

Adherence to disease management programs in patients with COPD

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Abstract: The management of COPD is complex and patient adherence to treatment recommendations is known to be poor. In this paper the methods used for evaluating adherence in COPD are compared. Self-reporting has satisfactory reliability and offers a cheap, simple and easy method for assessing adherent behaviors. Unlike the objective measures of adherence such as electronic monitoring, self-reporting helps in identifying the reasons for nonadherence, which in turn would be useful in addressing adherence issues.

Patients do not follow their treatment recommendations either intentionally or unintentionally. Intentional deviations are driven by patient beliefs and experiences about illness and treatment, which are in turn influenced by social and cultural factors. Unintentional deviations are often due to cognitive impairment and lack of routines. Factors associated with adherence in COPD have been explained using the Becker-Maiman model.

Strategies for overcoming nonadherence have to be formulated based on the nature and reasons for nonadherence. In the event of unintentional nonadherence, the use of adherence aids like Dosette boxes, calendar packs and reminders should be promoted. Understanding patient beliefs and experiences, patient education focusing on the pathology of COPD and the role of treatment, periodic monitoring and reinforcement are critical for overcoming the barriers of intentional nonadherence.

Keywords: adherence, COPD, intentional, unintentional, measure, factors

Introduction

Chronic obstructive pulmonary disease (COPD) is and will continue to be a major public health problem in both developed and developing countries (Murray and Lopez 1996, 1997; WHO 2004). Progressive introduction of pharmacologic, non-pharmacologic and surgical treatments are often necessary to cope with the deteriorating respiratory function in COPD (Pauwels et al 2001). Treatment effectiveness in any condition depends not only on the appropriateness of the drugs prescribed and/or the recommendations given, but also on patient commitment to the intended treatment (Marinker et al 1997). Failure to take medicines as intended or deviations from recommended management might result in therapeutic failure as well as wastage of health resources (McKenney and Harrison 1976; Col et al 1990; Stanton et al 1994; Howard et al 2003). Health professionals may be unaware of their patients' drug utilization patterns and may underestimate the effectiveness of drug regimens, in turn leading to prescribing errors (Mellins et al 1992). The importance of patient commitment for the success of COPD management programs is well recognised (Pauwels et al 2001).

The extent to which a person's behavior (in terms of taking medications, following diets, or executing lifestyle changes) coincides with medical or health advice was labeled as 'compliance' in late 1970s (Haynes et al 1979). In the modern era patient rights not to follow the medical advice is well recognized and 'compliance' is regarded to be politically incorrect. It is increasingly being replaced with 'adherence', which is

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less judgmental and more respectful of the role that patients can play in their own treatment (Marinker et al 1997). Deviations from clinical prescriptions or recommendations have been evaluated quantitatively and qualitatively. Quantitative definitions for medication adherence often refer to the extent of those deviations and include amount of medicine taken over a given time period, or to the extent of its correlation with aspects such as the recommended timing of the medication, the intended duration of the treatment and the recommended method of administration (Marinker et al 1997). Based on the extent of utilization, three patterns of medication nonadherence – viz ‘underutilization’, ‘over utilization’ and ‘inappropriate use’ have been reported (Dolce et al 1991). In a meta-analysis of studies reporting adherence to medical treatment, the average nonadherence rate was found to be 24.8% (DiMatteo 2004).

Qualitative definitions refer to variables such as intentionality, memory and health beliefs that result in deviations from the recommended treatment (Marinker et al 1997). Deviations from treatment recommendations could be intentional and/or unintentional. ‘Unintentional nonadherence’ may be due to simple forgetfulness, or inability to follow treatment instructions because of poor understanding or physical problems such as poor eyesight or dexterity problems (Marinker et al 1997). ‘Intentional nonadherence’ arises when the patient rejects either the doctor’s diagnosis or the doctor’s recommended treatment (Horne 1997; Marinker et al 1997). The latter is often a rational decision made by the patient to reject either the diagnosis or the recommended treatment after careful consideration of the perceived risks/costs versus benefits and has been called ‘intelligent nonadherence’ (Weintraub 1990). It is often driven by patient beliefs and experiences about illness and treatment, which are in turn influenced by social and cultural factors. This paper gives an overview of adherence research in COPD with a focus on the methods employed for studying adherence and the factors associated with adherent behavior.

A literature search using OVID and International Pharmaceutical Abstracts (IPA) was performed with the following terms: (COPD OR bronchitis OR emphysema) AND (adherence OR compliance OR concordance). Relevant articles were selected after reviewing the abstracts.

Adherence in COPD

Adherence to both pharmacological and non-pharmacological management is critical for optimal outcomes in patients with COPD (Pauwels et al 2001). Good medication adherence was associated with both decrease in the number

