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Enhancing community pharmacists' provision of medication adherence support to older adults: A mixed methods study using the Theoretical Domains Framework

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1 Enhancing community pharmacists' provision of medication adherence 2 support to older adults: a mixed methods study using the Theoretical 3 Domains Framework

4 Abstract

5 Background

6 Community pharmacists have an important role to play in providing medication adherence support
7 (MAS) to older patients. However, research has shown that pharmacists rarely ask patients about
8 adherence and offer limited solutions. The Theoretical Domains Framework (TDF) can guide the
9 selection of behaviour change techniques (BCTs), to enhance behaviours such as MAS provision.

10 Objectives

11 This study aimed to: (1) explore barriers/facilitators influencing community pharmacists' provision of
12 MAS to older patients prescribed multiple medications; (2) Identify theoretical domains to target for
13 behaviour change; (3) Select BCTs to deliver to pharmacists to enhance MAS provision.

14 Method

15 As part of a two-phase study, semi-structured interviews and a cross-sectional survey were
16 conducted. In Phase 1, community pharmacists in Northern Ireland (NI) were recruited using
17 purposive/snowball sampling. TDF-based interviews were audio-recorded, transcribed and analysed
18 by two independent researchers using the framework method/content analysis. In Phase 2, a TDF-
19 based postal survey was mailed to all community pharmacies in NI (n=521) and analysed using
20 descriptive statistics. Triangulated findings informed selection of target TDF domains and BCTs to
21 deliver to enhance MAS provision.

22 Results

23 Fifteen pharmacists were interviewed for Phase 1. Barriers and facilitators included inadequate
24 remuneration, time and knowledge of solutions and professional confidence. In Phase 2, 143 (27.4%)
25 survey responses were received. Potential barriers included inadequate training in motivational
26 techniques and difficulties with decision-making. Based on triangulated findings, seven domains (e.g.
27 skills, memory) were identified as targets and mapped across to 18 BCTs (e.g. behavioural
28 practice/rehearsal, prompts/cues).

29 **Conclusions**

30 This mixed methods study provides unique perspectives on the wide range of barriers/facilitators
31 that are perceived to influence the provision of MAS by community pharmacists. The 18 BCTs
32 identified to target each of the seven key target domains identified in this study will be tested in a
33 future pilot study of a patient-targeted intervention.

34 **Keywords**

35 Medication adherence, community pharmacists, mixed methods, behaviour change, polypharmacy,
36 theoretical domains framework

37 Introduction

38 Medication non-adherence is common in patients prescribed several medications (polypharmacy),
39 with older patients at particular risk due to high levels of multi-morbidity in this population group.
40 Interventions to improve medication adherence commonly focus on patients' behaviour but
41 healthcare professionals (HCPs) have a key role to play in supporting patients. Community
42 pharmacists, in particular, are ideally placed to support older patients due to their frequency of
43 contact when patients collect repeat prescriptions. There is growing recognition that in addition to
44 targeting patients' adherence behaviour directly, it is important to consider the behaviours required
45 of those who are responsible for supporting patients and delivering interventions to improve
46 adherence.¹⁻³ The 2003 World Health Organisation (WHO) report recognised that community
47 pharmacists require training in both assessing patients who are at potential risk of non-adherence,
48 and in the delivery of interventions to improve it.¹ Guidance from the UK National Institute for Health
49 and Care Excellence (NICE) also describes the provision of medication adherence support (MAS) as a
50 complex clinical behaviour, consisting of both identifying non-adherent patients and providing tailored
51 interventions.²

52 To date, there has been limited research into exactly what helps and hinders community pharmacists
53 in providing MAS to older patients.³ Preliminary qualitative and quantitative research has shown that
54 potential barriers include inadequate time, lack of confidence and patient resistance.⁴⁻⁸ In the context
55 of Northern Ireland, the extent to which community pharmacists identify non-adherent older patients
56 and provide tailored adherence support is currently unclear. Services currently offered in Northern
57 Ireland, such as the Medicine Use Review service, lack a clear structure with regards to improving
58 medication adherence, and their effectiveness in improving adherence and cost-effectiveness
59 currently remains unknown.^{9,10}

60 It is also important to consider community pharmacists' training requirements and potential
61 implementation barriers, such as environmental constraints in the community pharmacy setting,
62 which may impact on MAS provision as recommended in the NICE guidance.² The UK Medical Research
63 Council (MRC) recommends that complex interventions, including training packages, should be
64 systematically developed to maximise effectiveness and gain an understanding of their proposed
65 mechanism of action.

66 The Theoretical Domains Framework (TDF) is a theoretical framework which can act as a 'theoretical
67 lens' to explore HCPs' clinical behaviours and gain a more comprehensive understanding of the key
68 influences of that behaviour (i.e. the barriers and facilitators).¹¹ The 12 domain framework was
69 developed by a group of psychologists and health service researchers to overcome challenges
70 associated with theory selection. It combined theoretical constructs from 33 different behaviour

71 change theories into the following domains: 'Knowledge', 'Skills', 'Social/professional role and
72 identity', 'Beliefs about capabilities', 'Beliefs about consequences', 'Motivation and goals', 'Memory,
73 attention and decision processes', 'Environmental context and resources' and 'Social influences'. The
74 TDF can be used to identify exactly what aspects (i.e. domains) should be targeted to bring about
75 change in the behaviour. Key target domains that contain potential barriers and facilitators to the
76 performance of the behaviour are then selected as intervention targets. For example, in this context
77 the domain 'Knowledge' might be selected if pharmacists were unaware of the range of adherence
78 solutions available. Selected key TDF domains can then be mapped to strategies known as behaviour
79 change techniques (BCTs) using established methods reported in the literature.^{12,13} BCTs are defined
80 as *"...the smallest components of behaviour change interventions that on their own in favourable
81 circumstances can bring about change."* and these can form part of training packages or other
82 implementation strategies to enhance implementation of the desired behaviour.¹⁴
83 This mixed methods study reported here aimed to: (1) Explore determinants (i.e. barriers and
84 facilitators) that influence community pharmacists' provision of MAS to older patients who are
85 prescribed multiple medicines using TDF-based qualitative interviews and a quantitative
86 questionnaire; (2) Identify exactly what could be targeted to change pharmacists' behaviour and select
87 key TDF domains to target; (3) Select BCTs to deliver as part of a training package and implementation
88 strategies to include in future research studies to enhance pharmacists' provision of MAS.

89 **Methods**

90 **Rationale for a mixed methods approach**

91 The majority of TDF-based studies have adopted qualitative approaches to explore the behaviour in
92 question and identify barriers and facilitators to behaviour change.¹⁵ However, mixed methods
93 approaches¹⁶⁻¹⁸ are increasingly being used as triangulated qualitative and quantitative findings can
94 provide a more complete picture of the behaviour under question.¹⁹ The current study therefore
95 adopted a mixed methods approach to explore community pharmacists' provision of MAS using in-
96 depth qualitative interviews with community pharmacists (Phase 1), followed by a quantitative survey
97 (Phase 2). There are currently two versions of the TDF— a 12 domain (TDF1)¹¹ and 14 domain version
98 (TDF2).²⁰ TDF1¹¹ was selected as the theoretical framework of choice for this mixed methods study.
99 This decision was supported by a discriminant content validity exercise undertaken by Huijij et al.²¹
100 which recommended *'keeping to the 12 original domains as a basis for the development of TDF
101 questionnaires'*. Ethical approval for the study was granted by XXXXX. Phase 1 of this study has been
102 reported in line with the 'Consolidated criteria for reporting qualitative studies' (COREQ) checklist

103 which aims to ensure comprehensive reporting of qualitative methods ²² (see Supplementary file 1).
104 The specific methods employed for Phase 1 and Phase 2 of the study are detailed below.

105 **Phase 1: Semi-structured interviews**

106 TDF-based semi-structured qualitative interviews were selected to gain an initial in-depth
107 understanding of the target behaviour (provision of MAS to older adults prescribed polypharmacy).
108 Interviews were selected over focus groups as they were deemed a more cost-effective and
109 convenient approach for the target audience.

