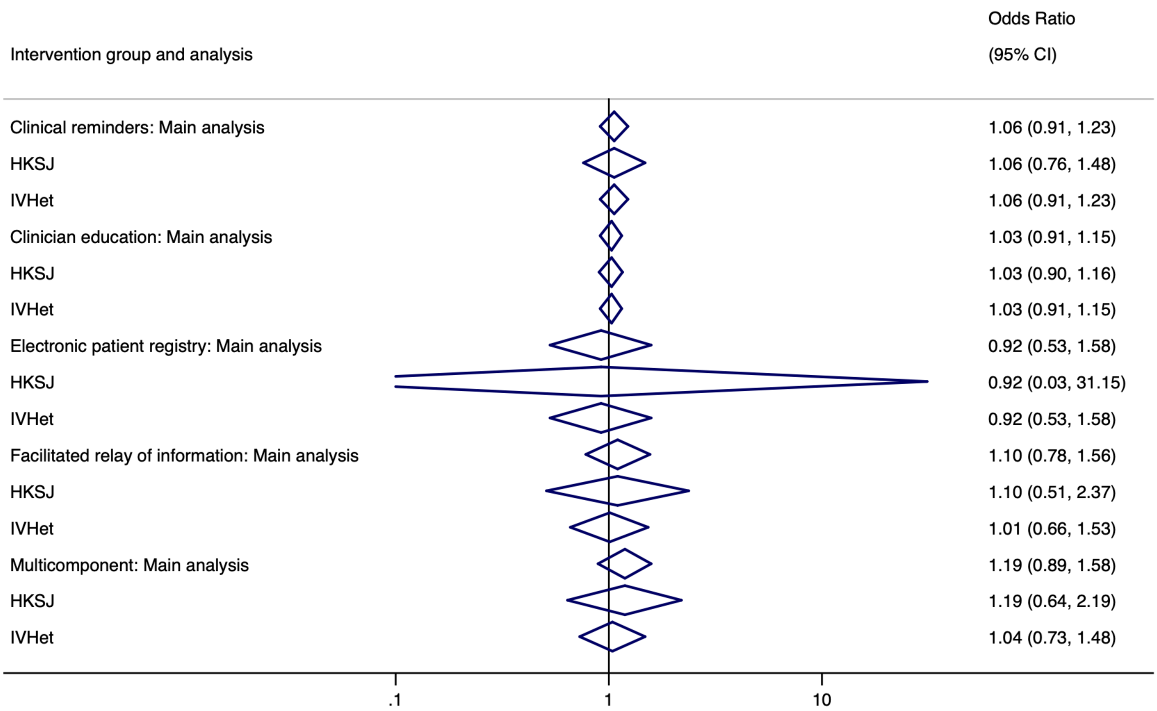
Two studies reported the effect of financial incentives on behavioural outcomes. One was an ITS study, and the other was a cRT. Due to the difference in reporting of data these were unable to be meta-analysed. One reported that financial incentives were significantly associated with reduced smoking, but not with reduced BMI or alcohol consumption in the six years following the introduction of the financial incentive.[310] The other showed there was no evidence of an effect of financial incentives on smoking cessation at 6 months.[298]

Four studies reported the effect of multicomponent interventions. There was no evidence that multicomponent interventions improved behavioural outcomes (OR 1.19, 95% CI 0.89 – 1.58, I^2=68.9%, 95% CI 10%-89%).

6.4.6 Sensitivity and subgroup analysis

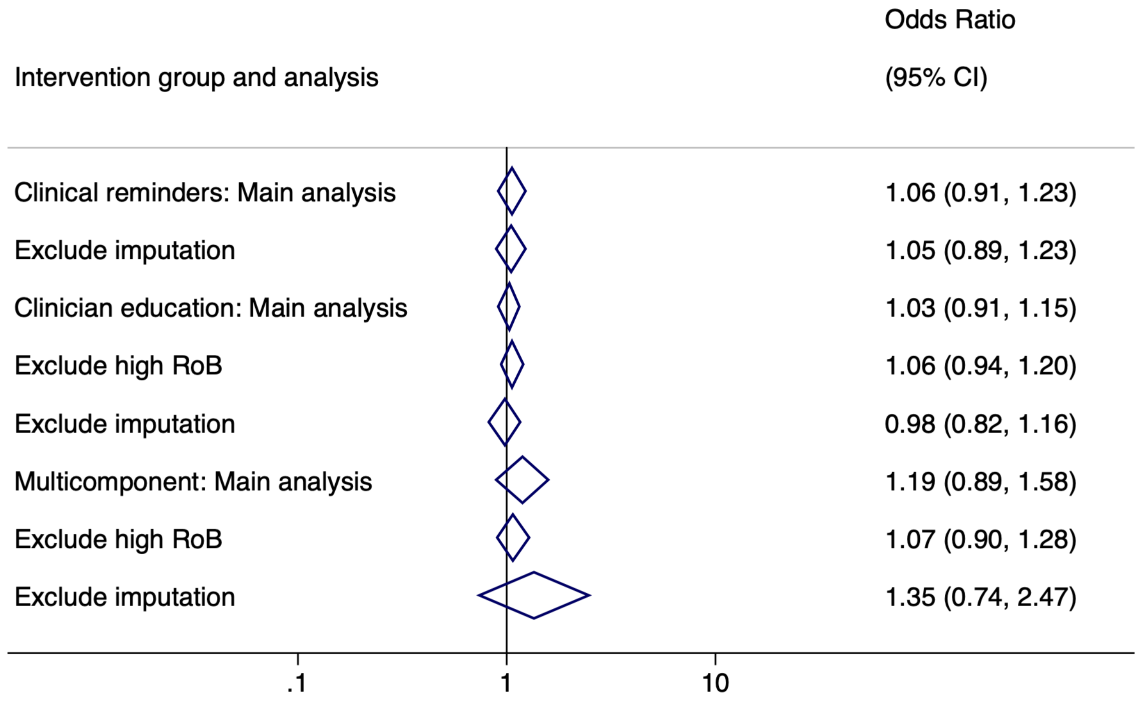
Sensitivity analysis showed no significant difference in meta-analysis results using different models (random effects, HKSJ, and IVHet) (Figure 6.7).

Figure 6.7 Meta-analysis summary diamonds as random effects (main analysis), Hartung-Knapp-Sidik-Jonkman (HKSJ) and inverse variance heterogeneity model (IVhet) models for behavioural outcomes



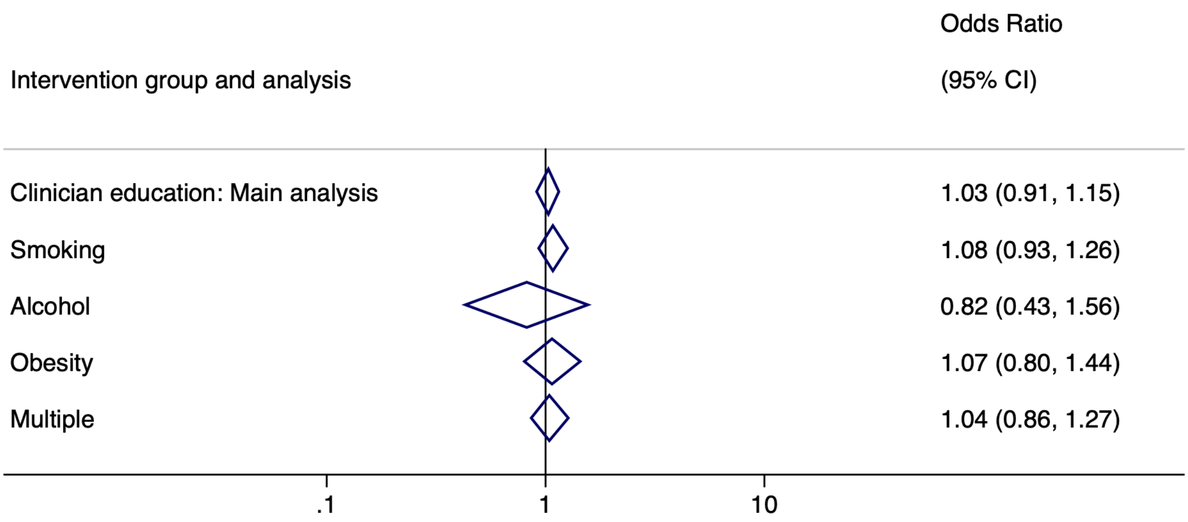
Similarly, there was no significant difference in meta-analysis results when excluding studies at high risk of bias, or studies that used imputed data (Figure 6.8).

Figure 6.8 Random effects meta-analysis summary diamonds excluding studies at high risk of bias and those that required data imputation for behavioural outcomes.



Due to the small number of studies in the meta-analysis, subgroup analysis was only conducted for clinician education studies. There was no evidence that the effect of clinician education varied between smoking, alcohol, obesity, or multiple behavioural outcomes (Figure 6.9).

Figure 6.9 Random effects meta-analysis summary diamonds of health behaviour subgroups for behavioural outcomes.



6.4.7 Secondary outcomes

Most studies did not report data on the secondary outcomes. Three studies reported no adverse effects of the intervention.[311-313] Thirteen studies reported that training received was useful, relevant, or increased healthcare professional confidence and self-esteem.[306 313-324] One electronic health record study commented that eReferral had good reach amongst people without health insurance, and this could help reduce health inequalities.[289] However, another study described how people from deprived communities and smokers were less likely to take up the offer of an additional health check.[288]

One study reported on barriers to weight management in follow up interviews. Healthcare professionals described how too many clinical reminders were counterproductive.[309] A clinical education smoking study in communities pharmacies described time constraints, privacy, and part-time staff as barriers to maintaining an accurate clinical record.[325] Healthcare professionals in another clinical education study questioned whether in-depth training for weight management was feasible against other competing clinical demands.[326]

Three studies presented data relevant to the cost-effectiveness of the intervention. One calculated the additional cost of clinician specific feedback at US$65 per estimated quit.[290] Another clinical education study targeting smoking cessation, found the intervention incremental cost per life year gained after 6 months was €969.[305] Finally, a clinical education study for excess alcohol found a similar cost effectiveness ratio between control and intervention practices.[327]

6.5 Discussion

6.5.1 Summary

This review identified evidence that many implementation strategies including clinical reminders, clinician education, facilitated relay of information and multicomponent interventions increased the occurrence of preventive processes of care. Clinical reminders had the largest pooled effect estimate and multicomponent interventions were the most robust in sensitivity analysis. There was some evidence in subgroup analysis that implementation strategies that target multiple behaviours may be less effective than those that target single behaviours. However, there was no consistent evidence that these process changes translated into improved behavioural outcomes. No studies looked specifically at implementation strategies in remote consultations.

6.5.2 Strengths and limitations

My search strategy was thorough, including 8 databases, grey literature, references, and citation searching, with no date or language constraints. The resulting sample is large with data from over 10 million participants. Included studies came from North America, Europe, South America, the Middle East, and Australia so my results are relevant to many healthcare systems.

Dividing interventions into implementation categories allows the results to be relevant to policy makers and public health professionals, although for a few studies, the predominant implementation strategy was not clear. I resolved these through consensus with my supervisory team and co-authors.

Many of the studies had a high risk of bias. This was partly due to my decision to include a greater range of study designs and include non-randomised studies. This decision was made as some interventions e.g., financial incentives implemented across an entire health care system cannot practically be randomised in a traditional trial setting. There was also high heterogeneity, especially in the primary analyses. This is not unexpected as, although interventions were of a similar type, they differed in intensity, duration, delivery, and format. In addition, studies were conducted in different countries, healthcare systems with different methods of usual care, and amongst different population demographics, which also likely contributed to the high heterogeneity. In the presence of such high heterogeneity, I considered it useful to conduct meta-analysis and examine statistical significance, but the individual point estimates should not be over-interpreted. Random-effects meta-analysis allows for differences in the intervention effect between studies and provides an estimate of the average intervention effect.[328] I also calculated prediction intervals for each meta-analysis conducted, these confirm the high levels of heterogeneity in the analysis, with a range of ORs plausible for different settings or populations. I did not formally assess for publication bias or other small study effects. However, it is unlikely that unreported studies or results would change these conclusions. Only two studies reported information about how the intervention effectiveness differed between socioeconomic groups. Future studies should collect this information to understand which population groups may benefit most.

I had to impute several calculations as many studies had not accounted for clustering, or I had to calculate an OR from available data. Whilst these are established methods, they introduce another opportunity for error. Resulting CIs were often wide, reflecting the uncertainty in data from single trials.

When analysing behavioural outcomes, I combined studies that targeted both behaviours directly and those that targeted outcomes of behaviours. It was not appropriate to meta-analyse these separately because there were too few studies. Had this been possible, it seems unlikely that this would change the conclusion that there was no evidence of effect.

Another limitation was the quality of the included studies; many studies used a cluster design but did not account for clustering in their analysis. Studies should ensure that studies are powered to detect modest effects on behavioural outcomes, account for clustering and allow sufficient follow-up time to accrue sufficient events to detect changes in behavioural outcome as well as process outcomes.

The observed difference in process and behavioural outcomes may be because outcomes can be measured more precisely in proximal (process) outcomes, behavioural outcomes take time to emerge, and many studies did not have sufficient follow-up periods to capture changes in patient behaviour. Furthermore, process outcomes are recorded at the time of consultation, while changes in behaviour may have occurred without the patient returning and/or the clinician asking about behaviour and recording the change at a subsequent consultation. Moreover, increases in recording of processes of care may reflect that clinicians start recording activity that was previously unrecorded. If so, increases in processes of care may occur while changes in patient behaviour would not be expected to increase. This is particularly likely to occur where the intervention is a financial incentive. However, trial data has shown that genuine increases in process outcomes do translate into beneficial behavioural outcomes.[27]

6.5.3 Comparison with existing literature

To my knowledge, this is the first systematic review to investigate implementation strategies for preventive healthcare in primary care. Other studies have focussed on quality improvement strategies in chronic disease management or falls prevention. For example, systematic reviews investigating quality improvement strategies in diabetes care found that multicomponent QI programmes may achieve meaningful population improvements for most immediate diabetes outcomes and that interventions at the health system or patient level may be more effective than interventions at the health professional level.[280 329] A comprehensive systematic review looking at falls prevention found evidence that team changes and multicomponent interventions may reduce falls.[330] Another review reported that clinician education and patient reminders and education were the most effective strategies for reducing systolic and diastolic blood pressure respectively.[331] This review supports these findings for the implementation of preventive healthcare in primary care. This suggests that quality improvement strategies may be generalisable across clinical targets. However, due to the high heterogeneity observed in this review, the results should be interpreted cautiously. Future research should collect data about which population subgroups may benefit most from these interventions.

However, one review investigating the effectiveness of implementation strategies for non-communicable disease guidelines in primary health care found that single interventions were the most effective and distribution of materials as the least effective. They concluded that reducing the complexity of strategies and tailoring to the local conditions and primary care professionals' needs may improve implementation.[332] This contrasts with the findings of the present study, which suggest that multicomponent interventions may be the most effective. Therefore, caution should be exercised when considering the applicability of these findings to other related clinical areas.

There are examples of innovative quality improvement strategies in primary care that are efficacious in specific setting. For example, Sweden has introduced a national Primary Care Quality (PCQ) framework which enables the automatic and systematic collection and data and feedback to over 97% of Swedish primary care centres. This approach has been shown to standardise and improve care both regionally and locally as practices can be benchmarked against quality indicators. [333] A recent review has also evaluated the barrier to quality improvement in primary care in low and middle income countries, noting that quality improvement int these settings has its own unique set of challenges in terms of health system support and capacity and external environment.[334] This review also highlighted that the majority of studies evaluating quality improvement in primary care are conducted in high-income countries, a pattern that was similarly observed in the present study.

Like this review, previous systematic reviews have found no evidence that financial incentives improve the quality of healthcare, with evidence of small benefits at best, and urged caution when policy makers are considering introducing new incentives.[335 336] However a recent study, which I co-authored found that a financial incentive for weight management referrals in primary care introduced in 2021 increased referrals fourfold.[166] In the context of this review, this policy could be categorised as a multicomponent strategy, as the financial incentive was accompanied by a clinical reminder on the patient electronic health record to remind the healthcare professional the patient was eligible for referral and efforts to encourage patients to seek support for weight management, for example the Better Health campaign.[337] Although this study was not able to meta-analyse the effectiveness of quality improvement strategies, another review found the Plan-Do-Study-Act (PDSA) improved the quality of care in most included studies, despite many studies not adhering to the key method features.[338 339]

A recent qualitative study highlighted that these implementation strategies are not applied in a vacuum and that the practice context matters when considering whether implementation will be successful.[340] They also highlighted the need to address initiative fatigue amongst healthcare professionals, something that is relevant to UK primary care where there is a record demand for services. Another recent review evaluated the effectiveness of different de-implementations strategies in primary care for low value or non-evidence based work. They found with moderate certainty that provider education combined with audit and feedback reduced the use of targeted low value care.[341] This is an important consideration, as the aim of this review is to identify strategies to increase the delivery of preventive care by healthcare professionals; however, within a fixed workforce, this is likely to necessitate a reduction in other clinical activities.

6.5.4 Implications for future research

No studies looked specifically at strategies that increased the delivery of preventive care in remote consultations. From the results from the other chapters in this thesis, I expect that there may be some strategies that work across both face-to-face and remote consultation modes, but some strategies may be more suited to either remote or face-to-face consultations. For example, in Chapter 3, one GP described how during a remote consultation, he was able to review the patient electronic health record more thoroughly. This could mean that implementation strategies that use the electronic health record could be more effective in this scenario. Conversely, a financial incentive may have a have similar efficacy across both consultation modes; the GP practice is equally incentivised to deliver preventive healthcare in a telephone and face-to-face consultation. Future research should consider how consultation mode interacts with the implementation strategy, to maximise impact.

6.5.5 Conclusions

These results show that a broad suite of intervention strategies, and in particular multicomponent interventions and clinical reminders may improve processes of preventive care. However, there is no evidence that these strategies improve patient outcomes through behaviour change, such as smoking cessation, increased physical activity, or reduced body weight or alcohol consumption. It is unclear to what extent this is also the case for remote consultations. Future research should aim to clarify to what extent implementation strategies for preventive care in remote consultations are similar or different to face-to-face consultations.

7 Discussion

7.1 Summary

This final discussion chapter includes an overview of the key findings arising from this thesis and presents the strengths of this research, notably the use of a variety of research methods including an interrupted time series, real-world electronic health record analysis, mixed method analysis and systematic review and meta-analysis approaches. I discuss the key limitations including missing and erroneous data in the electronic health record database and the focus on GP perspectives. I then discuss the implications of this research both in the short and long term, by considering the future research questions arising from this thesis. Finally, I discuss the clinical and policy implications and ideas for how prevention could be effectively embedded within the health service both in remote and face-to-face consultations and more broadly. I finish by positioning this thesis in the wider preventive healthcare landscape and the next steps in my prevention research journey.

7.2 Findings and contributions of this thesis

The overall aim of this thesis was to understand how remote consultations affect the delivery of preventive care (brief interventions for smoking, weight management, excess alcohol and physical activity) in primary care. ***Chapter 1*** synthesised the existing evidence base for prevention, highlighting both the effectiveness of preventive interventions and the persistent challenges associated with their implementation. Key barriers I identified included time constraints, workforce limitations, availability of services, and the perceived status of prevention within clinical practice. The first chapter also reviewed the emerging evidence on remote consultations and identified a research gap: Whilst the effectiveness of preventive care is well established, there remains an implementation challenge. The impact of a shift towards delivering more consultations remotely and the effect this has on interventions that were traditionally delivered opportunistically face-to-face (such as brief interventions for smoking, weight management, excess alcohol and physical activity) is not well understood, with a paucity of research in this area, providing the central rationale for this thesis.

Chapter 2 demonstrated that the COVID-19 pandemic was associated with a substantial reduction in the delivery of preventive care, with variable recovery across different behavioural risk factors. The reasons for this could be the after effects of the pandemic, where resource was redirected to manage acute COVID-19 cases, or the transition to a greater proportion of consultations being conducted remotely. As of June 2022, documented advice for all behavioural risk factors and referrals for smoking cessation had not returned to pre-pandemic levels. Referrals for excess alcohol had approximately returned to pre pandemic levels, while referrals for weight management and physical inactivity had exceeded pre-pandemic levels, likely reflecting the introduction of a specific primary care financial incentive to refer patients to weight management services which led to a four-fold increase in referrals. These findings highlight priority areas for health systems, including the need to restore smoking cessation referrals to at least pre-pandemic levels and to continue to increase the numbers of weight management referrals to all people who are eligible.

In ***Chapter 3***, a mixed methods study combining quantitative analysis of recorded consultations with qualitative interviews with general practitioners, provided insight into the real world challenges of implementing preventive care across different consultation modes. Quantitative findings showed no difference in the number of preventive care segments delivered in remote compared with face-to-face consultations. However, across all consultation modes, advice was delivered more frequently than referral or further support. Qualitative thematic analysis of GP interviews highlighted the importance of body language, visual cues, and patient responses in facilitating effective preventive care delivery, with remote consultations making these aspects more difficult to interpret. These communication challenges were particularly relevant for potentially stigmatising topics such as weight management or alcohol use. At the same time, some opportunities for remote preventive care were identified, such as the use of follow up telephone consultations to discuss alcohol use in the context of abnormal liver function tests. Across all consultation modes, unclear and changing referral pathways and uncertainty regarding responsibility for prevention were identified as barriers to implementation.