of hospitalizations and length of hospital stay among patients with chronic respiratory ailments (Balakrishnan and Christensen 2000). It would be reasonable to assume that in a symptomatic disease with progressive decline in quality of life such as COPD, patients would strictly follow the medical advice. However, in a meta analysis of adherence studies, the mean adherence to medical treatment in pulmonary diseases was found to be only 68.8% (DiMatteo et al 2002), which was much less compared to mean adherence in other chronic disease conditions. Nonadherence in COPD is a multi-dimensional quandary and includes short and long-term medication nonadherence (Chryssidis et al 1981; Taylor et al 1984; James et al 1985; Dolce et al 1991; Dompeling et al 1992; Rand et al 1992, 1995; Turner et al 1995; Bosley et al 1996; Hatton et al 1996; Pepin et al 1996; Simmons et al 1996, 2000; Corden et al 1997; Gallefoss et al 1999; Balakrishnan and Christensen 2000; van Grunsven et al 2000), nonadherence to life style changes such as smoking cessation (James et al 1985; Rand et al 1995; Turner et al 1995; Gallefoss et al 1999; Young et al 1999; Mapel et al 2000; Simmons et al 2000), non-participation in or early withdrawal from respiratory rehabilitation or exercise programs (Young et al 1999; Emery et al 2003; Arnold et al 2006), failure to meet vaccination requirements (Fox et al 1995; Nichol et al 1999; Garcia-Aymerich et al 2000), missing scheduled clinic or home visits (Turner et al 1995; Hatton et al. 1996), and inadequate monitoring of treatment response (Gallefoss et al 1999). Underutilization (Taylor et al 1984; James et al 1985; Dolce et al 1991; Dompeling et al 1992; Hatton et al 1996), overutilization (Chryssidis et al 1981; James et al 1985; Dolce et al 1991; Pepin et al 1996) and inappropriate use (Allen and Prior 1986; Horsley and Bailie 1988; Dolce et al 1991; Dompeling et al 1992; Chapman et al 1993; Nimmo et al 1993; Gray et al 1994, 1996; Thompson et al 1994; van Beerendonk et al 1998; Johnson and Robart 2000; van Grunsven et al 2000) of medications have been reported among patients with COPD. Poor adherence to drug therapy and disease management programs has been identified as the major factor resulting in emergency hospitalization among COPD patients (Col et al 1990; Fuso et al 1995; Garcia-Aymerich et al 2000).

Adherence evaluation in COPD

Various direct and indirect methods have been used for evaluating treatment adherence in COPD. The majority of the adherence studies have been carried out from the health professionals’ perspective with little regard for the perspective of patients. Wide variation exists in the definitions,

classifications and 'cut-off values' for optimal adherence in different studies. Each method has its own limitations and advantages. Wide variations were observed in the extent of nonadherence reported among COPD patients, based on the definition of adherence used, the method of assessment, the focus characteristic chosen for adherence assessment, 'cut-off values' for classification as adherent or nonadherent, patient population, time of assessment, and duration of follow-up. An overview of the various methods used for assessing adherence in COPD is given in Table 1.

Few researchers have used multiple methods or tools to study adherence in their study population and compared the results (Taylor et al 1984; Dolce et al 1991; Dompeling et al 1992; Rand et al 1992, 1995; Nides et al 1993; Bosley et al 1995; Simmons et al 2000). Self-reporting of missed doses underestimated nonadherence when compared to more objective measures such as capsule count (Dompeling et al 1992), inhaler weights (Rand et al 1995) and electronic monitoring (Rand et al 1992; Braunstein et al 1996; Simmons et al 2000). Self-report had moderate reliability (25%–67%) when compared against more objective measures of adherence such as canister weight (Rand et al 1995) and electronic monitoring (Gong et al 1988; Nides et al 1993; Bosley et al 1995). Being aware of monitoring of medication adherence using objective methods such as electronic monitoring might encourage some patients to exaggerate their self-reported adherence (Spector et al 1986). Awareness of monitoring device or feedback on monitoring results might improve patient adherence with the medication(s) under surveillance (Nides et al 1993; Turner et al 1995), but at the same time patients could be nonadherent with any medications unmonitored (Turner et al 1995).

Electronic monitors provide more objective and reliable information on adherence than any other measures of adherence that are currently available. However, they are useful only to detect the presence of a problem (nonadherence); they are unable to find the cause of the problem. For example, intentional nonadherence (such as steroid phobia) cannot be differentiated from unintentional nonadherence (eg, forgetfulness). Hence electronic monitors are not helpful in finding solutions for the issue, even if detected. Moreover, the feasibility and cost effectiveness of electronic monitoring in routine clinical practice are doubtful (Gong et al 1988). In the era of 'concordance' where adherence is assumed to be the joint responsibility of the patient and health professionals, the use of such devices without patient knowledge is unethical and might even disrupt the mutual relationship between the health professionals and patients. Currently electronic monitors are not available for all the

available dosage forms (eg, strip-packed tablets). Electronic monitoring cannot ensure that the medication withdrawn from the container had actually been consumed. Technical problems like battery failure or data retrieval problems have been shown to result in loss of adherence data, suggesting that researchers should not depend entirely on electronic monitors for monitoring adherence (Gong et al 1988; Nides et al 1993; Braunstein et al 1996; Simmons et al 1996, 1998, 2000). Self-report of nonadherence has been shown to have satisfactory reliability among patients with COPD, when verified against objective measures (Dolce et al 1991; Nides et al 1993; Rand et al 1995). Overestimation of adherence and poor reliability are common criticisms about self-reports; however, people who report nonadherence are likely to tell the truth (Haynes et al 1980; Inui et al 1981; Choo et al 1999; Erickson et al 2001).

Very few studies have incorporated inhalation technique assessment into the medication adherence evaluation process (Dolce et al 1991; Dompeling et al 1992; Turner et al 1995). Inhalation techniques have been assessed using checklists adapted from guidelines set by different professional organizations (Allen and Prior 1986; Armitage and Williams 1988; Horsley and Bailie 1988; Dolce et al 1991; Dompeling et al 1992; Chapman et al 1993; Nimmo et al 1993; Gray et al 1994, 1996; Thompson et al 1994; van der Palen et al 1995, 1999; van Beerendonk et al 1998; Johnson and Robart 2000). Only few researchers have assessed the total inhaler technique (Horsley and Bailie 1988; Dompeling et al 1992; Connolly 1995), while others categorized the steps in the inhalation process into 'key' or 'essential' and 'non-essential' steps and assessed only those 'critical steps'. (Dompeling et al 1992; van der Palen et al 1995, 1999; van Beerendonk et al 1998) Multiple raters (up to five) were involved in the assessment process in some studies (Allen and Prior 1986; Chapman et al 1993) and the poor inter- and intra-rater reliability reported among the raters (Allen and Prior 1986; Chapman et al 1993; Gray et al 1994), even for the 'critical steps', is a concern (Gray et al 1994). Some of the newer devices incorporate a flow sensor which has the capability to track the actual dose inhaled. Even 'objective monitoring' could detect only one of the problems associated with inhalation technique, ie, inadequate respiratory volume following canister actuation (Chapman et al 1993).