110 *Sampling and recruitment*

111 To be eligible for inclusion in this study, pharmacists had to be currently working in a registered
112 community pharmacy in Northern Ireland. Community pharmacists who had previously taken part in
113 a prior linked feasibility study of a patient-targeted intervention²³ were not eligible to participate. A
114 purposive sampling strategy was selected to allow for the inclusion of a variety of pharmacists working
115 in different locations and types of pharmacies (e.g. independently-owned pharmacies and chains). The
116 initial sampling frame included community pharmacies (n=164) who were part of the XXXX
117 undergraduate community pharmacy placement network. A snowball sampling approach was also
118 used, whereby recruited participants from the network identified other potentially information-rich
119 individuals.²⁴ To aid the identification of data saturation, preliminary data analysis and collection ran
120 concurrently. The researcher (XX) initially contacted community pharmacists from the sampling frame
121 via telephone to invite them to participate in Phase 1. Formal invitation letters and study information
122 sheets were mailed/e-mailed to those expressing an interest and pharmacists were given five working
123 days to make a decision about participation. The sample size was determined by data saturation which
124 was achieved when no new themes were emerging.²⁵

125 *Interview topic guide*

126 A semi-structured interview topic guide (supplementary file 2), based on TDF1¹¹, was developed by
127 the research team. Examples of questions included: 'What skills do you currently have as a community
128 pharmacist that would enable you to provide medication adherence support to an older adult who is
129 prescribed polypharmacy?' (Domain: Skills); 'To what extent is providing medication adherence
130 support to older adults prescribed polypharmacy a priority for you?' (Domain: Motivation and goals).
131 The topic guide was piloted with two researchers from XXXXXX who were practising in the community
132 pharmacy setting at the time of the study. Minor refinements were made based on feedback from
133 pilot participants (e.g. wording changes).

134 *Conduct of interviews*

135 Face-to-face interviews took place at a location and time that was convenient for both the researcher
136 and pharmacist (e.g. pharmacy site, local cafe). The researcher (XX, MPharm, PhD Research Student
137 at the time of the study/practising community pharmacist) had previous experience with qualitative
138 research and had completed training on qualitative research methodologies. Interviews were
139 conducted between August and November 2016. Prior to participation, pharmacists provided written
140 informed consent and demographic details (e.g. years qualified) were collected. To account for the
141 time allocated to this study, participants were offered an honorarium of £50 and a certificate of
142 participation.

143 All interviews were audio-recorded and transcribed verbatim with participants' consent. Each
144 participant was assigned a unique identification number (e.g. CP01). Transcripts were checked for
145 accuracy prior to importing into NVivo® QSR 11. All study documents were stored either in a locked
146 fire-resistant filing cabinet or on a password protected laptop.

147 *Quality of qualitative methods*

148 The use of multiple independent data coders and a clear audit trail of all decisions made (facilitated
149 by the use of NVivo®) aimed to ensure dependability of the findings (a concept whereby the same
150 results would be obtained if the study were to be repeated). Triangulation of the qualitative findings
151 with quantitative findings aimed to ensure credibility of the results (i.e. the extent to which such
152 results are believable). The use of the COREQ checklist also helped to ensure transparency of the
153 methods used and the findings (see completed checklist in Supplementary file 1).

154 **Phase 2: Cross-sectional survey**

155 *Questionnaire design*

156 For Phase 2, a self-administered postal survey was selected over an electronic survey due to the low
157 response rates commonly seen with the latter and lack of access to individual email addresses.^{26,27} The
158 questionnaire (see Supplementary file 3) was developed based on findings from the qualitative
159 interviews (Phase 1), similar literature,^{6,8,28,29} and with reference to the domains in TDF1.¹¹

160 The questionnaire contained three sections with Section 1 focusing on demographics. In Section 2,
161 respondents were asked about MAS activities they engaged with in their own practice on a five-point
162 scale (very frequently to never/not at all). Section 3 focused on potential determinants of providing
163 MAS and explored the domains in TDF1. The 'Nature of behaviours' domain (defined as 'essential
164 characteristics of the behaviour')³⁰ which has been described as a dependent variable, rather than an
165 independent variable was assessed in Section 2 and so was excluded from Section 3. Example survey

166 items in Section 3 included: 'I receive sufficient reimbursement for providing MAS to older patients'
167 (Domain: Motivation and goals); 'I have sufficient knowledge of the range of adherence strategies that
168 are available to support older patients' (Domain: Knowledge).

169 Barriers/facilitators were assessed at the domain level as it was deemed impractical to measure
170 individual theoretical constructs as domains contained between 4-24 constructs each. Responses to
171 items within Section 3 were based on a five-point Likert scale (strongly agree to strongly disagree) and
172 were assigned to each TDF domain (n=11) using a group consensus approach. This method reflected
173 approaches used in the development of previous TDF-based questionnaires.³¹⁻³⁴ Where possible,
174 Likert items (n=21) were adapted from previous TDF-based questionnaires.^{31,32,34-36} To ensure
175 relevance to the target behaviour, a number of new items (n=17) were developed based on Phase 1
176 qualitative findings and non-TDF based questionnaires in the literature related to medication
177 adherence.^{6,8}

178 For example the item 'I have sufficient pharmacist staff levels to allow me to provide medication
179 adherence support to older patients' was developed based on the qualitative findings in Phase 1 (See
180 Supplementary File 3). Open style questions were included in Sections 2 and 3 to identify any
181 additional MAS activities and barriers or facilitators.

182 *Face validity and piloting*

183 Face validity of the questionnaire was assessed by three members of the research team who had
184 previous experience with using TDF1. Items assigned to each theoretical domain were assessed to
185 determine whether they appeared on the surface to measure what they were intended to measure.
186 The questionnaire was also piloted with five pharmacists from XXXXX who had current (n=4) or
187 previous experience (n=1) of working in the community pharmacy setting. The aim of this was to
188 ensure the readability and acceptability of questionnaire items and to help estimate the time required
189 for completion. Following pilot testing, minor amendments were made to questions (e.g. ambiguous
190 items were reworded).

191 *Sampling and recruitment*

192 The target population for the questionnaire was community pharmacists working in the region of
193 Northern Ireland. Addresses for all pharmacy premises registered in Northern Ireland at the time of
194 the study (n=548) were obtained from the Pharmaceutical Society of Northern Ireland (PSNI). Twenty
195 seven pharmacies were excluded from the sampling frame because they had participated in Phase 1
196 of this study (n= 14), took part in a previous linked feasibility study (n=2), were based in a hospital
197 (n=10) or based in a prison (n=1).²³ An invitation letter (addressed to the pharmacist in charge),
198 questionnaire and freepost return envelope were posted to the 521 community pharmacies remaining

199 in the sampling frame. Participation in the study was voluntary, responses were anonymous and
200 informed consent was implicit upon returning the questionnaire.

201 *Response rate and non-response bias*

202 To maximise the response rate, a reminder copy of the questionnaire was posted four weeks after the
203 first mailing to all pharmacies (responses were anonymous so non-responders could not be identified).
204 Following a low response rate with the first mailing, the research protocol was amended and ethical
205 approval was sought to promote the questionnaire via relevant social media outlets (e.g. Twitter). To
206 detect non-response bias, demographic data collected from respondents was compared with data
207 available for all pharmacists on the PSNI register which included pharmacists in all sectors (e.g.
208 community, hospital, industry).

209 *Questionnaire data management*

210 Returned questionnaires were assigned a unique identifier number and responses were entered into
211 SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM
212 Corp.). Missing responses were coded accordingly. A random 10% sample was double-checked for
213 input accuracy. This detected a low inaccuracy rate of 0.23% which was deemed to be acceptable.
214 Qualitative responses were entered into Microsoft Word 2016.

