Adherence to Anti-Hypertensive Medication: Proposing and Testing a Conceptual Model

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Key words: adherence, anti-hypertensive medication, conceptual model

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Abstract

Objectives A conceptual model of the psychological factors underpinning adherence to anti-hypertensive medication is proposed and tested. The model suggests that adherence is influenced by three sets of variables: demography, health status and perceived effects of medication; cognitions and motivation; and intention to adhere.

Methods and Design Patients with known hypertension were recruited from three primary care practices in South-East England and were asked to complete a postal questionnaire. A total of 1070 responses were received. The questionnaire asked about the three sets of predictor variables, and adherence. Eight weeks after the first questionnaire, a second was posted to all respondents, this time asking about adherence over the intervening period.

Results The three sets of predictor variables were treated as blocks in a hierarchical model, so that each successive block added to the variance in adherence explained by the previous blocks. The data were analysed by hierarchical multiple regression. The predictors accounted for 19% of the variance in adherence at Time 1, and 34% at Time 2. The leading individual predictors at Time 1 were age, gender, conscientiousness, hypertensive identity, perceived behavioural control, and intention. At Time 2, they were the same, except that gender made way for adherence at Time 1.

Conclusions The model offers a parsimonious account, and the findings suggest a number of approaches to designing interventions to modify behaviour.

Adherence to Anti-Hypertensive Medication: A Conceptual Model

Adherence and hypertension

The term adherence refers to the following of treatment regimens as recommended by a healthcare provider (World Health Organization, 2003). Two 'types' of non-adherence are usually described in the literature – intentional and unintentional. Intentional non-adherence stems from a deliberate decision not to follow treatment recommendations, whereas unintentional non-adherence involves the failure to follow through intentions because of factors such as forgetting, physical inability to carry out instructions, or poor understanding of the regimen (Horne, 1997).

Explanations for non-adherence tend to address intentional aspects of the behaviour rather than unintentional ones. The adherence literature explains non-adherence by reference to a large number of demographic factors (Primatesta, Brookes, & Poulter, 2001): aspects of health care, such as patient/provider interaction, complexity of drug regimens and side effects of medication (Morisky & Ward, 2001; Weir et al., 2000); and patients' knowledge and beliefs concerning the condition and treatment in question, such as perceptions of the condition (for example, Horne, 1997, 1999; Horne & Weinman, 1999, 2002; Legare, Godin, Dodin, Turcot, & Lapierre, 2003; Lynch et al., 2000; Schmier & Leidy, 1998; Trachtenberg, Dugan, & Hall, 2005). Despite these explanations, the social-psychological mechanisms involved in medication adherence are poorly understood and no single conceptual framework has been developed in which to study it (Morrell, Park, Kidder, & Martin, 1997).

The aim of the present study was to investigate the predictors of medication adherence by developing a conceptual model, using a prospective longitudinal design to investigate possible causal pathways. This was pursued in the context of adherence to anti-hypertensive medication. We chose to study hypertension because it is a common condition

that is a risk factor for other potentially fatal conditions, such as myocardial infarction and stroke, and because blood pressure control in the UK is known to be sub-optimal -- even among those treated for hypertension, of whom only half to two-thirds are thought to be adherent (Ebrahim, 1998; Primatesta, Brookes, & Poulter, 2001).

Hypertension is the term for the presence of consistently pathologically high blood pressure. Currently, it is defined as blood pressure greater than 140/90 mmHg (UK Department of Health, 1999; Williams et al., 2004), although definitions vary across countries (Wolf-Maier et al., 2004). It may be primary (termed 'essential hypertension') or secondary. Secondary hypertension arises as a consequence of another disease process, such as renal disease, whereas essential hypertension exists in its own right. Treatment is usually a combination of diet/exercise modification and medication. All the common medications have side effects (Colledge, Walker & Ralston, 2010), and managing hypertension medically is not guaranteed to maintain blood pressure within the desired range. The current recommended treatment is multiple drugs, to be taken once a day (Williams et al., 2004). Whilst medication may occasionally require adjustment in order to achieve control, a well-managed programme of treatment to which the patient adheres is more likely to succeed than continual alteration of drug regimens.

Research suggests that approximately three-quarters of poor blood pressure control could be attributable to poor adherence (Morisky & Ward, 2001). It has been estimated that, within the first year of diagnosis, up to 50% of patients prescribed anti-hypertension agents discontinue their medication, or do not fully adhere to the regimen recommended by their GP (Ebrahim, 1998; Flack, Novikov, & Ferrario, 1996). Ebrahim (1998) conducted a comprehensive systematic review of the hypertension literature, from which he concluded that barriers to adherence were likely to be related to factors such as medication side effects, over-complex medication regimens, and 'unhelpful' health beliefs.

Predictors of adherence to hypertension medication

Although there is as yet no integrated model of adherence to hypertension medication, a number of individual predictors have nevertheless been identified. Moreover, research on other medical treatment regimens, and on protective health behaviours, offers further indications. The variables can be considered in three groups: demography, health status, and medication; cognitions and motivation; and behavioural intentions.

Demography, health status and medication regimen

The influence of demographic factors in health, such as age, marital status, and education, is well documented. For example, morbidity varies by ethnic group, and is raised in people from lower socio-economic groups, and those who have received fewer years of education (Marmot & Davey Smith, 1997). Adherence rates also tend to be lower in these groups (Taylor, 2006), not least for hypertension (Primatesta, Brookes, & Poulter, 2001). Hypertension itself is more common in older people, and is often associated with other health problems.

A well established factor in poor adherence is the side effects that medication produces. The literature reports a strong tendency for those who experience side effects to omit doses or to discontinue medication altogether. For example, Weir et al. (2000) identified a low tolerance for a range of side effects. Of their sample, 33% reported that they would not take a medication prescribed for hypertension if it caused fatigue, 51% if it made their face swell, and 42% if they developed a cough. Moreover, 58% would discontinue if the drug caused dizziness and 60% if they developed a rash. Whilst these are not the most common side effects, cough, frequency of micturition, dizziness and fatigue are all well-documented (Williams et al., 2004). Experiencing side effects influences beliefs about the costs and benefits of medication adherence: where a person perceives that the costs of adherence outweigh the benefits, adherence rates tend to fall (Horne & Weinman, 1999).