Factors associated with adherence in COPD

Patients with COPD have many potential risk factors for nonadherence. COPD being a disease condition characterized

Table 1 Methods for studying adherence in patients with chronic respiratory disease

Method	Description	Features
Indirect methods		
Inhaler weights (Chryssidis et al 1981; Rand et al 1992, 1995; Nides et al 1993; Braunstein et al 1996; Simmons et al 2000)	Patients are asked to produce all their used inhaled medication canisters at the time of clinic or home visit, which are weighed using a balance with high sensitivity and precision.	Patients might fail to produce all the used canisters; does not reflect adherence distribution over time; difficult to distinguish 'test' puffs from inhaled puffs; unable to identify 'overfills' in the canister leading to wrong findings; deliberate canister emptying prior to follow-up is possible; weighing the canisters is inconvenient.
Self-report on medication utilization (James et al 1985; Dolce et al 1991; Dompeling et al 1992; Rand et al 1992, 1995; Turner et al 1995; Braunstein et al 1996; Incalzi et al 1997; Garcia-Aymerich et al 2000; Simmons et al 2000)	Patients are asked specific questions about the drug usage pattern such as doses missed, prescribed and used doses in the past or over a definite time period.	Patients might overestimate adherence to impress their health professionals; limited by patients' ability to recall the events.
Medication adherence questionnaire (Morisky et al 1986; Dolce et al 1991; Horne 1996; Svarstad et al 1999; George et al 2005, 2006b)	Specific questions on intentional and unintentional deviations from the recommended management eg, Morisky's scale (Morisky et al 1986) or its modifications, and the Medication Adherence Report Scale (MARS) (Horne 1996).	Does not include all the factors influencing adherence; some questions could be confusing for patients on respiratory medications to be used on a 'when needed' (prn) basis; reliability needs to be tested in individual patient populations.
Electronic monitoring eg, Datalogger, Chronolog, clock counters, MEMS (medication event monitoring system) cap (Spector et al 1986; Gong et al 1988; Bosley et al 1996; Braunstein et al 1996; Pepin et al 1996; Simmons et al 1996, 1998, 2000; Corden et al 1997; Lin et al 2006)	Microprocessors or data-loggers record the date and time of medication use events, such as opening the cap of a bottle or release of medication from the container.	Expensive; could be obtrusive; unethical to use without prior information to patients; could alter the natural adherence pattern in patients who are aware of the technology; confirms only medication withdrawal not administration; cannot identify multiple medication withdrawal of solid dosage forms; monitor might dysfunction; not available for adherence assessment of all dosage forms; helpful in identifying dose dumping; more suitable for use in clinical trial settings than for routine clinical purposes.
Inhalation technique assessment (Allen and Prior 1986; Horsley and Bailie 1988; Dolce et al 1991; Dompeling et al 1992; Chapman et al 1993; Nimmo et al 1993; Gray et al 1994, 1996; Thompson et al 1994; van Beerendonk et al 1998; Johnson and Robart 2000)	Assessment of inhalation technique by one or more raters or objective rating using a flow sensor.	Rater assessments are subjective; depends on the expertise of rater(s); possibility of high inter- and intra-rater variability; utilization pattern in real life might be different to that during demonstration to the raters; should be combined with other measures to study medication taking behavior.
Medication or pill count (Dompeling et al 1992; van Grunsven et al 2000)	Patients are asked to produce their medications during the clinic or home visit, which are counted.	Intrusive; tedious process especially with multiple medications; does not reflect adherence distribution over time; patients might forget to bring in used medication containers; could dump medications before clinic visit.
Pharmacy refill data or claims data (Taylor et al 1984; Spector et al 1986; Kelloway et al 1994; Gallefoss et al 1999; Balakrishnan and Christensen 2000)	Medication refill histories or purchase data from pharmacies or claims data from the insurer.	Patients might not take their drugs despite having the prescriptions refilled; might not reflect the actual medication utilization (can hoard drugs); collection of information could be limited by privacy legislation; useful only for prescription medications; assessment is difficult in patients with multi-pharmacy patronage.

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Table I (Continued)

Method	Description	Features
Daily diary (Spector et al 1986; Gong et al 1988; Hatton et al 1996)	Patients record their daily medication usage or readings from monitoring devices (eg, peak-flow meter) or therapeutic response or symptoms in a diary.	Vulnerable to patient deceit; patients might forget to fill in diaries regularly.
In-depth, structured or semi-structured interviews (Dolce et al 1991; Earnest 2002; Arnold et al 2006; George et al 2006a, 2006c)	Interviews are conducted by a trained interviewer on a purposive sample based on an interview guide, which are often audio-taped, transcribed and analyzed for content and themes.	Data collection and analysis is time consuming; needs skills for interviewing; use sociological theories for data analysis and interpretation; findings are not assessed based on statistical significance; investigator will have flexibility on the depth and extent of the information being gathered.
Direct methods		
Biological assays (Taylor et al 1984; Turner et al 1995; Clark et al 1996; Hatton et al 1996; Simmons et al 2000)	Measurement of a drug or an agent (eg, nicotine) or their metabolites or markers in biological fluids.	Some techniques are invasive; assays are not available for all medications; drug interactions might alter drug levels (eg, smoking and theophylline levels).

