



Review

A review of interventions used to improve adherence to medication in older people

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ABSTRACT

Background: Medication mismanagement is a continuous problem particularly in older people. Numerous interventions have been developed and tested in an attempt to improve adherence with medication in this client group.

Objectives: This review aimed to examine the simple to complex interventions that have been used to assess and improve adherence with medication in older people.

Design: An extensive review of the literature was performed and 20 relevant research papers and one report were chosen.

Findings: Research papers were evaluated according to design, RCTs were analysed using the JADAD scoring system, systematic reviews and reviews of the literature were reviewed using the Critical Appraisal Skills Programme and subjected to a narrative analysis. This process assisted the development to emerging themes. Four themes were developed: patient barriers, health professional involvement, and health related outcomes and formation giving.

Conclusions: The salient findings of the review infer that there is no clear definition of non-adherent behaviour. Quantitative interventions fail to assess patient choice in relation to medication taking. Pharmacist-driven interventions are resource intensive. Health care outcomes and clinical effectiveness are seldom addressed in interventions. Among the many difficulties encountered when attempting to use interventions to promote adherence with medication in older people is their perceptions and beliefs, the appropriateness of the medicines prescribed as well as the impact of lifestyle patterns: smoking, alcohol and diet. Many intervention studies are of poor quality and do not include a theoretical framework to underpin the interventions being used. More focused research is needed to improve understanding of the theoretical knowledge that underpins the complexities of adherence with medication in older people. In-depth qualitative studies can be used to develop such theory. In addition, the quality of intervention research can be improved by the inclusion of a research framework such as the Medical Research Council model.

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What is already known about this topic?

- Adherence to medication can vary from 0% to 65% depending on the client population.

- Older people are a vulnerable group due to the adverse effects of aging and increased propensity to develop multiple diseases that require pharmacological treatment.
- Up to 10% of older people are susceptible to unplanned admission to hospital due to drug-related causes.

What this paper adds

- There is a lack of consensus on how adherence to medication is measured in selective diseases.

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- There is a paucity of medication adherence intervention research that has examined health care outcomes, clinical efficiency or cost-effectiveness.
- Combined interventions that simplify medicine dosing regimens and use educational interventions can be effective in improving adherence to medication in older people.
- There is a need for more qualitative research that critically examines the complexities of adherence to medication in older people. Such examination would enhance current comprehension and provide a theoretical framework for intervention studies.

1. Introduction

The most common healthcare intervention is the prescription of medicines. In 2004, 686 million NHS prescriptions were dispensed in England with an estimated cost of 8 billion pounds (Horne et al., 2005). Even though medicines are used as therapeutic agents in the management of long-term conditions, it is estimated that 30–50% of prescribed medicines are not taken as recommended. This can create problems for both patients and the National Health Service (NHS) in England due to poor management of conditions.

Adherence with medication is a complex and intriguing behavioural issue which has been the focus of much debate. Horne et al. (2005) define adherence “as the extent to which the patients’ behaviour matches agreed recommendations for the prescriber” (p. 12). Possible influential factors include anthropological, psychological, biomedical parameters as well as the patients’ perceptions of illness (Higgins and Regan, 2004) and medication beliefs. Health beliefs are thought to be a useful indicator of adherence and a more powerful predictor of medication adherence than either clinical or sociodemographic variables (Horne and Weinman, 1999). In one study they accounted for 22% of the variance in medication adherence in patients with long-term conditions (Phatak and Thomas, 2006). If patient’s symptoms disappear, they may mistakenly feel that they are cured and no longer require treatment (Kjellgren et al., 1995). In this case it is important to identify the patient’s views on the duration of their treatment.

Non-adherence with medication is not a new issue. Often patients do not disclose their medication taking behaviour. Equally prescribers may be unaware of their patients’ medication taking practices. In older people of all ages, non-adherence with medication is an increasing problem (Ames, 2001; Gray et al., 2001), particularly among octogenarians (Morrell et al., 1997). This may relate to the fact that older people generally have more chronic conditions that often require complex pharmacological management involving several medicines. In older people estimated rates of adherence with medication range from 26% to 59% (van Eijken et al., 2003) but may be as low as 0% (Haynes et al., 1996; Nicol et al., 1999). These estimates are independent of pathological condition (Dodds et al., 2000; Benson and Britten, 2003; Wang et al., 2002; Aim-Roijer et al., 2004; Krousel-Wood et al., 2005b; Rubin, 2005). Factors attributed to non-adherence include; access to