Cognitions and motivation

Beliefs and attitudes The literature indicates that patients are aware of – and concerned about – the risks of uncontrolled hypertension. However, many patients believe that it is possible to tell whether or not one's blood pressure is raised, and intentionally discontinue medications that cause side effects (Meyer, Leventhal, & Guttman, 1985; Weir et al., 2000). Consistent with Horne & Weinman's work, those who describe medication-related relief of symptoms exhibit greater adherence and better control, suggesting that patients develop implicit models or beliefs that drive their adherence behaviour, and that their beliefs are related to the experienced severity of the disorder (Baumann, Cameron, Zimmerman, & Leventhal, 1989; Scisney-Matlock & Watkins, 2003). Perception of serious consequences of a condition exerts both a direct effect upon adherence and an indirect effect via treatment beliefs, suggesting that, if people perceive severe consequences of their disease, they will be more likely to see the need for treatment and so to adhere (Horne & Weinman, 2002). It has also been shown that simple failure to understand one's treatment regimen may lead to unintentional non-adherence, through forgetting or carelessness (Casey, Johnson, & McClelland, 2003). A further factor is the perceived pressure to adhere that people experience from their salient others, which Ajzen (2002) and Ajzen & Fishbein(2005) in the Theory of Planned Behaviour call subjective norm.

Perceived control and self-efficacy Both perceived control and self-efficacy, which combine to make perceived behavioural control in the Theory of Planned Behaviour, are known to predict adherence to health-protective regimens - in, for example, haemodialysis (Christensen, Moran, Lawton, Stallman, & Voigts, 1997), anti-retroviral therapy (Godin, Côté, Naccache, Lambert, & Trottier, 2005), cardiac rehabilitation exercise programs (Woodgate, Brawley, & Weston, 2005), cholesterol-lowering diets (Burke, Dunbar-Jacob, Orchard, & Sereika, 2005), self-care for diabetes (Murphy, Thompson, & Morris, 1997;

O'Hea, 2005; Williams & Bond, 2002), and exercise in the healthy population (McCaul, Sandgren, O'Neill, & Hinsz, 1993). Strong senses of self-efficacy and perceived control are known to predict greater adherence (McCauley, 1993; Robertson & Keller, 1992).

Hypertensive self-identity Another predictor is self identity. Self-identity both predicts intentions (Armitage & Conner, 1999) and mediates the intention-behaviour relationship (Sheeran & Orbell, 2000). It has been found to predict intention independently of attitude for the consumption of organic foods (Sparks & Shepherd, 1992) and independently of prior behaviour for household recycling, suggesting that it is not merely a function of habitual action (Terry, Hogg, & White, 1999). Terry's prospective study demonstrated that self-identity predicted intention but not behaviour, something that has been confirmed by Conner & McMillan (1999) for cannabis use.

Hypertensive Self-Identity (HSI) reflects the degree to which a person sees being a hypertensive patient as positive or negative. If, for example, I see myself as someone who follows my doctor's advice, I may strive to maintain this identity through my behaviour, and my behaviour will be reinforced and will be predicted more strongly as time goes on (Charng, Piliavin, & Callero, 1988; Conner & Armitage, 1998). HSI has received little attention so far, but the available evidence suggests that it plays a part in adherence (Baumann, Cameron, Zimmerman, & Leventhal, 1989; Meyer, Leventhal, & Guttman, 1985). Three components of HSI can be distinguished -- the symptoms that individuals report, the illness label they give their problem, and how they monitor their illness. All three are likely to influence intention to adhere, and so adherence itself.

Conscientiousness One final predictor in this group is conscientiousness, the degree to which a person is organized, hardworking and careful. People high on this trait may be expected to make more of an effort to follow medical advice. Evidence from health behaviours suggests that the factor does predict adherence to medical regimens – in renal

dialysis, for example (Christensen & Smith, 1995), and cholesterol-lowering treatment (Stilley, Sereika, Muldoon, Ryan, & Dunbar-Jacob, 2004) – and it may even predict longevity (Friedman, Tucker, Schwartz, & Martin, 1995). At the time of writing in 2010, there is as yet no published work on hypertension, so far as we know.

Behavioural intentions

Behavioural intentions are generally regarded as the proximal and strongest predictors of behaviour (for example, Ajzen, 2002, Ajzen & Fishbein, 2005). Among the health behaviours to have been examined are smoking (Godin, Valois, Lepage, & Desharnais, 1992), breast feeding (Duckett et al., 1998), medical screening (Norman & Conner, 1993; Rutter, 2000; Steadman & Rutter, 2004), food choice (Conner, Povey, Bell, & Norman, 1994; Sparks & Shepherd, 1992) and condom use (Chan & Fishbein, 1993). According to the most frequently used approached to intention, the Theory of Planned Behaviour (Ajzen, 1991, 2005), intention to adhere to hypertension medication will be best predicted by the person's attitude to adhering, subjective norm about adhering, and perceived behavioural control over adhering – variables that were noted earlier in the Introduction. Attitude is a 'summary statement' of the person's beliefs for or against doing the behaviour and the consequences of it. Subjective norm comes from beliefs about what others want us to do and our motivation to comply with those wishes. Perceived behavioural control is concerned with the perceived presence or absence of internal or external factors that may facilitate or hinder performance of the behaviour. It is through the mediation of intention that the 'more distal' predictors of behaviour have their effects. It has also been suggested that the predictive power of intention might be moderated by how certain we are of our intentions (Sheeran & Abraham, 2003, Cooke & Sheeran, 2004).

Deriving a conceptual model of adherence to hypertension medication

The purpose of our paper is to provide an exploratory framework for what we believe is the first attempt to predict adherence to hypertension medication from a knowledge of individuals' intentions, cognitions and motivations, and demographic and medical backgrounds. Others have considered similar variables in health behaviour – see, for example, the discussion of 'social ecology' and 'personality' in Kaplan & Simon (1990), and the model social psychological mediators of the relationship between demographic factors and health outcomes in Rutter & Quine (1996). Our approach in the present paper sees the sets of variables as contributing hierarchically. Thus, demographic and health status variables are the most distal predictors of adherence, but will nevertheless make a noticeable contribution of their own; the second block of variables is those we have called cognitions and motivation; and intentions are the third. We predict that each level of the hierarchy will add significantly to the variance explained.

Method

Participants and procedure

The study was a longitudinal questionnaire survey. Following NHS Research Ethics approval, three Primary Care Practices (PCPs) in the South-East of England were approached and agreed to distribute 1784 questionnaire packs to surgery-registered patients with hypertension. The three PCPs covered rural, coastal and urban areas, reflecting the geographical characteristics of the area in question. The packs were made up and sealed by the researchers, and the surgery staff addressed and posted the envelopes. Practice staff identified registered hypertensive patients from surgery-maintained computerized records. The packs were delivered to each PCP in sealed envelopes, ready for address labels generated from the computerized search to be attached. They contained a covering letter, a patient information sheet describing the study and requirements for participation, two copies of a

consent form (one to return and one to keep), an address sheet for patients to record their name and address so that they could receive a follow-up questionnaire, and a copy of the first questionnaire. A reply-paid envelope addressed to the University was enclosed. Patients who consented to participate returned the consent form and the completed questionnaire, along with their names and addresses. A brief second questionnaire was sent eight weeks later to all those who responded.