Chapter 4 created a novel categorisation system for primary care clinical activity, including consultation mode to enable better quantification and specification of primary care workload. A key challenge in my planned research was the lack of reliable methods to classify consultation mode within electronic health record data. Engagement with multiple primary care database providers confirmed that existing approaches were not fit for this purpose. In response, I developed a new categorisation system to support my analyses of CPRD Aurum primary care electronic health record data (Chapter 5). This categorisation system extends beyond consultation mode to encompass the full range of primary care activity including administrative work and investigations, and has wider applicability for future research, including economic evaluation, workload estimation, and assessment of the impact of remote consultation on other aspects of care delivery. This tool is already being used in subsequent research, including collaborations in the wider University of Oxford (I am a co-investigator on a project looking at impact of surgical wait times and healthcare outcomes including number of GP appointments), and with researchers at the University of Manchester looking at how online consultations affect clinical outcomes and equity.

In ***Chapter 5,*** I used this new consultation categorisation approach in an analysis of electronic health record data from over 10 million individuals across a five year period. This showed that preventive interventions for smoking, weight management, physical activity, and alcohol were substantially less likely to be coded during remote consultations compared with face-to-face consultations, with an approximate reduction of 80-90%. This association was consistent across contemporaneous remote consultations, including telephone and video, and non-contemporaneous consultations such as text and email, as well as across different health behaviours and key population subgroups. In addition, across all consultation modes, preventive care was recorded less frequently than would be expected based on the prevalence of these behavioural risk factors in the population. This finding, consistent with results from ***Chapter 2***, suggests that the current volume of preventive care delivered in primary care is insufficient to meet population need, and that the increasing use of remote consultation may further exacerbate this gap.

Given the apparent sub-optimal delivery of preventive interventions, ***Chapter 6*** presented a systematic review and meta-analysis of strategies to improve the implementation of preventive care in primary care. Implementation strategies were categorised into ten groups, including team changes, changes to the electronic patient registry, facilitated relay of information, continuous quality improvement, clinician education, clinical reminders, financial incentives, and multicomponent interventions. There was evidence that clinical reminders (OR 3.46; 95% CI 1.72-6.96; I^2=89.4%), clinician education (OR 1.97; 95% CI 1.50-2.59; I^2=81.1%), facilitated relay of information (OR 1.95, 95% CI 1.10 – 3.46, I^2=88.2%), and multicomponent interventions (OR 3.10; 95% CI 1.60 – 5.99, I^2=96.1%) increased processes of care, for example referral to weight management or smoking cessation services. Multicomponent interventions showed consistent effects in sensitivity analyses. There was no evidence that other strategies, team changes (relevant due to current changes in the GP workforce and the expansion of ARRS roles in general practice), financial incentives, changes to the electronic patient registry or continuous quality improvement) improved processes of care. Furthermore, there was no evidence that any strategy improved behavioural outcomes such as weight loss, reduction in alcohol intake, increased physical activity or smoking cessation. No studies evaluated interventions specifically designed for remote consultations, so further research needs to investigate whether these types of implementation strategies are applicable in this clinical context. These findings suggest that policymakers should anticipate that improving preventive care delivery in primary care will require the use of multiple complementary strategies.

Overall, this thesis has quantified the impact of the COVID-19 pandemic on documented preventive care delivery and demonstrated that remote consultation is associated with reduced delivery of preventive care. I have provided insight into the mechanisms underlying these findings, including communication challenges and system level barriers, and has identified evidence based strategies that may support improved implementation. Together, these findings contribute to a more comprehensive understanding of how preventive care can be more effectively delivered within modern primary care.

7.3 Strengths and limitations

This thesis has several important strengths. Firstly, it adopts a multi-method approach, combining big data analyses across multiple databases, qualitative research, and a systematic review to investigate prevention in primary care from different perspectives. This has enabled the generation of unique insights that complement one another and provide a richer and more comprehensive understanding of the current landscape than any single method alone. The scale of the work further strengthens its contribution. Across the big data studies, over 20 million participants were included in Chapter 2 and over 10 million in Chapter 5. The systematic review incorporated 85 studies comprising over 4 million participants, and the mixed methods study included 66 recorded general practice consultations across three sites. While existing literature in this area has been predominantly qualitative, this thesis contributes both quantitative and mixed methods evidence and adds unique data insights to this Royal College of General Practitioners (RCGP) remote consulting research priority area.[82]

A further strength is its focus on the implementation of prevention, an area that is often overlooked in medical research. In many cases, there is considerable evidence about the efficacy of preventive interventions, yet these are not consistently delivered in routine practice. This thesis explicitly addresses this implementation gap, contributing to understanding about how and why prevention is not fully realised in primary care. The work has also been strengthened by engagement with policy and professional communities, including contributions to National Institute for Health and Care Excellence (NICE) guideline development and parliamentary inquiries where applicable. The thesis is also timely and directly aligned with current policy priorities, including the shift from treatment to prevention, from hospital to community care, and from analogue to digital systems as outlined in the NHS ten year health plan.[171] This thesis demonstrates that these policy priorities do not operate independently, but interact in complex ways within routine primary care. I identified a key tension between the ambition to increase preventive care delivery and the increasing reliance on digital and remote models of care.

The use of real world data is another key strength, drawing on electronic health records and recorded consultation data. This required working with the complexities of routine general practice, including interruptions during recorded consultations, inconsistent and sometimes poor coding within the electronic health record, and the absence of a reliable method to determine consultation mode from electronic health records. The thesis therefore reflects and adapts to the realities of real world data rather than relying on idealised datasets potentially making the findings more generalisable to routine practice. I am also uniquely placed as a practising NHS GP to understand how the electronic health record is used and the limitations of clinical coding. This understanding enabled me to develop OPCAC and to handle complex routine data that is grounded in the realities of NHS general practice.

Patient and public involvement represents both a strength and a limitation. A small budget was available for patient and public involvement activities. An initial information gathering session was conducted with a Patient Participation Group at a local general practice to inform early study design. A member of the public was subsequently recruited to provide input throughout the programme of work, and her contributions meaningfully influenced how data were processed and how subgroups were analysed and presented, as described in each individual study. Following completion of the studies, a roundtable event was held with seven members of the public with differing experiences of preventive care, and their input has informed future research directions outlined later in this chapter. However, while patient and public involvement meaningfully informed the overall programme of work, there were opportunities for deeper integration within individual studies which I did not pursue at the time. For example, incorporating patient interviews alongside general practitioner interviews in Chapter 3 may have enriched interpretation of the mixed methods findings.

Conducting research with real-world data resulted in several limitations. Three of the included studies used large electronic health record datasets and are therefore subject to the known limitations of routinely collected data. There was substantial missing data in key covariates, particularly ethnicity. In Chapter 5, this was addressed with the missing indicator method, with sensitivity analyses using complete case analysis to examine the robustness of the primary outcomes. In addition, Chapters 2 and 5 necessarily relied on the assumption that preventive care activities were accurately recorded using clinical codes within the electronic health record. However, in the context of time pressured consultations, preventive care may be deprioritised both in delivery and in documentation. General practitioners frequently report that competing demands make it challenging to incorporate preventive discussions, and even when such discussions occur, the associated coding may not be consistently completed. This may partly explain the lower observed incidence of preventive care in the big data analyses compared with the mixed methods study, in which preventive activity was identified directly from recorded consultations rather than from coded entries. In addition, telephone consultations may be perceived as briefer interactions and consequently documented less comprehensively than face to face consultations. However, while differential recording may have resulted in some overestimation of effect size, the strength and consistency of the observed associations across Chapter 5 analyses suggest that the overall conclusion that brief interventions were less likely to be delivered during remote consultations is unlikely to be affected.

A further limitation is the primary focus on general practitioners and general practice consultations. While this reflects the traditional organisation of primary care, there is an increasing shift towards multidisciplinary team based models. It remains unclear which members of the primary care team hold responsibility for delivering preventive care, which may contribute to challenges in implementation. Initiatives such as Making Every Contact Count promote a shared responsibility for prevention across all healthcare professionals. However, in practice, general practitioners continue to face substantial pressure in managing acute demand, which may limit opportunities to prioritise prevention. Including the perspectives and experiences of allied healthcare professionals would have broadened the scope of this work and may have provided a more comprehensive reflection of the realities of modern primary care. However, GPs are often leaders in primary care settings and therefore influential in terms of organisational culture and clinical priorities. Therefore, where prevention is not perceived as a priority among GPs, implementation of preventive care across the wider multidisciplinary team may be less likely.

7.4 Implications of this research and future directions

This section is comprised of my own personal reflections from conducting these five studies and reflections from a patient and public involvement roundtable event I held on Tuesday 17th March 2026 with seven members of the public. The aim of the roundtable event was to discuss next steps in prevention research in primary care. Over a morning session, I presented the key findings from my thesis and then asked their perspectives on what should happen next. The perspectives from the public contributors were incredibly insightful and generated new ideas that I had not thought of previously.

7.4.1 Research implications

The findings from this thesis provide a foundation for a programme of future research aimed at developing, implementing and evaluating interventions to improve the delivery of preventive care in primary care. One option discussed in my PPI roundtable event was co-development of GP prevention training for remote consultations. They particularly stressed the need for co-development with patients to ensure that this training was inclusive, equitable, and judgement-free. There is already existing GP training for weight management conversations, and these could also be adapted for remote consultations.[342] There is also the potential for optimising digital communication. The PPI roundtable group spoke positively of text messages for behaviour change, with the caveat being that this was seen as appropriate only after a rapport building face-to-face consultation. Text messages 'out of the blue' for prevention were generally not appreciated. There is the potential to apply evidence based behavioural science techniques to these types of interventions to maximise impact. Currently, these types of messages are written by each individual GP practice and there is considerable variation nationally with how these types of messages are written and existing evidence suggests that behaviour change communication guidance for general practice healthcare professionals is rarely clearly substantiated with a citation to relevant supporting evidence.[343]. Text message scripts could be co-designed with patients and trialled to ascertain what type of text message content resulted in the most engagement in preventive services.

Another idea that could increase confidence in preventive care delivery would be to ask about stage of change prior to consultation. This could occur when the patient is submitting an e-consult, or if this is considered too burdensome, on registration at the GP practice. If a healthcare professional sees that a patient is open to prevention, then this could give that individual confidence to begin a discussion. Weight, alcohol intake and smoking status are all routinely collected at registration. A further question about willingness to discuss weight management support or similar could also prompt the healthcare professional to move beyond advice giving, which I found the most frequent type of preventive talk in Chapter 3, and towards the offer of referral or further support.

Chapter 3 identified some interesting opportunities for remote preventive care discussions. For example, preventive conversations for excess alcohol often happened during a telephone consultation when following up a patient for liver function tests. This could be particularly impactful as Chapter 2 and Chapter 5 highlighted that current support for excess alcohol is rarely coded in the electronic health record, suggesting that this type of preventive care is not being delivered at a level that would be expected given the prevalence of excess drinking in the population. The PPI roundtable group suggested that flow charts or procedures could be developed to facilitate effective preventive talk by healthcare professionals. There is an opportunity to develop a remote alcohol brief intervention tool specifically for remote implementation after abnormal liver function tests, to facilitate this type of discussion.

In Chapter 6, the systematic review highlighted the lack of research of implementation of prevention in remote consultations. Out of the 85 studies included in my systematic review, there were no studies that specifically addressed prevention in remote consultations. Future work should consider what implementation strategies could be used to ensure preventive care is delivered remotely as it is unclear whether strategies that are effective in face to face consultations are equally as effective remotely. Interestingly, the PPI Round Table group suggested that prompts for healthcare professionals on the electronic health record could be particularly effective for remote consultations. They said that they strongly disliked GPs and healthcare professionals looking at their computer in a face-to-face consultation, but if the consultation was remote, they hoped that the GP would use that opportunity to thoroughly review their health record. They suggested that prompts for preventive care, including potential scripts for bringing up more sensitive topics, could be trialled. This would be something that they thought could help GPs bring up these topics in more sensitive ways. As UK general practice is moving to a hybrid service, it is important that opportunities for prevention are not lost with fewer face-to-face intervention opportunities. Implementation strategies that are particularly targeted at remote consultations should be prioritised for future research given the current lack of preventive care discussions in these types of consultations.

I intend to build on the findings from this thesis through my post-doctoral work and future grant applications focussed on improving the delivery of preventive care in primary care. This programme of work will include the co-design of clinician training and practical decision support tools to facilitate remote preventive care discussions. Initial priorities will be weight management which emerged as the most frequently volunteered behavioural risk factor in

Chapter 3 and is likely to become increasingly important with the wider implementation of GLP-1 RAs, and excess alcohol consumption, where telephone consultations following abnormal liver function test results may provide valuable opportunities for intervention. I will also develop and evaluate text messaging interventions to support behaviour change, particularly smoking cessation as practices are familiar with text messages for smoking cessation. Working with patients, clinicians and service providers, I will co-design message content and referral pathways that maximise engagement while ensuring equitable access to support and minimising the risk of exacerbating the inverse care law.

7.4.2 Clinical implications

The limited delivery of prevention remotely must be seen as an opportunity for change rather that a call to move back to conducting all consultations in person. I am not sure it is possible for GPs to deliver a brief intervention with referral for further support for each risk factor, to each patient individually, alongside cradle to grave management of an increasingly medically complex population. In fact, this concern for the time required to deliver all preventive care guidance has been a key issue with prevention amongst GPs historically, with one report suggesting US primary care physicians require 27 hours each working day to meet guideline recommendations, with over half of that for preventive interventions.[344] Clinically, recognising that prevention is less frequently discussed remotely and designing strategies that can overcome this is important. Having additional staff members, or using remote and digital technologies e.g., app based and text message support intentionally, being mindful of the impact on health inequalities are likely to be the only feasible way to implement the amount of preventive care that is needed with the current population prevalence of these key risk factors.

Some argue that this type of preventive care could be delivered more frequently and more effectively by a social prescriber or health coach, instead of a GP. One of the themes identified in the Chapter 3 GP interviews was lack of clarity around whose role in the primary care multidisciplinary team this was and this lack of clarity resulted in nobody doing so. Perhaps the scale of challenge facing the NHS in terms of prevalence of chronic disease and chronic disease management needs a complete rethink on how people interact with primary care. Instead of seeing a medical doctor who lacks the time to address prevention, people could instead consult with a social prescriber or health coach to ensure their preventive care needs are met. They could provide evidence-based advice and support for smoking, weight management, physical activity, and alcohol and for this to specifically be their remit. People could consult their health coach from early adulthood and form a relationship with them, with preventive care appropriate to their social context, more deprived areas could receive more intensive support. The existing literature suggests that social prescribing may contribute to small improvements in public health outcomes.[121] If there were greater training, awareness, and prioritisation of prevention in this type of role, perhaps these outcomes could be improved upon.

Drawbacks to this approach include: Increased fragmentation of primary care; reduced continuity with a named GP, which has been shown to improve health outcomes in the literature; and potentially reduced public satisfaction with access to their GP.[345] GPs also have a track record of prevention success. Since the 1960s, age standardised cardiovascular mortality rates in the UK have fallen by approximately 75%, with improved hypertension detection and treatment considered a major contributing factor. [346]

A more productive approach could therefore be to position interventions for smoking, weight management, excess alcohol and physical activity as a shared responsibility across general practice and the wider health system, rather than viewing them as either the sole responsibility of GPs or activities that can be completely outsourced from general practice. Effective prevention is likely to require a multidisciplinary approach in which GPs deliver preventive care alongside other team members for whom prevention forms a defined component of their role. To respond to the scale of the challenge, effective prevention is also likely to require innovative delivery models that extend beyond the consulting room. Co-designed interventions delivered through community settings, pharmacies, places of worship, voluntary organisations and digital platforms may improve reach and engagement, particularly when implemented according to the principle of proportionate universalism, with greater intensity of support directed towards more deprived communities.

Evidence from Chapter 3 in this thesis suggests that building rapport, visual cues and body language were vital to successfully discuss prevention with patients. The PPI roundtable supported this and additionally suggested that this is crucial for the first occasion prevention is introduced. Therefore, technology should be used strategically in primary care as part of a multi-modal strategy, with digital or remote follow up options deployed after the initial face-to-face consultation. This is currently not happening. A notable omission in the consultation recordings in Chapter 3 was the lack of recording of digital interventions deployed in primary care. Across all consultation modes, no GP mentioned app or digital referral pathways, if patients were referred or offered further support, this was to a traditional NHS service, or to another member of the multi-disciplinary team, for example a dietitian. Many studies have shown the efficacy of smartphone apps for behaviour change. For example, the Drink Less app was shown to decrease drinking by an additional 2 units of alcohol per week compared to control.[347] The intervention group received a web link to download the app, something that would be straightforward to implement in UK primary care, suggesting real-world efficacy. Similarly, the English NHS Digital Weight Management Programme, has been shown to produce clinically meaningful weight loss (the mean weight change for those who had time to finish the programme was -2.2kg (95% CI -2.25 to -2.16) in analysis of the national service level-data.[348] Using these digital alternatives in primary care, after an initial rapport building face-to-face consultation, could lead to greater implementation of preventive care.

However, to access the English NHS Digital Weight Management Programme, programme a patient needs to meet the referral criteria (18 or older; meet the BMI thresholds; and have a diagnosis of hypertension or diabetes), and be referred by their GP or local pharmacist, again adding complexity and confusion to the system as this system runs in parallel to any locally commissioned services. This is also true in many instances for physical activity and alcohol services. Adding a GP step to this service, where the bottle neck is in terms of access and time seems to reduce access to this efficacious service. Self-referral may introduce additional health inequalities, but another option could be extending referral to other members of the primary care multidisciplinary team, such as social prescribers or practice nurses or even secondary care.

Another potential approach would be the establishment of neighbourhood prevention hubs that provide a single point of access to locally available smoking cessation, weight management, alcohol and physical activity services. Healthcare professionals could discuss behavioural risk factors with patients and refer directly to the hub, rather than needing detailed knowledge of multiple locally commissioned referral pathways.[349] This may address a key barrier to brief intervention delivery, as clinicians often find referral processes more challenging to implement than providing advice alone. Confusion regarding the availability of preventive services was also identified during the patient and public involvement roundtable, suggesting that this challenge affects both healthcare professionals and patients. A prevention hub model could therefore reduce administrative burden and streamline access to preventive services for both clinicians and the public.

Across all consultation modes, Chapter 2 and Chapter 5 showed that prevention was still delivered less frequently than population prevalence of these risk factors would suggest. Chapter 3 also suggested that clinicians predominantly gave advice rather than referral for further support. There needs to be a larger culture shift within the health service that this is something that should be discussed with a healthcare professional and is deserving of the same type of evidence based treatment pathway. One PPI contributor noted that she had never encountered a double GP appointment specifically to discuss prevention, despite such appointments being commonplace for other medical concerns. This reflects a broader cultural undervaluing of prevention. Another PPI contributor highlighted a gap in communication around prevention between primary and secondary care. Despite having an in-depth discussion about weight with their surgeon, their GP remained unaware of this interaction, reflecting how correspondence between services rarely captures preventive care. In line with the findings from Chapter 6 that multi-component interventions are effective in increasing the delivery of preventive care in primary care, enabling secondary care to make direct referrals to preventive services may address this disconnect. Such an approach could ensure communication with the patient's GP about prevention, whilst reinforcing the importance of prevention.

Evidence from wider primary care literature indicates that medication based prevention is often easier to embed in clinical practice than behavioural intervention alone, both because it fits established prescribing practices and because patients and clinicians may view it as a more immediate and concrete response to risk.[41] It is interesting to consider whether pharmacotherapy may provide a route through which prevention becomes more visible, actionable, and more professionally valued in primary care. In the case of weight management, there is likely to be significant clinical change over the next few years with the roll-out of Glucagon-like peptide-1 receptor agonists (GLP-1RAs). Research suggests that GPs are broadly positive about integrating GLP-1 RAs into primary care for obesity management, largely because they viewed these medicines as an effective therapeutic option in a field where existing treatment pathways are often limited, fragmented, and difficult to access. At the same time, GPs expressed important concerns about implementation, including workload, inadequate resourcing, uncertainty about how to manage patient requests for NHS or private prescriptions, risks of misuse, and the possibility that medication could distract attention from the wider social determinants of obesity and from holistic care.[350] It will be interesting to see if GPs recognise the benefit that weight loss has for their patients and start to deploy other weight management strategies and appreciate the value of prevention more broadly as a consequence of an effective pharmacotherapy option. The roll out designed by NHS England is gradual over 12 years, with only 220,000 people included in the first three years.[126] Although this prioritisation is understandable in the context of finite capacity, it also raises a preventive tension. By targeting those at highest immediate risk first, the current model may defer treatment for many people who could derive substantial benefit from earlier intervention, before further comorbidity develops. A slow NHS rollout risks entrenching a two tier system in which those able to pay can access treatment early, while others wait for phased eligibility, despite often carrying a greater burden of obesity related disease and so increasing health inequalities. Data suggests that private GLP-1RAs prescriptions are concentrated amongst women from higher socioeconomic groups with modestly raised BMI.[129]

7.4.3 Policy implications

During this DPhil, the NHS 10 year plan was published with its three key aims being moving from treatment to prevention, hospital to community and analogue to digital.[171] Given that this thesis is examining how consultation mode impacts the delivery of preventive interventions in primary care, the results of this thesis are timely. This thesis highlights some tensions within these overarching aims for the NHS. Chapter 5 showed that preventive interventions are less frequently delivered in remote consultation. This relationship was true for both telephone/ video and text/email consultations. Moving to increased remote delivery of NHS primary care services (telephone, video, text message and email consultations) is associated with a reduction in interventions for smoking, weight management, alcohol and physical activity. Policymakers should be aware of these trade-offs and put strategies in place to mitigate them. For example, policy changes that aim to increase preventive care delivery should be wary of technology circumventing the spirit of the policy change. An example of this would be using text messages to provide smoking cessation advice, or to refer people to weight management service to meet QOF indicator requirements, with no context to this referral. Participants of my roundtable event were especially critical of random texts for behaviour change. The objective of these QOF indicators was to prompt a meaningful behaviour change conversation with the patient, with a referral if appropriate.