medicines, polypharmacy, multiple morbidity (Hughes, 2004), undiagnosed dementia and alcohol problems (Cooper et al., 2005), complexity of regimens (Donnan et al., 2002) uncertainty about physician instructions (Browne et al., 2001), the risk of adverse drug effects (Cohen, 2001), dexterity problems (Blenkiron, 1996), lack of social support (Balkrishnan, 1998), poor relationship with health care providers (Vik et al., 2004), poor communication between prescriber and patient, inadequate follow-up processes, unclear medical instructions and inadequate titration of treatment doses (Ellenbecker, 2004; Lin and Ciechanowski, 2008; Morris et al., 2006). The culmination of these effects can result in an increased risk of poor therapeutic control of medical conditions, possible deterioration of health status and false impressions of medication taking behaviour for the prescriber which may result in inappropriate outcome of medication review and possibly the prescription of additional medicines to treat existing conditions.

Pound et al. (2005) in a recent meta-ethnography of qualitative studies identified that many patients were reluctant to adhere to their medication regimens because they had concerns about their medicines. Although this study was not exclusively focused on older people, issues raised such as making medicine taking safe and the provision of choice for patients are relevant to older people.

Non-adherence with medication can be classified as intentional, often related to the need to avoid drug-related adverse effects (Hughes, 2004; Fernando et al., 2006) or unintentional related to cognitive or visionary impairment (van Eijken et al., 2003); poor cognition (Gray et al., 2001) or due to poor educational achievement or forgetfulness.

In patients who fail to adhere to prescribed medication regimens, disease management is predominantly suboptimal or ineffective; particularly in long-term conditions such as hypertension (Krousel-Wood et al., 2005b; Lowry et al., 2005; Li et al., 2007), heart failure (Rich et al., 1996; Murray et al., 2004), in cases of multiple co-morbidities (Bernstein et al., 2001) and in situations where there is discordance between the drugs the patient administers and the drugs are actually prescribed (Yang et al., 2001). Medication mismanagement in older people often leads to iatrogenic disease, problems gaining access to best treatment (Horne et al., 2005) and unplanned admission to hospital. Pearson (2000) identified that circa 10% of unplanned admissions involving older people were related to the adverse effects of medicines. This may not be surprising as older people receive 45% of the medicines prescribed in England (DH, 2002). In response to the ever increasing drug budget and its impact on NHS resources, the current government increased investment in practitioner involvement in the management of long-term care conditions (DH, 2005).

Numerous instruments have been developed and tested to assess older people’s capacity to manage and adhere to their medicines (Girerd et al., 2001; Roter et al., 1998). Educational strategies have been used in an attempt to improve adherence with medication (Grant et al., 2003). In addition to pharmacy-driven care programs that focus on educational initiatives along with blood pressure

monitoring (Li et al., 2007) and pharmacy-driven medication review interventions (Royal et al., 2006).

In their recent review, Farris and Phillips (2008) identified 15 instruments that have been developed for this purpose. Each instrument measured aspects of medication management but differed on the duration needed to administer the tool. Although five instruments were felt to be superior due to their brevity, assessment of numeracy and patient knowledge (Orwig et al., 2006), the instruments did not include measures to identify patients with medication mismanagement problems or the support networks that patients required in order to self-manage medicines. In addition, numerous interventions have been developed to improve understanding of the technicalities of non-adherence with medication, how to influence and improve it (Stuurman-Bieze et al., 2004; Parthan et al., 2006; Royal et al., 2006). Interventions range from minor adjustments to the medication regimen to complex, multiphase interventions that promote extended pharmacist roles and consider barriers to communication and how to improve health care provision (Roter et al., 1998; McDonald et al., 2002).

Many interventions include a wide age range and therefore do not focus specifically on older people. Even though non-adherence with medication can have a significant impact on health resources and health care costs such as drug budget and costs of unplanned hospitalization. It was felt appropriate to focus on this patient population to examine what impact adherence interventions may have in this population of patients. The aim of this review is to examine the available literature on interventions used to improve adherence with medication in older people.

2. Method

This review draws on established methods to review the literature (CRD, 2001). This review attempts to evaluate a range of existing research that is relevant to interventions that have been used to improve adherence with medication in older people populations. The aim of this review is to provide a succinct account of the range of existing evidence that has explored and researched the use of interventions to address adherence with medication in older people. This review provides evidence of a scoping exercise that illustrated the range of published evidence pertinent to styles of interventions currently used to address adherence with medication in older people: information giving, patient behavioural approaches, the role and inclusion of health care professions in interventions and impact on health related outcomes. The study drew on both UK and international literature in an attempt to illustrate for complexity and depth of the subject and the global nature of the subject matter.