Measures

The Time 1 questionnaire contained measures of adherence and the three sets of predictor variables. Adherence was measured by an augmented version of the four-item scale developed by Morisky, Green, & Levine (1986). Items were scaled from (1) always to (5) never: "Do you ever forget to take your blood pressure tablets?", "Are you careless about taking your tablets?", "When you feel better, do you stop taking your tablets?", and "If you feel worse when you take your blood pressure tablets, do you stop taking them?". To the four original items we added a fifth, because pilot respondents indicated that it was an important index of non-adherence: "Have you ever missed an appointment to see your doctor or nurse about your high blood pressure?". Reliability was assessed by Cronbach's alpha, and the value for the five-item scale was 0.66. Alpha for the four original Morisky items was 0.65 (against 0.61 in the Morisky, Green & Levine study).

Demography, health status and medication regimen

The measures of demography were gender, age, educational attainments, and socio-economic status (using the proxy measure of car availability from the UK Office of National Statistics). The measures of health status consisted of a five-point scale of self-rated general health, from (1) very bad to (5) very good; ten items on existing risk factors relating to hypertension - diabetes, stroke, angina, heart attack, heart murmur, abnormal heart rhythm,

and other heart trouble - and any medical treatment received for them; and corresponding items on risk factors in the patient's family. To provide information on medication regimen, participants were asked the names of their drugs, how frequently they took them each day, and when they were first prescribed.

Cognitions and motivation

The first measures in this section of the questionnaire were the predictors of behaviour identified by the Theory of Planned Behaviour (Ajzen, 1991, 2005): participants' attitude to taking the medication, their subjective norm about the behaviour, and their perceived behavioural control over carrying out the behaviour. The measures were direct, rather than derived indirectly from underlying beliefs (Ajzen, 2002; Ajzen & Fishbein, 2005; Montano, Kasprzyk, von Haeften, & Fishbein, 2001). For attitude there were five items, all based on the stem, "Taking my blood pressure tablets every day is…": "extremely foolish" (1) to "extremely wise" (5); "extremely harmful" (1) to "extremely beneficial" (5); "extremely unpleasant" (1) to "extremely pleasant" (5); "extremely inconvenient" (1) to "extremely convenient" (5); and "extremely worrying" (1) to "extremely reassuring" (5). Reliability was assessed by Cronbach's alpha, and the value was 0.70. The five scores were averaged to produce a single value. Subjective norm was the product of two items: "Most people who are important to me would approve of my taking my blood pressure tablets everyday", scored from (1) strongly disagree" to (5) "strongly agree", multiplied by "I feel under social pressure to take my blood pressure tablets every day", scored from (1) "strongly disagree" to (5) "strongly agree". For perceived behavioural control (PBC), there were three items: "How much personal control do you feel you have over taking your blood pressure tablets every day?", scored from (1) "no control" to (5) "complete control"; "For me to take my blood pressure tablets every day would be …" (1) "extremely difficult" to (5) "extremely easy"; and "Whether or not I take my blood pressure tablets every day is entirely up to me",

scored from (1) "strongly disagree" to (5) "strongly agree". The items were summed to produce a total score.

A further set of five questions, adapted from Sheeran & Orbell (2000), measured hypertensive self-identity: "I am a person who cares about my health and high blood pressure", "I am disciplined at taking my high blood pressure tablets", "I am concerned about the long-term *benefits* of taking my blood pressure tablets", "I am successful at taking my prescribed blood pressure tablets", and "I think about the consequences for my family with regard to taking my blood pressure tablets". All the items were scored (1) "Disagree strongly" to (5) "Agree strongly". Cronbach's alpha was 0.77, and the items were summed to produce a total score.

Conscientiousness was measured by the ten-item conscientiousness scale taken from the International Personality Item Pool (Goldberg et al., 2006). The items were scored from 1 ("very inaccurate") to 5 ("very accurate") and were as follows: "I"… "am always prepared", "pay attention to details", "get jobs done right away", "like order", "follow a schedule", "am exacting in my work", "leave my belongings around", "make a mess of things", "shirk my duties", and "forget to put things back in their proper place". Cronbach's alpha was 0.83, and the items sere summed to produce a total score.

Finally in this section of the questionnaire, knowledge about hypertension was measured by a 15-item scale devised by the authors. The scale was designed to represent common lay 'medical' beliefs about hypertension. With the rest of the questionnaire, it was piloted with samples of patients with hypertension. The 15 items were: "A person can always tell when they have high blood pressure", "Too much exercise is related to high blood pressure", "Another name for high blood pressure is hypertension", "Doctors tell people with high blood pressure to eat more salty foods", "Sometimes the doctor changes tablets for some people", "People with high blood pressure are told not to exercise and stay in bed more",

"There are different kinds of blood pressure tablets", "Smoking cigarettes and cigars lowers blood pressure", "Some people feel worse when they first start taking tablets for high blood pressure", "Being overweight is related to high blood pressure", "Being underweight is related to high blood pressure", "Having too much salt in the diet is related to high blood pressure", "High blood pressure runs in the family", "High blood pressure can cause cancer", and "High blood pressure can cause tuberculosis". Items scored 1 for correct and 0 for incorrect, and Cronbach's alpha for the scale was 0.70. Items were summed to produce a total scale score.

Intentions

Intentions were measured by four questions, the first three scored from (1) "strongly disagree" to (5) "strongly agree", the last one from (1) "very unlikely" to (5) "very likely". The questions were: "I intend to take my blood pressure tablets every day", "I plan to take my blood pressure tablets every day", "I want to take my blood pressure tablets every day", and "How likely is it that you will take your blood pressure tablets every day?". Cronbach's alpha was 0.85, and the items were summed to produce a total score. Since a number of writers have suggested that the link between intention and behaviour is moderated by how sure a person is about his or her intentions (see the meta-analysis by Cooke & Sheeran, 2004), intention certainty was also measured: "My intention to take my blood pressure tablets every day is…" (1) "very uncertain" to (5) "very certain". The total score for intention was multiplied by the score for intention certainty to give a single combined measure.

Time 2 questionnaire

The second questionnaire repeated the five questions used at Time 1 to measure adherence.

