MEDICATION NON-ADHERENCE
Among Older Adults
A Review of Strategies and Interventions for Improvement

ABSTRACT
Medication non-adherence among older adults is a prevalent and costly problem; approximately one half have problems following their prescribed medication regimen, and more than 10% of hospital admissions are the result of medication non-adherence. In this literature review, medication non-adherence is defined and described among adults age 50 and older. Factors associated with medication non-adherence are presented, interventions to improve medication non-adherence are discussed, and methods for assessing medication non-adherence are reviewed. In addition, nursing assessment and intervention to improve medication non-adherence are described.

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Medication non-adherence is a prevalent and costly problem among older adults. Older adults commonly have diagnoses of osteoarthritis, hypertension, osteoporosis, and diabetes, and are prescribed a mean of approximately five medications (Engberg, 2002). However, approximately 50% of older adults do not take drugs as prescribed (Curtin, Svarstad, Andress, Keller, & Sacksteder, 1997; Ferguson, Ziedins, West, Richardson, & Michocki, 1996; Oelzner, Brandstadt, & Hoffmann, 1996; Small, Freeman-Arnold, Goode, & Pyles, 1997). Consequently, more than 10% of hospital admissions of older adults are the result of medication non-adherence (Col, Fanale, & Kronholm, 1990). Thus, medication non-adherence presents a significant challenge to nurses providing health care to older adults and their families.

This article reviews the literature regarding non-adherence to medication regimen among adults age 50 and older. Factors associated with medication non-adherence, interventions to improve medication non-adherence, and methods for assessing medication non-adherence are reviewed. In addition, nursing assessment and intervention to improve medication non-adherence are discussed.

DEFINITIONS OF NON-ADHERENCE

Medication non-adherence can be defined in two ways. First, non-adherence is defined as the pattern of non-adherence demonstrated by the person. The following non-adherence patterns have been identified (Dunbar-Jacob & Schlenk, 2001):

- Failure to adopt the regimen.
- Early stoppage of drug treatment or dropping out of treatment.
- Alterations in dosage including decreasing or increasing the dose, missing doses, and taking doses too close together or too far apart.

Second, non-adherence is defined as the type of quantitative assessment performed. Medication non-adherence can be defined quantitatively in four ways:

- The proportion of the prescribed regimen that is not followed can be reported (i.e., the average non-adherence level).
- The proportion of individuals who do not meet a predetermined adherence level can be reported; this level is conventionally set at 80%.
- The proportion of individuals who do not achieve clinical benefit also can be reported, although this is not the same as non-adherence.
- The clinical judgment of non-adherence level can be reported, although this assessment method has been shown to be inaccurate (Dunbar-Jacob & Schlenk, 2001).

EXTENT OF NON-ADHERENCE

Medication non-adherence occurs among older adults who have a variety of diseases and has been reported to range from approximately 14% to 77%, depending on the measurement method. The lowest level of non-adherence was found in a study that relied on self-report in adults older than age 65. Overall, 13.7% of the participants reported non-adherence; 10.7% reported under-adherence and 4.3% reported over-adherence, with some participants reporting both (McElney, McCallion, Al-Deagi, & Scott, 1997).

Gray, Mahoney, and Blough (2001) examined medication non-adherence in adults age 65 and older who were taking three or more medications following hospital discharge. Based on pill counts, 30.6% of the participants were under-adherent and 18.4% were over-adherent with at least one medication, with overall non-adherence in 44% of the sample.

Using electronic monitors to assess non-adherence in hemodialysis participants older than age 65, Curtin et al. (1997) found approximately 43% of the participants underdosed, overdosed, or missed doses for more than 20% of their prescribed antihypertensives. In addition, approximately 65% of the participants underdosed, overdosed, or missed doses for more than 20% of their prescribed phosphate binders.

Among older adults with hypertension, Monane et al. (1996) found 77% of Medicaid enrollees age 65 and older were non-adherent with antihypertensives as measured by pharmacy records. Also using pharmacy records in participants age 65 and older taking angiotension-converting enzyme inhibitors, Small et al. (1997) found non-adherence ranged from 34% to 42%. Oelzner et al. (1996) measured urine levels of the antihypertensive medication, triamterene, in adults age 61 and older and found 44% of the outpatients were non-adherent.