The search strategy involved the use of the following data bases: Google scholar, Cinahl, advanced Google Scholar, the Cochrane Library, Pubmed, Medline and British Nursing Index. Evidence was also generated from hand searching individual journals. A defined search strategy was undertaken using the following terms: older people and medicines, elderly people, non-adherence to medications,

medication taking interventions, drug-related interventions, behavioural interventions, information focused interventions, combined medication interventions, single medication interventions. Search terms were used in combination. Research studies, RCTs, systematic reviews, exploratory studies using qualitative and quantitative research designs, Cochrane reviews, critical reviews of the literature and department of health reports were included in the review if they addressed the research question: which interventions improve adherence with medication in older people? References were preferentially selected from a 12-year period from 1996 to 2008 as it was felt that most relevant studies pertinent to the subject area would be located within this period and would reflect the currency of the available literature.

In total 892 references were identified electronically and by hand searching. Abstracts and titles were scanned for relevance. In total 60 reports were selected for in-depth evaluation and, of these 20 research studies emerged that examined interventions used to improve adherence with medication in older people (Tables 1 and 2). These included 2 RCTs, 7 systematic reviews, 2 Cochrane reviews, 2 meta-analyses, 3 critical reviews, 1 qualitative study, 3 quantitative studies and 1 NCCSDO report.

Studies were excluded if the sample population in studies was under 65 years of age, studies in which the sample population included a wide range of client ages as these studies would possibly not reflect the concerns of older people. Studies where the exploration of interventions did not focus on adherence with medication, or made no attempt to measure adherence with medication were excluded. In this review, the JADAD scoring system was used to analyse the quality and rigour of RCTs (Jadad et al., 1996). Using this scoring system, each RCT was summed to give an overall numerical score out of a possible 5. A score of 5 is indicated to be of the strongest and a score of 0 being the weakest indicator of quality. RCTs that achieved a score of 2 or less than 2 using the JADAD scoring system were excluded as they were felt to be of an inferior quality (Jadad et al., 1996) (Table 3). RCTs of short duration, less than 3 months were excluded as the short time scale would not be of sufficient length to measure the efficacy of interventions. Full text papers not written in English were excluded. Studies which focused on medication management interventions involving antipsychotic medication or patients with a history of psychotic or personality disorders were excluded as these patients may have altered perceptions of reality which could adversely influence adherence with medication.

Qualitative and quantitative papers were appraised using the Critical Appraisal Skills Programme (CASP, 1998) this approach allowed papers to be excluded in the review if they were judged to be insufficiently focused on older people, were interventions that did not address adherence to medication or studies that did not analyse data using qualitative methods. The papers included in the review used a variety of research designs: pilot studies, meta-analyses, systematic reviews, questionnaire surveys, randomised controlled trials, cohort studies, and a range of exploratory quantitative studies, and a qualitative study reporting the syntheses of qualitative studies. As studies

Table 1
Adherence interventions using RCTs.

Authors	Sample	Research approach	Main findings	Conclusion
Nazareth et al. (2001)	Multi-site RCT involving 362 elderly people, average age 84 years.	6 month RCT measuring adherence using self-report. Patients all administering at least four medicines.	Pharmacists provided counseling and medication advice to 71% of elderly people in the study.	The provision of counseling and medication advice to elderly individuals failed to have significant impact on health care outcomes
Wu et al. (2006)	442 older people administering 4–5 medicines to treat chronic diseases.	2 year RCT measuring medication adherence as a predictor of death in older people. Adherence measured by self-report and prescription refill.	Counseling calls associated with a 41% reduction in mortality risk. Adherence score, quantity of prescribed medicines was a predictors of death.	Poor adherence with medication was associated with increased mortality. Periodic telephone counseling improved adherence with medication.

differed in interventions used, outcomes measures employed, time scale involved, and results, no meta-analysis was possible. For this reason a narrative synthesis of the evidence was undertaken. This allowed subjective analysis and judgements of the relative merits of papers

specific to the aim and objectives of the study and to what extent these were addressed. This analysis aimed to extract the salient aspects and merits of each study and their contribution to the subject area in order to present a substantial and coherent overview of the available

Table 2
Summary of studies included in the synthesis.