Results

Preliminary analyses

Of the 1784 patients approached, 1070 (60%) responded at Time 1 and 934 of those met the study's inclusion criteria. The two main reasons for exclusion were not being on prescribed medication and being too elderly or infirm to complete the questionnaire (for example, living in a nursing home or residential home). Over half of participants (57.5%) were female, 42% were male, and the remainder (0.5%) failed to say. Mean age was 69.0 years (SD 11.7), with men (69.6 years) slightly older than women (68.8 years). Just over 75% of participants who responded at Time 1 returned a Time 2 questionnaire, and there was a significant attrition difference between genders, with 27.9% of women and 20.4% of men dropping out of the study. The majority of participants (67.8%) were married or living with a partner (80.3% of men but only 58.7 of women), and 32.2% lived alone. General health did not differ between the sexes: 62.1% of men and 57.9% of women reported good general health, and only 7.5% of men and 5.5% of women reported poor health. Significantly more men (87.4%) than women (64.7%) had permanent access to a car. Almost half the participants revealed no details of their education but, of those who did, there was again a significant difference between the sexes, with men more likely than women to have achieved qualifications in all the categories listed, except GCE 'O' level -- a reflection, perhaps, of the average age of the participants.

Medication

Almost 50% of participants had been on prescribed medication for six years or more. The vast majority (86%) took their principal medicine once a day, and fewer than 5% had a regimen of more than four times a day. Only 146 patients (15.6%) reported side effects,

some of which may not have been attributable to the medication. Just over 5% (55) reported two or more concurrent side effects, but the majority reported just one, if any.

Medical and genetic risk factors

In total, 27% (249) of patients were receiving current treatment for a heart condition. Most participants had relatively few medical risk factors for stroke and CHD, other than their hypertension, though some were unsure whether they had ever suffered from the conditions stated. The most common genetic risks factors were having a parent with hypertension or one who had had a heart attack or stroke. The percentages, measure by measure, averaged 15% to 20%, but as many as 40% of respondents did not know their parents' histories.

Intention and adherence

The measure of intention was highly skewed. For example, in answer to the item 'Do you intend to take your blood pressure tablets every day in the future', 63.5% answered that they intended to do so 'always' and 33.2% answered 'most of the time'. The distribution of adherence scores at both time points was also highly skewed, the majority of participants reporting almost full adherence. Completion of all adherence scale items yielded a score between 5 and 25 for each participant. At Time 1, only 0.8% (7) of participants scored 15 or below, 8.2% (76) scored 20 or below, and 44% (413) scored 24 or below. At Time 2, the figures were 0.9% (6), 5.6% (39) and 43.3% (305) respectively.

Predicting intention and adherence

Zero order correlations between predictors and outcome are given in Table 1. The first group of predictors revealed a number of statistically significant relationships with outcome, but there were many more for the second group, cognitions and motivation. In the final group, intention, intention certainty, and their product all correlated significantly with adherence at both Time 1 and Time 2.

Table 1

The second set of analyses used multiple regression, to predict the three principal outcomes: intention at Time 1, adherence at Time 1, and adherence at Time 2. A hierarchical approach was employed, so that each block of predictor variables was entered in turn, and the increment in variance explained by successive blocks was extracted. The results are given in Table 2. For intention, the first block of predictors (demography, health status and medication regimen) accounted for 4% of the variance (adjusted). The second block (cognitions and motivation) added a further 31%, giving 35% altogether. For Time 1 adherence, the increment from the first block to the second was again marked, 4% to 15%. The variance added by the final block (intention x intention certainty) was 4%, giving 19% in total. For Time 2 adherence, Time 1 adherence was entered as a first block, to control for baseline behaviour and so to allow *change* in behaviour from Time 1 to Time 2 to be examined. The remaining blocks were identical to those used in the analysis of Time 1 adherence. Much the largest contribution came from adherence at Time 1, and the four blocks together accounted for 34% of the variance. Standardised beta coefficients for the statistically significant predictors of outcome are given in Table 3. The values are taken from the final models, after the concluding block had been entered.

Tables 2 and 3

In a further analysis of the predictors of Time 1 adherence, regression-based path analysis was used to identify pathways from individual variables to adherence. The variables were the six significant predictors shown in Table 3 – gender, age, conscientiousness, hypertensive identity, perceived behavioural control, and intention x intention certainty. Gender dropped out, and the final pattern of pathways is shown in Figure 1. All predictors had direct pathways to adherence; conscientiousness, perceived behavioural control, and

hypertensive identity were also mediated by intention x intention certainty; and some of the effect of age was mediated through perceived behavioural control and hypertensive identity.

Figure 1

In a final set of analyses, we examined the distinction between intentional and unintentional non-adherence introduced at the beginning of the paper. Of the four indices in the Morisky, Green & Levine (1986) scale, forgetting to take one's medication and being careless about it are indices of unintentional poor adherence, while stopping medication if one feels better or worse reflects intentional behaviour. For each component, hierarchical multiple regression was used as before. Table 4 gives the final model summaries, and shows that the strongest predictions were for unintentional poor adherence: adjusted R^2 was .16 for both forgetting and carelessness. Table 5 gives the significant predictors from the final block of each analysis. The strongest predictors of unintentional non-adherence were age, hypertensive identity, and intention x intention certainty; for intentional non-adherence the single, strong, predictor was intention x intention certainty.

Tables 4 and 5

Discussion

Model and findings

The purpose of this paper has been to propose and test a model of adherence to anti-hypertensive medication. The model incorporates three blocks of possible predictors, which are seen as having their effects hierarchically: demography, health status and medication regimen; cognitions and motivation; and intentions. The variance explained in predicting adherence at Time 1 increased block by block as predicted and, when adherence was re-

examined at follow-up, much the strongest predictor was adherence at Time 1, as is typically found across a wide range of behaviours (Conner & Norman, 2005; Ouellette & Wood, 1998).

When the blocks were 'unlocked', and their individual components were examined, the single demographic variable to emerge as a significant predictor of adherence was age: the older the person, the greater the adherence. The key components of cognitions and motivation were conscientiousness, perceived behavioural control, and hypertensive identity – and both perceived behavioural control and hypertensive identity were predicted by age, again positively. All three of the variables predicted intention x intention certainty, which in turn was the strongest predictor of adherence. The 'profile' of the most adherent person is thus someone who is older, is conscientious, believes that he or she is able to deal with potential barriers to adherence, and has a well developed identity as someone with hypertension. Together, the variables lead to strong, resolute intentions. The pattern offers some support to the suggestion from Ebrahim (1998), that 'unhelpful' health beliefs will be among the leading predictors of poor adherence.

Although non-adherence has generally been examined as a single, composite measure, conceptually there are two underlying components, as we have noted: intentional and unintentional non-adherence. We may, for example, choose not to take our medication (intentional), or we may forget to take it (unintentional). Both forgetting and carelessness were predicted more strongly than stopping when one felt better or worse, and the model was therefore more successful with unintentional than intentional non-adherence. The variables that distinguished most strongly were age and hypertensive identity: forgetting and carelessness were predicted by relative youth and an ill-formed hypertensive identity, while intentional non-adherence was predicted by neither.