215 **Data analysis of interviews and questionnaires**

216 Data analysis for the current study consisted of three key stages which have been summarised in
217 Figure 1.

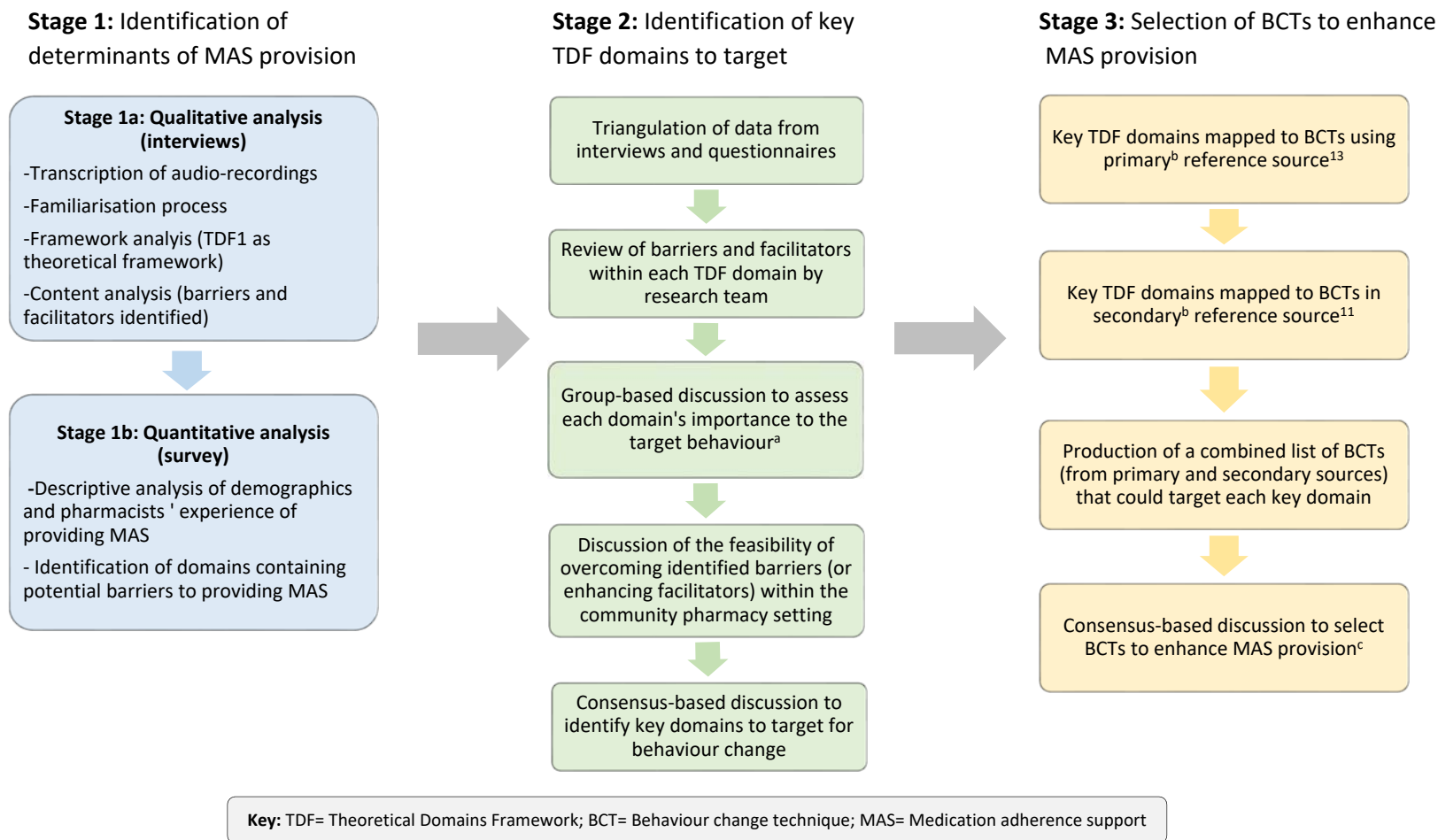


Figure 1: An overview of the three stages involved in data analysis

^a A domain was considered important if it was frequently coded as part of the qualitative analysis and/or it contained items that reflected potential barriers/facilitators to the target behaviour based on the quantitative analysis; ^b No BCTs mapped to 'Memory, attention and decision processes' and 'Social/professional role and identity' domains in the primary reference source hence the secondary reference source was also consulted; ^c Selection of BCTs was based on the expected feasibility of BCT delivery as part of a community pharmacist training package (or as implementation strategies in future research studies) and applicability to the target behaviour and audience

218 *Stage 1a: Identification of determinants of MAS provision from interviews*

219 Following transcription of the interview audio-recordings, an in-depth familiarisation process was
220 undertaken with repeated reading of transcripts. For the framework analysis each of the 12 domains
221 in TDF1 served as coding categories.³⁷ Inductive content analysis was then undertaken to identify
222 emergent barriers and facilitators within each TDF domain which were discussed and agreed upon by
223 the research team. Each transcript was independently coded by two researchers and any
224 disagreements were resolved through discussion.

225 *Stage 1b: Identification of determinants of MAS provision from the survey*

226 Descriptive statistical analyses were conducted for Section 1 (demographics) and Section 2
227 (experiences of providing MAS). Responses from open-style questions were qualitatively analysed for
228 emergent themes. In Section 3 (determinants of MAS provision), descriptive statistical analyses were
229 employed to explore the proportion of pharmacists in agreement or disagreement with each Likert
230 item (n=37). In some cases, Likert item scores can be combined to produce a summative scale score
231 (e.g. items around a particular personality trait).³⁸ However, before combining items it is important to
232 ensure they are measuring the same thing. Cronbach's alpha (α) on a scale of 0 to 1 is commonly used
233 to assess internal consistency with higher scores indicating greater similarities between items.³⁹ An α
234 value above 0.6 can be deemed sufficient for scaling multiple Likert items, whereas an α value below
235 0.6 indicates that the items are potentially measuring different concepts or theoretical constructs.⁴⁰
236 Alternatively, the Likert items can be analysed individually as ordinal-type questions.^{38,41,42} Likert items
237 in each TDF domain in this study were not combined into a scale as α values were less than 0.6 for six
238 out of the 11 TDF domains assessed. For consistency in data analysis, Likert items were assessed
239 individually within all domains. Individual responses to Likert items was assigned an integer, from
240 strongly agree=1 to strongly disagree=5, and the median value was calculated as a measure of central
241 tendency.⁴³ Higher median scores of 4 or 5 indicated more disagreement with the statement,
242 highlighting a potential barrier. TDF domains containing at least one potential barrier were identified
243 as possible targets for behaviour change.

244 *Stage 2: Triangulation of findings and identification of key TDF domains*

245 Key findings from Phases 1 and 2 were listed together to explore similarities and differences.¹⁹ The
246 research team discussed potential barriers identified within each domain and used the frequency of
247 interview coding in Phase 1 as a crude measure of the domains importance. Domains containing
248 potential barriers identified from the quantitative analysis in Phase 2 were also considered when
249 assessing the importance of each TDF domain in the context of the target behaviour. A domain was
250 subsequently deemed important if it was frequently coded in the qualitative analysis and/or the
251 findings from the quantitative analysis indicated potential barrier(s) within the domain.

252 Although a domain can be deemed important to the behaviour it may not be feasible to target the
253 barriers, or enhance the facilitators further, with an intervention. Using group consensus, the team
254 selected domains that contained barriers that could feasibly be overcome, or facilitators that could be
255 enhanced, either as part of a training package and/or using implementation strategies that could be
256 employed as part of future research studies (e.g. incentives, reminders). These selected domains were
257 termed 'key domains'.

258 *Stage 3: Mapping of Key TDF domains to BCTs*

259 Key domains were then mapped across to BCTs using methods originally developed by Michie et al.¹¹
260 and updated more recently by Cane et al.¹³ All potential BCTs that mapped to each domain were
261 considered and BCTs were selected using a group consensus approach which was informed by the
262 triangulated findings from Phases 1 and 2. When selecting BCTs the research team considered the
263 applicability of each BCT to the target behaviour and audience. Potential difficulties with delivering
264 BCTs, as part of a training workshop and/or as implementation strategies were taken into
265 consideration at this stage. For example, delivery of the BCT 'Motivational interviewing' would require
266 specialised training which may not be feasible in this context.

267 **Results**

268 **Summary of findings from Phase 1 (Interviews)**

269 *Interview participant characteristics*

270 Fifteen pharmacists (7 females) took part in qualitative interviews between August and November
271 2016. Participants had been registered with the PSNI for an average of 14.1 years (range 1-31 years).
272 A small minority of pharmacists (n=3) had additional pharmacy qualifications (e.g. Clinical Diploma).
273 Pharmacists from rural (n=7) and urban (n=8) areas were recruited including those working in
274 independently-owned pharmacies (n=7), small/medium chains with 2-9 stores (n=3) and large chains
275 with 10+ stores (n=5). Pharmacist roles included proprietors (n=3), managers (n=8) and non-managers
276 (e.g. support pharmacist) (n=4). Six pharmacists had received training on MAS and only two had
277 participated in previous research/service evaluations on MAS in the five years prior. Interviews lasted
278 between 30 to 72 minutes (average 46 minutes). Data saturation was reached by the fifteenth
279 interview as no new themes were emerging.

280 *Identification of determinants of MAS from interviews (Stage 1a results)*

281 Pharmacists reported a wide range of barriers and facilitators that influenced the provision of MAS.
282 The barriers and facilitators identified within each TDF domain are summarised in Table 1 together
283 with illustrative quotes.