Authors	Sample	Research approach	Main findings	Conclusions
Haynes et al. (1996)	Systematic review examining interventions used to assist patients to follow prescriptions of medicines.	13 RCTs of studies examining adherence to medication using a variety of approaches, clinical problems and clinical outcomes.	Substantial improvements in adherence to medication was limited to the most effective and complex interventions. It is difficult to assess the full therapeutic benefit of medicines at the current levels of adherence.	Although adherence with medication can be improved through the use of complex interventions, there needs to be considerable effort made to assist patients to adhere to treatment options.
Roter et al. (1998)	75, 853 subjects in 153 studies.	Meta-analysis of 153 studies that examined compliance interventions published between 1977 and 1994. Comp	Compliance indicators that were assessed include pill counts, refill records, health outcomes, urine and serum measurements, patient's records, appointment records.	No single intervention showed a clear advantage compared with another however comprehensive interventions combining cognitive, behavioural and affective components were more effective than a single-focus intervention.
Newell et al. (1999)	Review of RCTs generated from 1985 to 1996 involving 4976 participants.	20 RCTs of compliance intervention studies.	Adherence with medication was improved by reducing dose frequency, and the use of compliance enhancing packaging.	The poor quality of the studies reviewed prevent the development of strong recommendations treatment outcomes improvements in adherence and six interventions were related to improvements in treatment outcomes.
Nunney and Raynor (1999)	152 community pharmacies.	A questionnaire-based survey to assess multi-compartment compliance aids (MCAs).	78% response to a questionnaire. 92 pharmacists delivered MCAs to 1, 327 patients.	There appears to be limited benefit of MCAs. Unintentional adherence can be managed by the rationalization/simplification of regimens/medicine remainder charts.
McDonald et al. (2002)	Review of adherence literature on specific long-term conditions.	Review of 39 un-confounded RCTs examining adherence specific to treatment of long-term conditions.	49% of interventions were statistically significant increases in medication adherence.	Several interventions were apparent, but no consistent characteristics of effective interventions were identified.
Peterson et al. (2003)	Meta-analysis of RCTs and research reports.	61 studies of adherence interventions.	Data was not homogenous so conclusions are difficult to reach.	ES combined score for behavioural and educational interventions was small at 0.08 (CI 95% 0.04–0.12).

Table 2 (Continued)

Authors	Sample	Research approach	Main findings	Conclusions
van Eijken et al. (2003)	Systematic review examining interventions used to improve adherence to medication in older people living in the community.	14 RCTs used to assess to what extent multifaceted interventions improve adherence compared with single interventions.	14 RCTs reported 23 interventions. Of these telephone linked systems appeared to be more successful in promoting adherence.	Adherence rates were predominantly influenced by multifaceted and tailored interventions compared to single and generalized interventions.
Higgins and Regan (2004)	Systematic review of medication adherence in older people over the age of 65 years.	Review the literature from 1980 to 2002 that examined interventions to improve adherence with medication.	Seven studies revealed that interventions such as pill counts and patient interviews but independently and in combination.	There is no strong evidence to support the use of one intervention type, future research should focus on combination of approaches.
Ponnusankar et al. (2004)	90 older people with a history of asthma, hypertension, heart disease or diabetes.	9 month evaluation study where patients were randomized to usual care or counseling intervention.	After intervention, 67% of patients in the intervention group had increased medication knowledge.	Medication education increased compliance in the intervention group after assessment using the compliance score.
Carlson et al. (2005)	Sample of 360 female older people.	Used the Hopkins Medication schedule (HMS) to examine non-compliance with medication.	22% of patients were unable to complete the HMS and could not write or implement a routine medication regimen. The use of pill counts was strongly associated with memory recall.	The HMS can be used as a standardized measure to identify patients at risk of poor adherence to medication.
Haynes et al. (2005)	Cochrane review of interventions used to enhance adherence with medication.	Review of 49 RCTs that focused on medication interventions.	The most effective medication adherence interventions were those that were complex and combined strategies.	Even the most effective intervention failed to have any effect on clinical outcomes.
Heneghan et al. (2007)	Critical review of available RCTs on compliance aids.	Eight RCTs involving 1137 patients that examined the use of reminder packaging to improve adherence.	Meta-analysis of eight RCTs indicated that the use of reminder packaging significantly increased the percentage of pills taken.	Reminder packaging can be used as an effective method of improving adherence with medication with long-term conditions.
Kripalani et al. (2007)	Systematic review of RCTs of published trials from 1967 to 2004.	37 un-confounded RCTs that examined interventions of medication adherence in patients with long-term conditions.	Behavioural, informative and combined interventions assisted the development of adherence with medication.	Only 11 out of 36 studies showed improvement in at least one clinical outcome.
Pound et al., 2005	Meta-ethnography of qualitative studies.	42 studies of medicine taking behaviour and practice.	Patients with different diseases described their medication taking behaviour.	Patients fail to take their medicines usually because of concerns about the medicines.
Schroeder et al. (2004)	Cochrane review of interventions that could improve adherence with medication.	Review of 38 studies containing 15,519 patients with hypertension from 1975 to 2000.	Studies were too heterogeneous to pool findings. Simplifying drug regimens increased adherence in 9 studies from 8% to 19.6%.	Simplifying the drug regimen is a useful measure to improve adherence also motivational strategies can also be useful.
Lu et al. (2008)	Systematic review of interventions used to improve the quality of medication use in managed care.	Systematic review of 51 studies that examined drug education, formulary interventions, computerised and collaborative care schemes.	Effective interventions included pharmacist-led interventions, computerised alerts. Group education and educational materials have limited impact on adherence.	Although multifaceted approaches can improve adherence with medication, and also pharmacy-driven collaborative care is also beneficial but there is limited evidence of the cost-effectiveness of these interventions.
Williams et al. (2008)	Systematic review of the medication interventions used to improve adherence in older people with three or more chronic conditions.	Eight RCTs that examined the medication adherence interventions used to manage older people with three pre-existing chronic diseases.	Pharmacy led interventions focused on reducing polypharmacy and health care costs.	The complexity and heterogeneity of the tools used to assess adherence made it difficult to compare interventions. Psychosocial interventions require further development. Driven interventions were most commonly used.