Limitations of the study

There are three main limitations to our findings. The first is that outcome was measured by self-report. Whilst the evidence indicates that self report measures are reliable (for example, Haynes et al., 1980; Morisky, Green, & Levine, 1986), they are known to over-estimate adherence (for example, Garber, Nau, Erickson, Aikens, Lawrence, 2004; Kaplan & Simon, 1990) when compared with 'objective' measures, such as pill counting, prescription collection and filling, and electronic monitoring. However, as the reviews by Osterberg & Blaschke (2005) and Hawkshead & Krousel-Wood (2007) make clear, objective measures can be expensive, time-consuming, intrusive, and even invasive (for example, tracking serum levels of medication – see Jónsdóttir et al., 2010). There can also be questions of validity: throwing away tablets, making up for missed inhaler doses by discharging them into the air, and failing to fill collected prescription forms (Levine et al., 2006; Osterberg & Blaschke, 2005). In the event, the medical practices and ethics committee we worked with would not allow us to use these methods, principally because of the burden they would have placed on doctors, and self-report was the one technique available to us.

The self-report measure we chose is widely used (especially though not exclusively in hypertension), has reasonable reliability across studies, and is supported by published evidence of validity. For example, Morisky, Green & Levine (1986) themselves demonstrated concurrent and predictive validity with hypertensive patients: the scale predicted control over hypertension both in the present and three years later. Krapek et al., (2004) reported concurrent validity for the Haemoglobin A_{1c} index of control in Type II diabetes, and Schnitzler, Leffers & Häck (2010) have recently demonstrated concurrent validity in treatment for Parkinson's Disease. Self-report questionnaires in general have been found to be more concordant with objective measures than other self-report measures, such as interviews (see, for example, Garber, Nau, Erickson, Aikens, Lawrence, 2004). Thus, even if

the Morisky scale and similar measures over-estimate adherence, good concordance with objective measures means that the rank order of respondents will be the same for both approaches. Rank-order is the principal interest in the present paper, since our main concern has been patterns of correlation between predictors and adherence – not absolute levels of adherence. The evidence suggests that, for detecting those patterns, the self-report measure we used is adequate.

The second point concerns the use of postal questionnaires. One of the problems facing researchers who collect data in this way is that individuals who adhere are the most likely to respond (for example, Vaile, Calnan, Rutter & Wall, 1993). A substantial minority of patients sent the first questionnaire did not respond to it. Though it is likely that many of them were also not adhering fully to treatment, for reasons of ethics we were not allowed access to patients' home addresses or medical records, and we have no way of testing the suggestion. Other researchers are known to have experienced similar problems in attracting non-adhering patients into studies of this nature (Jackson et al., 2005).

The final point is that adherence was greater than the literature typically suggests (Ebrahim, 1998; Nabi et al., 2008; Primatesta et al., 2001), perhaps in part because the sample was mostly elderly. The age distribution reflects the geographical location and demographic makeup of the general practices that agreed to take part. Though the upshot was less variance to explain than anticipated, identifiable patterns of prediction emerged nevertheless.

Designing interventions to strengthen adherence

Central to our pattern of findings is the role of cognitions and motivation. While the intentions block added significantly to the prediction of behaviour, cognitions and motivation provide the underpinnings for intentions, and offer a useful means of intervention (Ajzen, 1991; Ajzen & Fishbein, 2005). Motivating people to acknowledge that the consequences of

poorly treated hypertension can be serious, indeed life-threatening, is central to strengthening both their conscientiousness and their identity as someone with hypertension. Motivational interventions should be particularly effective for intentional non-adherence – choosing not to take one's medication, because one fails to acknowledge its importance or is not sufficiently conscientious to follow a strict regimen.

A second approach suggested by our results is through perceived control, and is perhaps best seen as intervening to strengthen cognitions. Perceived behavioural control, as conceptualised by Ajzen (1991), is made up of both self-efficacy (the internal means to carry out a behaviour) and perceptions of barriers (the number and extent of anticipated external obstacles to carrying out the behaviour). Thus, low perceived behavioural control is present when I believe that I shall be unable to keep to a routine and when the number and extent of the barriers I foresee are too great. Here, a useful approach will be the planning interventions incorporated in implementation intentions interventions (Gollwitzer, 1999). Patients are asked to list obstacles that might prevent them keeping to their prescribed regimen, to think of how they will overcome them, and to write down the plan. The approach has had a degree of success in modifying a range of health behaviours (Sheeran, Milne, Webb & Gollwitzer, 2005), but has yet to be tested in people with hypertension.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50*, 179-211.

Ajzen, I. (2002). Constructing a TPB questionnaire: conceptual and methodological considerations. Retrieved 21 April 2011, from http://www.people.umass.edu/aizen/tpb.html

Ajzen, I (2005) *Attitudes, Personality and Behavior* (2nd ed.), Milton Keynes, England: Open University Press / McGraw-Hill.

Ajzen, I., & Fishbein, M. (2005). The influence of attitudes on behavior. In D. Albarracín, B. T. Johnson, & M. P. Zanna (eds.), *The Handbook of Attitudes* (pp. 173-221). Mahwah, NJ: Erlbaum.

Armitage, C. J., & Conner, M. (1999). The theory of planned behaviour: assessment of predictive validity and 'perceived control'. *British Journal of Social Psychology, 38*, 35-54.

Baumann, L., Cameron, L. D., Zimmerman, R., & Leventhal, H. (1989). Illness representations and matching labels with symptoms. *Health Psychology, 8*, 449-469.

Burke, L. E., Dunbar-Jacob, J., Orchard, T. J., & Sereika, S. M. (2005). Improving adherence to a cholesterol-lowering diet: a behavioral intervention study. *Patient Education and Counseling, 57*, 134-142.

Casey, J., Johnson, V., & McClelland, P. (2003). Impact of stepped verbal and written reinforcement of fluid balance advice within an outpatient hemodialysis unit: a pilot study. *Journal of Human Nutrition and Dietetics, 15*, 43-47.

Chan, D. K.-S., & Fishbein, M. (1993). Determinants of college women's intentions to tell their partners to use condoms. *Journal of Applied Social Psychology, 23*, 1455-1470.

Charng, H. W., Piliavin, J. A., & Callero, P. L. (1988). Role identity and reasoned action in the prediction of repeated behavior. *Social Psychology Quarterly, 51*, 303-317.

Christensen, A. J., Moran, P. J., Lawton, W. J., Stallman, D., & Voigts, A. L. (1997). Monitoring attentional style and medical regimen adherence in hemodialysis patients. *Health Psychology, 16*, 256-262.