Although prevention is relevant to many chronic conditions, a disease specific lens may help focus attention, prioritise resources and build support for preventive interventions among policy makers, healthcare professionals and the public. The National Cancer Plan provides a clear example of this approach. Smoking, excess weight and alcohol consumption are all established risk factors for cancer, and improvements in the delivery of preventive care in primary care therefore have the potential to contribute to reductions in future cancer incidence while simultaneously improving outcomes across a wide range of other long term conditions. The National Cancer Plan recognises that achieving meaningful improvements in prevention will require collaboration across healthcare, public health, community and voluntary sector organisations, alongside systems that incentivise long term investment in prevention.[351] It also highlights the potential of digital technologies, including the NHS App, to provide personalised support for smoking cessation and weight management. The findings of this thesis support these ambitions and suggest that effective prevention will require coordinated action across sectors, innovative delivery models and sustained investment in evidence based interventions that can be delivered at scale.

Using this disease specific lens, I have secured a Cancer Research UK postdoctoral fellowship to develop the implementation of cancer prevention in primary care, building on the findings and research priorities identified in this thesis. This fellowship will support further work to develop interventions that facilitate the implementation of prevention in routine practice as outlined in research implications. Alongside this programme of work, I will play a key role in the development and evaluation of emerging preventive innovations, including LungVax, a lung cancer prevention vaccine. This will include designing a Phase II community embedded prevention trial, ensuring that considerations of implementation, equity and primary care delivery are incorporated from an early stage of intervention development.

Throughout this thesis, I have also tried to engage with policy consultations where applicable to my research. For example, I responded to both National Institute for Health and Social Care Excellence (NICE) on diagnosis of overweight and obesity and management of overweight and obesity. I also submitted evidence for the House of Commons All-Party Parliamentary Health and Social Care Select Committee Inquiry into Prevention. Key points in these submissions included reducing diagnostic friction for obesity and overweight. One of the new NICE recommendations is to include a waist circumference measurement as part of the diagnosis for overweight and obesity, in addition to a body mass index (BMI) calculation. Whilst BMI has its limitations, it is good enough for primary care purposes and my research suggests that clinicians struggle to get to the impactful part of the consultation, offering referral or further support for weight management. Furthermore, accurately measuring a waist circumference would be even more challenging in the context of a remote consultation. Many patients would struggle to find a tape measure to accurately calculate their waist circumference whilst on a telephone call with a GP. Increasing the number of tasks that may marginally improve the accuracy of diagnosis is not the bottleneck in obesity care in the UK, getting to evidence-based management is.

In addition, the original NICE statement included the recommendation that people identified for the first time as living with overweight, obesity or central adiposity should receive up-to-date information on available local interventions and national programmes. I responded that this information should be available to people living with overweight and obesity at any point after diagnosis and not just the first time they are diagnosed. In Chapter 3, GPs highlighted the importance of continuity, developing a relationship with a patient, and co-creating prevention together. There was a perception that these types of conversations may evolve over multiple consultations and meeting the patient where they were in terms of behaviour change was important. In the final published NICE guideline, this statement has been edited so this information should be readily available at all time points, not just at diagnosis.

7.4.4 Implications for social determinants of health

As outlined in the introduction, offering advice and support for smoking, weight management, alcohol excess and physical activity alongside action on wider determinants of health (poverty, housing, employment, food environment, access to green spaces) is important to address the widening health inequalities in the UK population. In Chapter 2, I found some small differences between population subgroups on the impact of the COVID-19 pandemic on the delivery of brief interventions for smoking, weight management, alcohol excess and physical activity. For example, there was a greater reduction in initial step change between the most deprived quintiles compared to the least for weight management, alcohol and physical activity advice. However, this was then followed by a trend towards a quicker recovery (greater slope change) for the more deprived quintiles compared to the least deprived.

In Chapter 3 I found several GPs were concerned about the impact that text messaging for smoking cessation was having on the access of this essential care. They observed that smoking was commonly found amongst older patients in more deprived areas and introducing text messaging as an additional step to access smoking cessation care would introduce barriers that this patient group were the least well equipped to manage. Another GP site did not have access to a tier 2 weight management service, highlighting the geographical inequalities that exist in relation to accessing this care. For the 85% of people that do not smoke, poor diet and excess weight is likely to be the most significant risk factor for future disease. One study mapped the provision of Tier 3 and 4 weight management services and found the East of England had no Tier 4 weight management service. Whilst not the specific service investigated in this thesis, it does illustrate how lack of care can be clustered in areas of deprivation, for example, coastal areas.[127]

In Chapter 5 I found that the difference between the delivery of brief intervention remotely versus face-to-face between population subgroups was small. However, even relatively small differences in preventive care delivery may contribute to widening health inequalities when applied across large populations. I found that individuals from Black and Asian backgrounds, those from London and lower socioeconomic groups were relatively less likely to receive brief interventions remotely compared to face-to-face. Evidence suggests that people from more deprived areas are less likely to see a GP face-to-face and this may be the mechanism by which people are less likely to receive key preventive care.[102] As smoking, excess weight, excess alcohol and physical activity follow a social gradient and are more likely to occur in people living in areas of deprivation, results from this thesis suggest that those most in need of preventive care may be the least likely to receive it. I plan to conduct further analyses of electronic health record data to explore variation in the delivery of preventive care according to patient demographic and clinical characteristics. Specifically, I will examine how the provision of smoking cessation, weight management, alcohol reduction and physical activity interventions differ by age, sex, socioeconomic status, ethnicity, geographical region and multimorbidity. This work will identify inequities in preventive care delivery and hopefully generate evidence to support more equitable implementation of preventive care in primary care.

In Chapter 6, there was a lack of studies that accounted for or commented on social determinants of health when considering strategies to improve the implementation of preventive care in primary care. Future studies should account for and measure this this as it is plausible that different strategies may be more successful in certain contexts. For example, an additional team member may be more effective in practices in more deprived areas where individuals need more individual support.

Overall, this thesis demonstrates that the current configuration of remote consulting is not delivering preventive care equitably, particularly for the individuals and communities most likely to benefit from these interventions. Addressing this requires, first, critical evaluation of the pathways and technologies that facilitate or hinder access to preventive services for different health behaviours. When new pathways, interventions or technologies are developed, the PPI roundtable were clear that these should be developed using participatory or co-design methods. Consideration should be given to the complexity of these pathways, including the number of steps required to access support and whether technology is simplifying or inadvertently increasing this complexity. It is also important to assess whether preventive care interventions are designed to support clinicians, patients, or both, and whether locally available services are accessible and appropriate for the populations they serve in terms of geography, language, and cultural context.

For prevention to be more effectively integrated into remote consultation it is likely that targeted clinician training, alongside careful co-design of digital systems, including the NHS App, e-consultation platforms, and text messaging services will be required. Remote consulting is an established component of UK primary care, so it is vital that prevention is embedded within routine care delivery rather than treated a secondary consideration.

Finally, improvements in preventive care delivery are unlikely to succeed without greater action on the wider determinants of health, including housing, employment, the food environment, access to green spaces, and air pollution. Professional organisations such as the Royal College of General Practitioners, which hold significant influence in health policy discussions, should advocate clearly for action in these areas. Government should be prepared to implement stronger public health measures, and medical organisations should provide consistent support for more ambitious action to reduce health inequalities and improve population health.

7.5 Positioning of this thesis within the broader prevention landscape

The strategic emphasis within the NHS Ten Year Health Plan on prevention and the relocation of care into community settings is not novel. Comparable priorities have been articulated across multiple high income health systems, where strengthening prevention within primary care has been positioned as a central policy objective.[352 353] However, despite repeated policy commitments, international evidence suggests that these strategies have not translated into consistent or meaningful improvements in key prevention indicators, for example the prevalence of overweight and obesity continues to rise in the majority of high income countries.[354] A systematic review of preventive care implementation highlights the importance of organisational factors in shaping delivery. [355] The review suggests that system level values, structures, and care pathways can either enable or constrain preventive activity, and that individual clinicians are limited in their ability to overcome systemic barriers in their absence. This aligns closely with the findings presented in Chapter 3, where GPs described uncertainty around referral pathways and frequent changes in available services. These findings reinforce the argument that effective preventive care requires stable, coherent, and accessible pathways. Without such infrastructure, preventive care remains difficult to operationalise in routine clinical practice, and progress will continue to stall.

EUROPREV, part of the World Organization of Family Doctors (WONCA) Europe network, whose main role is to promote evidence based disease prevention and health promotion in general practice and family medicine published these seven principles of prevention in primary care in 2025.[356] These principles reflect the current position of the medical profession with respect to preventive care.(Table 7.1)

Table 7.1 EUROPREV principles for prevention in primary care (2025) [356]

Principle number	**Principle**
1	Accessibility and quality of general practice are the basis
2	Become knowledge experts in evidence based prevention
3	Avoid prevention not based on high quality evidence
4	Appreciate the value of structural prevention
5	Symptomatic and high risk patients have priority
6	Proportionate universalism, with additional efforts for socially disadvantaged patients
7	Start low and go slow

Results from this thesis support the first six EUROPREV principles. However, the principle of "start low and go slow" appears less consistent with the empirical findings of this research. Rather than representing a pragmatic implementation strategy, this approach appears to reflect the prevailing status quo, characterised by incremental change and limited impact. The quantitative analyses in Chapter 2 and Chapter 5 demonstrate persistently low levels of evidence based preventive care delivery in primary care, suggesting that gradualism has not produced meaningful system level change.

This critique is echoed in wider policy discourse. For example, the Health Foundation has argued for more ambitious and transformational approaches to prevention, including sustained investment in local public health services, and a reallocation of resources from acute to community care. [357] Concerns regarding short term financial pressures leading to the disinvestment in prevention services, such as smoking cessation and alcohol support and the long costly process to reinstate these services, further illustrate the structural challenges that undermine sustained preventive efforts. The call for independent scrutiny of financial prevention targets reflects a growing recognition that accountability mechanisms are required to support long term system change. The NHS Modernisation Bill aims to facilitate greater integration of primary and secondary care data systems. This could enable more comprehensive tracking of patients' journeys through preventive support service, for example, weight management or alcohol services and therefore improve both service evaluation and the capacity for population level analysis .[358] Improved interoperability of health records could also support greater continuity of preventive care by allowing clinicians to build upon behaviour change discussions initiated elsewhere in the healthcare system.

Change is possible and prevention can be delivered at scale. For example, The National Diabetes Prevention Programme has been associated with an approximate twenty percent reduction in progression from non-diabetic hyperglycaemia to type 2 diabetes mellitus, delivering clear clinical and economic benefits.[359] Evidence for the benefit of the NHS Health Check (a check for people aged 40-74, conducted every 5 years in primary care with the aim of reducing the risk of future disease) shows more modest benefit. One analysis, conducted in the UK Biobank found the programme was associated with a reduced risk of multiorgan disease and death.[360] Another, found that the programme was associated with an increased diagnosis of hypertension and type 2 diabetes mellitus and statistically significant, but clinically modest reduction in modelled cardiovascular risk. [361] Evaluation of these programmes is essential to quantify the clinical effects, and to refine and optimise future delivery. These programme evaluations provide evidence of how prevention can be implemented at scale with measurable benefits at both the individual and population level.

There is also growing interest in developing and implementing targeted preventive interventions at key points across the life course. For instance, the growing complexity of obstetric care and the associated clinical and financial consequences have driven renewed focus on preconception health. Initiatives such as the United Kingdom Pre Conception Partnership aim to develop primary care based interventions to improve preconception health. [362] As overweight and obesity are the most prevalent risk factor for complications during labour, presumably interventions at this stage will include a weight management component. A recent systematic review highlighted the benefit of weight loss prior to in vitro fertilization (IVF) in terms of an increase in total pregnancy rate and pregnancies resulting from unassisted conception.[363] These developments illustrate how prevention can be prioritised when there is a clear link between upstream risk factors and downstream clinical and economic outcomes.

Overall, the existing literature supports that general practice is an important setting for preventive interventions but highlights persistent challenges in implementation. The findings of this thesis contribute to this body of evidence by demonstrating that current approaches, characterised by incremental change and system fragmentation, are insufficient. More ambitious, coordinated, and system wide strategies are required to achieve meaningful improvements in preventive care delivery, including consistent pathways, sustained investment, and a willingness to reallocate resources in line with preventive priorities. The way people interact with primary care has changed in the last decade. Most GP practices now use a hybrid consultation model with a mixture of face-to-face and telephone consultations, supported by e-consultations and text messages with a wider variety of staff roles. This change could be used as a moment of opportunity to find new ways to embed prevention into primary care.

7.6 Conclusions

In conclusion, this thesis quantified differences in the delivery of preventive care between remote and face-to-face consultations, including the effects of the pandemic on consultation patterns for the four main behavioural risk factors in the UK population; smoking, excess weight, physical inactivity and excess alcohol. I identified interactional factors that may make preventive care more difficult to deliver remotely, while also demonstrating that, across all consultation modes, preventive care is delivered less frequently than expected based on population need. Where prevention does occur, it is more often limited to advice rather than the provision of further support. These findings reflect barriers operating at both patient and system levels to the effective implementation of preventive care, including increasing medical complexity, time constraints in primary care, and a lack of clarity regarding professional responsibility for prevention.

Ultimately, findings from this thesis suggest that meaningful expansion of prevention needs to move beyond the premise that prevention can only occur in a face-to-face consultation between a GP and a patient. Implementing prevention at the scale required is likely to require system level change, including redistribution of referral responsibilities across the wider primary care multidisciplinary team and secondary care, alongside the strategic deployment of evidence based technologies and the development of coordinated referral programmes. Due to the scale of the prevention challenge, new models and places of care should be developed to ensure that access to support is available for those who would have the greatest need. Where prevention does occur in primary care, more could be done to optimise delivery during remote consultations, and the use of technology should be evaluated to ameliorate the limitations of remote consultations. Primary care also needs to become more vocal in making the case for prevention as the right thing to do, to reduce pressure on services, improve patients' quality of life and reduce health inequalities. Overall, these findings highlight the need to move beyond individual and GP level solutions towards a more integrated and system wide approach to prevention.

8 Appendix 1: Code lists for outcomes of Chapter 2 interrupted time series analysis in the ORCHID database

SNOMED CT or EMIS code	Descriptor
Smoking cessation advice	
#171038002	Health education - smoking
#171055003	Pregnancy smoking education
#225323000	Smoking cessation education
#225324006	Smoking effects education
#281080007	Advice on smoking
#384742004	Smoking cessation assistance
#390901002	Negotiated date for cessation of smoking
#408425002	Lifestyle advice regarding smoking
#702388001	Tobacco use cessation education
#711081005	Negotiation of date for cessation of smoking
#771155005	Brief intervention for smoking cessation
#200221000000105	Smoking cessation advice provided by community pharmacist
#216841000000103	Smoking cessation advice provided by community pharmacist
#216851000000100	Smoking cessation advice provided by community pharmacist
#506491000000102	Brief intervention for smoking cessation
#507721000000106	Brief intervention for smoking cessation
#507731000000108	Brief intervention for smoking cessation
#521721000000109	Smoking cessation leaflet given
#838131000000103	Provision of written information about smoking cessation
#857861000000100	Education about tobacco use cessation
#1110791000000100	VBA (Very Brief Advice) on Smoking
Smoking cessation referral	
#152100002	Referral to stop-smoking clinic
#183871002	Referral to stop-smoking clinic
#315232003	Referral to stop-smoking clinic
#395600001	Referral to smoking cessation advisor
#395645002	Referral to smoking cessation advisor
#395700008	Referral to smoking cessation advisor
#401068004	Seen by smoking cessation advisor
#401160008	Smoking cessation programme start date
#770729006	Referral for brief intervention for smoking cessation
#77421000000108	Seen by smoking cessation advisor
#81821000000106	Seen by smoking cessation advisor

#201931000000109	Attends practice smoking cessation clinic
#201941000000100	Attends smoking cessation clinic not at practice
#505281000000106	Referral to National Health Service stop smoking service
#505301000000107	Referral to NHS (National Health Service) smoking cessation service
#510681000000102	Referral to NHS stop smoking service
#712971000000108	Practice based smoking cessation programme start date
#712981000000105	Practice based smoking cessation programme start date
#767641000000109	Referral for smoking cessation service offered
#780901000000101	Referral for smoking cessation service offered
#783011000000105	Stop smoking service opportunity signposted
#783021000000104	Stop smoking service opportunity signposted
#871661000000106	Referral to smoking cessation service
#871671000000104	Referral to smoking cessation service
#1084381000000100	Signposting to smoking cessation service
#1094321000000100	Referral for brief intervention for smoking cessation
Weight management advice	
#11816003	Diet education
#65912007	Diet counselling
#77806000	Calorie restricted diet
#151239000	Low calorie diet - prophylaxis
#151243001	Unsaturated fat diet - prophylaxis
#171046001	Health education - diet
#182956005	Low calorie diet - prophylaxis
#182960008	Unsaturated fat diet - prophylaxis
#183054002	Dietary advice
#183059007	High fibre diet education
#183061003	Low fat diet education
#183062005	Low cholesterol diet education
#183063000	Low salt diet education
#183065007	Low carbohydrate diet education
#183072008	Patient advised about diet NOS
#226079002	Very low energy diet
#229807004	Recommendation to change food and drink intake
#230091007	Recommendation to change fat intake
#248114003	Actions to lose weight
#266724001	Weight-reducing diet education
#281085002	Sugar-free diet education
#284350006	Diabetes mellitus diet education
#284352003	Obesity diet education
#285383009	Recommendation to change fruit and nut intake

#285390004	Recommendation to change carbohydrate intake
#361232005	Recommendation to change dietary intake
#388976009	Weight reduction regimen
#419155003	Recommendation to change diet
#428274007	Dietary education for type 2 diabetes mellitus
#429071001	Dietary education for lipid disorder
#429072008	Dietary education for hyperlipidaemia
#443288003	Lifestyle education regarding diet
#445033007	Discussion about ideal body weight
#609104008	Educated about weight management
#698471002	Patient advised about weight management
#698612005	Dietary education for impaired glucose tolerance
#699849008	Healthy eating education
#718361005	Weight management programme
#14051000175103	Dietary education for cardiovascular disorder
#299731000000109	Dietary health promotion advice
#300131000000107	Dietary advice for type II diabetes
#300201000000105	Lipid disorder diet education
#300211000000107	Hyperlipidaemia diet education
#300241000000108	Advice to change starchy food intake
#300251000000106	Advice to change biscuit intake
#300271000000102	Advice to change fat and oil intake
#300281000000100	Advice to change fatty food intake (InPS+developmental)
#300301000000104	Advice to change high energy food intake
#300321000000108	Advice to change carbohydrate food intake
#300331000000105	Advice to change refined carbohydrate food intake
#300341000000101	Advice to change ghee intake
#300351000000103	Advice to change sugar intake
#300361000000100	Advice to change vegetable and pulses intake
#301011000000106	Dietary advice for weight loss
#305231000000109	Advice to change sugary food intake (InPS+developmental)
#338981000000100	Recommendation to change cheese intake
#338991000000103	Recommendation to change savoury food intake
#339001000000103	Recommendation to change vegetable intake
#339011000000101	Recommendation to change potato intake
#339021000000107	Recommendation to change pulse vegetable intake
#339471000000102	Recommendation to change carbonated drink intake
#339481000000100	Recommendation to change fruit juice intake
#339611000000105	Recommendation to change bread intake
#339621000000104	Recommendation to change breakfast cereal intake
#339631000000102	Recommendation to change pasta intake