by multiple comorbidities (Ball et al 1995; Mapel et al 2000; Confalonieri et al 2001; Incalzi et al 2001; George et al 2005), patients are likely to be on complex medication regimens consisting of time-contingent and prn (when required) oral and inhaled respiratory medications (Dolce et al 1991; Jackevicius and Chapman 1997; Pauwels et al 2001) as well as other medications (Chryssidis et al 1981). Over one-third of patients with COPD were found to use complementary and alternative medicines (George et al 2004, 2005), adding further complexity to their already complex medication regimens. Complexity of the prescribed drug regimen in COPD is known to increase with disease severity as well as the presence of comorbidities (Friedman 1995). Patients often need to make alterations in their drug regimen depending on disease severity, opportunistic respiratory tract infections and seasonal changes. Reduction of therapy once symptom control has been achieved is not normally possible, even though none of the existing medications for COPD has shown to modify the long-term decline in lung function (Pauwels et al 2001; Cranston et al 2005).

According to Becker and Maiman (1975), motivating factors, and positive modifying and enabling factors contribute to adherence, while their absence or opposite effects could put adherence at risk. Factors found to be associated with adherence in COPD in various research studies could be incorporated into the Becker-Maiman model to explain adherent behavior of COPD patients (Table 2). Despite differences between these studies in methods employed to detect nonadherence, cut-off values used for classifying patients as adherent or nonadherent, and the populations studied,

adherence in COPD was found to be a dynamic process controlled by the presence or absence of motivating factors, and modifying and enabling factors. The validity of this model has been confirmed in both qualitative and quantitative studies (George et al 2005, 2006a, 2006b).

Patients analyze the benefits in following a recommended treatment against the risks/cost associated with it. They are likely to disregard those treatments which in their experience have little efficacy or if there are concerns about their safety or their impact on patients' lives. Regimen complexity does not pose challenges to adherence in those who could 'routinize' their medication regimen, ie, those who could incorporate medication taking into their unique and complex daily lives (Ryan and Wagner 2003; George et al 2006a). The need for managing a complex medication regimen could be an issue in patients with cognitive impairment and those with depressive illness, which might explain the unintentional deviations from the treatment recommendations observed in some elderly COPD patients. The poor inhalation techniques among patients is not surprising when health professionals such as doctors, respiratory therapists, nurses and pharmacists who are involved in educating patients on inhalation techniques, themselves are known to have poor knowledge and ability (mainly on the 'critical steps') to use those devices (Guidry et al 1992; Kesten et al 1993).

Message for health professionals and researchers

Many patients with COPD do not follow their treatment recommendations either intentionally or unintentionally.

Table 2 Factors associated with medication nonadherence: Becker-Maiman model

Factor associated with adherence	Research evidence in patients with COPD
Motivations <ul style="list-style-type: none"> • Concern about health matters in general • Willingness to seek and accept medical direction • Intention to comply • Positive health activities 	<p>Perceived lack of need for medications (Apter et al 1998; George et al 2005) have been reported among nonadherent patients.</p> <p>Patients nonadherent to long-term home nebuliser were found to continue smoking (Turner et al 1995).</p> <p>Running out of medications was one of the reasons for nonadherence (Dolce et al 1991)</p> <p>Patients with greater depression scores were nonadherent to regular inhaled respiratory medications (Bosley et al 1995).</p> <p>Patients who had good relationship family and friends had a desire to live longer and gave up smoking (George et al 2006c).</p> <p>Nonadherent subjects had greater disruption in their home and family life (Turner et al 1995).</p>
Value of illness threat reduction <ul style="list-style-type: none"> • Susceptibility or resusceptibility (incl. belief in diagnosis) • Vulnerability to illness in general • Extent of possible bodily harm (at motivating, but not inhibiting, levels) • Extent of possible interference with social roles (at motivating, but not inhibiting, levels) • Presence of (or past experience with) symptoms 	<p>Severity of respiratory symptoms and lung function predicted adherence to nebulizer (Turner et al 1995), inhaled bronchodilator (Chryssidis et al 1981), and Long-term Oxygen Therapy (Pepin et al 1996).</p> <p>Absence of respiratory symptoms (van Grunsven et al 2000) and feeling well (James et al 1985) were associated with nonadherence.</p> <p>Patients made variations in their recommended management based on how they felt. (George et al 2005)</p> <p>Worsening of respiratory symptoms might have contributed to improvement in adherence to supplemental oxygen with time in individuals with hypoxemic COPD (Earnest 2002).</p> <p>Greater impairment in quality of life was found to be associated with poor adherence to treatment (Bosley et al 1996; Corden et al 1997).</p> <p>Poor prognosis of COPD was found to be a major demotivating factor to quit smoking (George et al 2006c).</p>
Probability that compliant behavior will reduce the threat <ul style="list-style-type: none"> • Proposed regimen's safety • Proposed regimen's efficacy to prevent, delay or cure (including 'faith in doctors and medical care' and 'chance of recovery') 	<p>Greater understanding about COPD and its management, and greater confidence that the current management would keep illness under control were found to be associated with better adherence (George et al 2005).</p> <p>Perceived lack of benefit derived from treatment might have influenced discontinuation of theophylline, despite renewal of prescription (Taylor et al 1984).</p> <p>Nonadherent subjects had less confidence in long-term home nebulizer treatment (Turner et al 1995).</p>
Demographic factors (Very young or old)	<p>Cognitive impairment and memory loss, characteristic features of old age, were associated with poor adherence to medication regimens in ambulatory patients (Incalzi et al 1997).</p> <p>Elderly patients' competence with metered-dose inhaler technique was associated with their cognition (Allen and Prior 1986).</p> <p>Getting confused about medications was an independent predictor of nonadherence (George et al 2005).</p>
Structural factors (Cost, duration, complexity, side effects, accessibility of regimen, need for new patterns of behavior)	<p>Increasing cost of cigarettes and affordability of smoking cessation therapies were facilitators for smoking cessation (George et al 2006c).</p> <p>Prescription of multiple inhalation devices that need to be handled differently was found to confuse patients resulting in incompetent inhalation techniques (van der Palen et al 1999).</p> <p>Better adherence with oral theophylline than inhaled anti-inflammatory medications could have been due to simplicity of regimen and/or less concerns about side effects (Kelloway et al 1994).</p> <p>Side effects or concerns about side effects from medications (Dolce et al 1991; Earnest 2002; Dowson et al 2004; Rand et al 1995; Pepin et al 1996;</p>