284 **Table 1:** Determinants (barriers, facilitators) of community pharmacists' provision of MAS identified within each TDF domain and illustrative quotes (Phase 1: interviews)

Domain	Determinants (barriers, facilitator) of community pharmacists' provision of MAS	Illustrative quotes
Knowledge	<ul style="list-style-type: none"> • Knowledge (<i>facilitator</i>) or lack of knowledge (<i>barrier</i>) of medications/products/medical conditions • Knowledge of importance of adherence and consequences of non-adherence (<i>facilitator</i>) • Knowledge of patients (e.g. social background, medical history) (<i>facilitator</i>) • Knowledge (<i>facilitator</i>) or lack of knowledge (<i>barrier</i>) of adherence problems and solutions 	<p>"So there's the pharmaceutical knowledge and then I think just the community knowledge and background knowledge of knowing the patients and knowing their family set-up and, em, knowing their level of education..." (CP13)</p> <p>"I think we're, we're fairly aware of the... issues that are out there in terms of adherence." (CP03)</p> <p>"...And giving them (community pharmacists), sort of, even ideas that, that they could use within the pharmacy to help, help with the patients. And not just the simple Mediboxes... which are so time-consuming." (CP07)</p> <p>"...you're not going to give someone medication adherence sup- advice if you don't really know- if, you know, that you don't have obviously that, like, em, knowledge." (CP05)</p>
Skills	<ul style="list-style-type: none"> • Communication skills (e.g. listening, questioning) (<i>facilitator</i>) • Skills (<i>facilitator</i>) or lack of skills (<i>barrier</i>) required to motivate/persuade older patients to adhere • Interpersonal skills (e.g. relationship-building) (<i>facilitator</i>) • Time management and problem solving skills (delegation, organisational skills) (<i>facilitator</i>) • Computer/technology skills (<i>facilitator</i>) • Lack of consultation skills (e.g. reviews, follow-ups) (<i>barrier</i>) 	<p>"...communication skills is one of the most important ones to be able to converse with the patient. Em, and, eh, ask, sorry questions, so questioning skills, listening skills, everything within communication." (CP13)</p> <p>"...any type of training where you're, sort of, giving people ideas of how, how to approach people and just what way to speak with them, it's- I think it would be good." (CP07)</p> <p>"There's a skill that would be needed, is how to actually instigate a review, how to, you know, get something happening, but then to actually come back and review it..." (CP09)</p> <p>Aw we try... are my persuasion skills that good? Sometimes yes but it can-... you do in ways with different people, and it's back to the some of the people some of the time..." (CP11)</p>
Social, professional role and identity	<ul style="list-style-type: none"> • Important role to play in providing MAS including referral, liaison and social care roles (<i>facilitator</i>) • Not seen as major part of current role (<i>barrier</i>) • Unable to prescribe as part of current role (<i>barrier</i>) • Professional responsibility to support adherence (<i>facilitator</i>) • Isolated role/not integrated into primary care team (<i>barrier</i>) • Role unrecognised by others (e.g. patients, commissioners, GPs) (<i>barrier</i>) • Roles of pharmacy support staff [e.g. preparing Monitored dosage systems (MDS), identifying non-adherent patients] (<i>facilitator</i>) 	<p>"In terms of their adherence with medication you are the last person in that chain before the medicine arrives with the patient. Em, so you- I suppose you have ultimate responsibility for understanding why they're taking their medicines and how they should be taken." (CP15)</p> <p>"...if there was something that I thought it wasn't- it was beyond my responsibility I would still try and refer them to whoever... it was. Em, obviously like I can't change their tablets over to something else but I, I can refer them on to the GP who can..." (CP01)</p> <p>"...the only potential problem I see is one, perception... of the public that this is our role." (CP09)</p>

<p>Beliefs about capabilities</p>	<ul style="list-style-type: none"> Professional confidence (<i>facilitator</i>) Lack of confidence in certain circumstances (e.g. unfamiliarity with medical conditions/medications) (<i>barrier</i>) Lack of control over situations/difficult to change older patients' adherence behaviours (<i>barrier</i>) 	<p>"...when you say confident you, you, yeah you'd be confident to carry out the role..." (CP01)</p> <p>"...perhaps if it is some— you would even, medication itself, if you're not overly familiar with it, maybe could make you feel maybe a bit less confident about, em, dealing with any issues." (CP03)</p> <p>"I would like more training in, in engaging patients, you know, em, but I think a lot of it is down to confidence, you know, and em, but the MURs [Medicine Use Review Service] have definitely helped with that..." (CP15)</p> <p>"Trying to break their determination down (laughs) 'cause once they have an idea in their head, it's very difficult to get them to move." (CP04)</p>
<p>Beliefs about consequences</p>	<ul style="list-style-type: none"> Beliefs about potential positive outcomes (e.g. improved clinical outcomes, cost savings, fewer GP visits and hospital admissions) (<i>facilitator</i>) Beliefs about personal gain (e.g. job satisfaction, increased respect) (<i>facilitator</i>) Beliefs that providing MAS improves the profile of community pharmacy (<i>facilitator</i>) Beliefs about potential costs and impact on time (<i>barrier</i>) Concerns about potential adverse events (e.g. side effects) when adherence improves (<i>barrier</i>) 	<p>"I think there could be a financial benefit but also I think just a health benefit for people, em, and just ensuring that they're getting the best out of their medication." (CP02)</p> <p>"...just personal gain in, like, eh, more— increased respect and maybe, like, that would come probably with more opportunities..." (CP05)</p> <p>"...You'd definitely— if you get a positive outcome it makes you feel good about your job." (CP10)</p> <p>"'cause once someone is non-adherent and then becomes adherent, potential is there that they could actually get really unwell. Because they're not taking them as directed as before, then suddenly they're taking them and... somethings too strong..." (CP12)</p>
<p>Motivation and goals</p>	<ul style="list-style-type: none"> High intrinsic motivation (i.e. high personal priority) (<i>facilitator</i>) Motivated by potential benefits to patients (e.g. improved clinical outcomes) (<i>facilitator</i>) Lower priority than other pharmacy activities (e.g. dispensing, other paid services) (<i>barrier</i>) Conflicting priorities (professional responsibility verses commercial priorities) (<i>barrier</i>) Proprietors/owners largely motivated by financial rewards (<i>barrier</i>) Employees less motivated by financial rewards (<i>facilitator</i>) Prioritising high risk patients/medications (e.g. those with limited social support, patients taking warfarin) (<i>facilitator</i>)/(<i>barrier</i>) 	<p>"Very high priority yeah, very important, very important." (CP08)</p> <p>"Em, no I think it comes down to more than money. I think it's a service we have to provide, whether we get paid for it or not..." (CP04)</p> <p>"I wouldn't say it's a priority at the minute... the priority would be patients who you look at and you see them going downhill or they're not coping with their medication..." (CP02)</p> <p>"...we've a delicate balance between the commercial realities of having to keep customers happy and telling people this is what's good for you, you have to do it, you don't want to alienate people." (CP06)</p> <p>"...the contractors, you would probably want some sort of a remuneration for it." (CP14)</p> <p>"...directly I'm not a contractor so I don't get paid per MUR [Medicine Use Review]... I get paid to go in and do a day's work, what that— a day's work entails... it doesn't really make a difference to me. (CP15)</p>