Electronic monitoring was used to assess non-adherence in patients 65 years of age or older with coronary artery disease with and without depression who were prescribed twice-daily low-dose aspirin (Carney, Freedland, Eisen, Rich, & Jaffe, 1995). Non-adherence ranged from 31% in non-depressed patients to 55% in depressed patients.

Bedell et al. (2000) examined non-adherence in older patients (mean age, 62 years) in cardiology and internal medicine practices. Non-adherence was defined as the presence of discrepancies based on comparing medication bottles with medical records. Discrepancies were found in 76% of the patients and included taking medications not recorded (51%), not taking a recorded medication (29%), and differences in dose (20%).

Donnan, MacDonald, and Morris (2002) used pharmacy records to assess non-adherence in older patients (mean age, 68 years) with type 2 diabetes receiving oral hypoglycemic drugs. They reported non-adherence ranged from 66% to 69%.

EFFECTS OF NON-ADHERENCE

Costs

The overall costs of medication non-adherence are as high as $100 billion annually (Lewis, 1997). These costs include increases in clinic and emergency room visits, hospitaliza-
tions, laboratory tests, drugs prescribed, adverse effects, recurrences of illness, and premature deaths.

Researchers evaluated 315 consecutive adults age 65 or older admitted to a hospital and determined 11.4% of the admissions were because of medication non-adherence at a cost of $77,289 (Col et al., 1990). Toh, Low, and Goh (1998) found 112 (10.5%) emergency room visits by older adults during a 9-week period were drug related, and 69% of these patients were admitted. Of these emergency room visits, 58% were related to medication non-adherence.

Clinical Outcomes

Medication non-adherence also is related to adverse clinical outcomes in older adults. For example, of 28 adults older than age 60 being treated for hyperthyroidism, 14 experienced relapses. Medication non-adherence, based on self-reports of stopping the medication or not taking it regularly, was associated with relapse in 9 (64%) of the 14 participants (Takacs et al., 1996).

Shemesh et al. (2001) assessed non-adherence to captopril by pill counts in older adults (mean age, 61.3 years) post-myocardial infarction. Increasing non-adherence was significantly related to increasing number of severe adverse events, such as death or hospitalization for recurrent acute myocardial infarction, unstable angina, or arrhythmia ($r = .93, p = .006$).

Another study found medication non-adherence was significantly associated with poor blood pressure control in older adults (mean age, 59.5 years) with hypertension ($\beta = .440$, $p < .05$) (Morrell, Park, Kidder, & Martin, 1997). Dew et al. (1999) examined self-reported medication non-adherence in heart transplant participants, the majority of whom were age 50 or older. Medication non-adherence was significantly associated with acute graft rejection ($OR = 4.17, p < .05$) and incident coronary artery disease ($OR = 6.91, p < .05$).

Schectman, Nadkarni, and Voss (2002) examined non-adherence among low-income older adults (mean age, 59 years) with type 2 diabetes. Based on pharmacy records, poor non-adherence to oral hypoglycemics was significantly associated with worse metabolic control as measured by glycylated hemoglobin levels (parameter estimate = -.016, $p < .0001$).

Quality of Life

Investigators are beginning to examine the relationship between medication non-adherence and quality of life. Interest in quality of life has grown in conjunction with improved treatments that have increased longevity. Quality of life is considered an important outcome in older adults who often are managing multiple chronic disorders affecting their physical and mental health.

In a study of older adults (mean age, 64.4 years) with chronic obstructive pulmonary disease, non-adherence with home nebulized therapy was assessed using electronic monitoring. Patients who were non-adherent reported significantly greater impairment in their quality of life ($p = .03$) (Corden, Bosley, Rees, & Cochrane, 1997). Schron et al. (1996) reported non-adherence in older participants (mean age, 61 years) in the Cardiac Arrhythmia Suppression Trial was significantly associated with higher physical function ($OR = .904, p = .011$) and lower mental health ($OR = 1.04, p = .006$).

FACTORS ASSOCIATED WITH NON-ADHERENCE

Because of the extent and effects of medication non-adherence in older adults, risk factors should be identified to develop strategies for older adults at greatest risk for non-adherence. Although research into these risk factors among older adults is somewhat limited, factors that contribute to medication non-adherence in older adults include:

- Drug regimen characteristics.
- Health beliefs.
- Medication side effects.
- Social support.
- Depression.
- Cognitive function.