(Continued)

Table 2 (Continued)

Factor associated with adherence	Research evidence in patients with COPD
Attitudes (Satisfaction with visit, physician, other staff, clinic procedures and facilities)	<p>George et al 2006c), and finding medications to be physically challenging, inconvenient or unpleasant (Rand et al 1995; Pepin et al 1996; Apter et al 1998; Earnest 2002; George et al 2005) have been found to be associated with nonadherence.</p> <p>Interruptions or changes in routines (Dolce et al 1991), lack of time (Apter et al 1998; van Grunsven et al 2000), and forgetting to take the dose (Apter et al 1998; Dolce et al 1991; Rand et al 1995; van Grunsven et al 2000) have been reported as reasons for nonadherence.</p> <p>Adherent patients were more satisfied with their treatment and doctors than their nonadherent counterparts. (George et al 2005)</p> <p>Patient satisfaction with the treatment had significant correlation with medication adherence (Nagy and Wolfe 1984).</p> <p>The referring doctor is known to play a key role in the uptake of pulmonary rehabilitation programmes (Arnold et al 2006).</p> <p>Metered-dose inhaler techniques were found to be better in patients who were initiated on them in the hospital than by their general practitioner (Allen and Prior 1986).</p>
Interaction (length, depth, continuity, mutuality of expectation, quality and type of doctor-patient relationship, physician agreement with patient, feedback to patient)	<p>Follow-up education (Rand et al 1995; Bosley et al 1996; Pepin et al 1996; Gallefoss et al 1999) and feedback on usage (Simmons et al 1996) have been shown to improve medication adherence.</p> <p>Smokers complained about their health professionals lacking empathy and being inconsiderate about their difficulties; however unfriendly approaches had prompted smoking cessation in some patients (George et al 2006c).</p> <p>Improvement in adherence with inhaled medications over time has been attributed to the improvement in patients' knowledge and understanding about their medications (Chryssidis et al 1981).</p> <p>Instruction has been shown to improve inhalation technique (Horsley and Bailie 1988).</p> <p>Medication dumping was less in patients who were aware that their adherence was being monitored (Simmons et al 2000).</p>
Enabling factors (Prior experience with action, illness or regimen; source of advice and referral (incl. social pressure))	<p>Lack of effect or perceived benefit from treatment (Pepin et al 1996; Apter et al 1998; Earnest 2002) have been shown to result in nonadherence.</p> <p>Experiences from explicit or subconscious experimentation with Long Term Oxygen Therapy has been found to influence future decisions to use that therapy (Earnest 2002).</p> <p>Compromise on social status or role in the family due to the use of home oxygen was found to result in nonadherence (Earnest 2002).</p>

Motivating, enabling and modifying factors related to patient, disease, treatment, and health care providers could influence adherence. As time evolves COPD patients become more health conscious due to the progression of the disease and increase in disease burden, resulting in improved adherence. However, in the short-term adherence is likely to decline over time, unless enhanced by feedback and reinforcement. Patient knowledge about the role of treatment, confidence and feedback from health professionals are likely to enhance treatment adherence among COPD patients.

Adherence screening on all aspects of management should be routinely performed in patients with COPD using simple and practical tools. This need exists for all patients with COPD including those whose nonadherence has not

been a concern in the past. Health professionals should devote more time for patients whose nonadherence is of concern. Identifying the nature of nonadherence and the reasons for nonadherence are also critical in clinical practice along with its detection and quantification. Multiple methods – including objective measures – should be employed for monitoring adherence in clinical practice, especially when nonadherence is suspected. Electronic monitoring, though regarded as the 'gold standard' for adherence monitoring, is more appropriate in a clinical trial setting where the investigators have to ensure that patients use their drugs as prescribed and need to identify those patients who are not. Self-reporting offers a cheap, simple and easy method for assessing adherent behaviors. In addition, reasons for nonadherence can

be identified using self-report, which in turn would help in addressing those issues. Inhaler technique assessment forms a key component of adherence assessment in COPD and should be performed periodically.

Strategies for overcoming nonadherence have to be formulated based on the nature and reasons for nonadherence. In the event of unintentional nonadherence, especially in the elderly; those with complex medication regimens; and those with cognitive impairment, the use of adherence aids such as medication lists, Dosette boxes and timers should be promoted. Wherever possible, the recommend treatment regimens should fit into the lifestyles and limitations of patients and their families. Coordinating medication use with a daily activity; storage of medications at places closer to their use; and assistance/reminding systems for the timely administration of medicines and for regular supply of medicines might avoid unintentional nonadherence.