<p>Memory, attention and decision processes</p>	<ul style="list-style-type: none"> • Difficult to remember (<i>barrier</i>) • Decisions tailored to individual patients (<i>facilitator</i>) • Involvement of patients, carers and other HCPs in decisions (<i>facilitator</i>) • Lack of structured approach to aid decisions (<i>barrier</i>) 	<p>“...without a formal assessment tool at the minute, em, it’s done very much on an individual basis...” (CP06)</p> <p>“Well the patient’s response to the questions or to the proposed interventions, em... so whether they would– whether a change would make any difference. Em, whether the GP buys into the change as well or the prescriber...” (CP15)</p> <p>“I think, you need some system that will highlight it, otherwise you see so many people, so many things that yeah some you might remember but no you wouldn’t consistently remember.” (CP02)</p>
<p>Environmental context and resources</p>	<ul style="list-style-type: none"> • Time constraints due to heavy workload (<i>barrier</i>) • Currently funded services (MUR, MYM) (<i>facilitator</i>) • No service focusing specifically on adherence (<i>barrier</i>) • Accessibility of community pharmacy (<i>facilitator</i>) • Presence of multiple pharmacists (<i>facilitator</i>) • Inadequate pharmacist staff levels (<i>barrier</i>) • Adequate pharmacy support staff (levels, competency) (<i>facilitator</i>) • Technology (PMR, internet access, websites such as patient.co.uk) (<i>facilitator</i>) • Physical resources (e.g. reminder charts) (<i>facilitator</i>) • Inadequate space (<i>barrier</i>) • Lack of integration in primary healthcare team (<i>barrier</i>) • Lack of access to full medication history (ECR) (<i>barrier</i>) 	<p>“But pharmacies like to say time is a problem—we don’t have time to do anything. (Laughs) No I think time is the only one but you would just fit it in– just one of those things.” (CP04)</p> <p>“...the only thing that puts me off is time, you know, pharmacy’s got busier and busier...” (CP15)</p> <p>“...well I suppose just MURs [Medicine Use Review Service] and medicines management [Managing Your Medicines Service] would help, you know, would help identify the problems.” (CP01)</p> <p>“So if I’m not integrated within a team, then there’s, there’s only so much I can actually do...” (CP09)</p> <p>“So I think, em, even having access to maybe the ECR [Electronic Care Record] or something like that where we could see exactly what sort of prescriptions have been... processed and, and that kind of thing would help to sort of establish if there was any issues.” (CP03)</p>
<p>Social influences</p>	<ul style="list-style-type: none"> • Positive influences from patients, relatives, pharmacy support staff and other HCPS (e.g. GP, nurse, formal carers) (<i>facilitator</i>) • Resistance from patients (<i>barrier</i>) • Resistance/lack of support from GPs and surgery staff (<i>barrier</i>) • Pressure from others to provide solutions (e.g. pressure from formal carers, hospital staff to provide MDS) (<i>barrier</i>) • Others make decisions about solutions (<i>barrier/facilitator</i>) • Influence from colleagues in senior positions to focus on business priorities (e.g. proprietor, management) (<i>barrier</i>) 	<p>“All of our patients have either been referred by doctors, by carers, by relatives.” (CP11)</p> <p>“Some patients, no matter what you say to them or how much you try and you try to talk to them about something, just don’t want to know.” (CP01)</p> <p>“...for whatever reason the powers that be, be it the family, the doctors, the carers– ‘cause the carers completely refuse to deal with medication if it’s not in a blister pack [Monitored Dosage System]” (CP04)</p> <p>“Sometimes you can, you can, reach a bit of a, not loggerheads but you’re kind of having problems with maybe getting onto a surgery, trying to get stuff sorted and you’re getting resistance there.” (CP12)</p> <p>“...obviously, like, you’re working for a company– would be, like, patients but your other, like, staff obviously, like, my, like, manager would have like a huge say in that and, em, like, what... we need to focus on, like in any kind of business...” (CP05)</p>

Emotion	<ul style="list-style-type: none"> • Positive affect (i.e. encouraged)(<i>facilitator</i>) • Worried about providing incorrect advice (<i>barrier</i>) • Stress due to time constraints (<i>barrier</i>) 	<p><i>"You feel like you're helping somebody so you feel like you're, you're doing good so yeah it does make you feel good, if it, if it works out."</i> (CP01)</p> <p><i>"It makes you feel good, that you're actually doing something of benefit... and that they're getting the best... that they can get."</i> (CP04)</p> <p><i>"I suppose a bit of a fear thing isn't it like? Where, you're afraid of saying the wrong thing..."</i> (CP12)</p>
Behavioural regulation	<ul style="list-style-type: none"> • Reactive behaviour (i.e. not proactive in identifying and supporting patients) (<i>barrier</i>) • Lack of formalised procedures (i.e. no standard operating procedures or framework currently in use) (<i>barrier</i>) • Record-keeping (e.g. on PMR) (<i>facilitator</i>) • Positive feedback from patients (<i>facilitator</i>) • Reminder systems as moderators of intention-behaviour gap (e.g. diary, notes on PMR) (<i>facilitator</i>) • Monitoring patients' adherence behaviour (e.g. frequency of dispensing using PMR) 	<p><i>"Speaking to the patient would probably be one of the main ones, seeing are they happier, you know. Do they feel like things have improved?"</i> (CP01)</p> <p><i>"I suppose with their PMRs [Patient Medication Records] we've an opportunity to highlight sort of things on it... and throw up messages that maybe, you know, you can check back with them the next time..."</i> (CP02)</p> <p><i>"...you'd like to assume that people's following the directions and taking their medication as is, until that problem is identified. So maybe, potentially it might be something more proactive that we could do."</i> (CP12)</p>
Nature of the behaviours	<ul style="list-style-type: none"> • Direct experience through provision of funded services (e.g. MUR, MYM services) (<i>facilitator</i>) • Identification of non-adherent patients is not routine (<i>barrier</i>) • Most routine activity is the supply of MDS (<i>barrier</i>) 	<p><i>"Em... there's nothing that I'd routinely do I suppose it would be coming from, like, the patient themselves."</i> (CP05)</p> <p><i>"I think the current trend would be medidose boxes [Monitored Dosage System]... you know, if somebody's having difficulty taking their tablets, put it in a medidose box but I've seen people do strange things with medidose boxes once they get them (Laughs)."</i> (CP15)</p> <p><i>"... we're kind of already doing it with our smoking cessation and our MURs [Medicine Use Review service], you know, Medicines Management [Managing Your Medicines Service], things like that."</i> (CP12)</p>

285 Summary of findings from Phase 2 (Cross-sectional survey)

286 *Survey participant characteristics*

287 In total, 143 questionnaires were returned giving a response rate of 27.4%. Eighty-two respondents
288 were female (57.3%), which was marginally under-representative as 68.1% of pharmacists on the PSNI
289 register were female. Respondents had been practising an average of 15.3 (SD: ± 11.2) years and 63.7%
290 survey respondents were aged 44 years or under, compared with 68.1% of all pharmacists on the PSNI
291 register who were aged 40 years or under. Fifty-nine respondents (41.3%) worked for a large chain
292 (10+ stores), 40 respondents (28.0%) worked for a small/medium chain (2-9 stores) and 41
293 respondents (28.7%) worked at an independently-owned pharmacy. Pharmacists also reported
294 working across a range of locations including rural (30.1%), suburban (22.4%) and urban (45.5%) areas.
295 Further demographic data including information on staffing characteristics, service provision and
296 training can be found in Supplementary file 4.

297 *Survey participants' experiences of providing medication adherence support*

298 In Section 2 of the survey, less than half of the respondents reported very frequent or frequent use of
299 pharmacy held-records (44.8%) or return of unused medications (41.3%) as methods for identifying
300 non-adherent older patients. Only a third of pharmacists (33.6%) reported very frequently or
301 frequently asking older patients about missed doses. Less than a third of pharmacists (30.1%) reported
302 very frequently or frequently exploring the underlying reasons for older patients' non-adherence.

303 Just over half of the respondents (55.3%) reported that they very frequently or frequently considered
304 options to improve adherence in discussion with older patients and just over a third (38.5%) reported
305 very frequently or frequently tailoring adherence support strategies to the underlying reasons for non-
306 adherence. Adherence solutions that were most frequently employed (i.e. more than 70% of
307 pharmacists reported very frequent or frequent provision) included: prescription collection services
308 (93.7%), supply of Monitored Dosage Systems (MDS) at the request of others (88.1%),
309 support/reassurance/encouragement (79.7%), prescription ordering services (76.2%) and deliveries
310 to patients' homes (70.6%). Adherence solutions that were employed least frequently (i.e. less than
311 30% of pharmacists reported very frequent or frequent provision) included: techniques to increase
312 motivation such as goal-setting or action plans (12.6%), requesting changes to medications/regimens
313 (21%), provision of alternative packaging (27.3%), recommendations to purchase adherence aids
314 (27.3%) and recommendation of self-monitoring strategies (e.g. diary, calendar) (29.4%) The full
315 results of Section 2 can be found in Supplementary file 5. Only a few additional adherence strategies
316 were reported by respondents including: synchronising medications so that they could all be ordered

317 at one time, home visits, colour coding time slots on MDS and asking patients to return MDS packaging
318 to check adherence before providing a new supply.

319 *Identification of determinants of MAS from the survey (Stage 1b results)*

320 The proportion of respondents that agreed or disagreed with each Likert item in Section 3 of the
321 questionnaire is displayed in Table 2. Six out of the 36 items analysed had high medians (of 4 or 5)
322 indicating disagreement with the statement and highlighting potential barriers to the behaviour.
323 These six items had been assigned *a priori* to four TDF domains: 'Skills', 'Environmental context and
324 resources', 'Memory, attention and decision processes' and 'Motivation and goals'. The Likert item,
325 'Others (e.g. GPs, carers) decide which adherence support strategies are required by older patients,
326 was excluded from the analysis as it could be either a barrier or a facilitator depending on the
327 appropriateness of the recommendations made by others. No additional barriers were identified in
328 the open-style question in Section 3.