#344751000000100	Recommendation to change butter intake
#344841000000105	Advice to change convenience food intake (InPS+developmental)
#345301000000101	Recommendation to change energy intake
#346341000000107	Advice to change savoury snack intake
#346351000000105	Advice to change pudding intake
#346361000000108	Advice to change sandwich intake
#361671000000108	Advice to change margarine intake
#361681000000105	Advice to change oil intake
#509011000000108	Lifestyle advice regarding diet
#509021000000102	Lifestyle advice regarding diet
#509031000000100	Lifestyle advice regarding diet
#709811000000101	Dietary education for impaired glucose tolerance
#755501000000106	Advice given about weight management
#755511000000108	Advice given about weight management
#768111000000102	Advice about food intake
#768121000000108	Advice about food intake
#776931000000102	Discussion about weight management programme
#776941000000106	Discussion about weight management programme
#780621000000101	Calorie restricted diet
#780631000000104	Very low energy diet
#819321000000101	Weight management plan started
#837891000000105	Provision of written information about diet and nutrition
#846441000000103	Dietary education for eating out
#860961000000102	Provision of written information about weight reduction diet
#886171000000107	Healthy eating education
#891291000000108	Healthy eating education
#990121000000104	Weight management programme
Weight management referral	
#398752005	Referral to weight maintenance regimen service
#408289007	Refer to weight management programme
#700154005	Seen in weight management clinic
#197911000000106	Weight management programme offered
#212621000000105	Weight management programme offered
#212631000000107	Weight management programme offered
#767661000000105	Referral to weight management service offered
#771491000000104	Referral to local authority weight management programme
#771501000000105	Refer to local authority weight management programme
#780911000000104	Referral to weight management service offered
#819361000000109	Weight management programme offered
#837111000000105	Referral to residential weight management programme

#837121000000104	Refer to residential weight management programme
#837181000000103	Referral to weight management special interest general practitioner
#837191000000101	Referral to weight management special interest general practitioner
#877951000000105	Seen in weight management clinic
#877961000000108	Seen in weight management clinic
#894961000000105	Referral to multidisciplinary obesity clinic
#894971000000103	Referral to multidisciplinary obesity clinic
#1326201000000101	Referral to weight management service
Alcohol advice	
#24165007	Alcoholism counselling
#148262002	Health education - alcohol
#148281005	Pregnancy alcohol advice
#151362000	Patient advised about alcohol
#151369009	Alcohol leaflet given
#171039005	Health education - alcohol
#171057006	Pregnancy alcohol education
#183091008	Patient advised about alcohol
#183098002	Alcohol leaflet given
#281078001	Education about alcohol consumption
#315212004	Patient advised about alcohol
#316494009	[V]Alcohol abuse counselling and surveillance
#408947007	Alcohol abuse prevention education
#413473000	Alcohol consumption counselling
#413474006	Alcohol counselling by other agencies
#171191000000103	Alcohol consumption counselling
#171221000000105	Alcohol counselling by other agencies
#175851000000101	Alcohol consumption counselling
#175881000000107	Alcohol counselling by other agencies
#366371000000105	Brief intervention for excessive alcohol consumption completed
#366381000000107	Brief intervention for excessive alcohol consumption
#366391000000109	Brief intervention for excessive alcohol consumption
#366421000000103	Extended intervention for excessive alcohol consumption completed
#366431000000101	Extended intervention for excessive alcohol consumption completed
#366441000000105	Extended intervention for excessive alcohol consumption completed
#375941000000101	Advised to contact primary care alcohol worker
#375951000000103	Advised to contact primary care alcohol worker
#375961000000100	Advised to contact primary care alcohol worker
#376401000000103	Referral to alcohol brief intervention service
#376411000000101	Referral to alcohol brief intervention service
#376421000000107	Referral to alcohol brief intervention service

#402321000000101	[V]Alcohol abuse counselling and surveillance
#527961000000108	Alcohol counselling by other agencies
#837841000000100	Provision of written information about alcohol
#837851000000102	Provision of written information about alcohol misuse
#946101000000100	Specialist alcohol treatment service signposted
#946111000000103	Specialist alcohol treatment service signposted
#955731000000102	Family wellbeing discussion about alcohol
#955741000000106	Discussion about family wellbeing - alcohol
#1104571000000100	Signposting to drug and alcohol support service
#1111231000000100	Provision of information about alcohol use
#1325551000000109	Seen by community alcohol team
Alcohol referral	
#38670004	Referral to alcoholism rehabilitation service
#389933003	Referral to community alcohol team
#390667003	Referral to community alcohol team
#390857005	Referral to community alcohol team
#417096006	Referral to community drug and alcohol team
#431260004	Referral to specialist alcohol treatment service
#188201000000102	Referral to community drug and alcohol team
#191701000000100	Referral to community drug and alcohol team
#335851000000105	Referral to specialist alcohol treatment service
#335861000000108	Referral to specialist alcohol treatment service
#335871000000101	Referral to specialist alcohol treatment service
#372501000000100	Seen by counsellor for alcohol misuse
#809401000000103	Referral to alcohol misuse clinic
#1099141000000106	Referral to alcohol misuse service
Physical activity advice	
#171045002	Health education - exercise
#281090004	Recommendation to exercise
#304507003	Exercise education
#386463000	Prescribed activity/exercise education
#389293005	Target physical activity
#390029002	Target physical activity
#391105003	Target physical activity
#408426001	Lifestyle advice regarding exercise
#408578001	Physical activity target minimal exercise
#408579009	Physical activity target strenuous exercise
#408580007	Physical activity target light exercise
#408581006	Physical activity target moderate exercise

#429778002	Patient given written advice on benefits of physical activity
#762227003	Provision of advice about aerobic exercise
#819961005	Physical activity guidance
#94541000000104	Physical activity target minimal exercise
#94551000000101	Physical activity target light exercise
#94561000000103	Physical activity target moderate exercise
#94571000000105	Physical activity target strenuous exercise
#99411000000100	Physical activity target minimal exercise
#99421000000106	Physical activity target light exercise
#99431000000108	Physical activity target moderate exercise
#99441000000104	Physical activity target strenuous exercise
#286321000000102	Advice to aim for 30 minutes of moderate activity on 5 days or more each week
#286331000000100	Advice to aim for 30 minutes of moderate activity on 5 days or more each week
#286341000000109	Advice to aim for 30 minutes of moderate activity on 5 days or more each week
#293681000000103	Patient given written advice on benefits of physical activity
#293691000000101	Patient given written advice on increasing physical activity
#293701000000101	Patient given written advice on increasing physical activity
#375031000000109	Brief intervention for physical activity completed
#522471000000109	Brief intervention for physical activity offered
#522481000000106	Brief intervention for physical activity offered
#525601000000105	Brief intervention for physical activity follow-up completed
#525611000000107	Brief intervention for physical activity follow-up completed
#526391000000103	Physical activity brief intervention follow-up
#526401000000100	Physical activity brief intervention follow-up
#756021000000103	Intervention for risk to health associated with overweight and obesity, advice about diet and physical activity
#756031000000101	Intervention for risk to health associated with overweight and obesity, advice about diet and physical activity
#806001000000101	Provision of advice about aerobic exercise
#806011000000104	Advice about aerobic exercise
#837751000000105	Provision of written information about exercise
#1105751000000100	Patient given written advice under PACAP (Physical Activity Clinical Advice Pad) programme
Physical activity referral	
#151260006	Exercise on prescription
#182982001	Exercise on prescription
#310882002	Exercise on prescription
#389936006	Referral to physical activity programme
#390670004	Referral to physical activity programme
#390864007	Referral for exercise therapy
#390893007	Referral to physical activity programme

#710005006	Referral to physical training instructor
#770749002	Referral for combined healthy eating and physical education programme
#511991000000101	Referral for exercise on prescription declined
#512001000000103	Referral for exercise on prescription declined
#519081000000103	Referral for graded exercise therapy
#519091000000101	Referral for graded exercise therapy
#526151000000109	Referral to exercise on referral programme
#526161000000107	Referral to exercise on referral programme
#767621000000102	Referral for physical activity service offered
#780891000000102	Referral for physical activity service offered
#1094331000000103	Referral for combined healthy eating and physical education programme

9 Appendix 2: Interview topic guide for Chapter 3

What are General Practitioners (GPs) views on the barriers, facilitators and opportunities for brief interventions in different consultation modalities? *

** Below is a list of topics/questions to be discussed in this study. The qualitative work will remain flexible with respect to participants' agendas but we will cover the broad topics/questions noted. It is common in qualitative work to iteratively develop topics and questions as new ideas emerge from early data collection. Therefore, we may add new topics as the interviews progress and data collection continues. However, the key topics will explore General Practitioner's (GPs) views on the barriers, facilitators and opportunities for brief interventions and associated modalities.*

Preamble

Thank you for agreeing to do this interview. My name is X and I will be interviewing you for about thirty minutes today. I am going to ask you some questions about how you discuss health behaviours, in particular smoking, obesity, physical activity and alcohol and how consultation modality (for example face-to-face or telephone) affects this. If there are any questions that you do not feel comfortable answering, tell me and I'll move on to another topic. Or, if you decide you want to stop the interview altogether that's fine, just let me know. This is not a test of your knowledge as a GP it is just to get an understanding of how you approach health behaviours in consultation.

Our conversation today is completely confidential, except if you tell me something that is concerning. In this case, I will discuss with my research team and decide what action to take. I will tell you why I have to break confidentiality.

I will be using an external audio recorder to record the interview today. I will not be recording the interview on Microsoft Teams. Please do not record the interview yourself.

Do you have any questions before we begin the interview? Ok I will turn on the audio recorder.

Consent [re-read consent form and check whether participant still consents, if participant withdraws consent end interview].

Introduction to discussing health behaviours

Primary Question	Potential Prompts
Do you ever try to encourage someone to stop smoking, lose weight, become more physically active or moderate their drinking? What makes you decide to do this? The purpose of this question is to get an initial understanding of when GPs will discuss health behaviours	• What do you do typically? Why is that? • Can you tell me a bit more about your answer? • Do you have these discussions in the same way with all patients? • What would help you have more of these types of discussions? • Has this changed over time? • Is anyone else involved in these discussions?

Perspectives on consultation modality

Primary Question	Potential Prompts
Do you do this over the phone? How does it feel? The purpose of this question is to understand whether GPs recognise a difference in approach and whether they can reflect on why this might be the case.	• How does your approach differ? • Why do you think that is? • Does seeing or not seeing the person in front of you change the conversation? • Why or why not? • Some people have suggested that telephone consultations are more transactional that face-to-face consultations. What are your thoughts on that?

Reflection on recorded consultations

Primary Question	**Potential Prompts** **Note: This depends on the content of the recorded consultation so will vary between participants**
I have a recording from one/two of your consultations where you did/did not discuss smoking/obesity/physical activity/ alcohol. I would like to play this back to you now, we can listen together and then have a chat about them, does that sound okay? The aim of this is to reflect on the differences in face-to-face and remote consultation practices. Ideally, I will play 2 consultation extracts – one from a face-to-face, the other from a remote consultation where brief intervention has taken place (or not taken place if this was avoided).	• Can you chat me through what you were thinking here? • Would you be happy to share your thoughts on how the type of consultation affected these discussions? • I'm interested by your use of the word/phrase "xxxxxxx", could you elaborate a bit more on your thinking at this point? • If you could do this consultation again, is there anything you would have done differently? • What advice might you give to new doctor navigating this for the first time?

Conclusion

Is there something else you would like to mention that you think may be important for me to know? Thank-you for your time, I will turn off the recorder now.

Next Steps

That is the end of the interview. Thank you for participating. I will send you a copy of the consent form via email. I will then begin analysing your interview data. You can email me if you have additional questions.

Would you like to be sent research outputs?

Do you have any questions for me?

10 Appendix 3: Journey through the study for participants in Chapter 3 mixed methods study

Approximately 3 GP practices recuited through up to 3 CRNs

- Local Information pack (LIP) sent to each GP practice. Site initiation visit (SIV) and training scheduled.

SIV and training at each site

- Training with practice manager (PM), participating GPs and practice receptionists to cover:
  - 1. Identifying relevant routine clinic list using inclusion/ exclusion criteria (PM)
  - 2. How to take informed consent (Reception staff)
  - 3. How to use the audio recorders (GPs)
  - 4. How to transfer the audio recordings to the University of Oxford secure shared drive (PM)

Recorded consultations take place

- GPs record approximately one routine clinical session each.
- At the end of the session, the audio recorder transferred to the PM to upload audio files to the University of Oxford secure shared drive.
- Once confirmed receipt by the research team, audio recordings are deleted from the recording device.
- The audio recorder (with no recordings) is mailed back to the research team in Oxford.

Interviews with GPs take place approximately 2 weeks later

- Up to 12 GPs are interviewed for 30 minutes each
- This takes place on Microsoft Teams
- GP practices are reimbursed for the clinical time

11 Appendix 4: Initial communication with participants for Chapter 3 mixed methods study

UNIVERSITY OF OXFORD
NUFFIELD DEPARTMENT OF PRIMARY CARE HEALTH SCIENCES
Medical Sciences Division

1. Initial text message to patients

Dear/ To (patient name) *#this line is automatically populated by Accurx software*

Your GP practice is participating in a research study investigating how remote consultations affect what topics are discussed with your doctor. You are invited to participate but are under no obligation to do so. Please review the attached patient information sheet. A member of the practice team will call you to answer any questions and take informed consent if you are happy to participate.

Thank you for your time.

2. Initial email to participating GPs

Dear Dr X,

Your surgery is participating in a clinical research study titled '**How has the transition to remote consulting affected the preventive care content of primary care consultations?'**

As part of this study, we are asking GPs at participating practices to:

1. Audio record up to two routine clinical sessions (with a mixture of face-to-face and remote consultations) with eligible, consented patients
2. Participate in a subsequent 30-minute interview over Microsoft Teams with a member of the research team.

Please see the attached Participant Information Sheet for further information. If you are happy to participate, please review and complete to online consent form (LINK PROVIDED HERE). The demographic information section is optional but would be valuable for providing further context for data analysis.

Once the consent form has been received, a member of the research team will be in touch to discuss timing of your interview. Training on how to record your session will be given at your GP practice. The practice is being reimbursed for your clinical time to participate.

If you have any further questions, please email to Principal Investigator, Dr Laura Heath at: laura.heath@phc.ox.ac.uk.

Many thanks for your time.

Laura Heath

12 Appendix 5: Promotional material for Chapter 3 mixed methods study

UNIVERSITY OF OXFORD

NUFFIELD DEPARTMENT OF
PRIMARY CARE
HEALTH SCIENCES
Medical Sciences Division

Are you a GP practice interested in how remote consultations could be changing the content of consultations?

We are investigating how the transition to remote consulting has affected the preventive care content of primary care consultations.

The study aims to understand the rate of preventive care (including brief interventions) that occurs in different consultation mediums.

Taking part in the study will involve:

- **Reception staff able to consent patients (training provided)**
- **Approximately 4 GPs (partner, salaried or locum) recording up to 2 routine clinical sessions with a range of consultation modalities (telephone, face-to-face as a minimum)**
- **A subsequent 30 minute Microsoft Teams interview with participating GPs after the recorded session/s.**
- **Funding is available for sites**

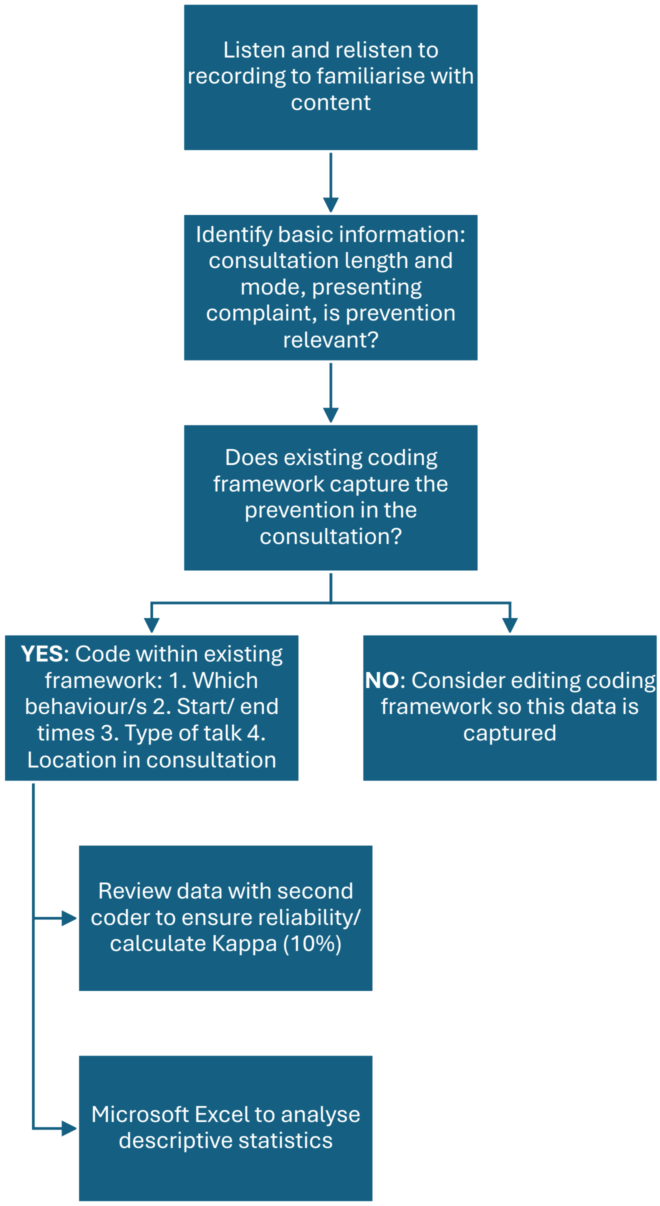
Any England based GP practice with four of more practising GPs is eligible.

For more information on taking part please contact your local CRN or the principal investigator for the study, Laura Heath:

Email: laura.heath@phc.ox.ac.uk

Study Title: **How has the transition to remote consulting affected the preventive care content of primary care consultations?**
IRAS reference number 327578 Funder: Wellcome Trust
Poster v1.0 7th December 2023

13 Appendix 6: Procedural flow diagram for developing coding framework for quantitative component of Chapter 3 mixed methods analysis



14 Appendix 7: Definition of agreement between OPCAC and Aurum systems for Chapter 4

Definition of agreement between OPCAC system and conssourceid/consmedcodeid descriptions

OPCAC	Aurum system (consourceid and consmedcodeid) descriptions
Admin	admin|prescription
Document	document|mail|letter|report|docman|note
Email	email|e-mail|MJog|online|patientchase
Emergency Department	minor injuries|hospital|emergency|casualty|accident|urgent care
Face-to-face	face|surgery|clinic|practice|centre|unit
Home Visit	home|visit
Investigation	radiology|lab| result
Secondary Care	hospital|referral|outpatient|inpatient
Telephone	phone|call
Text Message	text|SMS|MJog|accurx
Vaccination	vaccin
Video	video|camera|multimedia
Unclear	accurx|consultation|appointment|general practitioner|meeting|email|e-mail|MJog|online|patientchase|face|surgery|clinic|practice|centre|unit|home|visit|phone|call|text|SMS|MJog|accurx|video|camera|multimedia

15 Appendix 8: Code lists for outcomes in Chapter 5 CPRD analysis

Smoking cessation advice

MedCodeId	Term	SnomedCTConceptId
a338608011	Smoking cessation advice	225323000
a818061000006111	Smoking cessation education	225323000
a936011000006114	Advice on effects of smoking on health	225324006
a1484933010	Negotiated date for cessation of smoking	390901002
a1125741000000111	Brief intervention for smoking cessation	506491000000102
a16581000006111	Other smoking information	16581000006107
a265092010	Pregnancy smoking advice	171055003
a1811991000006111	Health education - parental smoking	203551000000108
a4939261000006116	Smoking effects education	225324006
a4939251000006118	Advice on smoking	225323000
a2982426011	Provision of smoking cessation leaflet	699033005
a303501000000115	Smoking cessation advice provided by community pharmacist	200221000000105
a13499671000006118	Brief intervention for smoking cessation	771155005
a4640171000006113	Pregnancy smoking education	171055003
a8279661000006118	Provision of written information about smoking cessation	838131000000103
a7559591000006110	Tobacco use cessation education	702388001
a8196151000006112	Smoking cessation leaflet given	521721000000109
a4939241000006115	Advice on effects of smoking on health	225323000
a6427931000006116	Smoking cessation assistance	384742004
a7696001000006118	Patient request for smoking cessation information	712829007
a12626191000006119	VBA (Very Brief Advice) on Smoking	1110791000000100
a923201000006112	Pregnancy smoking advice	923201000006108

Smoking cessation referral

MedCodeId	Term	SnomedCTConceptId
a1489355012	Referral to smoking cessation advisor	395700008
a1780273014	Seen by smoking cessation advisor	401068004
a459722017	Referral to stop-smoking clinic	315232003
a1773560017	Smoking cessation programme start date	401160008
a1709641000000115	Referral for smoking cessation service offered	767641000000109
a856371000006111	Smoking clinic	856371000006107
a1750931000000118	Stop smoking service opportunity signposted	783011000000105
a1715591000006117	Referral to National Health Service stop smoking service	505281000000106
a2251911000000114	Referral to smoking cessation service	871661000000106
a2717211000000112	Signposting to smoking cessation service	1084381000000100
a1563081000000115	Practice based smoking cessation programme start date	712971000000108
a1704561000006112	Referred for chronic obstructive pulmonary disease structured smoking assessment	375851000000108
a1771191000006119	Attends smoking cessation clinic not at practice	201941000000100
a8061901000006111	Attends practice smoking cessation clinic	201931000000109
a1778181000006110	Group session: Stop smoking education programme	1778181000006106
a1777011000006118	Reason for referral: Smoking Cessation	1777011000006102
a1704551000006110	Referred for COPD structured smoking assessment	375851000000108
a14933931000006118	Community Pharmacy Smoking Cessation Service	1659131000000104

a1873511000006118	Care contact service: Smoking/substance cessation/interven prog.	1873511000006102
a13494621000006118	Referral for brief intervention for smoking cessation	770729006
a2741221000000116	Referral for brief intervention for smoking cessation	1094321000000100
a6649431000006116	Smoking cessation program start date	401160008
a8190531000006112	Referral to NHS (National Health Service) stop smoking service	505281000000106