Christensen, A. J., & Smith, T. W. (1995). Personality and patient adherence: Correlates of the five-factor model in renal analysis. *Journal of Behavioral Medicine, 18*, 305-313.

Colledge, N. R., Walker, B. R. & Ralston, S. H. (eds.) (2010). *Davidson's Principles and Practice of Medicine* (21st ed.). Amsterdam: Churchill-Livingstone / Elsevier.

Conner, M., & Armitage, C. J. (1998). Extending the theory of planned behavior: A review and avenues for further research. *Journal of Applied Social Psychology, 28*, 1429-1464.

Conner, M., & McMillan, B. (1999). Interaction effects in the theory of planned behaviour: studying cannabis use. *British Journal of Social Psychology, 38*, 195-222.

Conner, M. & Norman, P. (eds.) (2005). *Predicting Health Behaviour* (2nd ed.). Milton Keynes: Open University Press / McGraw-Hill.

Conner, M., Povey, R., Bell, R., & Norman, P. (1994). GP intervention to produce dietary change. Paper presented to the *Annual Conference of the British Psychological Society Special Group in Health Psychology*, Sheffield.

Cooke, R., & Sheeran, P. (2004). Moderation of cognition-intention and cognition-behaviour relations: a meta-analysis of properties of variables from the theory of planned behaviour. *British Journal of Social Psychology, 43*, 159-186.

Department of Health. (1999). *Saving Lives: Our Healthier Nation* (No. CMND 1523). London: The Stationery Office.

Duckett, L., Henly, S., Avery, M., Potter, S., Hills-Bonczyk, S., Hulden, R., et al. (1998). A theory of planned behavior-based structural model for breastfeeding. *Nursing Research, 47*, 325-336.

Ebrahim, S. (1998). Detection, adherence and control of hypertension for the prevention of stroke: A systematic review. *Health Technology Assessment, 2*, 1-78.

Flack, J. M., Novikov, S. V., & Ferrario, C. M. (1996). Benefits of adherence to anti-hypertensive drug therapy. *European Heart Journal, 17 Supplement A*, 16-20.

Friedman, H. S., Tucker, J. S., Schwartz, J. E., & Martin, L. R. (1995). Childhood conscientiousness and longevity: Health behaviors and cause of death. *Journal of Personality and Social Psychology, 68*, 696-703.

Garber, M. C., Nau, D. P., Erickson, S. R., Aikens, J E. & Lawrence, J. B. (2004). The concordance of self-report with other measures of medication adherence. A summary of the literature. *Medical Care, 42*, 649-652.

Godin, G., Côté, H., Naccache, L., Lambert, D., & Trottier, S. (2005). Prediction of adherence to antiretroviral therapy: a one-year longitudinal study. *AIDS Care, 17*, 493-504.

Godin, G., Valois, P., Lepage, L., & Desharnais, R. (1992). Predictors of smoking behavior - an application of Ajzen's theory of planned behavior. *British Journal of Addiction, 87*, 1335-1343.

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., et al. (2006). The International Personality Item Pool and the future of public-domain personality measures. *Journal of Personality Research, 40*, 84-90.

Gollwitzer, P. M. (1999). Implementation intentions: strong effects of simple plans. *American, Psychologist, 54*, 493-503.

Hawkshead, J. & Krousel-Wood, M. A. (2007). Techniques for measuring medication adherence in hypertensive patients in outpatient settings: advantages and limitations. *Disease Management & Health Outcomes, 15*, 109-118.

Haynes, R. B., Taylor, D. W., Sackett, D. L., Gibson, E. S., Bernholz, C. D., & Mukherjee, J. (1980). Can simple clinical measurements detect patient noncompliance? *Hypertension, 2*, 757.

Horne, R. (1997). Representations of medication and treatment: advances in theory and measurement. In K. J. Petrie & J. A. Weinman (eds.), *Perceptions of Health and Illness*. Amsterdam: Harwood Academic Publishers.

Horne, R. (1999). Patients' beliefs about treatment: the hidden determinant of treatment outcome? *Journal of Psychosomatic Research, 47*, 491-495.

Horne, R., & Weinman, J. (1999). Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. *Journal of Psychosomatic Research, 47*, 555-567.

Horne, R., & Weinman, J. (2002). Self-regulation and self-management in asthma: exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventative medication. *Psychology and Health, 17*, 17-32.

Jackson, C., Lawton, R., Knapp, P., Raynor, D. K., Conner, M., Lowe, C., et al. (2005). Beyond intention: do specific plans increase health behaviours in patients in primary care? A study of fruit and vegetable consumption. *Social Science & Medicine, 60*, 2383-2391.

Jónsdóttir, H., Opjordsmoen, S., Birkenaes. A. B., Engh, J. A., Ringen, P. A., Vaskinn, A., Aamo, T. O., Friis, S. & Andreassen, O. A. (2010). Medication adherence in outpatients with severe mental disorders. *Journal of Clinical Psychopharmacology, 30*, 169-175.

Kaplan, R. M. & Simon, H. J. (1990) Compliance in medical care: reconsideration of self-predictions. *Annals of Behavioral Medicine, 12*, 66-71.

Krapek, K., King, K., Warren, S. S., George, K. G., Caputo, D. A., Mihelich, K., Holst, E. M., Nichol, M. B., Shi, S. G., Livengood, K. B., Walden, S. & Lubowski, T. J. (2004). Medication adherence and associated hemoglobin A_{1c} in Type 2 diabetes. *The Annals of Pharmacotherapy, 38,* 1357-1362.

Legare, F., Godin, G., Dodin, S., Turcot, L., & Lapierre, L. (2003). Adherence to hormone replacement therapy: a longitudinal study using the theory of planned behavior. *Psychology and Health, 18*, 351-371.

Levine, A. J., Hinkin, C. H., Marion, S., Keuning, A., Castellon, S. A., Lam, M. N., Robinet, M., Longshore, D., Newton, T., Myers, H. & Durvasula, R. S. (2006). Adherence to antiretroviral medications in HIV: differences in data collected via self-report and electronic monitoring. *Health Psychology, 25*, 329-335.

Lynch, D. J., Repka, F. J., Nagel, R., Birk, T., Gohara, A., Leighton, R. F., et al. (2000). Prediction of dietary adherence in cholesterol reduction: relative contribution of personality variables and health attitudes. *Psychology and Health, 15*, 821-828.

Marmot, M. G., & Davey Smith, G. (1997). Socio-economic differentials in health. *Journal of Health Psychology, 2*, 283-296.

McCaul, K. D., Sandgren, A. K., O'Neill, H. K., & Hinsz, V. B. (1993). The value of the theory of planned behavior, perceived control, and self-efficacy expectations for predicting health-protective behaviors. *Basic and Applied Social Psychology, 14*, 231-252.