Table 3
JADAD scoring for assessing randomised controlled trials.

Item	Score	Nazareth et al. (2001)	Wu et al. (2006)
Was the study described as randomised?	0/1	1	1
Was the method used to generate the sequence of randomization described and appropriate?	0/1	1	1
Was the study described as double blind?	0/1	1	1
Was there a description of withdrawals and dropouts?	0/1	0	1
Deduct one point if the method used to generate the sequence of randomization was described and appropriate	0/–1	0	0
Deduct one point if the study was described as double blind but the method of blinding was inappropriate	0/–1	0	0
Total score		3	4

A numerical score is provided between 0 and 5 as a rough measure of study design/reporting quality. A score of 0 is regarded as weak and a score of 5 is regarded as strong.

evidence. The results also include the findings and inferences provided from an extensive NCCSSDO report on concordance, adherence and compliance in medication taking (Horne et al., 2005).

3. Findings

Studies that reported on specific interventions to improve and enhance adherence with medication were heterogeneous in terms of their quality, patient population, duration, outcome measures employed and follow-up duration schedules. Two RCTs were included: Nazareth et al. (2001) and Wu et al. (2006). Wu et al. (2006) achieved the highest JADAD score of 4, followed by a score of 3 for Nazareth et al. (2001).

Quality concerns also existed with regard to the methodological rigour of systematic reviews. Higgins and Regan (2004) identified that few RCTs employed randomisation, concealment allocation or power analysis methods. A definition of adherence was only provided in studies by Ware et al. (1991) and Wolfe and Schirm (1992). This finding concurs with a recent study (Williams et al., 2008). Only three studies identified some statistical significant effect but had limited clinical outcome (Ware et al., 1991; Lipton and Bird, 1994; Lowe et al., 2000). Significant findings relate to either cognitive support specific to the mechanics of medication delivery or education strategies and the use of physical aids to enhance adherence with medication. Ware et al. (1991) reported a significant improvement in adherence using blister calendar packs and cognitive support data indicate that a significant improvement in adherence with medication with values of (86.7% vs. 66.7%) at discharge and (48.9% vs. 23.1%, $p < 0.05$) at 3 months follow-up. In Lipton and Bird (1994) study, the significant data refer to the composite medication taking adherence score based on assessment and self-reporting during patient interview. The following data were yielded with respect to improvement in adherence with medication (96.3% vs. 91.2%, $p < 0.05$). Lowe et al. (2000) also used an adherence score based on individual tablet count. Data indicate mean values of 91.3% (95% CI: 88.7, 93.9) vs. mean of 79.5% (95% CI: 74.7, 84.3 $p < 0.0001$). Although the data illustrate that significant effect were achieved the clinical outcome in terms of patient benefit or a considerable change in

patient medication taking behaviour appears to be limited.

In the systematic review by Vergouwen et al. (2003) the heterogeneity of studies prevented any meaningful quantitative comparisons and therefore studies were summarized qualitatively. Even though educational intervention appeared to enhance adherence with anti-depressant medication, meaningful statistical analysis was not available.

In contrast, Kripalani et al. (2007) assessed the effect size or standard deviation units for four types of interventions: informational, behavioural, family and social and combined. Effect size (ES) was assessed as being small (0.20 to <0.5), medium (0.50 to <0.80) or large (>0.8) in order to provide an estimation of the true effect of the intervention. The ES data varied depending on the intervention. Adherence increased most following behavioural interventions that reduced the medication dosing demands. Data in three studies indicated a large ES of (0.89–1.2). Information interventions produced a variable effect on adherence. Evidence from six multi-session trials resulted in varied ES data of (0.3–1.13), and in combined interventions the ES data was (0.3–1.20). The ES data imply that combined interventions are more effective than informational interventions in improving medication adherence in patients with long-term conditions.