Drug Regimen Characteristics

Researchers have examined aspects of drug regimens that contribute to non-adherence, specifically number of prescribed medications or doses, number of health-care providers prescribing drugs, and costs of medication. Studies have shown that the greater the number of medications or doses prescribed, the greater the non-adherence (Andrejak et al., 2000; Barat, Andreassen, & Damsgaard, 2001; Bedell et al., 2000; Donnan et al., 2002; Gray et al., 2001; Nikolaus et al., 1996).

Andrejak et al. (2000) used electronic monitors to assess non-adherence to antihypertensive medication. For patients taking twice-daily medication (mean age, 59 years), non-adherence was significantly worse compared to participants taking once-daily medication (mean age, 55 years) ($p = .002$).

Barat et al. (2001) reported the use of three or more drugs in patients age 75 was significantly associated with self-reported non-adherence to the number of prescribed drugs ($OR = 2.2, 95% CI 1.2 to 4.1$), dose ($OR = 2.3, 95% CI 1.3 to 3.8$), and regimen frequency ($OR = 2.5, 95% CI 1.5 to 4.1$). Bedell et al. (2000) reported the number of recorded medications was significantly associated with discrepancies between medication bottles and medical records in older outpatients (mean age, 62 years) ($OR = 2.28, 95% CI 1.47 to 3.53$).

Donnan et al. (2002) examined non-adherence in participants with type 2 diabetes (mean age, 68 years) using pharmacy records. Daily number of sulfonylurea pills taken ($OR = .79, 95% CI .68 to .91$) and number of co-medications taken with sulfonylureas ($OR = .65, 95% CI .52 to .81$) and metformin ($OR = .60, 95% CI .41 to .87$) were significantly associated with non-adherence.
Gray et al. (2001) reported taking a greater number of medications after hospitalization was significantly associated with underadherence among adults age 65 or older (OR 1.16, 95% CI 1.03 to 1.31). Nikolaus et al. (1996) also found a greater number of prescribed medications was significantly related to self-reported non-adherence in older adults (mean age, 81.9 years) (beta = -1.53, p = .042).

Non-adherence may arise from having multiple health-care providers prescribing medication. This problem may be especially prominent among older adults, who often have multiple chronic disorders treated by different specialists. Barat et al. (2001) reported the number of prescribing physicians was significantly associated with self-reported non-adherence to the number of prescribed drugs in participants age 75 (OR = 2.5, 95% CI 1.3 to 4.8).

Similarly, Col et al. (1990) found seeing many physicians regularly was significantly associated with being hospitalized for non-adherence among adults age 65 or older who were admitted to the hospital (OR = 2.0, p = .005). In addition, the relationship between medication costs and self-reported non-adherence also was examined in this same population. Higher monthly costs of medication, after insurance reimbursement, were significantly associated with higher non-adherence rates (p < .004). Further, older adults whose medications were not covered by insurance were significantly less likely to take their medications than those whose medications were covered by insurance (52% vs. 31%, p = .04).

In another study, Ferguson et al. (1996) reported 57% (37 of 65) of adults age 65 or older self-reported intentionally stopping medication. Of these cases, 24% (9 of 37) cited the cost of medication as a cause (14% overall).

Health Beliefs

Health beliefs have been investigated as predictors of non-adherence. Self-efficacy was a significant predictor of global self-reported medication non-adherence in women age 60 or older with cardiac disease (parameter estimate = .221, p = .002) (Clark & Dodge, 1999). Similarly, self-efficacy was significantly associated with non-adherence in older adults (mean age, 59 years) with rheumatoid arthritis (beta = 3.02, p = .01) (Brus, van de Laar, Taal, Rasker, & Weigman, 1999).

Arnsten, Gelfand, and Singer (1997) reported older adults (mean age, 53.7 years) who were non-adherent with anticoagulation therapy perceived significantly fewer health benefits (OR, .3 to .5, p < .05) and significantly more barriers (OR, 2.2 to 3.0, p < .05) to taking warfarin. Another study found global self-reported medication non-adherence was significantly predicted by powerful others health locus of control beliefs (beliefs that physicians, family, or friends are responsible for a person’s health care) among adults age 55 or older (beta = .26, p = .05) (McDonald-Misczak, Maki, & Gould, 2000).