Understanding patient beliefs and experiences, patient education focusing on the pathology of COPD and the role of treatment, periodic monitoring and reinforcement are critical for overcoming the barriers of intentional nonadherence. The impact of patient education is likely to be enhanced if health professionals elicit patients' concerns and disappointments about their management and address those issues on an individual basis. Such efforts are likely to enhance COPD patients' confidence leading to improved patient adherence to both medications and non-pharmacological management. When the health care professionals are unsure and have questionable inhalation skills, their patients cannot be expected to use the inhalation devices properly. Training in inhalation techniques and their assessment are critical for all health professionals involved in instruction and assessment of inhalation techniques for patients. New interventions for reducing intentional and unintentional nonadherence in COPD need to be developed and tested in large randomized controlled trials.

References

- Allen SC, Prior A. 1986. What determines whether an elderly patient can use a metered dose inhaler correctly? *Br J Dis Chest*, 80:45–9.
- Apter AJ, Reisine ST, Affleck G, et al. 1998. Adherence with twice-daily dosing of inhaled steroids. Socioeconomic and health-belief differences. *Am J Respir Crit Care Med*, 157:1810–7.
- Armitage JM, Williams SJ. 1988. Inhaler technique in the elderly. *Age Ageing*, 17:275–8.
- Arnold E, Bruton A, Ellis-Hill C. 2006. Adherence to pulmonary rehabilitation: a qualitative study. *Respir Med*, 100:1716–23.
- Balakrishnan R, Christensen DB. 2000. Inhaled corticosteroid use and associated outcomes in elderly patients with moderate to severe chronic pulmonary disease. *Clin Ther*, 22:452–69.
- Ball P, Harris JM, Lowson D, et al. 1995. Acute infective exacerbations of chronic bronchitis. *QJM*, 88:61–8.
- Becker MH, Maiman LA. 1975. Sociobehavioral determinants of compliance with health and medical care recommendations. *Med Care*, 13:10–24.
- Bosley CM, Corden ZM, Rees PJ, et al. 1996. Psychological factors associated with use of home nebulized therapy for COPD. *Eur Respir J*, 9:2346–50.
- Bosley CM, Fosbury JA, Cochrane GM. 1995. The psychological factors associated with poor compliance with treatment in asthma. *Eur Respir J*, 8:899–904.
- Braunstein GL, Trinquet G, Harper AE. 1996. Compliance with nedocromil sodium and a nedocromil sodium/salbutamol combination. Compliance Working Group. *Eur Respir J*, 9:893–8.
- Chapman KR, Love L, Brubaker HA. 1993. Comparison of breath-actuated and conventional metered-dose inhaler inhalation techniques in elderly subjects. *Chest*, 104:1332–7.
- Choo PW, Rand CS, Inui TS, et al. 1999. Validation of patient reports, automated pharmacy records, and pill counts with electronic monitoring of adherence to antihypertensive therapy. *Med Care*, 37:846–57.
- Chryssidis E, Frewin DB, Frith PA, et al. 1981. Compliance with aerosol therapy in chronic obstructive lung disease. *N Z Med J*, 94:375–7.
- Clark DJ, Tan KS, Lipworth BJ. 1996. Evaluation of plasma and urinary salbutamol levels in COPD. *Eur J Clin Pharmacol*, 51:91–3.
- Col N, Fanale JE, Kronholm P. 1990. The role of medication noncompliance and adverse drug reactions in hospitalizations of the elderly. *Arch Intern Med*, 150:841–5.
- Confalonieri M, Gorini M, Ambrosino N, et al. 2001. Respiratory intensive care units in Italy: a national census and prospective cohort study. *Thorax*, 56:373–8.
- Connolly MJ. 1995. Inhaler technique of elderly patients: comparison of metered-dose inhalers and large volume spacer devices. *Age Ageing*, 24:190–2.
- Corden ZM, Bosley CM, Rees PJ, et al. 1997. Home nebulized therapy for patients with COPD: patient compliance with treatment and its relation to quality of life. *Chest*, 112:1278–82.
- Cranston JM, Crockett AJ, Moss JR, et al. 2005. Domiciliary oxygen for chronic obstructive pulmonary disease. *Cochrane Database Syst Rev*, CD001744.
- DiMatteo MR. 2004. Variations in patients' adherence to medical recommendations: a quantitative review of 50 years of research. *Med Care*, 42:200–9.
- DiMatteo MR, Giordani PJ, Lepper HS, et al. 2002. Patient adherence and medical treatment outcomes: a meta-analysis. *Med Care*, 40:794–811.
- Dolce JJ, Crisp C, Manzella B, et al. 1991. Medication adherence patterns in chronic obstructive pulmonary disease. *Chest*, 99:837–41.
- Dompeling E, Van Grunsven PM, Van Schayck CP, et al. 1992. Treatment with inhaled steroids in asthma and chronic bronchitis: long-term compliance and inhaler technique. *Fam Pract*, 9:161–6.
- Earnest MA. 2002. Explaining adherence to supplemental oxygen therapy: the patient's perspective. *J Gen Intern Med*, 17:749–55.
- Emery CF, Shermer RL, Hauck ER, et al. 2003. Cognitive and psychological outcomes of exercise in a 1-year follow-up study of patients with chronic obstructive pulmonary disease. *Health Psychol*, 22:598–604.
- Erickson SR, Coombs JH, Kirking DM, et al. 2001. Compliance from self-reported versus pharmacy claims data with metered-dose inhalers. *Ann Pharmacother*, 35:997–1003.
- Fox R, French N, Davies L, et al. 1995. Influenza immunization status and viral respiratory tract infections in patients with chronic airflow limitation. *Respir Med*, 89:559–61.
- Friedman M. 1995. Changing practices in COPD. A new pharmacologic treatment algorithm. *Chest*, 107:194S–7S.
- Fuso L, Incalzi RA, Pistelli R, et al. 1995. Predicting mortality of patients hospitalized for acutely exacerbated chronic obstructive pulmonary disease. *Am J Med*, 98:272–7.
- Gallefoss F, Bakke PS, Rsgaard PK. 1999. Quality of life assessment after patient education in a randomized controlled study on asthma and chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*, 159:812–7.