Weight management advice

MedCodeId	Term	SnomedCTConceptId
a818011000006113	Diet health education	11816003
a1131791000000118	Lifestyle advice regarding diet	443288003
a1662431000000112	Advice given about weight management	698471002
a839191000006115	Weight control education	410200000
a977951000006110	Health education - weight management	410200000
a200241000006114	Patient advised about weight-reducing diet	266724001
a200161000006118	Low fat diet education	183061003
a240871000006110	Low cholesterol diet education	183062005
a200111000006116	Diabetes mellitus diet education	284350006
a200121000006112	Diet education	11816003
a411892019	Weight loss advised	275919002
a240911000006113	Patient advised to lose weight	275919002
a1753311000006112	"Intervention for risk to health associated with overweight and obesity general advice on healthy weight and lifestyle"	756001000000107
a200081000006110	Low carbohydrate diet education	183065007
a401535015	Target weight discussed	268523001
a854681000006113	Weight reducing diet advised	854681000006109
a854691000006111	Low fat diet advised	854691000006107
a265091015	Diet in pregnancy advice	171054004
a264764015	Ideal weight discussed	170803009
a200151000006115	Patient advised about high fibre diet	183059007
a7275101000006116	Lifestyle education regarding diet	443288003
a1714271000000112	Advice about food intake	768111000000102
a7508801000006119	Patient advised about weight management	698471002
a854701000006111	Sugar free diet advised	854701000006107
a200211000006110	Sugar-free diet education	281085002
a5494311000006110	Weight-reducing diet education	266724001
a917001000006118	Patient advised re diet	917001000006102
a1735631000000119	Discussion about weight management programme	776931000000102
a1753321000006116	"Intervention for risk to health associated with overweight and obesity advice about diet and physical activity"	756021000000103
a282832010	Low calorie diet - prophylaxis	182956005
a918281000006116	Pt advised re diabetic diet	918281000006100
a918351000006118	Patient advised re low cholesterol diet	918351000006102
a4640141000006117	Pregnancy diet education	171054004
a81211000006112	Unsaturated fat diet - prophylaxis	182960008
a1753331000006118	"Intervention for risk to health associated with overweight and obesity advice about diet and physical activity consider drugs"	756041000000105
a4719741000006111	High fibre diet education	183059007
a4718981000006113	Low carbohydrate diet - prophylaxis	182955009
a5494331000006116	Dietary advice for weight reduction	266724001
a5686501000006114	Obesity diet education	284352003
a5003521000006117	Recommendation to change fat intake	230091007
a2688161000006119	Advice about diet	11816003

a918271000006119	Pt advised re wt reducing diet	918271000006103
a7493191000006115	Educated about weight management	609104008
a5700681000006111	Recommendation to change carbohydrate intake	285390004
a2688171000006114	Advice on diet	11816003
a5000051000006112	Recommendation to change food and drink intake	229807004
a5700201000006117	Recommendation to change dairy food intake	285351003
a5700591000006110	Recommendation to change fruit and nut intake	285383009
a918331000006113	Pt advised re low fat diet	918331000006109
a918371000006111	Pt advis re low carbohydrate diet	918371000006107
a918311000006119	Pt advised re high fibre diet	918311000006103
a6932761000006111	Advice to change diet	419155003
a5000071000006119	Recommendation to change food intake	229808009
a5700211000006119	Advice to change dairy food intake	285351003

Weight management referral

MedCodeId	Term	SnomedCTConceptId
a2154209017	Refer to weight management programme	408289007
a297811000000117	Weight management programme offered	819361000000109
a1750991000000117	Weight management service opportunity signposted	783041000000106
a1709681000000111	Referral to weight management service offered	767661000000105
a297841000000116	Weight management plan started	819321000000101
a14176391000006111	Referral to weight management service	1326201000000101
a1721501000000113	Referral to local authority weight management programme	771491000000104
a14811551000006116	Referral to NHS Digital Weight Management Programme	1402911000000108
a628891000000118	Counterweight weight management programme	313251000000103
a14811711000006112	Referral to NHS Tier 3 specialist weight management service	1403011000000103
a2714971000000116	Signposting to weight management service	1083431000000109
a1735631000000119	Discussion about weight management programme	776931000000102
a14393821000006111	Referred to Adult's Weight Management Service	14393821000006107
a1844501000006115	Referral to weight management special interest general practitioner	837181000000103
a2173321000000116	Referral to residential weight management programme	837111000000105
a14811701000006114	Referral to NHS Tier 4 specialist weight management service	1402991000000104
a2326311000000114	Intensive weight management programme commenced	904551000000107
a1778201000006111	Group session: Weight management	1778201000006107
a7771301000006110	Weight management program	718361005
a7771291000006114	Weight management programme	718361005
a6759901000006112	Refer to weight management program	408289007
a2000621000006111	Date for weight management intervention offered to patient	2000621000006107
a8278851000006114	Referral to weight management GPwSI (general practitioner with special interest)	837181000000103

Alcohol advice

MedCodeId	Term	SnomedCTConceptId
a240741000006114	Education about alcohol consumption	281078001
a817981000006115	Health education - alcohol	408947007
a936001000006111	Advice relating to alcohol consumption	281078001
a1680121000006110	Brief intervention for excessive alcohol consumption completed	366371000000105
a283028013	Alcohol leaflet given	183098002
a265094011	Pregnancy alcohol education	171057006

a1680131000006113	Extended intervention for excessive alcohol consumption completed	366421000000103
a2532939017	Alcohol consumption counselling	413473000
a6769921000006111	Alcohol abuse prevention education	408947007
a1724531000000116	Advised to abstain from alcohol consumption	704106009
a2534258017	Alcohol counselling by other agencies	527961000000108
a739501000000112	Advised to contact primary care alcohol worker	375941000000101
a8066881000006119	Discussion about maternal wellbeing - alcohol	206301000000105
a2437261000000112	Family wellbeing discussion about alcohol	955731000000102
a2007461000006118	SRH care activity - alcohol brief intervention	2007461000006102
a1538911000006119	Structured alcohol intervention	1538911000006103
a923221000006119	Pregnancy alcohol advice	923221000006103
a6841781000006117	Alcohol consumption counseling	413473000

Alcohol referral

MedCodeId	Term	SnomedCTConceptId
a1484890014	Referral to community alcohol team	390857005
a2549646014	Referral to community drug and alcohol team	417096006
a622961000000116	Referral to specialist alcohol treatment service	431260004
a831091000006115	Referral to alcohol abuse team	831091000006104
a831101000006114	Referral to alcohol counsellor	831101000006105
a740641000000115	Referral to alcohol brief intervention service	376401000000103
a2419601000000110	Specialist alcohol treatment service signposted	946101000000100
a851931000006116	Referral to alcohol recovery project	851931000006100
a2716771000000111	Signposting to alcohol misuse service	1084171000000100
a1675391000006112	Referral by community alcohol team	1675391000006108
a2475831000000114	Alcohol harm reduction programme	720175009
a3122331000006110	Patient referral for alcoholism rehabilitation	38670004
a7613321000006119	Alcohol reduction programme	707166002
a13770661000006117	Referral to alcoholism rehabilitation service	38670004
a8259601000006117	Referral to alcohol misuse clinic	809401000000103
a12117371000006112	Referral to alcohol misuse service	1099141000000106
a2485391000000114	Alcohol twelve step programme	720178006
a12618991000006114	Signposting to drug and alcohol support service	1104571000000100
a7613331000006116	Alcohol reduction program	707166002
a1808611000006118	AREP - Alcohol rehabilitation education program	1808611000006102

Physical activity advice

MedCodeId	Term	SnomedCTConceptId
a240861000006115	Patient advised about exercise	183073003
a818031000006119	Health education - exercise	304507003
a936021000006118	Exercise education	304507003
a265093017	Pregnancy exercise advice	171056002
a1590481000006111	Advice to aim for 30 minutes of moderate activity on 5 days or more each week	286321000000102
a1485132013	Target physical activity	391105003
a1485055014	Osteoporosis - exercise advice	391026001
a1627181000006119	Patient given written advice on benefits of physical activity	429778002
a1783961000006115	Provision of advice about aerobic exercise	762227003
a1783971000006110	Provision of advice about muscle strengthening exercise	736786002
a918521000006117	Patient advised re exercise	918521000006101

a1753321000006116	"Intervention for risk to health associated with overweight and obesity advice about diet and physical activity"	756021000000103
a5929971000006113	Advice about exercise	304507003
a2160131014	Physical activity target moderate exercise	408581006
a2160130010	Physical activity target light exercise	408580007
a5647271000006114	Recommendation to exercise	281090004
a4915601000006111	Recommendation regarding activity	223415003
a2347341000000110	Education about chair based exercise programme	913431000000101
a2160128013	Physical activity target minimal exercise	408578001
a4640201000006112	Pregnancy exercise education	171056002
a5647281000006112	Advice to exercise	281090004
a1753331000006118	"Intervention for risk to health associated with overweight and obesity advice about diet and physical activity consider drugs"	756041000000105
a1753341000006111	"Intervention for risk to health associated with overweight and obesity advice about diet and physical activity consider drugs consider surgery"	756061000000106
a2160129017	Physical activity target strenuous exercise	408579009
a6517651000006118	Osteoporosis exercise education	391026001
a7729481000006110	Combined healthy eating and physical education programme	715282001
a4916051000006113	Recommendation to undertake activity	223440005
a6455431000006119	Prescribed activity/exercise education	386463000
a923211000006110	Pregnancy exercise advice	923211000006106
a5929981000006111	Exercise health education	304507003
a12619901000006110	Patient given written advice under PACAP (Physical Activity Clinical Advice Pad) programme	1105751000000100

Physical activity referral

MedCodeId	Term	SnomedCTConceptId
a454407012	Exercise on prescription	310882002
a2549517012	Referred for exercise programme	416974006
a1476247014	Referral to physical activity programme	390893007
a1484897012	Referral for exercise therapy	390864007
a343410018	Home exercise programme	229075007
a1174481000000114	Referral to exercise on referral programme	526151000000109
a1773561018	Group exercise programme	401167006
a1709601000000118	Referral for physical activity service offered	767621000000102
a308041000000118	Referral to heart failure exercise programme	704095000
a1159051000000110	Referral for graded exercise therapy	519081000000103
a4989031000006114	Home exercise program	229075007
a8221791000006117	Exercise referral scheme	720661000000101
a6900171000006111	Referred for exercise program	416974006
a6649531000006117	Group exercise program	401167006
a6516041000006114	Referral to physical activity program	390893007
a12736321000006111	Structured physical activity programme	748061000000108
a1918111000006117	Referral to physical training instructor	1918111000006101

16 Appendix 9: Frequency of brief intervention codes in Chapter 5 CPRD Aurum study cohort by consultation mode and target health behaviour from 1st January 2019 – 31st December 2022

Advice	**Home visit**	**Face-to-face**	**Video**	**Telephone**	**Text message**	**Email**	**Unclear consultation**	**Total**
Smoking	8,096	3,450,938	1285	127,110	1,178,236	26,198	2,859,024	7,650,887
Weight management	6,666	2,910,124	208	97,778	104,517	2440	341,129	3,462,862
Alcohol	3297	1,796,172	59	31,315	40,038	1005	178,193	2,050,079
Physical activity	6,541	2,850,229	198	75,407	72,522	2,826	289,280	3,297,003
Referral								
Smoking	249	190,230	24	5086	48,143	313	129,445	373,490
Weight management	408	223,389	58	7,624	173,462	931	182,821	588,693
Alcohol	14	1,262	2	267	989	19	4,195	6,748
Physical activity	220	154,127	261	10,196	9,480	654	42,092	217,030
Total	25,491	11,576,471	2,095	354,783	1,627,387	34,386	4,026,179	17,646,792

17 Appendix 10: Example search strategy for Chapter 6 systematic review and meta-analysis

Medline Search Strategy

1	Primary Health Care/
2	exp General Practice/
3	general practitioners/ or physicians, family/ or physicians, primary care/
4	exp Community Health Nursing/
5	Nurses, Community Health/
6	house calls/ or office visits/
7	Community Health Services/ or Community Pharmacy Services/ or Community Health Centers/
8	(primary adj2 (health* or care)).ti,ab,kf.
9	((general or family) adj2 (pract* or doctor* or physician*)).ti,ab,kf.
10	family medicine.ti,ab,kf.
11	((community adj2 nurs*) or health visitor? or district nurs*).ti,ab,kf.
12	(community adj2 (care or health* or service*)).ti,ab,kf.
13	(community adj2 pharmac*).ti,ab,kf.
14	((home or house) adj (call? or visit?)).ti,ab,kf.
15	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14
16	smoking cessation/ or smoking reduction/ or "tobacco use cessation"/
17	healthy people programs/ or weight reduction programs/
18	((obes* or overweight or weight or diet* or nutrition*) adj3 (intervention? or program* or referral?)).ti,ab,kf.
19	(smoking adj3 (intervention? or program* or referral?)).ti,ab,kf.
20	((physical activit* or exercis* or pa or walking or running or cycling or bicycl* or jog* or swim*) adj3 (intervention? or program* or referral? or prescri*)).ti,ab,kf.
21	((alcohol* or drinking) adj3 (intervention? or program* or referral?)).ti,ab,kf.
22	Preventive Health Services/
23	health education/ or health promotion/
24	counseling/ or directive counseling/ or motivational interviewing/
25	(intervention? or education or promotion or program*).ti.
26	((education* or promot*) adj3 intervention?).ti,ab,kf.
27	(counsel* or advi?e or coach*).ti,ab,kf.
28	((motivational or brief) adj2 (intervention? or advi?e or interview* or messag*)).ti,ab,kf.
29	22 or 23 or 24 or 25 or 26 or 27 or 28
30	smoking/ or exp "tobacco use"/ or Electronic Nicotine Delivery Systems/
31	weight loss/ or exp overweight/
32	exp Exercise/ or exp Sports/ or Motor Activity/ or Dancing/
33	alcohol abstinence/ or exp alcohol drinking/
34	exp Life Style/

35	(smoker? or smoking or "tobacco use").ti,ab,kf.
36	(obes* or overweight).ti. or (weight adj2 (loss or lose or losing or control or manage* or reduc* or maintain or maintenance)).ti,ab,kf.
37	(physical activity or exercise?).ti,ab,kf.
38	alcohol*.ti. or (drinker? or (alcohol adj2 (risk* or "use" or consum* or drink* or abstain* or abstinence or reduc*))).ti,ab,kf.
39	((healthy or healthful or healthier) adj2 (diet? or eating or lifestyle? or living or behavi*)).ti,ab,kf.
40	30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39
41	29 and 40
42	16 or 17 or 18 or 19 or 20 or 21 or 41
43	Reminder Systems/
44	Physician Incentive Plans/
45	reimbursement mechanisms/ or reimbursement, incentive/
46	exp education, continuing/ or mentoring/ or exp inservice training/
47	Quality Improvement/
48	Total Quality Management/
49	medical records systems, computerized/ or exp electronic health records/
50	exp Health Personnel/ed
51	Decision Making, Computer-Assisted/ or Decision Support Techniques/
52	exp Professional Role/
53	(remider? or prompt? or alert?).ti,ab,kf.
54	(reimburse* or incentive? or reward?).ti.
55	((financial or monetary) adj2 (reimburse* or incentive? or reward?)).ti,ab,kf.
56	((quality or performance or benchmark*) adj2 (reimburse* or incentive? or reward?)).ti,ab,kf.
57	((physician* or doctor? or general practi* or clinician? or nurse? or staff or personnel or professional? or provider?) adj3 (reimburse* or incentive? or reward?)).ti,ab,kf.
58	("pay for quality" or "pay for performance" or p4q or p4p).ti,ab,kf.
59	((quality based or performance based or result? based or output? based) adj2 (financ* or pay* or subsid*)).ti,ab,kf.
60	(quality improvement or total quality management).ti,ab,kf.
61	((teach* or educat* or train* or mentor*) adj3 (physician* or doctor? or general practi* or clinician? or nurse? or staff or personnel or professional? or provider?)).ti,ab,kf.
62	(("in house" or "in service" or inservice or "in practice") adj2 training).ti,ab,kf.
63	(skill? adj2 (build* or development)).ti,ab,kf.
64	((staff or professional) adj development).ti,ab,kf.
65	((education* or academic*) adj2 (outreach or detailing)).ti,ab,kf.
66	((audit or performance) adj2 feedback).ti,ab,kf.
67	((electronic adj2 record?) or ehr or emr or epr).ti,ab,kf.
68	(mentor? or expert? or leader? or champion? or facilitator?).ti.
69	((clinical or practice or health) adj2 (leader* or expert? or mentor* or champion* or facilitator?)).ti,ab,kf.
70	(role? adj2 (change? or changing or expand* or expansion)).ti,ab,kf.

71	43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70
72	randomized controlled trial.pt.
73	controlled clinical trial.pt.
74	multicenter study.pt.
75	pragmatic clinical trial.pt.
76	(randomis* or randomiz* or randomly).ti,ab.
77	groups.ab.
78	(trial or multicenter or multi center or multicentre or multi centre).ti.
79	(intervention? or effect? or impact? or controlled or control group? or (before adj5 after) or (pre adj5 post) or ((pretest or pre test) and (posttest or post test)) or quasiexperiment* or quasi experiment* or pseudo experiment* or pseudoexperiment* or evaluat* or time series or time point? or repeated measur*).ti,ab.
80	non-randomized controlled trials as topic/
81	interrupted time series analysis/
82	controlled before-after studies/
83	or/72-82
84	exp animals/
85	humans/
86	84 not (84 and 85)
87	review.pt.
88	meta analysis.pt.
89	news.pt.
90	comment.pt.
91	editorial.pt.
92	cochrane database of systematic reviews.jn.
93	comment on.cm.
94	(systematic review or literature review).ti.
95	or/86-94
96	83 not 95
97	15 and 42 and 71 and 96

18 Appendix 11: Chapter 6 systematic review and meta-analysis imputed calculations

Imputed calculations

Where an intra-cluster coefficient (ICC) was not provided, the upper quartile of ICCs provided from the included studies was used:

Study	**ICC**
Minian 2019	0.134
Goodfellow 2016	0.094
Bardach 2013	0.1
Linder 2009	0.007
Wadland 2007	0.902
Kaner 2003	0.064
Rothemich 2008	0.061
Campbell-Scherer 2019	0.4
Rosario 2022	0.81
VanLieshout 2016	0.05
Jumbe 2022	0.059
Goodfellow 2016	0.003
Haller 2016	0.026
Lennox 1998	0.13
Upper quartile	**0.133**

Study	Rationale	Calculation
Clinical Reminders		
1. Banerjee 2019	Randomised trial, gave 2x2 table, need OR and 95% CI	Stata code: cci 38 220 11 228 **OR = 3.58 (95% CI 1.74 – 7.95)**
2. Rothemich 2008	ICC = 0.061 given Adjusted p value given No adjusted effect size Methods taken from Cochrane Handbook 23.1.4.1	Intervention: 181/561; 9 practices Control: 172/588; 9 practices ICC =0.061 Average cluster size = (561+588)/ (18) = 63.8 Design effect for the trial is: 1 +(M-1)ICC = 1 +(63.8-1) x 0.061 = 4.83 Intervention sample size 561/4.83 = **116** Intervention cases 181/4.83= **37** Control sample size 588/4.83 = **122** Control cases 172/4.83= **36** Stata code cci 37 79 36 86 **OR = 1.12 (95% CI 0.62 – 2.02)** **Without rounding: OR 1.15 (95% CI 0.66-2.00)**
3. Milch 2004	No adjustment for clustering	Combining both stamp and SAQ arms as both clinical reminders of differing intensity. Data from table 2 and figure 3: Clinician advice: 38% of 77 patients (stamp) 47% of 92 patients (SAQ) 20% of 238 patients (control) = 29/77 + 43/92 = 72/169 intervention received clinical advice 48/238 control received clinical advice Average cluster size Intervention 7+7 =14 physicians Control = 15 physicians (169+238)/29 = 14.034 Design effect for the trial is:

		1 +(M-1)ICC = 1 +(14.034-1) x 0.133 = 2.734 Intervention sample size 169/2.734= 62 Intervention cases 72/2.734= **26** Control sample size 238/2.734= 87 Control cases 48/2.734= 18 **Stata code: cci 26 36 18 69** **OR = 2.77 (95% CI 1.26 – 6.10)** **Without rounding: OR = 2.94 (95% CI = 1.42 – 6.08)** Smoking cessation outcomes: SAQ: 14/46 Stamp: 2/45 Control 17/154 Intervention combined = 16/91 Average cluster size = (154+91)/29 = 8.448 Design effect for the trial is: 1 +(M-1)ICC = 1 +(8.448-1) x 0.133 = 1.991 Intervention sample size 91/1.991= **46** Intervention cases 16/1.991= **8** Control sample size 154/1.991= **77** Control cases 17/1.991= **9** **Stata code: cci 8 38 9 68** **OR = 1.59 (95% CI 0.49 – 5.06)** **Without rounding: OR = 1.72 (95% CI = 0.61 – 4.87)**