Medication Side Effects

Side effects also have been examined as a reason for medication non-adherence in older adults. Ferguson et al. (1996) reported 57% (37 of 65) of adults age 65 or older self-reported discontinuing their medication on their own. The majority of these (92%) cited side effects as a reason.

Among adults age 65 or older whose hospital admission was related to non-adherence, the most common cause was medication side effects (35%) (Col et al., 1990). In another study, Nikolaus et al. (1996) reported approximately 20% of older adults (mean age, 81.9 years) discharged from the hospital who self-reported being non-adherent cited side effects as a cause for medication non-adherence.

Pettinger et al. (1999) investigated non-adherence in older adults (mean age, 66 years) with peripheral vascular disease enrolled in a clinical trial. Side effects were reported as the reason for missing medication significantly more often in the active niacin group compared to the placebo group (19% vs. 9%, p < .004).

Maidment, Livingston, and Katona (2002) investigated global self-reported non-adherence to antidepressant medication in participants age 65 or older. They found severity of side effects was a significant independent predictor of non-adherence (beta = .682, p < .05).

Social Support

Social support can affect medication non-adherence in older adults. In one study, adults age 55 or older who received help at home with activities of daily living and their antihypertensive regimen in the last year of life from their spouse (OR = 1.61, p ≤ .001) or female relatives (OR = 1.31, p = .05) were significantly more likely to adhere to antihypertensive medications than those who did not have such in-home support (Fosu, 1995). Barat et al. (2001) also reported living alone was significantly associated with self-reported non-adherence to dose (OR = 2.0, 95% CI 1.1 to 3.5) for adults age 75.

Salas et al. (2001) used pharmacy records of adults age 55 or older to assess non-adherence with antihypertensive drugs. For those with cognitive impairment who lived alone, the risk for non-adherence was significantly increased (OR = 2.9, 95% CI 1.2 to 7.5). Similarly, living alone significantly predicted global self-reported medication non-adherence in women with cardiac disease who were age 60 or older (parameter estimate = -.167, p = .05) (Clark & Dodge, 1999).

Depression

Depression has been investigated as a correlate of medication non-adherence. Carney et al. (1995) examined the relationship between current major depression and medication non-adherence in participants with coronary artery disease who were age 65 or older. Electronic monitoring was used
to assess non-adherence to a twice-daily regimen of low-dose aspirin. Depressed patients were non-adherent on 55% of days compared to non-depressed patients who were non-adherent on 31% of days (p < .02).

Using pharmacy records to determine the proportion of days covered by antihypertensive medication in a sample of primarily older adults (age 65 or older), Wang et al. (2002) reported depressive symptoms were significantly associated with non-adherence (OR = .93, 95% CI .87 to .99). Similarly, among adults age 55 or older, Spiers and Kutzik (1995) found level of depression was significantly related to global self-reported non-adherence (adjusted R² = .18).

**Cognitive Function**

*Memory.* Forgetting is the most commonly reported reason for medication non-adherence in older adults (Col et al., 1990; Nikolaus et al., 1996; Pettinger et al., 1999), which suggests strategies that prompt remembering and circumvent disruptions to medication taking can be useful in improving medication non-adherence. In a clinical trial of older adults (mean age, 66 years) with peripheral vascular disease, the majority (75%) of participants attributed forgetfulness as the reason for missing medication (Pettinger et al., 1999). Likewise, among adults age 65 or older admitted to the hospital who self-reported medication non-adherence, the most common cause given was forgetting to take the medication (39.6% of the participants) (Col et al., 1990). In another study of older patients (mean age, 81.9 years) discharged from the hospital who self-reported non-adherence, approximately 16% cited forgetfulness as a cause for medication non-adherence (Nikolaus et al., 1996).

*Comprehension.* Comprehension of the prescribed regimen is an initial step in successfully adhering to the prescription. Several investigators have reported older adults have difficulty understanding or recalling their medication regimen. In a study of adults age 75 or older, Blenkiron (1996) reported participants correctly named 64% of their medications, knew the purpose for 72% of their medications, and accurately recalled dosage instructions for 75% of their medications. Similarly, Nikolaus et al. (1996) reported only 55% of older adults (mean age, 81.9 years) discharged from the hospital knew the names and indications of all of their drugs, while 16% did not remember any drug name or indication.