The systematic review by Haynes et al. (1996), identified that only 7 out of 15 intervention studies indicated some significant improvement in adherence with medication and only 6 out of the 15 intervention studies led to significant improvement in treatment outcomes. Haynes comments that irrespective of the advancements in medical therapeutics and the multitude of highly rigorous RCTs, there has not been an equivalent response with regard to intervention RCTs. In fact there is a paucity of available studies. Many of these overestimate adherence due to the use of imprecise measurements such as self-report or the small numbers of patients involved. Small scale studies usually lack the statistical power to detect clinical outcomes or important effects in 25% of patients.

Evidence from current research contributed to the development of four key themes: patient behavioural approaches, information giving, health professional involvement, and health related outcomes (Table 4).

Table 4
Interventions used to examine adherence with medication in older people.

Intervention approaches	Interventions used
Behavioural	Drug compliance aids, blister packaging, drug calendars, reminder charts, pill boxes, refill containers.
Educational	Individual and group teaching and discussions, medication cards and charts.
Health care professional involvement	Domiciliary visits, brown bag reviews, patient education programmes, medication review, drug check ups.
Health outcome specific	Blood pressure, cholesterol and peak flow monitoring serum and urinary drug levels.

4. Patient behavioural approaches

Behavioural approaches have been used to assess medication taking behaviour and improve adherence with medication since 1990s. Approaches include: the use of specialized packaging such as blister and reminder packaging (Haynes et al., 1996; Newell et al., 1999; Higgins and Regan, 2004; Horne et al., 2005; Heneghan et al., 2007), medication reminder charts, multi-compartment compliance aids (Nunney and Raynor, 1999; Heneghan et al., 2007), pill counting techniques (Ponnusankar et al., 2004; Roter et al., 1998) and pill boxes (Carlson et al., 2005). Also self-monitoring of pills, direct observation of therapy, patient medication feedback (Carlson et al., 2005; Heneghan et al., 2007; Schroeder et al., 2004) and self-assessment of patients (Ponnusankar et al., 2004).

Blister packaging can be useful when combined with cognitive support (Higgins and Regan, 2004); independently its effect is variable. In studies with 1137 participants only 11% found blister packaging useful (Heneghan et al., 2007) which may be a reflection of the manufacturers packaging or dexterity related problems (Roter et al., 1998).

Assessment of adherence has been undertaken through pill counting and counseling techniques to compile a medication score. Ponnusankar et al. (2004) reported compliance scores of 94 ± 4.5 compared to 84.7 ± 11.8 in usual care group and self-reported estimates of compliance were 66.6% vs. 25% in the counseling and usual care groups, respectively. These data imply that pill boxes can improve adherence. However, not all patients can manage pill boxes or maintain a routine medication schedule (Carlson et al., 2005). Although these are interesting findings, inconsistency in measuring adherence using measures such as direct self-report, pill counts, and direct questioning is reported and more uniform approaches are needed (Schroeder et al., 2004).

More success may be achieved by reducing the complexity of the medication regimen through reduction of the quantity of medicines administered in order to improve unintentional non-adherence (Nunney and Raynor, 1999; Schroeder et al., 2004). Such reductions can improve the adherence range from 8% to 19.6% and increase adherence rates (90% vs. 82%, $p < 0.01$) (Schroeder et al., 2004) but it is debatable whether they result in a change in clinical outcome (Kripalani et al., 2007). In general RCTs poorly illustrate how behavioural approaches to medication adherence impact on patient behaviour. Horne et al. (2005) recommend that interventions should address patients' perceptual and practical barriers (cognitive capacity) in order to evaluate their possible contribution to adherence.