Facilitated relay of information		
4. Grant 2014	Difference in difference, need OR Cochrane Handbook section 10.6	Need to find standard deviation (SD) to use Chinn formula. As this is not in Grant 2014 paper, use a value from similar paper. In this review, Goodfellow 2016 has a similar BMI (SD) of 30.2 (5.4). The SD for weight = 17.9kg, in lbs = 39lbs Chinn 2000 formula: $\mathrm{SMD} = \frac{\sqrt{3}}{\pi}\ln\mathrm{OR}.$ Effect size = EXP((3.1415*(**0.16/39**)/(SQRT(3))) = 1.34 = 1.0075 Lower CI = EXP((3.1415***0.10/39**)/(SQRT(3))) = 1.20 = 1.0047 Upper CI = EXP((3.1415***0.21/39**)/(SQRT(3))) = 1.46 = 1.0098
5. Saitz 2003	Reasonable first order approximation to OR and CI	Using formula: p= k/n SE(p) = SQRT((p(1-p))/ n) P = 0.56 CI = 0.41-0.70 SE = (0.7-0.41)/ 3.92 = 0.07398 n = (0.56x 0.44)/ (0.07398)^2 = 45 therefore **25 events in sample of 45** Similarly for other values: P = 0.41; CI = 0.3-0.52 **31/ 77** P = 0.22; CI = 0.13-0.35 **12/54** P = 0.26; CI = 0.15-0.42 **11/41** Calculating OR and CI for these values: Process outcome OR = **1.85 (95% CI 0.98 – 3.90)** **Without rounding: OR = 1.83 (95% CI = 0.87 – 3.85)** Outcome outcome OR = **0.78 (95% CI 0.30 – 2.00)** **Without rounding: OR = 0.80 (95% CI = 0.31 – 2.08)**
Multicomponent Interventions		
6. Ackerman 2005	Give 2x2 table and adjusted p value for both	Given exercise advice at provider visit, for all enrolled patients p= 0.07 and therefore z = 1.8119 = logOR/ SE OR = (45/127)/ (35/129) = 1.3060

	process and clinical outcomes	logOR = 0.2669 SE = 0.2669/1.8119 = 0.1473 Log(95% CI) = logOR +/- 1.96* SE =0.2669 +/- (1.96*0.1473) = **0.5556, -0.0218** e^0.5556= **1.74** e^-0.0218= **0.98** **aOR = 1.31 (95% CI 0.98-1.74)** After 4 months regular exercise, for all enrolled patients p= 0.06 and therefore z = 1.8808 = logOR/ SE OR = (35/137)/ (28/136) = **1.2409** logOR = 0.2158 SE = 0.2158/1.8808 = 0.1147 Log(95% CI) = logOR +/- 1.96* SE = 0.2158+/- (1.96 * 0.1147) = 0.4406, -0.00901 e^= **0.99** e^= **1.55** **aOR = 1.24 (95% CI 0.99 – 1.55)**
7. Young 2002	Give OR for posttest versus baseline for intervention and control groups. Need to have a between group comparison.	R code: betaI<-log(1.68) betaC<-log(1.23) beta<-betaI-betaC seI<-log(8.48/0.33)/3.92 seC<-log(7.48/0.20)/3.92 se<-sqrt(seI^2+seC^2) beta 0.3117796 se 1.240736 exp(beta+1.96*se*c(0,-1,1)) 1.3658537 0.1200241 15.5431866 Therefore **OR 1.37 (95% CI 0.12 – 15.54)**
8. Twardella 2007	Have 2x2 table (UC vs TI)for process outcome, need to adjust for clustering	The study gives 2x ICC in table 4. Use the largest of these to be conservative (0.042). Intervention: 83/114; 21 medical practices Control: 32/54; 20 medical practices Average cluster size = 114+54/ 41 = 4.0976 Design effect for the trial is: 1 +(M-1)ICC = 1 +(4.0976-1) x 0.042 = 1.130

		Intervention sample size 114/1.13= **101** Intervention cases 83/1.13= **73** Control sample size 54/1.13= **48** Control cases 32/1.13= **28** **Stata code: cci 73 28 28 20** **OR = 1.86 (95% CI 0.85 –4.06)** **Without rounding: OR = 1.84 (95% CI = 0.89 – 3.80)**
9. Lee 2023	Give log OR, SE, z, p value and OR in supplementary material	Need to calculate a CI for the OR Log(95% CI) = logOR +/- 1.96* SE = 2.83+/- (1.96*0.11) = 3.05 and 2.61 e^3.05 = 21.02 e^2.61 = 13.66
Team Changes		
10. Alageel 2019	Have standardised mean difference, need effect measure	Mean difference (BMI) = -0.29 Standard deviation of control group BMI = 5.6 $\mathrm{SMD} = \frac{\sqrt{3}}{\pi}\ln\mathrm{OR}.$ SMD = -0.29/5.6 = -0.0518 Upper CI = -0.31/5.6 = -0.0554 Lower CI = -0.27/5.6 = -0.0482 Effect size = EXP((3.1415*-**0.0518**)/(SQRT(3))) = 0.9103 Lower CI = EXP((3.1415*-**0.0482**)/(SQRT(3))) = 0.9044 Upper CI = EXP((3.1415*-**0.0554**)/(SQRT(3))) = 0.9163 Need to invert OR and CI **OR = 1.10 (95% CI 1.09 – 1.11)**
11. Schwartz 2014	Have 2x2 table for smoking cessation outcomes, not adjusted for clustering	Use Control and Intervention (PMA support) arm. Use table 3, self-reported quit for at least 1 week Control: 63.8% of 141 = 90/141

		PMA support: 64.1% of 92 =59/92 Average cluster size: (141+92)/14(teams in PMA + control) = 16.643 Design effect for the trial is: 1 +(M-1)ICC = 1 +(16.643 -1) x 0.133 = 3.081 Intervention sample size 92/3.081= **30** Intervention cases 59/3.081= **19** Control sample size 141/3.081= **46** Control cases 90/3.081= **29** **Stata code: cci 19 11 29 17** **OR = 1.01 (95% CI 0.35 – 2.96)** **Without rounding: OR = 1.01 (95% CI = 0.39 – 2.65)** Prescribed Nicotine Replacement Therapy (from the VA's EMR) Calculate lost to follow up factor 83% followed up in control = 731 people 66% followed up in intervention = 278 people 6.2% control of 731 smokers 7.5% PMA intervention of 278 smokers 0.062 x 731 = 45/731 0.075 X 278 = 21/278 Average cluster size: (731+278)/14 = 72.071 Design effect for the trial is: 1 +(M-1)ICC = 1 +(72.071-1) x 0.133 = 10.452 Intervention sample size 278/10.452= **27** Intervention cases 21/10.452= **2** Control sample size 731/10.452= **70** Control cases

		45/10.452= **4** **Stata code: cci 2 25 4 66** **OR = 1.32 (95% CI 0.11 – 9.85)** **Without rounding: OR = 1.25 (95% CI = 0.22 – 7.08)**
12. Little 2009	Have an adjusted p value, need to find a CI	Find an CI that is consistent with a p value of 0.01 p= 0.01 and therefore z = 2.5758 = logOR/ SE OR = (2779/1249)/ (318/10282) = 71.94 logOR = 4.2758 SE =4.2758 /2.5758 = 1.660 Log(95% CI) = logOR +/- 1.96* SE = 4.2758+/- (1.96*1.660) = 7.5294 and 1.022 e^7.5294 = 1861.99 e^1.022= 2.779 **aOR = 71.94 (95% CI 2.78- 1862.00)**
Clinician Education		
13. Corelli 2022		Peto method used to calculate OR Peto method had to be used to manage the 0 non-events in the intervention arm. Using this method, p=0.01 which was a similar result to that reported in the paper (p = 0.001) with **OR 10.5 (95% CI 2.67-41.63)**
14. Welzel 2021	Have Cohens d standardised effect sizes, can use Chinn 2000 formula to calculate OR from difference in difference	$\mathrm{SMD} = \frac{\sqrt{3}}{\pi}\ln\mathrm{OR}.$ Process outcome Effect size = EXP((3.1415***0.20**)/(SQRT(3))) = **1.44** Lower CI = EXP((3.1415*-**0.18**)/(SQRT(3))) = **0.71** Upper CI = EXP((3.1415***0.60**)/(SQRT(3))) = **2.92** Clinical outcome NB the 6 month outcome was used here as the 12 month outcomes were incorrectly reported. Effect size = EXP((3.1415*-**0.29**)/(SQRT(3))) = **0.59** Lower CI = EXP((3.1415***-0.65**)/(SQRT(3))) = **0.31** Upper CI = EXP((3.1415***0.77**)/(SQRT(3))) = **4.04**
15. Malta 2016	Unadjusted 2 x 2 table	Stata code: Cci 82 58 47 94 OR = 2.83 (95% CI 1.69-7.73) Adjust for clustering using the highest ICC in the included studies (to be conservative) Imputed ICC (upper quartile from other studies) = 0.133

		Intervention: 82/140; 9 practices Control: 47/141; 8 practices ICC =0.133 Average cluster size = (140+141)/ (17) = 16.5294 Design effect for the trial is: 1 +(M-1)ICC = 1 +(16.5294-1) x 0.133 = 3.065 Intervention sample size 140/3.065= **46** Intervention cases 82/3.065= **27** Control sample size 141/3.065= **46** Control cases 47/3.065= **15** **Stata code: cci 27 19 15 31** **OR = 2.94 (95% CI 1.16 – 7.53)** **Without rounding: OR = 2.82 (95% CI = 1.21 – 6.61)**
16. Rosario 2022	Have Cohens d standardised effect size, can use Chinn's formula to calculate OR	Brief intervention rate at 12 month follow up $\mathrm{SMD} = \frac{\sqrt{3}}{\pi} \ln \mathrm{OR}.$ Process outcome Effect size = EXP((3.1415***0.27**)/(SQRT(3))) = **1.63** Lower CI = EXP((3.1415*-**0.52**)/(SQRT(3))) = **0.39** Upper CI = EXP((3.1415***1.05**)/(SQRT(3))) = **6.77**
17. Ruf 2010	Gave an adjusted p value but no effect size	p= 0.781 and therefore z = 0.278 = logOR/ SE OR = (27*5)/ (5*14) = **1.9286** logOR = 0.6568 SE = 0.6568/ 0.278 = 2.3626 95% CI = logOR +/- 1.96* SE = 0.6568 +/- (1.96*2.3626) = **-3.97, 5.29** e^-3.97 = **0.02** e^5.29 = **197.80** **aOR = 1.93 (95% CI 0.02-197.80)**
18. Kaner 2003	Table of results unadjusted for clustering,	We used the estimate given in the paper in the absence of an actual ICC for the study. Intervention: 704/1130; 134 practices

	give ICC of 0.064 for similar studies.	Control: 222/370; 76 practices ICC =0.064 Average cluster size = (1130+370)/ (134+76) = 7.1429 Design effect for the trial is: 1 +(M-1)ICC = 1 +(7.1429-1) x 0.064 = 1.3931 Intervention sample size 1130/1.3931= **811** Intervention cases 704/1.3931= **505** Control sample size 370/1.3931= **275** Control cases 222/1.3931= **165** **Stata code: cci 505 306 165 110** **OR = 1.10 (95% CI 0.82– 1.47)** **Without rounding: OR = 1.10 (95% CI = 0.83 – 1.46)**
19. Prokhorov 2010	Give and adjusted p value and a 2x2 table	p= .04 and therefore z = 2.0537 = logOR/ SE OR = (10/52)/ (6/51) = **1.6346** logOR = 0.4914 SE = 0.4914/ 2.0537 = 0.2393 95% CI = logOR +/- 1.96* SE = 0.4914 +/- (1.96*0.2393) = **0.96, 0.0223** e^0.96 = **2.61** e^0.0223 = **1.02** **aOR = 1.63 (95% CI 1.02-2.61)**
20. Keller 2000	Give stages of change table, need to calculate an effect measure	Create 2x2 table using those people who were not at motivation at baseline and then moved to motivation post intervention/ control At baseline, not at motivation: IG = 21+15+2+2 = 40 CG = 30 +17+6+3 = 56 Of these 5/40 moved to motivation in IG and 8/56 moved to motivation in C Average cluster size = (40+56)/74 = 1.297 Use upper quartile ICC of 0.133 from other studies: Design effect for the trial is: 1 +(M-1)ICC = 1 +(1.297-1) x 0.133 = **1.0395** Intervention sample size

		40/1.0395= **38** Intervention cases 5/1.0395= **5** Control sample size 56/1.0395= **54** Control cases 8/1.0395= **8** **Stata code: cci 5 33 8 46** **OR = 0.87 (95% CI 0.21 – 3.35)** **Without rounding: OR = 0.86 (95% CI = 0.25 – 2.91)**
21. Adams 1998	Have % patients where provider tried to set up a follow up appointment, need an effect measure	Intervention = 67/100 Control = 6/100 p = 0.001 and therefore z = 3.2905= logOR/ SE OR = (67/33)/ (6/94) = 31.81 logOR = 3.4597 SE = 3.4597/3.2905= 1.0514 Log(95% CI) = logOR +/- 1.96* SE = 5.5204, 1.3990 e^5.5204= 249.73 e^1.3990 = 4.05 **aOR = 31.81 (95% CI 4.05 – 249.73)**
22. Cummings 1989	1. Have % patients given a follow up appointment, need an effect measure 2. Have biochemically confirmed abstinence >= 9 months, need an effect measure	1. Intervention 71/466; 40 physicians Control 21/417; 41 physicians Average cluster size = (466+417)/81 = 10.90 Design effect for the trial is: 1 +(M-1)ICC = 1 +(10.90-1) x 0.133 = 2.3169 Intervention sample size 466/2.3169= **201** Intervention cases 71/2.3169= **31** Control sample size 417/2.3169= **180** Control cases 21/2.3169= **9** **Stata code: cci 31 170 9 171**

		OR = 3.46 (95% CI 1.55 – 8.51) **Without rounding: OR = 3.39 (95% CI = 1.57 – 7.33)** 2. Intervention = 26/1004; 40 physicians Control = 15/1008; 41 physicians Average cluster size = (1044 + 1008)/81 = 25.33 Design effect for the trial is: 1 +(M-1)ICC = 1 +(25.33-1) x 0.133 = **4.2463** Intervention sample size 1004/4.2463= **237** Intervention cases 26/4.2463= **6** Control sample size 1008/4.2463= **237** Control cases 15/4.2463= **4** **Stata code: cci 6 231 4 233** **OR = 1.51 (95% CI 0.35 – 7.38)** **Without rounding: OR = 1.76 (95% CI = 0.47 – 6.52)**
23. Mejia 2013	We have an adjusted p value, no effect size for 1. Agreed to in-person follow up appointment at 12 months 2. Self-reported tobacco abstinence at 12 months	1. p= 0.209 and therefore z = 1.2563 = logOR/ SE OR = (21/729)/ (12/616) = **1.48** logOR = **0.3911** SE = 0.3911/1.2563 = **0.3113** Log(95% CI) = logOR +/- 1.96* SE = 1.0012, -0.2190 e^= 2.72 e^= 0.80 **aOR = 1.48 (95% CI 0.80 – 2.72)** **Without rounding: OR = 1.48 (95% CI = 0.80 – 2.76)** 2. p= 0.435 and therefore z = 0.7807= logOR/ SE OR = (181/569)/ (144/484) = **1.07** logOR = **0.0669** SE = 0.0669/0.7807 = **0.0857** Log(95% CI) = logOR +/- 1.96* SE = 0.2349, -0.1011

		e^0.2349= 1.26 e^-0.1011= 0.90 **aOR = 1.07 (95% CI 0.90 – 1.26)** **Without rounding: OR = 1.10 (95% CI = 0.86 – 1.40)**
24. Lennox 1998	Give 2x2 table and ICC as 0.013, need to calculate an effect size	1. Process outcome (mentioned smoking) Intervention: 420/529; 8 practices Control 355/474; 8 practices Average cluster size = (529 + 474)/16 = 62.6875 Design effect: 1 +(M-1)ICC = 1 +(62.6875-1) x 0.013 = **1.8058** Intervention sample size 529/1.8058= **293** Intervention cases 420/1.8058= **233** Control sample size 474/1.8058= **262** Control cases 355/1.8058= **197** **Stata code: cci 233 60 197 65** **OR = 1.28 (95% CI 0.84 –1.95)** **Without rounding: OR = 1.29 (95% CI = 0.87 – 1.92)** 2. Clinical outcome: point prevalence of smoking at 14 months Intervention: 100/898; 8 practices Control: 93/795; 8 practices Average cluster size (898+795)/16 = 105.8125 Design effect for the trial is: 1 +(M-1)ICC = 1 +(105.8125-1) x 0.013 = **1.3626** Intervention sample size 898/1.3626= **659** Intervention cases 100/1.3626= **73** Control sample size 795/1.3626= **583**

		Control cases 93/1.3626= **68** **Stata code: cci 73 586 68 515** **OR = 0.94 (95% CI 0.65 – 1.36)** **Without rounding: OR = 0.95 (95% CI = 0.60 – 1.50)**
25. Sinclair 1998	Design effect was approximately 1. Effect measure calculated from given 2x2 table	Process outcome: pharmacy personnel discussed stopping smoking Intervention: 113/133 Control: 99/159 Stata code: cci 113 20 99 60 **OR = 3.42 (95% CI 1.87– 6.41)** Clinical outcome: 9 month continuous abstinence Intervention: 26/217 Control: 19/257 Stata code: cci 26 191 19 238 **OR = 1.71 (95% CI 0.88– 3.36)**
26. Kottke 1989	Have 2x2 table and results are given at the level of the clinician	Using t test of proportions, can get a p value of 0.0249 (paper states 'NS but we are including 2/3 arms workshop and control) Intervention: 10.3/100 Control 3.8/100 Stata code: cci 103 897 38 962 OR = 2.90 p= 0.0249 and therefore z = 2.2429 = logOR/ SE logOR = 1.0671 SE = 1.0671/2.2429 = 0.4758 Log(95% CI) = logOR +/- 1.96* SE = 1.9997. 0.1345 e^1.9997= 7.386 e^0.1345= 1.144 **aOR = 2.90 (95% CI 1.14 – 7.39)**
27. Olano Espinosa 2013	Have 2x2 table but not adjusted for clustering. Also '0' in one cell	Use the Peto method to manage '0' Stata code: set obs 1 generate var1 = 31 in 1

		generate var2 = 2718 in 1 generate var3 = 0 in 1 generate var4 = 3192 in 1 list gen nonevents1=var2-var1 gen nonevents2=var4-var3 list metan var1 nonevents1 var3 nonevents2, peto **OR = 8.90** Then adjust for clustering using imputed ICC from other studies: Adjusting CI for clustering: Design effect for the trial is: (2718 +3192)/35 HCCs = 168.86 1 +(M-1)ICC = 1 +(168.86-1) x 0.133 = 23.325 SQRT(23.325) = 4.830 display 2.185-1.477 display 2.894-2.185 scalar halfwidth = 2.185-1.477 display halfwidth display 2.185-halfwidth*4.83 display 2.185+halfwidth*4.83 display exp(2.185-halfwidth*4.83) display exp(2.185+halfwidth*4.83) **Therefore aOR = 8.90 (95% CI 0.29 – 271.68)**
28. Moore 2003	Have difference in weight between intervention and control arms and SD at baseline	Rearranging Chinn 2000 formula and using the SD of the control group weight (17.4kg)at baseline $\mathrm{SMD} = \frac{\sqrt{3}}{\pi}\ln\mathrm{OR}.$ Effect size = EXP((3.1415*(1.0**/17.4**)/(SQRT(3))) = 1.11 Lower CI = EXP((3.1415*(-1.9**/17.4**)/(SQRT(3))) = 0.82 Upper CI = EXP((3.1415*(3.9**/17.4**)/(SQRT(3))) = 1.50
29. Baldeon 2018	Say adjusted and unadjusted analysis were	Process outcome (referral to nutrition counselling): Intervention: 11/111; 3 health care centres

	similar and so only report the unadjusted analysis. Decided that as give no further detail e.g., an ICC we will impute an ICC and adjust for clustering	Control: 11/81; 3 health care centres Average cluster size = (111+81)/6 = 32 Design effect for the trial is: 1 +(M-1)ICC = 1 +(32-1) x 0.133 = 5.123 Intervention sample size 111/5.123= **22** Intervention cases 11/5.123= **2** Control sample size 81/5.123= **16** Control cases 11/5.123= **2** **Stata code: cci 2 20 2 14** **OR = 0.70 (95% CI 0.05 – 10.84)** **Without rounding: OR = 0.70 (95% CI = 0.09 – 5.25)**
30. Babor 2004	Give % in each group and total n of patients	Patients, n=1329 As 10 practices intervention and 5 practices control, assume that patients distributed in a ratio 10:5 Therefore: Patients intervention = 886 – 47% asked about alcohol consumption = 416 Patients control = 443 – 21.9% asked about alcohol consumption = 97 Average cluster size = 1329/15 = 88.6 Design effect for the trial is: 1 +(M-1)ICC = 1 +(88.6-1) x 0.133 = 12.65 Intervention sample size 886/12.65= **70** Intervention cases 416/12.65= **33** Control sample size 443/12.65= **35** Control cases 97/12.65= **8** **Stata code: cci 33 37 8 27** **OR = 3.01 (95% CI 1.12 – 8.68)** **Without rounding: OR = 3.16 (95% CI = 1.25 – 7.99)**
Financial Incentives		

