MEDICATION ADHERENCE INTERVENTIONS FOR OLDER ADULTS

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ABSTRACT

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Older adults aged 65 and over are the fastest growing segment of the United States population. Older adults today are living longer than any of their predecessors and therefore are more likely to be diagnosed with chronic conditions that require the use of medications as treatment. With the increase of medications being used to treat chronic conditions, the risk for nonadherence to medication regimens increases. Nonadherence can lead to otherwise preventable morbidity and mortality of older adults, as well as poor health outcomes and ineffective disease management. Multiple barriers are associated with the ability to adhere to medication regimens and these barriers affect the individual with varying degrees of influence. Interventions can be created and implemented with the goal of increasing the rate at which older adults adhere to their prescribed medications. The goal of this systematic review of the literature is to analyze the effectiveness of interventions created with the intention of increasing medication adherence in older adults. Through the use of the ecological systems model, this review also analyzes the ways in which these interventions address the complexity of the influences on medication adherence.
This systematic review is dedicated to my mom and dad, as well as the family members, friends, and colleagues that have helped me accomplish my goals throughout my educational career.
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INTRODUCTION

On average, older adults aged 65 and over have the highest prevalence of chronic illnesses and disabilities, and subsequently consume more medications to treat these ailments than any other age group in the United States. Specifically, 92 percent of older adults are diagnosed with at least one chronic condition and 77 percent have at least two (National Council on Aging, 2014). It is also not uncommon for an older adult to have at least three to four chronic conditions, and as a result, be prescribed a complex medication regimen (Jackson, 2012). The high rates of medication consumption is a result of modern prescribing practices in which older individuals are twice as likely to receive prescribed therapy when compared with younger individuals (National Center for Health Statistics [NCHS], 2014). Currently, older adults constitute about 15 percent of the population and consume more than one-third of all prescribed medications (Marcum, Driessen, Thorpe, Gellad, & Donohue, 2014; Ortman, Velkoff, & Hogan, 2014). An older adult living in the community setting, on average, fills about 40 to 50 prescriptions each year and visits a pharmacy at least twice per month (Marcum et al., 2014). In fact, 17 to 19 percent of older men and women are taking at least ten medications in any given week (Slone Epidemiology Center, 2006). The number of medications an older adult is prescribed is an issue of concern because older adults are more susceptible to nonadherence complications due to the high prevalence of comorbidities being treated with complex drug regimens among the population (Meyer, 2015).

The World Health Organization (WHO) identified medication nonadherence as the leading cause of preventable morbidity and mortality, as well as a source of increased healthcare costs (Sabaté, 2003). Evidence supports an association with poor medication adherence and poor health outcomes, as well as increased risk for hospitalization, poor disease control, disability, and
early death (Jackson, 2012; Thiruchselvam et al., 2012). Specifically, poor medication adherence leads to over 125,000 preventable deaths each year, as well as 33 to 69 percent of all medication-related hospital admissions in the United States (National Council on Patient Information and Education [NCPIE], 2013; Health Information Network [HIN], 2010). It is also directly tied to $100 billion dollars in hospitalizations, in addition to excess medical spending and lost work productivity, costing the United States about $290 billion annually (Meyer, 2015; Agency for Healthcare Research & Quality [AHRQ], 2012).

Many individuals would not enjoy the same quality of life they do today without accessibility to multiple prescription drugs that are readily available to treat and prevent certain diseases, as well as reduce the symptoms and progressions of many chronic illnesses. However, the benefits of medications are often not fully realized for millions of people due to nonadherence, which creates a large burden on the healthcare system (Meyer, 2015). Also, older adults who are not consistent with taking their medications as prescribed may compromise the effectiveness of their treatment. When patients do not take their medications as directed, this creates a problem that should raise universal concern in the healthcare system due to its costly consequences on the individual and the healthcare system (Jackson, 2012).