Table 2: Community pharmacists' responses to Likert items within each TDF domain (Phase 2: survey) (items in bold denote identified barriers to providing MAS)

TDF domain	Likert-items assigned to each TDF domain	Strongly agree N (%) (score:1)	Agree N (%) (score:2)	Neither agree nor disagree N (%) (Score:3)	Disagree N (%) (Score:4)	Strongly disagree N (%) (score:5)	Missing responses N (%)	Median score for item (IQR) ^a	Potential target for behaviour change
Knowledge	I know how to provide MAS to older patients in line with NICE guidance	14 (9.8)	77 (53.8)	36 (25.2)	12 (8.4)	3 (2.1)	1 (0.7)	2.0 (2.0-3.0)	No (no items with high medians in this domain)
	I know the appropriate questions to ask older patients to determine underlying reasons for non-adherence	16 (11.2)	87 (60.8)	26 (18.2)	12 (8.4)	1 (0.7)	1 (0.7)	2.0 (2.0-3.0)	
	I have sufficient knowledge of the range of adherence strategies that are available to support older patients	14 (9.8)	67 (46.9)	32 (22.4)	27 (18.9)	2 (1.4)	1 (0.7)	2.0 (2.0-3.0)	
Skills	I have been trained to provide MAS to older patients in line with NICE guidance	11 (7.7)	33 (23.1)	45 (31.5)	44 (30.8)	9 (6.3)	1 (0.7)	3.0 (2.0-4.0)	Yes (domain contains an item with high median)
	I have the communication skills required to provide MAS to older patients	38 (26.6)	89 (62.2)	13 (9.1)	1 (0.7)	0 (0)	2 (1.4)	2.0 (1.0-2.0)	
	I do not require additional training on techniques that can be used to increase older patients' motivation to adherence^b	3 (2.1)	12 (8.5)	31 (21.7)	71 (49.7)	24 (16.8)	2 (1.4)	4.0 (3.0-4.0)¹	
Social, professional role and identity	Providing MAS to older patients is part of my current role as a community pharmacist	34 (23.8)	86 (60.1)	17 (11.9)	2 (1.4)	2 (1.4)	2 (1.4)	2.0 (2.0-2.0)	No (no items with high medians in this domain)
	It is my responsibility to provide MAS to older patients	22 (15.4)	83 (58.0)	29 (20.3)	7 (4.9)	1 (0.7)	1 (0.7)	2.0 (2.0-3.0)	
	Older patients consider the provision of MAS to be part of my role as a community pharmacist	10 (7.0)	52 (36.4)	56 (39.2)	22 (15.4)	1 (0.7)	2 (1.4)	3.0 (2.0-3.0)	
Beliefs about capabilities	I find it easy to discuss medication adherence with older patients ^b	15 (10.5)	88 (61.5)	27 (18.9)	9 (6.3)	3 (2.1)	1 (0.7)	2.0 (2.0-3.0)	No (no items with high medians in this domain)
	I am confident that I can address any medication adherence problems that I encounter with older patients	20 (14.0)	96 (67.1)	20 (14.0)	6 (4.2)	0 (0)	1 (0.7)	2.0 (2.0-2.0)	
	I am confident that I can provide MAS to older patients even when they are not motivated	13 (9.1)	82 (57.3)	28 (19.6)	19 (13.3)	0 (0)	1 (0.7)	2.0 (2.0-3.0)	
	I am confident that I can provide MAS to older patients even when I am unfamiliar with their medical conditions	10 (7.0)	58 (40.6)	37 (25.9)	34 (23.8)	3 (2.1)	1 (0.7)	3.0 (2.0-4.0)	

Beliefs about consequences	Providing MAS to older patients improves the profile of community pharmacy	53 (37.1)	75 (52.4)	11 (7.7)	1 (0.7)	1 (0.7)	2 (1.4)	2.0 (1.0-2.0)	No (no items with high medians in this domain)
	Providing MAS to older patients leads to health benefits for patients and cost-savings for the NHS	65 (45.5)	67 (46.9)	6 (4.2)	0 (0)	1 (0.7)	4 (2.8)	2.0 (1.0-2.0)	
	Providing MAS to older patients gives me job satisfaction	51 (35.7)	80 (55.9)	10 (7.0)	1 (0.7)	0 (0)	1 (0.7)	2.0 (1.0-2.0)	
Motivation and goals	Seeing the benefits of providing MAS to older patients helps me to overcome barriers such as lack of time and reimbursement	16 (11.2)	46 (32.2)	53 (37.1)	20 (14.0)	7 (4.9)	1 (0.7)	3.0 (2-3.0)	Yes (domain contains an item with a high median)
	Providing MAS to older patients is a high priority for me in my daily practice ^b	13 (9.1)	66 (46.2)	43 (30.1)	18 (12.6)	2 (1.4)	1 (0.7)	2.0 (2.0-3.0)	
	I want to support more older patients with medication adherence in the future	41 (28.7)	90 (62.9)	8 (1.4)	2 (1.4)	1 (0.7)	1 (0.7)	2.0 (1.0-2.0)	
	It is important to always offer MAS to older patients	39 (27.3)	85 (59.4)	17 (11.9)	1 (0.7)	0 (0)	1 (0.7)	2.0 (1.0-2.0)	
	I receive sufficient reimbursement for providing MAS to older patients	2 (1.4)	6 (4.2)	25 (17.5)	53 (37.1)	56 (39.2)	1 (0.7)	4.0¹ (4.0-5.0)	
Memory, attention and decision processes	Providing MAS is easy for me to remember	4 (2.8)	35 (24.5)	72 (50.3)	29 (20.3)	2 (1.4)	1 (0.7)	3.0 (2.0-3.0)	Yes (domain contains an item with high median)
	Deciding on the best adherence support strategy for older patients is easy^b	2 (1.4)	11 (7.7)	30 (21.0)	92 (64.3)	6 (4.2)	2 (1.4)	4.0¹ (3.0-4.0)	
Environmental context and resources	I have sufficient pharmacist staff levels to allow me to provide MAS to older patients	10 (7.0)	35 (24.5)	18 (12.6)	53 (37.1)	26 (18.2)	1 (0.7)	4.0¹ (2.0-4.0)	Yes (domain contains items with high medians)
	I have sufficient non-pharmacist staff levels to allow me to provide MAS to older patients	8 (5.6)	47 (32.9)	26 (18.2)	40 (28.0)	21 (14.7)	1 (0.7)	3.0 (2.0-4.0)	
	I have sufficient space in the pharmacy to allow me to provide MAS to older patients	29 (20.3)	57 (39.9)	22 (15.4)	20 (14.0)	14 (9.8)	1 (0.7)	2.0 (2.0-3.0)	
	I have enough time to provide MAS to older patients^b	5 (3.5)	15 (10.5)	36 (25.2)	59 (41.3)	26 (18.2)	2 (1.4)	4.0¹ (3.0-4.0)	
	Lack of access to patients medical notes is <u>not</u> a barrier to providing MAS^b	2 (1.4)	11 (7.7)	20 (14.0)	62 (43.4)	47 (32.9)	1 (0.7)	4.0¹ (4.0-5.0)	

Social influences	Colleagues in senior positions support me in providing adherence support to older patients	5 (3.5)	31 (21.7)	47 (32.9)	44 (30.8)	14 (9.8)	1 (0.7)	3.0 (2.0-4.0)	No (no items with high medians in this domain)
	I <u>do not</u> face resistance from <u>GPs</u> when trying to provide MAS ^b	9 (6.3)	54 (37.8)	33 (23.1)	35 (24.5)	11 (7.7)	1 (0.7)	3.0 (2.0-3.0)	
	I <u>do not</u> face resistance from <u>patients</u> when trying to provide MAS ^b	8 (5.6)	60 (42.0)	43 (30.1)	31 (21.7)	0 (0)	1 (0.7)	3.0 (2.0-3.0)	
	Others (e.g. GPs, carers) decide which adherence support strategies are required by older patients ^c	19 (13.3)	63 (44.1)	38 (26.6)	19 (13.3)	2 (1.4)	2 (1.4)	2.0 (2.0-3.0) ²	
Emotion	I <u>do not</u> worry about giving the wrong advice to older patients when providing MAS ^b	14 (9.8)	65 (45.5)	39 (27.3)	23 (16.1)	1 (0.7)	1 (0.7)	2.0 (2.0-3.0)	No (no items with high medians in this domain)
	I am comfortable talking to older patients about medication adherence ^b	32 (22.4)	88 (61.5)	18 (12.6)	3 (2.1)	1 (0.7)	1 (0.7)	2.0 (2.0-2.0)	
Behavioural regulation	I try to be proactive by planning how I can identify and support older patients with medication adherence	7 (4.9)	48 (33.6)	42 (29.4)	40 (28.0)	5 (3.5)	1 (0.7)	2.0 (2.0-4.0)	No (no items with high medians in this domain)
	I monitor and record the type of MAS that I provide to older patients	6 (4.2)	43 (30.1)	34 (23.8)	52 (36.4)	6 (4.2)	2 (1.4)	3.0 (2.0-4.0)	
	Receiving negative feedback from a patient regarding adherence support advice would <u>not</u> prevent me from offering this advice to others ^b	15 (10.5)	82 (57.3)	25 (17.5)	18 (12.6)	1 (0.7)	2 (1.4)	2.0 (2.0-3.0)	

Key: IQR= Interquartile range; MAS= Medication adherence support; MDS= Monitored dosage system; NICE= National Institute for Health and Care Excellence; N= Number of survey respondents; TDF= Theoretical Domains Framework ^aA high median of 4 or 5 signified a potential barrier to the provision of MAS; ^bItem reverse worded in questionnaire and rephrased/recoded for data analysis purposes so that all items could be analysed in the context of barriers; ^c This item could be either a barrier or facilitator depending on the appropriateness of the solutions recommended by others. For this reason this item was excluded from the analysis.