Among adults age 65 or older who were admitted to the hospital, Col et al. (1990) found poor recall of the medication regimen was significantly associated with being hospitalized for non-adherence (OR = 7.1, p < .01). In another study, Gray, Sager, Lestico, and Jalaluddin (1997) found being age 80 or older was significantly related to not understanding medication directions (OR = 6.2, p = .017).

*Cognitive impairment.* Several studies used the Mini-Mental Status Examination (MMSE) to determine the association between cognitive impairment and non-adherence. In their post-hospital discharge study of adults age 65 or older, Gray et al. (2001) reported MMSE scores less than 24 were significantly associated with under-adherence (OR = 2.5, 95% CI 1.02 to 6.10). Similarly, Barat et al. (2001) reported MMSE scores less than 24 were significantly associated with self-reported non-adherence to regimen frequency in participants age 75 years (OR = 9.0, 95% CI 1.1 to 72.5).

Salas et al. (2001) used pharmacy records of adults age 55 or older to assess non-adherence with antihypertensive drugs and found MMSE scores of 25 or less were significantly associated with non-adherence (OR = 2.0, 95% CI 1.4 to 2.8). Likewise, Okuno, Yanagi, and Tomura (2001) reported MMSE scores less than 24 were significantly associated with non-adherence (OR = 2.94, 95% CI 1.32 to 6.58) in adults age 60 or older. Nikolaus et al. (1996) also reported MMSE score was significantly associated with self-reported non-adherence (beta = 1.77, p = .037) in older adults (mean age, 81.9 years).

Although they did not measure non-adherence, Ruscin and Selma (1996) assessed the ability to perform tasks associated with medication management in participants age 62 or older, such as reading prescription labels, interpreting medication instructions, opening vials, removing pills from vials, and differentiating pill colors. They found MMSE scores less than 24 were a significant risk factor for poor overall medication management skills (OR = 9.39, 95% CI 7.82 to 10.96).

Incalzi et al. (1997) assessed medication non-adherence in older adults (median age, 72 years) with chronic obstructive pulmonary disease. Non-adherence was significantly associated with a Mental Deterioration Battery less than 4 (χ² = 7.7, p < .006) and an impaired long-term memory index less than 7 (χ² = 7, p = .008).

**INTERVENTIONS TO IMPROVE NON-ADHERENCE**

Research about interventions to improve medication non-adherence in older adults has described the following:

- Instruction format.
- Patient education and counseling.
- Inpatient self-medication programs.
- Other additional strategies.

**Instruction Format**

A series of studies by Morrow et al. has focused on effective instruction formats for older adults (ages 59 to 90) (Morrow, Hier, Menard, & Leirer, 1998; Morrow, Leirer, & Altieri, 1995; Morrow, Leirer, Altieri, & Tanke, 1991; Morrow, Leirer, Andressy, Hier, & Menard, 1998). Comprehension and recall of medication information was facilitated significantly when drug-taking instructions were explicit and organized in lists rather than paragraphs, used pictorial icons to supplement written...
medication instructions, and were consistent with internal schemas.

However, pictorial icons must be used with caution because the comprehension of prescription information may be hindered, rather than facilitated, by certain types of pictorial stimuli. For example, inference is required to interpret that a milk carton on a medication label indicates pills should be taken with milk (Morrell, Park, & Poon, 1990).

Internal schemas were defined as mental representations of how individuals ordinarily take medications and handle problems, such as missed doses. For example, the “how to take” category includes information on dose, schedule, duration, and warnings. Medication information given out of order of the schema is more difficult to comprehend.

**Patient Education and Counseling**

Patient education and counseling strategies have been effective in improving non-adherence. Lowe, Raynor, Purvis, Farrin, and Hudson (2000) examined the effects of pharmacist counseling in adults age 65 or older on multiple drug regimens. All participants received three home visits by the pharmacist; however, those in the pharmacist counseling group also received medication review and education. Participants who received pharmacist counseling compared to a control group had significantly better adherence based on pill counts (91.3% vs. 79.5%, p < .0001).

Participants (mean age, 49.6 years) who received feedback at clinic visits regarding their medication taking using inhalers (ipratropium bromide or placebo) with electronic monitors had better adherence to the prescribed regimen of two inhalations three times daily than those in the control group not receiving feedback. Feedback consisted of detailed printouts of their pattern of inhaler use, praise, and suggestions for tailoring inhaler use to daily habits. The feedback group adhered significantly better to the prescribed three sets per day (1.95 vs. 1.63, p = .003) and used the prescribed two actuations in a significantly greater percentage of sets (80.6% vs. 60.3%, p < .0001) than the control group based on electronic monitors (Nides et al., 1993).