- Garcia-Aymerich J, Barreiro E, Farrero E, et al. 2000. Patients hospitalized for COPD have a high prevalence of modifiable risk factors for exacerbation (EFRAM study). *Eur Respir J*, 16:1037–42.
- George J, Ioannides-Demos LL, Santamaria NM, et al. 2004. Use of complementary and alternative medicines by patients with chronic obstructive pulmonary disease. *Med J Aust*, 181:248–51.
- George J, Kong DC, Santamaria NM, et al. 2006a. Adherence to disease management interventions for chronic obstructive pulmonary disease patients: patients' perspectives. *J Pharm Pract Res*, 36:279–86.
- George J, Kong DC, Thoman R, et al. 2005. Factors associated with medication nonadherence in patients with COPD. *Chest*, 128:3198–204.
- George J, Mackinnon A, Kong DC, et al. 2006b. Development and validation of the beliefs and behaviour questionnaire (BBQ). *Patient Educ Couns*, 64:50–60.
- George J, Kong DC, Santamaria N, et al. 2006c. Smoking cessation: COPD patients' perspective. *J Pharm Pract and Res*, 36:107–10.
- Gong H Jr, Simmons MS, Clark VA, et al. 1988. Metered-dose inhaler usage in subjects with asthma: comparison of Nebulizer Chronolog and daily diary recordings. *J Allergy Clin Immunol*, 82:5–10.
- Gray SL, Nance AC, Williams DM, et al. 1994. Assessment of interrater and intrarater reliability in the evaluation of metered dose inhaler technique. *Chest*, 105:710–4.
- Gray SL, Williams DM, Pulliam CC, et al. 1996. Characteristics predicting incorrect metered-dose inhaler technique in older subjects. *Arch Intern Med*, 156:984–8.
- Guidry GG, Brown WD, Stogner SW, et al. 1992. Incorrect use of metered dose inhalers by medical personnel. *Chest*, 101:31–3.
- Hatton MQ, Allen MB, Vathenen SV, et al. 1996. Compliance with oral corticosteroids during steroid trials in chronic airways obstruction. *Thorax*, 51:323–4.
- Haynes RB, Taylor DW, Sackett DL. 1979. Compliance in healthcare. Baltimore: John Hopkins University Press.
- Haynes RB, Taylor DW, Sackett DL, et al. 1980. Can simple clinical measurements detect patient noncompliance? *Hypertension*, 2:757–64.
- Horne R. 1996. The Medication Adherence Report Scale. Brighton: University of Brighton.
- Horne R. 1997. Representations of medications and treatment: Advances in theory and measurement. In Petrie KJ, Weinman JA, eds. Perceptions of health and illness. London: Harwood Academic. p 155–88.
- Horsley MG, Bailie GR. 1988. Risk factors for inadequate use of pressurized aerosol inhalers. *J Clin Pharm Ther*, 13:139–43.
- Howard RL, Avery AJ, Howard PD, et al. 2003. Investigation into the reasons for preventable drug related admissions to a medical admissions unit: observational study. *Qual Saf Health Care*, 12:280–5.
- Incalzi RA, Gemma A, Marra C, et al. 1997. Verbal memory impairment in COPD: its mechanisms and clinical relevance. *Chest*, 112:1506–13.
- Incalzi RA, Pedone C, Onder G, et al. 2001. Predicting length of stay of older patients with exacerbated chronic obstructive pulmonary disease. *Aging*, 13:49–57.
- Inui TS, Carter WB, Pecoraro RE. 1981. Screening for noncompliance among patients with hypertension: is self-report the best available measure? *Med Care*, 19:1061–4.
- Jackevicius CA, Chapman KR. 1997. Prevalence of inhaled corticosteroid use among patients with chronic obstructive pulmonary disease: a survey. *Ann Pharmacother*, 31:160–4.
- James PN, Anderson JB, Prior JG, et al. 1985. Patterns of drug taking in patients with chronic airflow obstruction. *Postgrad Med J*, 61:7–10.
- Johnson DH, Robart P. 2000. Inhaler technique of outpatients in the home. *Respir Care*, 45:1182–7.
- Kelloway JS, Wyatt RA, Adlis SA. 1994. Comparison of patients' compliance with prescribed oral and inhaled asthma medications. *Arch Intern Med*, 154:1349–52.
- Kesten S, Zive K, Chapman KR. 1993. Pharmacist knowledge and ability to use inhaled medication delivery systems. *Chest*, 104:1737–42.
- Lin SK, Kuna ST, Bogen DK. 2006. A novel device for measuring long-term oxygen therapy adherence: a preliminary validation. *Respir Care*, 51:266–71.
- Mapel DW, Picchi MA, Hurley JS, et al. 2000. Utilization in COPD: patient characteristics and diagnostic evaluation. *Chest*, 117:346S–353S.
- Marinker M, Blenkinsopp A, Bond C, et al. 1997. From compliance to concordance: achieving shared goals in medicine taking. London: Royal Pharmaceutical Society of Great Britain.
- McKenney JM, Harrison WL. 1976. Drug-related hospital admissions. *Am J Hosp Pharm*, 33:792–5.
- Mellins RB, Evans D, Zimmerman B, et al. 1992. Patient compliance. Are we wasting our time and don't know it? *Am Rev Respir Dis*, 146:1376–7.
- Morisky DE, Green LW, Levine DM. 1986. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care*, 24:67–74.
- Murray CJ, Lopez AD. 1996. The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries and risk factors in 1990 and projected to 2020. Cambridge: Harvard University Press.
- Murray CJ, Lopez AD. 1997. Alternative projections of mortality and disability by cause 1990–2020: Global Burden of Disease Study. *Lancet*, 349:1498–504.
- Nagy VT, Wolfe GR. 1984. Cognitive predictors of compliance in chronic disease patients. *Med Care*, 22:912–21.
- Nichol KL, Baken L, Nelson A. 1999. Relation between influenza vaccination and outpatient visits, hospitalization, and mortality in elderly persons with chronic lung disease. *Ann Intern Med*, 130:397–403.
- Nides MA, Tashkin DP, Simmons MS, et al. 1993. Improving inhaler adherence in a clinical trial through the use of the nebulizer chronolog. *Chest*, 104:501–7.
- Nimmo CJ, Chen DN, Martinusen SM, et al. 1993. Assessment of patient acceptance and inhalation technique of a pressurized aerosol inhaler and two breath-actuated devices. *Ann Pharmacother*, 27:922–7.
- Pauwels RA, Buist AS, Calverley PM, et al. 2001. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. NHLBI/WHO Global Initiative for Chronic Obstructive Lung Disease (GOLD) Workshop summary. *Am J Respir Crit Care Med*, 163:1256–76.
- Pepin JL, Barjhoux CE, Deschaux C, et al. 1996. Long-term oxygen therapy at home. Compliance with medical prescription and effective use of therapy. ANTADIR Working Group on Oxygen Therapy. Association Nationale de Traitement a Domicile des Insuffisants Respiratoires. *Chest*, 109:1144–50.
- Rand CS, Nides M, Cowles MK, et al. 1995. Long-term metered-dose inhaler adherence in a clinical trial. The Lung Health Study Research Group. *Am J Respir Crit Care Med*, 152:580–8.
- Rand CS, Wise RA, Nides M, et al. 1992. Metered-dose inhaler adherence in a clinical trial. *Am Rev Respir Dis*, 146:1559–64.
- Ryan GW, Wagner GJ. 2003. Pill taking 'routinization': a critical factor to understanding episodic medication adherence. *AIDS Care*, 15:795–806.
- Simmons MS, Nides MA, Kleerup EC, et al. 1998. Validation of the Doser, a new device for monitoring metered-dose inhaler use. *J Allergy Clin Immunol*, 102:409–13.
- Simmons MS, Nides MA, Rand CS, et al. 1996. Trends in compliance with bronchodilator inhaler use between follow-up visits in a clinical trial. *Chest*, 109:963–8.
- Simmons MS, Nides MA, Rand CS, et al. 2000. Unpredictability of deception in compliance with physician-prescribed bronchodilator inhaler use in a clinical trial. *Chest*, 118:290–5.
- Spector SL, Kinsman R, Mawhinney H, et al. 1986. Compliance of patients with asthma with an experimental aerosolized medication: implications for controlled clinical trials. *J Allergy Clin Immunol*, 77:65–70.
- Stanton LA, Peterson GM, Rumble RH, et al. 1994. Drug-related admissions to an Australian hospital. *J Clin Pharm Ther*, 19:341–7.
- Svarstad BL, Chewning BA, Sleath BL, et al. 1999. The Brief Medication Questionnaire: a tool for screening patient adherence and barriers to adherence. *Patient Educ Couns*, 37:113–24.
- Taylor DR, Kinney CD, McDevitt DG. 1984. Patient compliance with oral theophylline therapy. *Br J Clin Pharmacol*, 17:15–20.