31. Roski 2003	Have 2x2 table (combining incentive and registry arm) and adjusted p value. Need to calculate and effect size for both process and clinical outcomes	1. Process outcome (smokers who were offered assistance to quit at last visit between baseline and follow up) Combining arms: Intervention = (0.314*352) + (0.367*182) = **177** events Therefore, intervention: **177/534** Control: **112/329** p = 0.451 and therefore z = 0.7537= logOR/ SE OR = (177/357)/ (112/217) = **0.96** logOR = -0.0402 SE = -0.0402 /0.7537= -0.0533 Log(95% CI) = logOR +/- 1.96* SE = 0.0642, -0.1447 e^-1.0848 = 0.87 e^1.0045= 1.07 **aOR = 0.96 (95% CI 0.87 – 1.07)** 2. Clinical outcomes (Current non-smoker -7-day sustained abstinence from smoking at 6 months) Combining arms: Intervention = (0.224* 229) + 0.217*139) = **81 events** Therefore, intervention: **81/ 368** Control = **39/205** p= 0.20 and therefore z = 1.2816= logOR/ SE OR = (81/287)/ (39/166) = **1.20** logOR = 0.1834 SE = 0.1834 /1.2816= **0.1431** Log(95% CI) = logOR +/- 1.96* SE =0.4639, -0.0971 e^0.4639= 1.59 e^-0.0971 = 0.91 **aOR = 1.20 (95% CI 0.91- 1.59)**
Electronic patient registry		
32. Fiore 2019	Have 2x2 table, but do not adjust for clustering.	Health system A Average cluster size: (From supplementary material, no. of current smokers) 3020 + 3415 = 6435 6435/11 clinics = 585 Design effect for the trial is: 1 +(M-1)ICC = 1 +(585-1) x 0.133 = 78.672 Intervention sample size 3415/77.27= **44**

		Intervention cases 610/77.27= **8** Control sample size 3020/77.27= **38** Control cases 115/77.27= **1** **Stata code: cci 8 36 1 37** **aOR = 8.22 (95% CI 1.00 – 374.43)** **Without rounding: OR = 5.49 (95% CI = 0.88 – 34.12)** Health system B Average cluster size (from supplementary material, no. of current smokers): 4135 + 4066 = 8201 8201/12 clinics = 683.42 Design effect for the trial is: 1 +(M-1)ICC = 1 +(683.42-1) x 0.133 = 91.76 Intervention sample size 4066/91.76= **44** Intervention cases 770/91.76= **8** Control sample size 4135/91.76= **45** Control cases 216/91.76= **2** **Stata code: cci 8 36 2 43** **aOR = 4.78 (95% CI 0.86 – 48.19)** **Without rounding: OR = 4.24 (95% CI = 0.93 – 19.22)**
33. Boston 2023	Need to combine CDS groups and then adjust for clustering	Process level outcome Any tobacco cessation Rx recommendation 9.1% of 3006 = 274 6.9% of 7110 = 491 6.7% of 9543 = 639 Combining groups CDS+ and CDS- therefore = (274 + 491)/ (3006+7110) = 765/ 10116; 38 clinics Control = 639/9543; 27 clinics Average cluster size = (10116 + 9543)/ (38+27) = 302.446 Design effect for the trial is: 1 +(M-1)ICC = 1 +(302.446-1) x 0.133 = 41.094

		Intervention sample size 10116/41.094= **246** Intervention cases 765/41.094= **19** Control sample size 9543/41.094= **232** Control cases 639/41.094= **16** **Stata code: cci 19 227 16 216** **OR = 1.13 (95% CI 0.53 – 2.41)** **Without rounding: OR = 1.14 (95% CI = 0.57 – 2.29)**
34. Minian 2002	Have change in exercise, need to convert to an OR	'Mean exercise minutes changed from 32 (SD 44.7) to 110 (SD 196.1) in the intervention arm and from 32 (SD 45.1) to 113 (SD 195.1) in the control arm (group effect: B=-3.7 minutes; 95% CI -17.8 to 10.4; P=.61)' SD at baseline in control group = 45.1 minutes Chinn 2000 formula: $\mathrm{SMD} = \frac{\sqrt{3}}{\pi} \ln \mathrm{OR}.$ Effect size = EXP((3.1415*(-3.7/45.1)/(SQRT(3))) = **0.86** Lower CI = EXP((3.1415*-17.8/45.1)/(SQRT(3))) = **0.49** Upper CI = EXP((3.1415*10.4/45.1)/(SQRT(3))) = **1.52**

19 Appendix 12: Chapter 6 systematic review and meta-analysis prediction interval calculation and interpretation

Intervention category	Odds ratio (OR)	95% Confidence interval (CI)	Interpretation of CI	95% Prediction interval (PI)	Interpretation of PI
Results for process outcomes					
Clinician reminders	3.46	1.72 to 6.96	We are 95% certain the true average OR is between 1.72 and 6.96	0.30 to 39.6	Given 7 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.30 or as high as 39.6
Clinician education	1.86	1.46 to 2.46	We are 95% certain the true average OR is between 1.50 and 2.59	0.58 to 6.20	Given 29 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.58 or as high as 6.20
Electronic patient record	2.00	0.89 to 4.48	We are 95% certain the true average OR is between 0.89 and 4.48	0.12 to 32.5	Given 5 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.12 or as high as 32.5
Facilitated relay of information	1.95	1.10 to 3.46	We are 95% certain the true average OR is between 1.10 and 3.46	0.15 to 27.1	Given 4 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.15 or as high as 27.1
Financial incentives	1.10	0.82 to 1.48	We are 95% certain the true average OR is between 0.82 and 1.48	N/A	Given 2 studies it is not possible to estimate a prediction interval.
Multicomponent	3.10	1.60 to 5.99	We are 95% certain the true average OR is between 1.60 and 5.99	0.27 to 35.2	Given 12 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.27 or as high as 35.2
Team changes	9.80	0.16 to 584.2	We are 95% certain the true average OR is between 0.16 and 584.2	N/A	Given 2 studies it is not possible to estimate a prediction interval.
Results for behavioural outcomes					

Clinician reminders	1.06	0.91 to 1.23	We are 95% certain the true average OR is between 0.91 and 1.23	0.40 to 2.82	Given 3 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.40 or as high as 2.82
Clinician education	1.03	0.91 to 1.15	We are 95% certain the true average OR is between 0.91 and 1.15	0.85 to 1.24	Given 15 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.85 or as high as 1.24
Electronic patient record	0.92	0.53 to 1.58	We are 95% certain the true average OR is between 0.53 and 1.58	N/A	Given 2 studies it is not possible to estimate a prediction interval.
Facilitated relay of information	1.10	0.78 to 1.56	We are 95% certain the true average OR is between 0.78 and 1.56	0.03 to 37.4	Given 3 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.03 or as high as 37.4
Multicomponent	1.19	0.89 to 1.58	We are 95% certain the true average OR is between 0.89 and 1.58	0.39 to 3.65	Given 4 studies with this heterogeneity, it is plausible that settings or populations exist in which the OR is as low as 0.39 or as high as 3.65

20 Appendix 13: Characteristics of included studies in Chapter 6: Strategies to increase the implementation of preventive care in primary care: A systematic review and meta-analysis

Study, year	Study design	Location	Health behaviour	N randomised	Main inclusion criteria	Main exclusion criteria	% male	Average age	Ethnicity	Intervention description	Comparator	Follow- up
Clinical Reminders												
Baer 2016	cRT	MA, USA	Obesity	12 clinics	All patients with at least 1 visit between June 11, 2012, and December 10, 2012, BMI ≥25mg/kg2	Providers with <50 patients during this period.	Patient: 35.3% male	Patient: 50 years	15.5% Hispanic/ Latino	Reminders and alerts for overweight/ obesity	Usual care	12 months
Banerjee 2013	RT	PA, USA	Obesity	843	Patient with obesity, obesity not on their problem list, had not had obesity addressed, not pregnant, had an appointment within 5 months of the follow up	Not meeting inclusion criteria, patients of 3 providers at the study site who were aware of the study	Patient: 27% male	Patient: 47 years	Patient: 80% white	Obesity prompt	Usual care	5 months
Dubey 2006	cRT	Toronto, Canada	Multiple	4 clinics	Physicians consented to a trial on prevention	Did not meet inclusion criteria	Patient: 39.5% male; Physician: 89% male	Patient: 44.4 years; Physician: 42.0 years	Not given	Prevention checklist	Usual care	5 months
Linder 2009	cRT	MA, USA	Smoking	26 clinics	All 26 affiliated clinics, patients who made a consultation 9 months before and patients who made a consultation in the study period	Not reported	Physicians: 46% male; Smokers: 39% male	Smokers: 48.5 years	Smokers: 64.4% white	Smoking cessation reminders	Usual care	9 months
Milch 2004	cNRT	Boston, MA, USA	Smoking	5 teams, 38 HCPs	All patients attending the practice between April - September 1999, current smokers	Not regular and current smokers, denied on follow-up interview that they were smokers, denied to their clinician they smoked or were terminally ill, patients seen by the chief of practice (who allocated intervention/control)	Patient: 49% male	Patient: 41 years	72% white in patient population	Vital signs stamp	Usual care	9 months
Minian 2019	cRT	Ontario, Canada	Alcohol	221 clinics	Enrolled in the STOP smoking cessation programme	Not using the online portal e.g., paper-based referrals	Patient: 55% male	Patient age: 47.9 years	Not given	Clinical decision support prompt	Usual care (no prompts)	6 months

Rossom 2022	cRT	Midwest, USA	Multiple	80 clinics	PCPs must be a general internist, family physician, or adult-care non-obstetric nurse practitioner. Provide ongoing primary care for adults with SMI in 2012 and provide written informed consent. Patients must meet the study criteria to be diagnosed with SMI (one inpatient or two outpatient ICD-9 codes for schizophrenia, schizoaffective disorder, or bipolar disorder; >17 and <80 years old; not pregnant; Charlson comorbidity score 3 or less; be linked to a consented PCP; have at least 1 primary care visit with a consented PCP in the 12m prior to clinic randomisation	Not meeting inclusion criteria, patients in nursing homes or hospices or those with active cancer care	Patients: 44.9% men	Patients: 48.4 years	Patients: 83.7% white	Electronic Health Record Best Practice advisories to print information of modifiable CV risk factors	Usual care	12 months
Rothemich 2008	cRT	Virginia, USA	Smoking	18 practices, 73 clinicians	Practices with at least 2 clinicians who specialised in adult primary care	Residency programs, clinics serving special populations, practices not under institutional review board, practices with an existing systematic tobacco identification and reminder system.	Physicians: 69% male Patients: 60% male	Physicians: not given; Patients: 52 years	Physicians: 84% white	Vital sign stamp	Usual care	6 months
Wadlin 2021	cRT	Maryland, USA	Smoking	15 clinics	All primary care offices included if had visits from adult >= 18 years. Encounters were eligible if the patient was labelled as currently smoking tobacco	Other encounters where the BPA fired e.g., nursing or medication refill were excluded	Not given	Not given	Not given	Best practice alerts	Usual care	6 months
Clinician Education												
Adams 1998	cRT	MA, USA	Alcohol	29 healthcare providers; 530 patients	High risk drinkers were included	Not described	Providers 41% male; patients 63% male	Providers: 37.8 years (SD 5.4); patients 45.1 years (SD 13.9)	Not given	Alcohol intervention training used a 'patient-centred' counselling approach that elicits active patient involvement in behaviour change	Usual care	6-32 months, average 19 months
Anderson 2021	cRT	Bogata (Columbia)Mexico City (Mexico)	Alcohol	29 PHCC (use hypothesis 2)	Fully qualified HCP, written consent	Not described	Providers 23.1% male	Providers: 38.6 years	Not given	1.5-2 hours of tailored training	Usual care	4.75 months

		and lima (Peru)										
Babor 2004	cRT	USA	Alcohol	173 healthcare professionals	Each managed care organisation was required to have at least three comparably sized Family or Internal Medicine clinics with annual visits of at least 7,000 unduplicated adult patients, a designated MCO liaison to coordinate SBI activities, and no current alcohol screening programs.	Not described	Healthcare professionals (inc. medical students): 40% male	Healthcare professionals (inc. medical students): 35 years	not given	Cutting back training curriculum	Usual Care	3 months
Baldeon 2018	cRT	Ecuador	Obesity	6 health care systems	Age ≥ 30 years and BMI ≥ 25	Patients taking lipid-lowering medications, those with known coronary heart disease, and those with secondary causes of hyperlipidaemia were excluded. Also, those who declined to participate, did not come to the appointment, were not accessible, or did not meet the definitive eligibility criteria	Patients 30% men	Patients similar in age (value not given)	Not given	Training: didactic component on the relationship between behaviour and CVD risk; training resources; patient-centred counselling; clinical guidelines	Usual care	6 months
Butler 2013	cRT	Wales	Multiple	53 general practitioners	Patients Alcohol—Score >4 for men or >3 for women on AUDIT-C Diet—Consumption of <5 fruit and vegetable items per day or ≥3 servings of any of the subset of DINE fat items Exercise—<30 minutes for at least 5 days a week of vigorous or moderate exercise Smoking—≥1 cigarettes smoked per day. Aged 18 or older; able to provide informed consent	If considered inappropriate by the clinician; unable to complete the questionnaire in English	GPs: 34%; patients 38%	GPs: not given; patients: 50.9 (SD 49.55)	not given	Behaviour change counselling was developed from motivational interviewing. Clinicians were trained using a blended learning programme called Talking Lifestyles	Usual care	12 months
Campbell-Scherer 2019	cRT	Alberta, Canada	Obesity	24 clinics	All allied healthcare professionals and adult patient visits were included in the study	Clinics were excluded for lack of team or predominantly telephone-based visits	Not given	Nurses: 46.8 years	Not given	12 x 2-hour interactive educational sessions	Usual care	9 months
Corelli 2022	cRT	California USA	Smoking	63 technicians	(a) a private counselling area, (b) the ability to relocate the non-prescription nicotine replacement therapy (NRT)	Stores in Los Angeles County because of a concurrent tobacco cessation program	Technicians: 22% male	Technicians: 38.6 years	Technicians: 58% white	Live training session in addition to self-study training module	Self-study training module	12 weeks

					medications from the customer service area at the front of the store to the pharmacy area, and (c) no planned construction in the 12-week study							
Cummings 1989	cRT	California, USA	Smoking	81 internists	All smokers who made a visit to any doctor participating in the study were included	Excluded physicians who had fewer than 20 patient visits a week, patients who did not speak English	Physicians:71.5% male; Patients: 45% male	Physician: not given; Patients: 45.5 years	Not given	3 x 1-hour seminars to demonstrate and practice counselling about smoking cessation	Self-help booklet	1 year
Evins 2022	cRT	USA	Smoking	77 clinics	All adults who smoked tobacco and were eligible for Department of Mental Health psychiatric rehabilitation services for serious mental illness through the largest two behavioural health organisations	Declined to participate, not outpatients, received primary care at a clinic serving fewer than 3 participants	70% male	47.8 years (patients)	45.5% white	Physician education only arm - educational outreach to primary care staff	Usual care	2 years
Flocke 2021	cRT	Cleveland, Ohio, USA	Smoking	8 sites	Not given	Not given	Patients: 37.3% male. Physicians: 33.1% male	Patients: Median age: 49.5. Physicians: not given	Patients: 51.3% white. Physicians: not given	Clinician-focussed teachable moment communication process.	AAC training - Ask, Advise, Connect	Average 14.5 months
Funk 2005	RT	Australia, Belgium, Denmark, England, New Zealand, and Spain	Alcohol	464 GPs	GPs were included if they were registered practitioners who delivered general medical services	GPs were excluded if they moved away from the study area, provided only locum or emergency medical services, they were on extended leave, they had been involved in pilot work for this study, or if a practice partner had already been approached for the study.	76% male	45 years	not given	One face to face training session related to brief intervention programme	Written instructions	3 months
Girvalaki 2018	cNRT	Crete	Smoking	24 GPs	Eligible patients were 18 years or older; current smokers; seen in practice for a nonurgent medical visit or prescription and able to read/ understand Greek	Not described	Smoker's sex: 57.6% male	Smoker's age: 48 years	Smokers: 97.9% Greek	Training, practice, and patient tools	Usual care	4 months
Haller 2014	cRT	Switzerland	Alcohol	33 family physicians (1 withdrew after randomisation before	Young person (15-25) consulting at the practice	Acute illness; severe mental disturbance; substance abuse requiring immediate attention; previous treatment for dependence; inability to read or understand	Physicians: 58% male. Patients: 46.8% male	Physicians: median age 50.5 years. Patients: 18.5 years	Not described	2 x training sessions (3h and 2h) simulations, practicing BIs, feedback	Usual care	12 months

				patient recruitment)		French; any other disorder impacting their ability to consent						
Haskard 2008	RT	West Coast, USA	Multiple	80 physicians	Patients had to be literate and able to communicate in English or Spanish. Spanish speaking patients could be included if their physician was fluent in Spanish and both the interaction and patient questionnaire were completed in Spanish	No physicians who volunteered were excluded	63% male	Physicians: 37.3 years (SD = 10.1)	not given	18 hours of training over 3 months with 90-120 minutes of coaching (review of consultations) alongside	No training (received after trial completed)	6 months
Hilbink 2012	cRT	Netherlands	Alcohol	82 practices with 124 GPs	All GPs in the practice had to agree to participate	Not described	Patients: 69.7% male	Patients: 47.5 years	Not given	Educational visits by a trained facilitator, personal feedback	Mailed guidance	2 years
Houston 2013	cRT	Dental practices from Alabama, Georgia, Florida and North Carolina, USA	Smoking	143 practices			Patients: 47.8% male	Patient: median age = 37	Patients: 84.7% white	OralCancerPrevention.org - educational cases, patient education, forum, email reminders	Usual care	6 months
Hudmon 2018	cRT	Connecticut and Washington state, USA	Smoking	64 pharmacies	Listed pharmacy in either state	Not described	Not given	Not given	Not given	Academic detailing (on-site training)	Printed materials	12 months
Joseph 2004	cRT	Veterans Affairs Medical Centers, Minnesota, USA	Smoking	Not given	Existence of a referral-based smoking cessation program that treated a minimum of 50 patients a year, Information Resource Management capacity for data collection, Institutional Review Board capacity and evidence of commitment to the project	Small sites, lack of experience with research. Facilities serving predominantly psychiatric patients	Patients: 96% male	Patients: 64 years	Patients: 75% white	2-day training meeting including smoking as a vital sign approach, delivery of brief intervention to all smokers, use of pharmacological therapy and further site visits	Usual care	12 months
Jumbe 2022	cRT	60 community pharmacies in England and Wales	Smoking	60 pharmacies; 30 intervention, 30 control	Provided stop smoking services and were identified from lists provided by NHS service commissioners in each recruiting area. Patients: all current smokers 18 or older who joined the stop smoking services in participating	None specifically given	50.16% Male	Mean age smokers 45.83 (SD 14.31)	not given	STOP training intervention, 1 x half-day 3hr session for pharmacists	Usual care	6 months

					pharmacies and who attended their first session							
Kaner 2003	cRT	Seven health districts across northern England	Alcohol	144 practices	At least one nurse who would not be away from the practice for more than 2 weeks	Not described	Nurses 99% female	Nurses: 45 years (SD 8)	Not given	34-minute outreach visit detailing brief intervention procedures and pre-empting problems	Letter covering guidelines	3 months
Keller 2000	cRT	Hesse and Theringde n, Germany	Multiple	74 primary care physicians	Geographical criteria (for physicians), patients had newly diagnosed or previously untreated cardiovascular risk factors	Patients were excluded if cardiovascular disease or other serious diseases were known or if they had received a cardiovascular risk factor intervention in the past	Patients: 57% male	Patients: 49 years	Not given	One day interactive workshop focussing on the trans-theoretical model and general counselling strategies for behaviour modification	Usual care	12 months
Kottke 1989	cRT	Minnesot a family practice, USA	Smoking	44 physicians	Not described	Not described	GP: 84.9% men; patients 33% men	GPs: 40 years; patients 40 years	not given	6-hour training covering dangers of smoking, intervention skills, counselling skills and planning the practice for smoking cessation	Usual care	12 months
Lennox 1998	cRT	Aberdeen city, UK	Smoking	16 practices	All practices (other than practices the research staff worked at) invited to participate	Staff member had attended pilot workshop prior to joining practice, impending large staff changes, staff member worked for more than one practice	Not given	Not given	Not given	Interactive approach to smoking cessation, some didactic teaching on the Stages of Change model	Usual care	14 months
Malta 2016	cNRT	Sao Paulo State, Brazil	Multiple	43 doctors and nurses	All doctors providing low risk antenatal care within the public health network of Botucatu municipality	Disaffiliation with municipal primary care staff	Not given	Dr and nurses: 36.6 years	Not given	16h intervention package including an introductory course and 3 workshops	Usual care	12 months
McRobbie 2008	cRT	Eat London, UK	Smoking	91 GPs	Not given	Not given	Not given	Not given	Not given	Training session including practical guidelines and simple skills to refer smokers for treatment	Referral guidance by post	3 months
Mejia 2016	cRT	Argentina	Smoking	254 physicians; 1378 smokers	Physicians who saw more than 100 patients a month in primary care specialties within the 6 health systems 3 months before the study began	Not described	Physicians: 47% men; patients:19 % men	Physicians: 44.5 years; patients median age 35-49	not given	2 x 3-hour didactic sessions	Usual Care	12 months
Moore 2003	cRT	Northern and Yorkshire region of England	Obesity	44 practices	All general practitioners and practice nurses in the 44 GP practices were eligible to participate	Not described	26% male	48 (11) years	not given	3 x 90-minute training sessions about feasible interventions and how to deliver them	Usual care	12 months