Rich, Gray, Beckham, Wittenberg, and Luther (1996) examined the effect of a multidisciplinary intervention on medication non-adherence in participants age 70 or older who were hospitalized with congestive heart failure. The multidisciplinary intervention included comprehensive patient education by a nurse, dietary and social service consultations, medication review by a geriatric cardiologist, and intensive post-discharge follow up. The intervention was compared to usual medical care by the physician and standard hospital services, such as dietary instruction and predischARGE medication instructions. There was a significant difference in non-adherence as measured by pill counts in the intervention group compared to the usual medical care group (12.1% vs. 18.9%, p = .003). Further, 15% of the intervention group had less than 80% adherence compared to 30.3% for the usual medical care group (p < .036).

**Inpatient Self-Medication Programs**

Two studies have reported inpatient self-medication programs before hospital discharge improved older adults’ non-adherence at follow up. Lowe, Raynor, Courtney, Purvis, and Tesale (1995) studied an inpatient self-medication program in participants age 57 or older. The intervention consisted of patient assessment and medication instructions from a nurse and pharmacist, a drug reminder chart, and a graduated program of self-medication in which patients assumed increasing independence for taking their medication during their hospitalization. The control participants were given medications by the nurse and, at hospital discharge, received medication instructions from the nurse and a drug reminder chart. Ten days after hospital discharge, patients who participated in the self-medication program had significantly better medication adherence based on pill counts compared to control patients (95% vs. 83%, p < .02).

Similarly, Pereles et al. (1996) investigated an inpatient self-medication program in older adults (mean age, 80 years). The program included medication instructions from a pharmacist and progressive advancement to self-medication under nursing supervision. The control group had their medications administered as usual by the nurses. One month after hospital discharge, patients who participated in the self-medication program made significantly fewer medication errors based on pill counts compared to control patients (.045 vs. .086, p < .001).

Self-medication programs allow inpatients to assume increasing responsibility for the administration of their own medications while being monitored. This provides the opportunity for health-care providers to identify older adults who need more supervision or education.

**Other Additional Strategies**

A variety of additional strategies have been evaluated for use with older adults. In a pilot study, Esposito (1995) compared adults age 65 or older who received one of the following interventions on the day of hospital discharge:

- Standard education consisting of a medication fact sheet.
- Standard education and 30 minutes of verbal instruction.
- Standard education and a medication schedule.
- Standard education, a medication schedule, and 30 minutes of verbal instruction.

Participants who received a medication schedule or a medication schedule and verbal instruction made fewer medication errors based on pill counts than those without a medication schedule.

In another study by Park, Morrell, Frieske, and Kincaid (1992), adults age 60 or older received one of the following interventions:

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• No intervention.
• An hour-by-hour chart of their medication regimen.
• A 1-week pillbox.
• Both the chart and pillbox.

Drug omission errors, as measured by electronic monitors, were significantly lower in participants who were given the two types of external organizers (both the hour-by-hour chart of their medication regimen and a 1-week pillbox) compared to either external organizer alone or none ($F(1,57) = 7.73$, $p < .05$).

Raynor, Booth, and Blenkinsopp (1993) examined older patients (group mean ages ranging from 68 to 70 years) being discharged from the hospital who received one of the following interventions:
• Daily drug reminder chart and routine nurse counseling.
• Daily drug reminder chart and structured pharmacist counseling including an explanation of the chart.
• Nurse counseling.
• Pharmacist counseling.

A mean adherence score of $> 85\%$, based on pill counts, was reported for $86\%$ of those receiving the daily drug reminder chart versus $63\%$ of those who did not receive the chart ($p < .001$).

Ware, Holford, Davison, and Harris (1991) compared the use of calendar blister packs to standard bottles or packets among older patients (average age, 78 years) who were being discharged from the hospital. There was a significant difference in adherence among patients with the calendar blister packs compared to control patients both 1 month ($64.4\%$ vs. $38.5\%$, $p = .03$) and 3 months ($48.9\%$ vs. $23.1\%$, $p = .03$) after discharge.