329 *Triangulation of findings and identification of key TDF domains (stage 2 results)*

330 Following comparison of the summary of findings from Phases 1 and 2, and discussion among
331 members of the research team, eight out of 12 domains were identified as important in the context
332 of the target behaviour: 'Knowledge', 'Skills', 'Social, professional role and identity', 'Motivation and
333 goals', 'Memory, attention and decision processes', 'Environmental context and resources', 'Social
334 influences' and 'Behavioural regulation'. Six of these domains were selected because they were
335 frequently coded in the qualitative analysis (listed in order of frequency): 'Environmental context and
336 resources', 'Motivation and goals', 'Social, professional role and identity', 'Social influences' 'Skills' and
337 'Knowledge'. All but two of these domains ('Knowledge', 'Social, professional role and identity') also
338 had had potential barriers identified in the quantitative analysis (Phase 2). In Phase 2, the 'Memory,
339 attention and decision processes' and 'Behavioural regulation' domains also revealed potential
340 barriers to the target behaviour and so were also selected as important to target for change.

341 Four domains were not frequently coded in the qualitative analysis and no potential barriers were
342 identified in the quantitative analysis (Phase 2). These domains were therefore not seen as important
343 in the context of the target behaviour: 'Beliefs about capabilities', 'Beliefs about consequences',
344 'Emotion', 'Nature of the behaviours'.

345 Out of the eight domains deemed important in the context of the target behaviour, seven of these
346 were considered to be key domains to target for behaviour change. The domain 'Social, professional
347 role and identity' was not selected for targeting as changing the role of community pharmacists was
348 deemed to be beyond the scope of this research.

349 *Mapping of key TDF domains to BCTs (Stage 3 results)*

350 The seven key domains identified in Stage 2 were mapped across to 39 BCTs which were considered
351 for inclusion in a training package or as implementation strategies in future research studies.^{12,13} Based
352 on group consensus-based discussion 18 BCTs were identified as suitable for inclusion— these are
353 presented in Table 3. Further detail regarding the reasons for selection (or non-selection) of BCTs are
354 provided in Supplementary File 6.

355

Table 3: Final selection of BCTs to deliver to community pharmacists as part of a training package (or as implementation strategies) to enhance the provision of MAS

Key TDF domain	Behaviour change technique (BCT) ^a mapped to the key TDF domain
Knowledge	<ul style="list-style-type: none"> • Information on health consequences/behaviour • Antecedents • Feedback on behaviour
Skills	<ul style="list-style-type: none"> • Graded tasks • Behavioural rehearsal/practice • Self-monitoring • Feedback on behaviour • Rewards; incentives • Increasing skills (e.g. decision making, problem solving) • Modelling or demonstrating the behaviour • Homework
Motivation and goals	<ul style="list-style-type: none"> • Behavioural contract • Action planning • Rewards; incentives • Graded tasks • Increasing skills (e.g. decision making, problem solving) • Social support (unspecified) • Persuasive communication/credible source Information on health consequences/behaviour
Memory, attention and decision processes	<ul style="list-style-type: none"> • Self-monitoring • Action planning • Prompts/cues
Environmental context and resources	<ul style="list-style-type: none"> • Restructuring the social environment (i.e. pharmacy staff) • Prompts/cues
Social influences	<ul style="list-style-type: none"> • Social support (unspecified) • Restructuring the social environment (i.e. pharmacy staff) • Modelling or demonstrating the behaviour • Social reward/incentive
Behavioural regulation	<ul style="list-style-type: none"> • Behavioural contract • Action planning • Prompts/cues • Use of imagery
<p>^aSome BCTs in the two reference sources (Michie et al.¹²; Cane et al.¹³) have overlapping characteristics and similar names. The research team opted for the most up-to-date terminology, as reported by Cane et al.¹³, as these are consistent with the BCTTv1.⁴⁴</p>	

Table 4: Proposed delivery of BCTs as part of a training package and/or as implementation strategies to enhance MAS provision

Behaviour change technique (BCT)	How might the BCT be delivered to pharmacists to improve the provision of MAS?		
	Training package	Implementation strategy	Example of how the BCT could be operationalised
Information on health consequences/behaviour	✓		Information about the behaviour and potential positive outcomes for patients could be presented.
Antecedents	✓		Pharmacists could be provided information about the factors that can positively or negatively affect the performance of the behaviour such as time, skills training etc.
Feedback on behaviour	✓	✓	Pharmacists could be given verbal feedback on their performance during practice sessions in a training workshop or following the provision of MAS in the community pharmacy.
Graded tasks	✓		Pharmacists could be set tasks to perform as part of training, ranging in complexity from easy to difficult.
Behavioural rehearsal/practice	✓		Pharmacists could practice performing the behaviour with patient actors as part of a training workshop using role play scenarios.
Self-monitoring		✓	Pharmacists could record the number of patients they provided MAS to in a daily pharmacy tasks diary.
Rewards; incentives		✓	Small monetary rewards could be provided to encourage CPs to perform the target behaviour.
Increasing skills (e.g. decision making, problem solving)	✓	✓	Pharmacists could be trained on how to decide on the best adherence solutions for older patients during a training workshop. This could also be facilitated by a decision-making tool (e.g. web-application) that maps adherence problems across to potential adherence solutions.
Modelling or demonstrating the behaviour	✓		A training package could include video demonstrations of the target behaviour.
Homework	✓		Pharmacists could be given reading material on the target behaviour to review at home in advance of, or following, a training workshop.
Behavioural contract	✓		Pharmacists could be asked to sign a written contract, agreeing to carry out the target behaviour in their own clinical practice as instructed in a training workshop.
Action planning	✓		As part of a training workshop, pharmacists could be instructed to develop advance plans for how they will identify and provide MAS to older patients in their own clinical practice.
Social support (unspecified)	✓	✓	Group support could also be encouraged as part of a training workshop and following this using online platforms.
Persuasive communication/credible source	✓		An expert or leader in the field could present arguments in favour of performing the behaviour to pharmacists at a training workshop.
Prompts/cues		✓	Prompts could be included as part of an electronic adherence support decision-making tool. In addition, pharmacy support staff could help prompt CPs to provide MAS to older people.

Restructuring the social environment		✓	Pharmacists could be advised to restructure their social working environment by involving pharmacy support staff in the process of identifying potentially non-adherent older patients.
Social reward	✓	✓	Pharmacists could be given verbal rewards if there has been sufficient effort/progress in performing the behaviour during practice sessions or in their own clinical practice.
Use of imagery	✓		Visuals (e.g. videos) could be used to deliver other selected BCTs (e.g. demonstration of the behaviour).

356

357 **Discussion**

358 This mixed methods study used the TDF as a ‘theoretical lens’ to identify key determinants influencing
359 the provision of MAS by pharmacists to older adults prescribed polypharmacy. Following identification
360 of key TDF domains to target for behaviour change using triangulated qualitative and quantitative
361 data, seven domains were mapped across to BCTs using established methods and 18 BCTs were
362 identified as suitable for changing pharmacists’ behaviour.^{12,13} This study also explored what
363 community pharmacists in Northern Ireland were doing in their daily practice to support older patients
364 with medication adherence. The finding that only a third of surveyed pharmacists reported frequently
365 asking older patients if they had missed doses of medications reflects findings from an EU-wide survey
366 of 3,196 HCPs, including pharmacists, doctors and nurses, that found only half of HCPs regularly asked
367 patients about missed doses.²⁹ In comparison with doctors, pharmacists in the EU survey were five
368 times less likely to ask patients about missed doses (OR: 0.2; 95% CI: 0.17-0.27). This represents a
369 missed opportunity in the community pharmacy setting to identify non-adherent patients and a key
370 area for improvement.