5. Information giving

Patient education is a traditional approach to tackling the problem of adherence with medication in older people. Education is often implemented either as a single intervention involving one or several hours of instruction, accompanied by written instructions or as part of a complex or multiphase interventional approach (Roter et al., 1998; McDonald et al., 2002; Peterson et al., 2003; Higgins and Regan, 2004; Kripalani et al., 2007; Schroeder et al., 2004; Lu et al., 2008). The delivery of patient medication education is predominantly led by pharmacists where teaching is provided on an individual basis but can also take the form of self-medication programmes and home visits (Higgins and Regan, 2004; Lu et al., 2008). Although pharmacist led teaching was considered effective, educational interventions were generally ineffective with reported ES scores of 0.11 (95% CI: 0.06–0.15) (Peterson et al., 2003), and a wide ranging (ES score of 0.35–1.13) in 6 out of 12 studies (Kripalani et al., 2007). Even though Kripalani et al. (2007) reported that educational interventions delivered over multiple sessions can lead to some improvements in adherence, other reports are less favourable (McDonald et al., 2002; Vergouwen et al., 2003; Schroeder et al., 2004; Lu et al., 2008). Educational interventions are largely unsuccessful, complex interventions are more efficient and productive and can increase adherence by as much as 5–41% (Schroeder et al., 2004). Although Roter et al. (1998) concluded that direct education as a single intervention strategy was comparable to familial support and behavioural strategies; no individual intervention strategy was thought to be superior.

6. Health care professional involvement

Pharmacists have predominantly been recruited to intervention studies to provide advice and guidance to patients on how to manage their medicines (Nazareth et al., 2001; Higgins and Regan, 2004; Wu et al., 2006; Lu et al., 2008; Williams et al., 2008). These interventions vary in terms of design and pharmacist involvement and include; the use of tailored educational tools and the recognition of medication discrepancies (Williams et al., 2008), telephone counseling service (Wu et al., 2006), educational programme or pharmacist-driven discharge planning programme and follow-up visit (Nazareth et al., 2001), education plus icon-labeled medication containers plus therapeutic monitoring or the provision of collaborative care by pharmacists (Lu et al., 2008). Although the heterogeneity of study design makes it difficult to compare study outcomes, Wu et al. (2006) and Lu et al. (2008) agree

that pharmacists involvement was beneficial as they helped to augment adherence with medication in older people.

In some cases pharmacy involvement reduced mortality rates in older people evidenced by a reduction in the risk of death (Wu et al., 2006). In 1011 patients the adjusted relative risk for death was 1.61 (95% CI: 1.05, 2.48, $p = 0.029$) and relative risk 2.87 (95% CI: 1.80, 2.57, $p < 0.001$) in patients with compliance scores of 34–66% and 0–33%, respectively (Wu et al., 2006). However, not all pharmacist-led interventions were beneficial. One only increased medication knowledge in older people (Nazareth et al., 2001). In contrast, Higgins and Regan (2004) reported that pharmacists who lacked clinical experience impeded the success of educationally focused interventions.

7. Health related outcomes

The ultimate goal of adherence interventions is to improve health related outcomes. Evidence from systematic reviews indicate that health related improvement is variable with only 18 out of 49 RCTs indicating some improvement (Haynes et al., 2005) and ES scores of (0.17–3.41) in 9 out of 20 RCTs (Kripalani et al., 2007). The most effective RCTs are complex, multi-multifaceted, combined interventions which are more likely to address the multiple barriers to non-adherence and result in differences in compliance rates (van Eijken et al., 2003). However not all complex interventions are effective. Williams et al. (2008) found that the use of such interventions in chronic conditions were generally ineffective and weak. There is some evidence that longer duration intervention studies, e.g. greater than 12 months strategies may reduce health care costs (Bernstein et al., 2001).

In their meta-ethnography of qualitative studies, Pound et al. (2005) stressed the need to prioritize and explore innovative measures that can provide new ways to address patient adherence with medication for long-term conditions and the safety of medicines. Horne et al. (2005) also acknowledged that currently there is a paucity of good quality research that has adequately addressed the complexity of adherence with medication especially in older people and common medical conditions with reported poor adherence with medication, e.g. hypertension and heart failure. There has been some development in terms of research quality of intervention studies. The Medical Research Council (MRC) framework raises awareness of some of the methodological issues that are important when assessing adherence with medication in older people.

8. Discussion

Medicines management of the long-term conditions that affect older people is an important aspect of the care they receive. The decision-making processes that underpin the treatment of long-term conditions and the use of medicines as therapeutic agents are extremely important for the success of any therapeutic intervention (Belcher et al., 2006; Braddock et al., 1997). For therapeutic

interventions to operate successfully, the manner by which health care professionals communicate with patients is important and is a salient feature to the development of a concordant alliance with the patient (Pound et al., 2005). A key and essential feature of this alliance is the development of trust between the patient and the prescriber and the provision of opportunities for the patient to share their health beliefs, possible concerns about the relative dangers of medication and dependence and impressions of the role of medicines in the management of their condition (Horne and Weinman, 1999; Phatak and Thomas, 2006). It is equally important to examine the patients' educational and personal needs to explore how influence the administration of their medicines (Jones, 2003; Pound et al., 2005). Esposito (1995) and Elliot (2003) have shown that education can have a significant impact on adherence with medication and can help to optimise adherence when used concurrently with the provision of written instructions. In this regard nurses have been found to be influential in providing patient centred medication education especially post discharge from hospital (Wolfe and Schirm, 1992).