**ASSESSMENT OF NON-ADHERENCE**

There are a variety of methods for assessing medication non-adherence that provide different information about non-adherence and different reports of non-adherence. Assessment methods include:
• Self-reports.
• Pill counts and canister weights.
• Pharmacy records.
• Biochemical measures.
• Clinical judgment.
• Therapeutic response.
• Electronic monitoring.

Clinical settings tend to use self-reports, biochemical measures, and therapeutic response, whereas clinical trials tend to use pill counts and electronic monitoring (Dunbar-Jacob, Sereika, Rohay, & Burke, 1998).

Measurement of non-adherence is important in estimating the extent of non-adherence, identifying the effects and factors associated with non-adherence, and evaluating interventions to improve non-adherence. Measures that underestimate non-adherence, such as self-reports, pill counts, and pharmacy records, can lead to misinterpretation of treatment efficacy in older adults. Measures that detect patterns of non-adherence (e.g., underdosing, overdosing, missing doses, and making errors in the dosage interval), such as daily diaries and electronic monitoring, can help identify problems and direct interventions to remedy these problems.

**Self-Reports**

Self-reports of non-adherence can be obtained using interviews, structured questionnaires, and daily diaries (Dunbar-Jacob et al., 1996; Morisky, Green, & Levine, 1986; Straka, Fish, Benson, & Suh, 1997). Medication non-adherence tends to be significantly underestimated by self-reports compared to electronic monitoring (Dunbar-Jacob et al., 1996; Schlenk, Dunbar-Jacob, Rohay, & Bielory, 1996; Straka et al., 1997). Self-reports rely on the individual’s memory and willingness to report and may be influenced by a desire to please the nurse or other health-care provider.

Self-reports are often obtained for the period close to the clinic visit when it is easier for patients to remember recent medication taking and when non-adherence is reduced (Cramer, Scheyer, & Mattson, 1990).

For example, Cramer et al. (1990) reported mean non-adherence rates using electronic monitors of $11.7\%$ during the 5 days preceding the clinic visit, $13.6\%$ during the 5 days after the clinic visit, and $27.2\%$ during a 5-day period 1 month later ($p = .01$).

Daily diaries are better than global self-reports for assessing non-adherence. However, diaries rely on individuals’ willingness to accurately record their daily medication regimen. An advantage of daily diaries is that patterns of non-adherence may be detected.

**Pill Counts and Canister Weights**

Pill counts and canister weights rely on individuals remembering to return their pill bottles or canisters and their willingness to do so. Pill counts tend to underestimate non-adherence compared to electronic monitoring (Dunbar-Jacob et al., 1996; Schlenk et al., 1996).

Underestimation of non-adherence can occur when participants dump medication from their bottles and canisters. For example, Nides et al. (1993) reported $15\%$ of the control group acted their inhalers at least 100 times within a 3-hour period shortly before the clinic visit in an attempt to deceive the investigators about their non-adherence. In contrast, no dumping occurred in the feedback group, which had been informed of the ability of the electronic monitor in the inhaler to record and store the date and time of use. Patterns of non-adherence are not detectable with pill counts and canister weights.

**Pharmacy Records**

Pharmacy records require one pharmacy or one payor to facilitate gathering the refill information. Pharmacy records tend to underestimate non-adherence rates compared to electronic monitoring (Frick, Gal, Lane, & Sewell, 1998). However, these records have been considered satisfactory (Gregoire, Guilbert, Archambault, & Contandriopoulos,
1997) if an adequate observation period is used in adults age 70 or older, such as a 90-day period (Lau, de Boer, Beuning, & Porsius, 1997). Patterns of non-adherence are not detectable with pharmacy records.

**Biochemical Measures**

Biochemical measures have been used to collect information about non-adherence in adults age 61 or older, specifically urine levels of hypertensive medication (Oelzner et al., 1996). Other types of biochemical measures are available and could be used in older adults, such as markers for drug treatments (Del Boca, Kranzler, Brown, & Korner, 1996), drug blood levels (Gomes, Maia Filho, & Noe, 1998), drug saliva levels (Hugen et al., 1998), and drug metabolites in plasma and saliva (Dumontier et al., 1998). Biochemical measures are influenced by the half-life of the drug and variations in metabolic rate. These measures assess recent non-adherence and cannot detect patterns of non-adherence.