McCauley, E. (1993). Self efficacy and the maintenance of exercise participation in older adults. *Journal of Behavioral Medicine, 16*, 103-113.

Meyer, D., Leventhal, H., & Guttman, M. (1985). Common sense models of illness: the example of hypertension. *Health Psychology, 4*, 115-135.

Montano, D., Kasprzyk, D., von Haeften, I., & Fishbein, M. (2001). Towards and understanding of condom use behavior: A theoretical and methodological overview of Project SAFER. *Psychology, Health and Medicine, 6*, 139-150.

Morisky, D. E., Green, L. W., & Levine, D. M. (1986). Concurrent and predictive validity of a self-reported measure of medication adherence. *Medical Care, 24*, 67-74.

Morisky, D. E., & Ward, H. J. (2001). Self-reported medication-taking behavior: a valid method for assessing adherence. *American Journal of Hypertension, 14* (4 Supplement 1), A231.

Morrell, R. W., Park, D. C., Kidder, D. P., & Martin, M. (1997). Adherence to antihypertensive medications across the life span. *The Gerontologist, 37*, 609-619.

Murphy, L. M. B., Thompson, R. J., & Morris, M. A. (1997). Adherence behavior among adolescents with type I insulin-dependent diabetes mellitus : The role of cognitive appraisal processes. *Journal of Pediatric Psychology, 82*, 811-825.

Nabi, H., Vahtera, J., Singh-Manoux, A., Pentti, J., Oksanen, T., Gimeno, D., Elovainio, M., Virtanen, M., Klaukka, T., & Kivimaki, M. (2008). Do psychological attributes matter for adherence to antihypertensive medication? The Finnish public sector cohort study. *Journal of Hypertension, 26*, 2236-2243.

Norman, P., & Conner, M. (1993). The role of social cognition models in predicting attendance at health checks. *Psychology and Health, 8*, 447-462.

O'Hea, E. L. (2005). Adherence to medical regimens in low-income adults with type 2 diabetes: The influence of perceived control constructs. *Dissertation Abstracts International, B65/07*, 3718.

Osterberg, L. & Blaschke, T. (2005). Adherence to medication. *New England Journal of Medicine, 353*, 487-497.

Ouellette, J., & Wood, W. (1998). Habit and intention in everyday life: the multiple processes by which past behavior predicts future behavior. *Psychological Bulletin, 124*, 54-74.

Primatesta, P., Brookes, M., & Poulter, N. R. (2001). Improved hypertension management and control: Results from the Health Survey for England 1998. *Hypertension, 38*, 827-832.

Robertson, D., & Keller, C. (1992). Relationship among health beliefs, self-efficacy and exercise adherence in patients with coronary heart disease. *Heart Lung, 21*, 56-63.

Rutter, D. R. (2000). Attendance and reattendance for breast cancer screening: A prospective three year test of the theory of planned behaviour. *British Journal of Health Psychology, 5*, 1-13.

Rutter, D. R. & Quine, L. (1996). Social psychological mediators of the relationship between demographic factors and health outcomes: a theoretical model and some preliminary data. *Psychology and Health, 11*, 5-22.

Schmier, J. K., & Leidy, N. K. (1998). The complexity of treatment adherence in adults with asthma: challenges and opportunities. *Journal of Asthma, 35*, 455-472.

Schnitzler, A., Leffers, K. W. & Häck, H. J. (2010). High compliance with rotigotine transdermal patch in the treatment of idiopathic Parkinson's disease. *Parkinsonism and Related Disorders*, 03-July-2010 (Epub ahead of print).

Scisney-Matlock, M., & Watkins, K. W. (2003). Validity of the cognitive representations of hypertension scales (CRHTN). *Journal of Applied Social Psychology, 33*, 817-832.

Sheeran, P., & Abraham, C. (2003). Mediator of moderators: temporal stability of intention and the intention-behavior relation. *Personality and Social Psychology Bulletin, 29*, 205-215.

Sheeran, P., Milne, S., Webb, T. L. & Gollwitzer, P. M. (2005). Implementation intentions and health behaviour. In M. Conner & P. Norman (eds.), *Predicting Health Behaviour* (2nd ed.) (pp. 276-323). Milton Keynes: Open University Press / McGraw-Hill.

Sheeran, P., & Orbell, S. (2000). Self-schemas and the theory of planned behavior. *European Journal of Social Psychology, 30*, 533-550.

Sparks, P., & Shepherd, R. (1992). Self-identity and the theory of planned behavior: Assessing the role of identification with "green consumerism". *Social Psychology Quarterly, 55*, 388-399.

Steadman, L., & Rutter, D. R. (2004). Belief importance and the theory of planned behaviour: comparing modal and ranked modal beliefs in predicting attendance at breast screening. *British Journal of Health Psychology, 9*, 447-463.

Stilley, C. A., Sereika, S., Muldoon, M. F., Ryan, C. M., & Dunbar-Jacob, J. (2004). Psychological and cognitive function: Predictors of adherence with cholesterol lowering treatment. *Annals of Behavioral Medicine, 27*, 117-124.

Taylor, S. E. (2009). *Health Psychology* (7th ed.). New York: McGraw-Hill.

Terry, D. J., Hogg, M. A., & White, K. M. (1999). The theory planned behaviour: Self-identity, social identity and group norms. *British Journal of Social Psychology, 38*, 225-244.

Trachtenberg, F., Dugan, E., & Hall, M. A. (2005). How patients' trust relates to their involvement in medical care. *Journal of Family Practice, 54*, 344-352.

Vaile, M. S. B, Calnan, M., Rutter, D. R., & Wall, B. (1993) Breast cancer screening services in three areas: uptake and satisfaction. *Journal of Public Health Medicine, 15*, 37-45.

Weir, M. R., Maibach, E. W., Bakris, G. L., Black, H. R., Chawla, P., Messerli, F. H., et al. (2000). Implications of a health life style and medication analysis for improving hypertension control. *Archives of Internal Medicine, 160*, 481-490.

Williams, B., Poulter, N. R., Brown, M. J., Davis, M., McInnes, G. T., Potter, J. F., et al. (2004). British Hypertension Society guidelines for hypertension management 2004 (BHS-IV): summary. *British Medical Journal, 328*, 634-640.

Williams, K. E., & Bond, M. J. (2002). The roles of self-efficacy, outcome expectancies, and social support in the self-care behaviours of diabetics. *Psychology, Health and Medicine, 7*, 127-141.

Wolf-Maier, K., Cooper, R. S., Kramer, H., Banegas, J. R., Giampaoli, S., Joffres, M. R., et al. (2004). Hypertension treatment and control in five European countries, Canada, and the United States. *Hypertension, 43*, 10-17.