Problems encountered when attempting to challenge non-adherent drug taking behaviour in the older person is the lack of a simple descriptor of the non-adherent patient and the difficulties encountered in actually measuring drug adherence. Quantitative interventions to assess adherence with medication, e.g. drug counts and electronic monitoring often fail to assess the reasons why patients are non-adherent with their medicines (Stimson, 1974; Horne et al., 2005) which is related to patient choice (Weintraub, 1990; Pound et al., 2005).

Interventions used to enhance patient/service user interaction, e.g. pharmacist or nurse involvement can be effective however these interventions are resource intensive and their effectiveness may decline over time (Hawe and Higgins, 1990; Rich et al., 1996). Similarly, interventions employed to reduce patient barriers such as complexity of drug regimens or using blister packs have demonstrated favourable results (Ware et al., 1991; Heneghan et al., 2007). This approach can be used as a component of a combined or multiphase intervention strategy where each individual component is evaluated in order to express their individual benefit (Kripalani et al., 2007).

Few interventions evaluate and produce significant health related outcomes such as the extent of clinical effectiveness in conditions such as hypertension, asthma and schizophrenia (Haynes et al., 1996, 2005; Kripalani et al., 2007). There are inherent difficulties of using interventions to evaluate non-adherence with medication in elderly populations such as the impact of associated factors and their influence on therapeutic efficacy; perceptions of illness, need for medication, lifestyle patterns, alcohol use, diet, the appropriateness of prescribed medication regimens and the fact that many patients modify their drug regimens related to the significance of drug-related side effects (Haynes et al., 2005; Horne et al., 2005).

For interventions to be successful, they need to be both perceptual (addressing the patient's beliefs and preferences)

and practical related to factors that underpin intentional and unintentional non-adherence such as motivation and cognitive capacity (Horne et al., 2005). Interventions should be multifaceted, tailored to meet the needs of the patient, and sufficiently pragmatic to reduce unnecessary administration of drugs. They need to concurrently simplify the dosage regimen and take into consideration the patient perspective (Lipton and Bird, 1994; Dodds et al., 2000; Elliott, 2003; van Eijken et al., 2003; Hughes, 2004). Multiphase intervention strategies are also needed to consider patient considerations from biological, sociological and psychological perspectives in order to address variables that can have an impact of non-adherence with medication (Krousel-Wood et al., 2005a).

The RCTs reviewed did not use a theoretical framework to underpin their studies. There is an absence of theoretical models that assess the complexities of adherence with medication in older people. Extensive theory development is needed to assist and enhance current understanding of the complexities of patterns of adherence, older patients' preferences and actions specific to adherence with medication and to help guide the development of theoretical models that can be used in applied research. To achieve this, more in-depth qualitative studies are needed that examine older patient's adherence with medication.

Although the research framework such as the MRC model (Campbell et al., 2000) is available and can be used to assess and evaluate complex adherence interventions in a systematic way with identified stages that can be used to accumulate evidence of what works and why and also permits an evaluation of cost-effectiveness (Horne et al., 2005; Elliott et al., 2005), however there is acknowledgement of the need for a theoretical frame to assist the development of intervention studies.

The aim of this review was exploratory in that it aimed to present the available evidence from qualitative and quantitative studies that investigated the use of interventions to assess adherence with medication in older people. This review is limited in several ways. It did not permit a full exploration of studies with respect to their design, study population and their characteristics, an evaluation of the size of effects across studies, and an assessment of the possible factors that may limit the generalizability of the results of the review. Also despite extensive searching some studies may have been omitted. This may be due indexing of studies or the fact that intervention studies pertinent to older people may traverse a wide range of diseases.

9. Conclusion

Non-adherence with medication in older people is a complex problem which is exaggerated by the lack of consensus on how adherence is measured in selective diseases (Hughes, 2004) and the absence of theoretical comprehension of the tenets of non-adherent behaviour related to medication. A research framework is available in the form of the multi staged MRC model tool that can test the cost-effectiveness of interventions (Campbell et al., 2000; Horne et al., 2005). According to Horne et al. (2005) a

research priority is the need "to develop effective, efficient and equitable interventions to facilitate informed choice and optimal adherence to appropriate prescriptions where adherence matters most" (p. 160). In order to achieve this greater understanding of the underpinning knowledge of adherence with medication is required particularly in related to older people due to the quantity of medicines prescribed.

Conflict of interest

None.

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