**Clinical Judgment**

Estimates of non-adherence by clinicians are no better than chance guesses and should not be used as reliable measures of non-adherence. For example, in a sample of adults with human immunodeficiency virus (age range, 21 to 62 years; median age, 40 years) in which non-adherence to protease inhibitors was defined as less than 95% based on electronic monitors, physicians incorrectly misjudged the degree of non-adherence in 41% of participants and clinic nurses incorrectly misjudged the degree of non-adherence in 30% of participants (Paterson et al., 2000).

**Therapeutic Response**

Therapeutic response is not a reliable measure of non-adherence. Therapeutic response, for example glycemic or blood pressure control, relies on the regimen being adequate in terms of medication type, dosage, and frequency. However, individuals can adhere without seeing clinical benefit if the prescription is incorrect. Individuals also can fail to adhere fully and yet see some clinical benefit. For example, Haynes et al. (1976) reported significant reductions in blood pressure with 20% non-adherence to antihypertensive medications.

**Electronic Monitoring**

Electronic monitoring is considered the gold standard for measuring non-adherence. Electronic monitoring can be used for medication delivered in blister packs, bottles, aerosols, and eye drops (Cramer, 1998) as well as for peak flow monitoring in asthma (Cote, Cartier, Malo, Rouleau, & Boulet, 1998). For example, to monitor pill taking from a bottle, the microelectronic components of the monitor are housed above the inner liner of the medication cap. The electronic monitor records and stores the date and time the cap is removed from the medication bottle. With the use of a communicator module and software package, the data can easily be downloaded from the cap for review and analysis using a personal computer.

Electronic monitoring is the most complete and timely measure of non-adherence and can detect patterns of non-adherence. Electronic monitoring allows for more accurate evaluation of treatment efficacy and safety.

Drawbacks to this technology are:
- Electronic monitors do not record medication ingestion.
- Electronic monitors are not useful with pillboxes, infrequent medications, and several bottles in different locations.
- Cost is prohibitive for widespread use in clinical practice.

Although electronic monitoring has been used primarily in the research arena to date, information from electronic monitors could be shared with older adults at clinic visits to identify when dosage errors occur and to devise strategies to address non-adherence (Nides et al., 1993).

**NURSING IMPLICATIONS**

Several implications for nursing assessment and intervention across clinical settings can be developed from this literature review of medication non-adherence in older adults.

**Assessment**

As part of their assessment of older adults, nurses should obtain patients' prescriptions from all health-care providers. The number of prescribed medications and doses should be reviewed with the prescribing health-care providers, and nurses should collaborate with them to make medication regimens clear and simple to remember. This assessment process may reduce polypharmacy and identify alternative drugs with once-daily rather than multiple-daily dosing regimens.

Risk factors for non-adherence in older adults, such as medication costs, medication side effects, and extent of family support and supervision of the medication regimen, should be assessed. Nurses also should be alert to potential non-adherence in older adults who are depressed or have cognitive impairment. The MMSE, a brief and easy-to-administer assessment tool, can be used to identify cognitive impairment in older adults because scores less than 24 on this tool have repeatedly been associated with medication non-adherence.

Older adults' understanding of the names, purposes, and dosage instructions of their medications also needs to be determined, and nurses should correct any misunderstandings about the regimen. Various assessment methods are available to measure non-adherence, and nurses should consider their advantages and limitations before using them in older adults.

**Interventions**

While more research is needed on interventions specific to older adults, this literature review provides direction for some useful strategies. Nurses should ensure medication instructions being given to older adults use appro-
pRIATE FORMATS. IN PARTICULAR, THE MEDICATION INFORMATION SHOULD BE EXPLICIT AND FIT TOGETHER LOGICALLY; THE USE OF BULLETED LISTS AND SIMPLE ICONS CAN AID PATIENTS’ COMPREHENSION.

Nurses also should provide feedback about medication-taking patterns to older adults. Specifically, nurses can review results of assessments of non-adherence with older adults, provide praise for good adherence, and make suggestions for tailoring medication regimens to daily habits. Nurses can explore the implementation of inpatient self-medication programs for older adults in their hospitals to identify and correct medication errors prior to discharge. Finally, nurses can suggest various strategies to remedy adherence problems in older adults, such as daily drug reminder charts and pill boxes.

References


ance and plasma levels in patients treated with indinavir (IDV) (abstract no. 512/32330). International Conference on AIDS, 12, 586-587.


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