Olano-Espinosa 2013	cRT	Spain	Smoking	35 primary health care centres, 830 health professionals, 5970 smokers	All nurses and doctors from the 35 clinics were included. Patients were at least 18 years old, identified as smokers, attended a consultation during the follow up period	No exclusion criteria for practices, Patients were excluded if they were immobile, terminal, in geriatric centres or "absent" (someone else had come in their place).	Healthcare professionals: 50% male; patients: 47% male	Healthcare professionals: 45; Patients: 44 years	Not given	6-hour training (4 x 90min) - training based on stage of change model, clinical cases and role playing	Usual care	12 months
Ornstein 2013	cRT	15 states of USA	Alcohol	20 primary care practices	First 20 practices volunteering for the study	None described	44% male	Patients: 60 years (providers not given)	Not given	Network meeting; 2 on-site educational visits; all received passive dissemination of guidelines, electronic health record update, audit, and feedback	all practices received passive dissemination of guidelines, Electronic Health Record update, audit, and feedback	12 months
Prokhorov 2010	cRT	Texas, USA	Smoking	16 communities of 87 physicians and 83 pharmacists	At least 18 years, able to speak and write in English or Spanish	Not described	Physicians 57% male; pharmacists 47% male; patients 30% male	Physicians: 44 (11) years; pharmacists 44(13) years; patients 45 (15) years	Physicians 69% white; pharmacists 67% white; patients 81% white	Smoking cessation continuing education training	Skin cancer training	12 months
Ribeiro 2011	cRT	District of Lisbon, Portugal	Alcohol	73 doctors	Random sample of doctors	Not described	39.7% male	53.5 years	Not given	Training in identification and counselling of patients with risky alcohol consumption	Usual care	9 months
Rosario 2022	cRT	Portugal	Alcohol	12 clinics	All primary health care units will be eligible to participate	PHC units will be excluded if they have less than 55 patient lists, or if they have a specific alcohol programme implemented in their practice	Physicians: 10% male	Physicians: 43 years	Not given	4 sessions covering evidence of alcohol harm, how to screen and deliver brief interventions, share experiences, personalised plans, and practice of brief interventions	Usual care	12 months
Ruf 2010	cRT	South Baden and South Württemberg, Germany	Alcohol	69 practices	Use of broadband internet, at least one practice nurse	Non defined by study	GPs: 65.2% male; patients: 73.6% male	GPs: 51.5 years; patients: 54.2 years	Not given	Online and training programme for general practitioners. Additionally, education for the whole practice	Access to the system with no training	3.5 months
Sinclair 1998	cRT	Grampian, Scotland	Smoking	62 pharmacies	All pharmacies in Grampian area	City pharmacies due to a concurrent training initiative	Patient: 38% men	Patient: 41 years	Not given	Training package based on the stage of change model of smoking cessation	Usual care	9 months
VanLieshout 2016	cRT	Dutch general practice	Multiple	34 general practices	Patients had to be adults (aged 18 or older), have a high risk of CVD, no established CVD,	Diabetes mellitus, pregnancy and lactation, terminal illness, cognitive	PNs: Not given; Patients: 65% male	Practice nurse: 42 years;	Not given	Structured feedback; access to online education programme; and a flowchart	Usual care	6 months

					capable of providing informed consent	impairment, and poor language skills		Patients: 72 years		for dealing with depressive symptoms		
Verbiest 2014	cRT	The Netherlands	Smoking	49 GPs, 3401 patients (677 smokers)	No more than 5 self-reported stop smoking advice per week	No participating colleague in the same practice	38.6% male	52.5 years	not given	1 hour training for GPs on the 5A behavioural change model and a toolkit	Usual care	9 months
Welzel 2021	cRT	Central Germany	Obesity	50 practices	None for GPs; patients BMI >30kg/m2 age 18-60, not acute illness presentation	Patients do not meet inclusion criteria	Patients 37.8% male; GPs 38.8% male	GPs: 48.6 years; patients 43.3 years (SD 10.7)	not given	Online tutorial access	Usual care	12 months
Electronic Patient Record												
Fiore 2019 A	cRT	Wisconsin, USA	Smoking	12 clinics in health system A (unclear)	Clinics had to provide primary care, have a volume of >60 patients a week, >= 3 primary care clinicians, have received prior training in F2Q to the Wisconsin Tobacco Quitline and willingness to accept random assignment.	Not described	Patients: 43.7% male	Patient:55.4 years	Patients: 97.3% white	eReferral process to Quitline on electronic health record (with training on how to. Use this)	Faxed referral	6 months
Fiore 2019 B	cRT	As above	As above	As above	As above	As above	Patients: 41.8% male	Patient: 55.0 years	Patients: 76.4% white	As above	As above	6 months
Houston 2015	cRT	US	Smoking	174 practices	All smokers in the practices were eligible for referral	Not described	Not given (trial 1)	Not given (trial 1)	Not given (trial 1)	ePortal with online referrals to Web-Assisted Tobacco intervention	Paper referrals	6 months
Rindal 2022	cRT	Midwest, USA	Smoking	15 non-academic primary care dental clinics	For a dental practitioner to be eligible for the study, they could be either a dentist or a dental hygienist. They had to use an EagleSoft or Dentrix electronic dental record (EDR), provide estimates of their patient attributes, agree to participate in training along with their staff, and agree to be randomized to one of the study arms. Patients had to be 18 or over, smoked cigarettes and was not yet exposed to clinical decision support	Dental practitioners whose practices were limited to specialty services other than periodontal care or who practiced at an educational or government institution or in a Federally Qualified Health Centre (FQHC) were not eligible to participate.	60% male	42.3 (15.8)	42% white	The CDS tool required the dental provider to assess 3 health behaviour variables for all patients who reported smoking cigarettes	Usual care	6 months
Minian 2022	RT	Ontario, Canada	Multiple	5331 patients	Treatment-seeking smokers enrolled at the STOP program at one of the partnering primary care settings, reported physical activity and fruit and vegetable consumption that	Not meeting inclusion criteria	48% male	53 (SD 13) years	not given	Diet and physical activity clinical decision support tool	Usual care	6 months

					was lower than national guidelines. English--speaking and have provided at least piece of contact information (for follow up)							
Boston 2023	cRT	Community health Centres in USA (low-income patients)	Smoking	70 community health centres	Included patients were medication-naive and aged 40 to 75 years with ≥1 uncontrolled cardiovascular disease risk factor, with known diabetes or cardiovascular disease, or ≥10% 10-year reversible CVD risk.	Not meeting inclusion criteria or declined to participate	Patients: 47.8% men	58.5 years (8.8)	Patients 65.7% white	Clinical decision support prompt and implementation resources	Usual Care	18 months
Facilitated relay of information												
Grant 2014	cNRT	Kaiser Permanente Northern California	Physical Activity	11 medical centres; 696,267 adults	Adults aged 18-89 years, continuous membership plan, visited their PCP during the study observation period	Switched medical affiliation during the study period, recent hospitalisations or pregnancies, presence of comorbidities that might limit exercise capacity	Patients: 47.7%	Patients: 51.4 years	Patients: 46.6% white	Change to medical assistant workflow and an added feature to the electronic medical record	Did not have exercise as vital sign (EVS) program	12.5 months (average time post implementation for 4 clinics)
Wadland 2007	cRT	Michigan, USA	Smoking	87 practices; 308 clinicians	Practices offered usual primary care, agreed to participate, completed baseline survey forms	Not described	Physicians: 53% male	Patients: 23% >65	Patients: 80% white	Comparative feedback report to clinicians	Usual care	18 months
Unrod 2007	cRT	Boroughs of New York, USA	Smoking	70 physicians	Physicians: internal or family medicine specialty, plans to continue practicing in current location for at least 1 year, at least 75 patient visits/week, primarily English-speaking patients, fewer than 25% geriatric patients. Patients: At least 18 years, smoked in the past 7 days, smoked more than 100 cigarettes in their lifetime, English-speaking, to keep their physician for the next 1 year.	Not meeting inclusion criteria	Patients: 39% male	Patients: 43 years	Patients: 62% white	Patient smoking report collected by research staff for review by physician	Usual care	6 months
Bentz 2007	cRT	Providence Health Systems, an integrated delivery system in Portland, Oregan.	Smoking	19 clinics. Control (n=9); Intervention (n=10)	Both fax and self-referrals included, patients gave consent, had to be smokers	Not specified	Patient: 33.7% male; Provider: 50.5% male	Patient: 52.5	Not given	Clinicians received feedback on Asked, Advised, Assessed and Assisted components of smoking cessation	No feedback	12 months

Saitz 2003	cRT	Boston University Medical Centre, Boston, MA, USA	Alcohol	50 physicians	Faculty and resident PCPs in an urban academic medical practice	Physicians who saw <80 patients in previous 3 years or who anticipated leaving the practice within 6m	Patient: 63.5% male; Physicians: 55% male	Patient: 43 years; Physicians: 34.5 years	Patient: 19% white Physicians: 66% white	Sheet of paper attached to notes prior to physician visit with the results of the alcohol intake, assessment of alcohol problems, advice for next steps (referral, discussion etc)	No relay of information to physicians	6 months
Financial Incentives												
Bardach 2013	cRT	New York City, USA	Smoking	84 practices	Practices with <10 clinicians, having at least 200 eligible patients for measurement, at least 10% Medicaid or uninsured patients, have been using the electronic health record for at least 3 months	Not given	Patients: 41% male	Patients: 46 years	Not given	Financial incentives and bench lined quarterly reports	Benchmarked quarterly performance	1 year
Coleman 2007	ITS	English primary care	Smoking	1,607,782 patients in 2004	Patients aged 15-75 years	Not described	Not given	Not given	Not given	Introduction of new contract with financial incentive (QoF) for smoking brief intervention in 2004	N/A	12 months
Fichera 2016	ITS	English primary care	Multiple	11,270 in BMI sample (used in extraction)	Individuals reporting at least one condition incentivised by the QOF	Not given	Patients: 47% male	Patients: 55 years	Not given	Introduction of QOF for obesity, smoking, alcohol (BMI chosen as first outcome)	N/A	5 years post QOF introduction 2004 - 2009
O'Donnell 2020	ITS	England	Alcohol	4,278,723	Individual practices were eligible if their data were published after the Acceptable Mortality Reporting and Acceptable Computer Usage dates. Patients were eligible if they were newly registered (defined as within the previous 12 months), aged 16-99, and registered with a practice that had been contributing to THIN for at least 2 years prior to the patients' registration date	Patients with recorded ages of 100+	Patients: 57.5% male	Patients: 38 years	Not given	Introduction of financial incentives for alcohol screening	N/A	11 years
Rieckmann 2018	ITS	Oregan, USA	Multiple	516,708 participants total	Individuals aged 18-64	Individuals dually enrolled in Medicaid and Medicare, those eligible for Medicaid under Medicaid expansion, people not aligned to a CCO	Study population: 30% male	Study population: 35 years	Study population: 70% white	Incentive payments to CCOs when they implement SBI.	N/A	30 months follow up time
Roski 2003	cRT	Midwest, USA	Smoking	37 clinics	For patient tobacco endpoints - 18 or older, having a telephone number in their	Not described	Not given	Not given	Not given	Financial incentive for meeting smoker id and advice target (and target	Guideline dissemination	6 months

					records, having an office visit 90 days prior to July 10, 2000					assessment through chart abstraction)		
Szatkowski 2016	ITS	England	Smoking	3,337,881 patients in the database per month	All patients aged >16 years who contributed to the database from April 2004 to March 2013	Not given	Not given	Not given	Not given	QOF smoking revision	N/A	1 year
Multicomponent interventions												
Ackermann 2005	cRT	Seattle, USA	Physical Activity	31 physicians and nurse practitioners; 336 patients	All staff and fellow physicians, nurse practitioners, and physician assistants caring for primary care patients were eligible. Patients were eligible with written consent, aged 50 or older, lived within 25 miles of the VA.	Practitioners on a leave of absence. Patients with severe cognitive deficits.	Patients: 99% male	Patient age: 66 years. Physician age: 43	Not described	10-minute individualised training session and prompts for each patient detailing their stage of change	Analogous tobacco training	4 months
Anderson 2016	cRT	Catalonia, England, the Netherlands, Poland, and Sweden	Alcohol	120 primary care health units (24 in each country)	Any fully trained full- or part-time medical practitioner, nurse, or primary care assistant with a permanent contract	None given	Patients: 55% male; providers: 26% male	Patient: 53 years; Provider 47 years	Not given	Training, financial reimbursement, referring identified heavy drinking patients to an internet-based method of delivering advice.	Printed guidance	12 weeks
Asadi-Aliabadi 2023	cRT	4 Iranian districts	Multiple	31 community health centres	At least 2 healthcare providers, rural - without a satellite village	Excluded fields with specific characteristics that differentiate from other fields in the district	50% men	49 years	not given	Goal setting, education, operational planning, and incentive payments	Usual care	12 months
Bailey 2023	cNRT	USA	Smoking	8 community health centres	The study included adults (aged ≥18 years) with ≥1 primary care visit between August 2016 and September 2019 to ≥1 of the 8 community-based primary care study clinics that primarily serve uninsured or publicly insured patients.	Not meeting inclusion criteria	30.4% male	Median 35-64	49.6% white	EHR referral functionality and expansion of staff roles	Usual care	24 months
Balasubramanian 2022	ITS	USA	Smoking	1795 practices	Smaller practices (< 10 FTE clinicians), had to have an electronic health record	Not meeting inclusion criteria, declined to participate, other reasons	not given	Not given	Intervention 59.8% white	ITS	ITS	2 years
Goodfellow 2016	cRT	East Midlands England	Obesity	28 general practices	All practices in the East Midlands of England (except Derbyshire Clinical Commissioning Group)	The exclusion criteria for practices were (a) participation in another study of obesity and assessing similar outcomes during the previous year and (b) if	Patient: 52% male	Patient: 51.3 years	Patient: 68.6% white	Training, team discussion, discussion about sample questions, booklet for patients, guidelines summary	Usual care	9 months

						the practice had recently changed or were planning to change their computer system over the trial period						
Harris 2017	cRT	Australian states	Multiple	32 practices	Eligible patients 40-69 years without CVD, renal disease or diabetes who had visited the practice within 1 year; proficient in English; had cognitive awareness	severe mental illness, substance abuse, pregnancy	Patients: 30.4% male	Patients: 55 years	Not given	Clinician education; audit and feedback; practice facilitation visits	Usual care N/A Usual care	12 months
Kowitt 2022	cRT	North Carolina, USA	Smoking	28 practices	10 or fewer clinicians and had an HER	Not described in this paper	Patients:40. 1% male	Not given	Patients: 73.1% white	Healthy Heart Now (HHN): online coaching and support, HER practice population management dashboard, educational tools, Coach worked with practices on Plan-Do-Study-Act cycles	Usual care	6 months
Lee 2023	cRT	Washingt on State, USA	Alcohol	22 practices (19 sites, 3 practices on same site)	All patients who were at least 18 years old with a visit(s) to trial primary care practice(s) between January 1, 2015, and July 31, 2018.	Not described	42% male	48 (18) years	70% white	EHR clinical decision support, performance feedback, practice facilitation	Usual care	2 years
Little 2009	cRT	USA	Smoking	14 dental practices	Not described	Excluded smokers where they had only been seen by a dentist at a new patient exam	42.6% male	46 years	Approximately 84% whit *demographic data is from post-visit sample of patients completing questionnaire	Training to offer brief tobacco counselling and encourage patients to talk by telephone with a trained tobacco counsellor, performance monitoring and feedback, facilitated relay of information	Usual care	14 months
McElwaine 2014	cNRT	New South Wales Australia	Multiple	17 community health facilities; 571 nurses and allied healthcare professional s	Adults, at least 1 face to face appointment in the past 2 weeks, not previously selected, spoke English, mentally and physically capable of completing the interview, not involved in another community healthcare study	Not described	Participants: 35% male	Median age of participants: >=60	Not given	Electronic medical record modification; monthly performance reports; practice change support officers; email helpline; clinician report pack	Usual preventive care	12 months
Patwardan 2012	RT	South - Central Wisconsin , USA	Smoking	16 pharmacies; 30 pharmacists	1) they belonged to a specific large national chain pharmacy, 2) they were located within 75 miles radius from Madison, and 3) they were in an area of	Not specified	50.5% male	39.6 years	not given	Training, workflow recommendations, poster, support visit (+ control)	Cards and informal presentation	Unclear - 5m (July 2008 pharmacy recruitment, data gathered November 2008)

					lower socioeconomic status than the state average							
Rose 2008	cRT	21 primary care practices across the USA	Alcohol	21 primary care practices	Practices members of the Practice Partner Research Network (PPRNet) First 22 practices to volunteer	Not described	Patient: 43% male (intervention arm)	Patient: 62 years (intervention arm, do not give control, but say statistically similar)	Not given	Academic detailing, performance reports, network meetings	Received performance feedback	2 years
Sturgiss 2023	ITS	ITS	Alcohol	17,107 (plus clinic 6 regular patients - not given)	ITS	ITS	not given	Not given	not given	ITS	ITS	10 months
Twardella 2007	cRT	Germany	Smoking	41 medical practices; 45 general practitioners	Smoked at least 10 cigarettes per day; aged 36-75 years	Not described	patients: 49.5% male	Patients: Median 45-54 years	not given	Physician group training and direct physician payments for every smoker not smoking at 12 months	Usual care	12 months
van Beurden 2012	cRT	Netherlands	Alcohol	77 general practices	Practices could only enrol if all GPs within the practice agreed to participate	Refused to participate	GPs 33% male	GPs: 47.4 years	not given	Educational training session, reminder card, feedback report, facilitation of the cooperation with local addiction services, outreach by trained facilitator	Usual care	12 months
Wiggers 2017	cRT	New South Wales, Australia	Multiple	56 practices	Adult health centres that provided: community nursing, diabetes, aged care, counselling, dietetics, psychology, physiotherapy, and occupational therapy services	Child based services, in-patient services, specialist community services	Client: 41% male	Client: median age 60+	Not given	6 key strategies: leadership and consensus processes, enabling systems, educational meetings and training, audit and feedback, practice change support, and practice change information and resources.	Usual care	Average 24 months
Young 2002	cRT	Sydney, Australia	Smoking	60 family practitioners from 39 practices	All family practitioners in a defined geographical area around Sydney	Worked fewer than 2 days a week, planning to leave within 6 months, on extended or maternity leave, did not employ a receptionist, already participating in a clinical audit, more than 50% of their patients spoke a language other than English at home. Patients	patients 39% male; physicians 38% male	Patients median 45 years; physicians 48 years	Not given	Audit and feedback, resources and skill training, prompt sheet, reminder for medical records, patient brochures	Cervical cancer training	Max 6 months

						were ineligible if they did not speak or read English, were unable to read or understand the questionnaire, were too sick or distressed to participate, or had participated previously.							
Continuous Quality Improvement													
Yano 2008	cRT	Veterans Health Administration health care networks in SW USA	Smoking	18 practices, 925 smokers' intervention; 1016 control practices	3 or more primary care providers and 3000 or more primary care patients	research team's home institution, practice had insufficient time to participate/ patients excluded if not eligible, refused, phone problems or not located	Patients: 93% male	Patients: 57 years	Patients: 64% white	QI strategies	Usual care	12 months	
Team Changes													
Flocke 2020	CBA	Ohio, USA	Smoking	8 clusters, 81 MA/RNs	Eligibility for QL programme included 18 or older, Medicaid insurance, no insurance or pregnant. All patients seen by MA/RNs during the observation period were eligible for tobacco assessment	Not described	Patients: 30.9% male	Patients: Median age: 49.5. Physicians: not given	Patients: 48% white	New HER section to Ask-Advice-Connect to be implemented before clinic appointments by medical assistants or registered nurses as part of vital signs.	Usual care	12 months	
Alageel 2019	ITS	England	Multiple	450,801	Health check cohort included participants in England aged 40-74 years who had a health check between 1/4/23and 31/12/2013	A diagnosis of ischaemic heart disease, stroke, or diabetes, or were treated with antihypertensive drugs or statins before the date of the health check.	51.9% male	Patient median = 50	Not given	Introduction of the NHS health check for the primary prevention of cardiovascular disease and related disorders	Usual care	6 years	
Schwartz 2014	cRT	New York Harbor, USA	Smoking	20 teams (13 in the arms analysed)	All PACT teams	If there were no primary care physicians	94% males	63 years	not given	Addition of a Panel Management Assistant who identified gaps in care, conducted patient outreach, supported hypertension and smoking outcomes	Usual care	8 months	

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