- Thompson J, Irvine T, Grathwohl K, et al. 1994. Misuse of metered-dose inhalers in hospitalized patients. *Chest*, 105(3):715–7.
- Turner J, Wright E, Mendella L, et al. 1995. Predictors of patient adherence to long-term home nebulizer therapy for COPD. The IPPB Study Group. Intermittent Positive Pressure Breathing. *Chest*, 108:394–400.
- van Beerendonk I, Mesters I, Mudde AN, et al. 1998. Assessment of the inhalation technique in outpatients with asthma or chronic obstructive pulmonary disease using a metered-dose inhaler or dry powder device. *J Asthma*, 35:273–9.
- van der Palen J, Klein JJ, Kerkhoff AH, et al. 1995. Evaluation of the effectiveness of four different inhalers in patients with chronic obstructive pulmonary disease. *Thorax*, 50:1183–7.
- van der Palen J, Klein JJ, van Herwaarden CL, et al. 1999. Multiple inhalers confuse asthma patients. *Eur Respir J*, 14:1034–7.
- van Grunsven PM, van Schayck CP, van Deuveren M, et al. 2000. Compliance during long-term treatment with fluticasone propionate in subjects with early signs of asthma or chronic obstructive pulmonary disease (COPD): results of the Detection, Intervention, and Monitoring Program of COPD and Asthma (DIMCA) Study. *J Asthma*, 37:225–34.
- Weintraub M. 1990. Compliance in the elderly. *Clin Geriatr Med*, 6:445–52.
- World Health Report. 2004. World Health Organization.
- Young P, Dewse M, Fergusson W, et al. 1999. Respiratory rehabilitation in chronic obstructive pulmonary disease: predictors of nonadherence. *Eur Respir J*, 13:855–9.