371 Despite recent emphasis on the importance of tailored approaches to address medication non-
372 adherence⁴⁵, only 38.5% of pharmacists in Phase 2 of this study reported frequently tailoring
373 adherence solutions to the underlying reasons for non-adherence. One of the most frequently offered
374 adherence solutions was the provision of MDS which reflects findings reported by Mansoor et al.⁶
375 (2014), whereby 95% of Australian community pharmacists reported that MDS was the most common
376 adherence strategy. Although MDS are commonly used, systematic reviews that have explored their
377 effectiveness have reported mixed findings.⁴⁶⁻⁴⁸ Furthermore, the UK Royal Pharmaceutical Society
378 has noted that this solution is commonly selected without giving full consideration to the range of
379 adherence solutions available.⁴⁹

380 This study has highlighted multiple determinants potentially influencing pharmacists’ provision of
381 MAS to older adults in their practice. The barriers of inadequate time, pharmacist staff levels (domain:
382 ‘Environmental context and resources’) and reimbursement (domain: ‘Motivation and goals’) reflect
383 findings from similar research conducted in Australia.⁶ In Phase 1 (qualitative), a lack of time was the
384 most frequently mentioned barrier whereas in Phase 2 (quantitative) a lack of reimbursement
385 appeared to be the greatest potential barrier with 76.3% of respondents indicating they did not
386 receive sufficient reimbursement (compared with 59.5% of respondents who indicated they did not
387 have enough time). A qualitative study conducted in Scotland⁴ has also reported that a lack of time
388 was not seen as the greatest barrier to implementing an adherence intervention, which was in
389 contrast with previously conducted research.⁵⁰ The use of a comprehensive theoretical model of
390 behaviour change in this study has helped go beyond identifying the barriers commonly cited in the

391 literature (e.g. time, reimbursement). This theory-based approach has facilitated an exploration of
392 other important areas to target for behaviour change such as pharmacists' skills and approaches to
393 decision-making. For example, although pharmacists were mainly confident in providing MAS, two-
394 thirds of survey respondents indicated that they required additional training on techniques that can
395 be used to increase older patients' motivation to adhere (domain: 'Skills'). Over two-thirds of survey
396 respondents also reported that they found it difficult to decide on the best adherence solutions to
397 offer older patients. The 2003 WHO report recognised this difficulty and highlighted that clinical
398 decision-making processes needs to be covered as part of training alongside the development of
399 behavioural tools for HCPs.¹

400 Eight theoretical domains in TDF1 were identified as important in the context of the target behaviour.
401 Although the domain 'Environmental context and resources' was identified as a key target domain, it
402 should be noted that some of the barriers identified under this domain (including a lack of access to
403 medical records and inadequate pharmacist staffing levels) would be beyond the scope of future
404 research studies to target directly. However, the BCTs 'Restructuring the social environment' and
405 'Prompts and cues' were selected as the involvement of support staff in the process of identifying
406 non-adherent patients and prompting pharmacists to intervene could improve the provision of MAS.
407 Four domains ('Beliefs about capabilities', 'Beliefs about consequences', 'Emotion', 'Nature of the
408 behaviours') were not selected as important as they were not frequently coded in
409 Phase 1 and Phase 2 did not highlight potential barriers/facilitators to the target behaviour within
410 these domains. In relation to pharmacists' 'Beliefs about capabilities', the qualitative findings suggest
411 that this stems from their level of skills training and so focusing on the latter appears to be of greater
412 importance. The quantitative component of this study confirmed that the majority of pharmacists
413 were confident in providing adherence support but lacked the skills required to motivate patients to
414 change their behaviour. In relation to pharmacists' 'Beliefs about the consequences', these were
415 discussed less frequently than other domains in Phase 1 and pharmacists reported having awareness
416 of the positive consequences of providing MAS. In addition, no barriers were identified under this
417 domain in Phase 2. Emotions were rarely discussed in the context of the target behaviour in Phase 1
418 and no barriers were identified under the 'Emotion' domain in Phase 2 which confirmed this finding.
419 The overall behaviour was not seen as automatic and instead requires planning and consideration and
420 consequently, the 'Nature of the behaviours' domain was not deemed important in this context.
421 Although the domain 'Social, professional role and identity' was identified as important in this context,
422 it was not selected as a key target domain for behaviour change. Pharmacists largely considered the
423 target behaviour to be part of their role, although they recognised that an inability to prescribe and
424 lack of integration in the primary healthcare team were potential barriers to the provision of MAS.

425 Changing the role of pharmacists in the primary care setting would require major policy and
426 organisational changes which was deemed to be beyond the scope of future research studies.

427 The study has highlighted the usefulness of a mixed methods approach in selecting domains that are
428 important to target for behaviour change. The majority of studies that have previously employed the
429 TDF to select target domains have relied on qualitative data from interviews and used frequency
430 counts as a crude measure of a domain's importance.⁵¹ This study takes this a step further by providing
431 quantitative data to support the qualitative findings and also identify domains which are likely to be
432 important but are infrequently coded in qualitative research (e.g. 'Behavioural regulation' in the
433 current study).

434 This study has identified 18 BCTs that can be delivered to pharmacists as part of a training package or
435 as implementation strategies to enhance the provision of MAS in community pharmacies. These BCTs
436 will be tested in the next phase of the project which involves the pilot testing of theory-based patient-
437 targeted adherence intervention that will be delivered in the community pharmacy setting. To the
438 best of our knowledge, this is the first mixed-methods study to detail the steps undertaken in
439 identifying key TDF domains to target and selection of BCTs which will form the active ingredients of
440 future behaviour change intervention for community pharmacists. As noted in guidance published by
441 Atkins et al.⁵¹ on the use of TDF, TDF methodology is evolving to include quantitative approaches and
442 the current study contributes to the growing literature on the use of mixed methods TDF-based
443 approaches.

27

444 **Strengths and limitations**

445 To the authors' best knowledge, this is the first study to make use of the TDF as a theoretical lens to
446 explore the provision of MAS by community pharmacists to older adults prescribed polypharmacy. A
447 key strength of this study was the triangulation of data from both qualitative and quantitative
448 approaches which helps to increase the generalisability of findings. The study followed guidance from
449 the MRC which recommends incorporating a theoretical base when developing interventions designed
450 to change behaviours, including training packages for HCPs.⁵² The qualitative methods employed in
451 this study reflect the methods advocated in recently published guidance on how to use the TDF.⁵¹

452 As a limitation of this study, the low response rate (27.4%) achieved for the survey (Phase 2) should
453 be noted. This response rate was comparable to the response rate (27.6%) obtained in a survey on
454 MAS that was mailed to 500 community pharmacists in New South Wales, Australia.⁶ Similarities in
455 terms of gender, age groups and post-graduate qualifications were observed between the sample of
456 survey respondents and all pharmacists who were registered with the PSNI at the time of the study.
457 However, it is important to note that there was a slight underrepresentation of females and potential

458 over-representation of those in managerial roles. The potential for social desirability bias must also be
459 noted, as pharmacists were made aware of the latest guidance on supporting patients with medication
460 adherence that had been published by NICE.² By using an anonymous self-administered questionnaire
461 which included both positive and negatively phrased items it is hoped that the level of social
462 desirability bias in the survey was minimal.

463 Conclusions

464 This study involved a mixed methods approach to explore community pharmacists' clinical behaviour,
465 in terms of providing MAS to older adults prescribed polypharmacy. A range of barriers and facilitators
466 were perceived to influence the target behaviour including insufficient reimbursement, lack of
467 relevant skills, and social support from other HCPs. Triangulation of qualitative and quantitative
468 findings facilitated the selection of seven key theoretical domains that could be targeted for behaviour
469 change. Established methods were employed to map key TDF domains to BCTs, and using group
470 consensus methods, 18 BCTs were identified as applicable to the target audience and behaviour. As
471 part of future research these BCTs will be delivered as part of a pilot study of a patient-targeted
472 intervention which will include a training package for community pharmacists.

473 Declarations of interest

474 None.

475 Authors' contributions

476 XXXX: Conceptualisation; Investigation; Project administration; Formal analysis; Funding acquisition;
477 Writing - original draft.

478 XXXX: Conceptualisation; Supervision; Formal analysis; Funding acquisition; Writing - review &
479 editing.

480 XXXX: Conceptualisation; Supervision; Formal analysis; Funding acquisition; Writing - review &
481 editing.

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488

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