Woodgate, J., Brawley, L. R., & Weston, Z. J. (2005). Maintenance cardiac rehabilitation exercise adherence: effects of task and self-regulatory self-efficacy. *Journal of Applied Social Psychology, 35*, 183-197.

World Health Organisation. (2003). *Adherence to Long-Term Therapies: Evidence for Action*. Geneva: World Health Organization.

Table 1 Zero order correlations (*r)* between predictors and outcome

	Intention	Adherence at Time 1	Adherence at Time 2
Gender	-.03	-.06	-.03
Age	.08*	.19***	.21***
Marital status	.03	.03	.03
Car ownership	.05	-.08*	-.03
Health status	.06	-.03	-.02
Years on medication	.09**	.10**	.01
Daily dosage	-.01	.04	.05
Perceived side effects	-.16***	-.09**	-.08*
Medical risk factors	-.01	.07*	.02
Family risk factors	.05	-.01	-.02
Conscientiousness	.22***	.18***	.11**
Hypertensive identity	.44***	.31***	.26***
Knowledge	.09**	-.04	-.08*
Attitude	.41***	.20***	.20***
Subjective norm	.43***	.18***	.17***
PBC	.33***	.24***	.10**
Intention	1.00	.32***	.24***
Intention certainty	.66***	.38***	.33***
Intention x certainty	.92***	.35***	.30***
Adherence at Time 1	.32***	1.00	.57***

Pairwise deletion: *n* ranges from 537 to 921

*p<.05 **p<.01 ***p<.001

Table 2 Model summaries for prediction of intention and adherence

Model	R^2	Adj R^2	R^2 change	F change	df1	df2	Sig *F* change
Time 1 Intention							
1	.05	.04	.05	3.9	10	682	p<.001
2	.36	.35	.31	55.0	6	676	p<.001
Time 1 Adherence							
1	.06	.04	.06	4.1	10	682	p<.001
2	.17	.15	.12	16.0	6	676	p<.001
3	.21	.19	.03	28.1	1	675	p<.001
Time 2 Adherence							
1	.32	.32	.32	253.4	1	535	p<.001
2	.34	.33	.02	61.7	10	525	ns
3	.36	.34	.02	2.2	6	519	p<.05
4	.37	.34	.01	4.7	1	518	P<.05

Table 3 Standardised beta coefficients from final models for each outcome

	Standardised Beta	t	Zero order correlation	Partial correlation	Semipartial correlation
Intention at Time 1					
Side effects	-.12	3.61**	-.16	.14	-.11
Hypertensive identity	.23	6.18***	.44	.23	.19
Knowledge	.08	2.42*	.09	.09	.07
Attitude	.17	4.70***	.41	.18	.14
Subjective norm	.23	6.22***	.43	.23	.19
PBC	.17	5.28***	.33	.20	.16
Adherence at Time 1					
Gender	-.08	-2.05*	-.06	-.08	-.07
Age	.12	2.85**	.19	.11	.10
Conscientiousness	.10	2.59**	.18	.10	.09
Hypertensive identity	.14	3.30**	.31	.13	.11
PBC	.11	3.05**	.24	.12	.10
Intention x certainty	.24	5.31***	.35	.20	.18
Adherence at Time 2					
Age	.14	3.17**	.21	.14	.11
Years on medication	-.09	-2.34*	.01	-.10	-.08
PBC	-.08	-2.16*	.10	-.09	-.08
Intention x certainty	.10	2.16*	.30	.10	.08
Time 1 adherence	.52	13.09***	.57	.50	.46

p<.05 ** p<.01 ***p<.001

Coefficients for predictors that failed to reach statistical significance are not shown

Table 4 Model summaries for prediction of individual measures of adherence at Time 1

	R^2	Adj R^2	df1	df2	F	Sig
Forget	.18	.16	17	675	8.9	p<.001
Careless	.18	.16	17	675	9.0	p<.001
Stop if feel better	.15	.13	17	675	6.9	p<.001
Stop if feel worse	.08	.06	17	660	3.4	p<.001

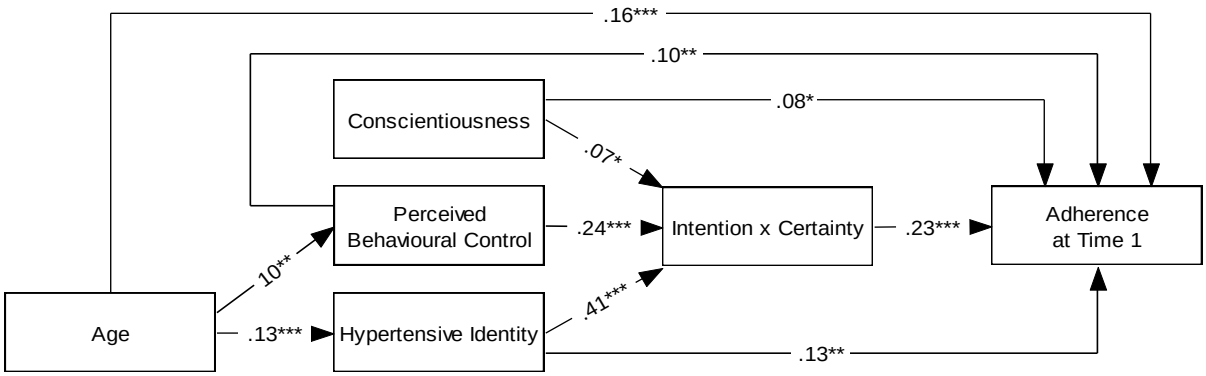
Table 5 Standardised beta coefficients from final model for individual adherence measures at Time 1

	Unintentional		Intentional	
	Forget	Careless	Stop if feel better	Stop if feel worse
Gender	.00	-.03	-.01	.06
Age	-.24***	-.15***	.01	-.04
Years on medication	.05	.00	-.04	-.06
Perceived side effects	.00	.07*	.09*	.05
Conscientiousness	-.07	-.07*	-.02	-.03
Hypertensive identity	-.14**	-.20***	-.09	-.03
Knowledge	.05	.04	.10*	.04
Subjective norm	.02	.04	.10	.05
PBC	-.06	-.04	.03	-.05
Intention x certainty	-.18***	-.16***	-.33***	-.21***

*p<.05 **p<.01 ***p<.001

Coefficients for predictors that failed to reach significance for any of the five measures of adherence are not shown

Figure 1 Path diagram for predictors of attendance at Time 1



Coefficients are standardised beta coefficients *p<.05 ** p<.01***p<.001

Adjusted R^2 0.18, F (4, 694) = 32.28 p<.001