Over 3.8 billion prescriptions for medications are written annually in the United States (Cutler & Everett, 2010). More than 50 percent of prescription medications are not taken as directed (Osterberg & Blaschke, 2005). Furthermore, it is estimated that 20 to 30 percent of these prescriptions are not even filled (AHRQ, 2012). The enormity of the problem is especially a concern since more than half of older adults use five or more medications to manage their medical conditions (Qato et al., 2008). With the majority of older adults in the United States prescribed to a certain drug therapy regimen, it is important to recognize the likelihood of large
numbers of older adults who are at risk for medication nonadherence and lack of compliance with physician and pharmacist recommendations regarding the proper use of medications.

**Adherence and Compliance**

By definition, medication adherence is described as the “degree to which use of medication by the patient corresponds with the prescribed regimen,” (Sabaté, 2003, p. 47). When a patient does not adhere to a physician’s instructions regarding their prescription regimen, and is inappropriately taking their medications, it is considered a nonadherent behavior. Adherence is often used synonymously with the term compliance. However, the two terms vary in the meanings they denote. The term compliance has been criticized for its paternalistic nature that seems to passively involve the patient as they follow their physician’s orders without much say in what they are prescribed (Osterberg & Blaschke, 2005; Mukhtar, Weinman, & Jackson, 2014). The term also implies that the patient is fully at fault when they become noncompliant and places all the blame on them when something goes wrong (Mukhtar et al., 2014). Since there has been a shift toward more person-centered practices and self-management in the healthcare system overall, adherence is a more fitting term as it implies that both the patient and the prescribers are invested in and share an agreement with the medication therapy (Institute of Medicine, 2001; Meyer, 2015). Adherence denotes a more positive meaning that is reflective of the individual’s personal agency and being in control of one’s own medication-taking behaviors.

**Behaviors Associated with Medication Nonadherence**

Nonadherence is a multifactorial process that can manifest itself through many different behaviors. Some of these nonadherent behaviors include, but are not limited to: missing, skipping or forgetting to take a dose (Conn, Taylor, & Miller, 1994; Holt, Rung, Leon, Firestein, & Krousel-Wood, 2014); neglecting to fill a prescription (AHRQ, 2012); inability to organize
complex dosing schedules (Okuno, Yanagi, & Tomura, 2001); pill-cutting or reducing dosages (Holt et al., 2014); and not taking the medication for the specified duration (Brown & Bussell, 2011). Older adults have an increased risk for nonadherent behaviors due to cognitive, memory, and physical dexterity changes that are associated with aging (Lim et al., 2004; Maddigan, Farris, Keating, Wiens, & Johnson, 2003). Nonadherent behaviors have also been found to be heavily influenced by prior experiences, cultural factors, personal beliefs, potential side effects, the relationship with one’s healthcare provider, cost, and government regulations (Holt et al., 2014; Ruppar, Conn, & Russell, 2008). Nonadherence is also caused by both intentional and unintentional reasons, and the difference between these two processes is important when analyzing nonadherence issues with older adults.

**Unintentional versus intentional.** There is a growing literature base regarding the distinction between two major forms of nonadherent behaviors: unintentional and intentional. Unintentional nonadherence is described as a situation in which a patient fails to follow a prescribed medication therapy without making an active, conscious decision to do so (Mukhtar et al., 2014). In simpler terms, unintentional nonadherence refers to a patient forgetting to take their medications (Carr-Lopez et al., 2014). This passive process encompasses behaviors such as inadvertently forgetting to take a medication or lacking the general ability to understand the disease and follow the regimen prescribed to them (Brown & Bussell, 2011). The causes of these behaviors are often cited as due in part to cognitive impairment, poor vision, and lack of motor dexterity, which affects the ability to open the pill bottle or even handle the pills themselves (Mukhtar et al., 2014).

Intentional nonadherence is regularly observed in older adults and can result in negative health outcomes for the individual patient and increased healthcare costs (Mukhtar et al., 2014).
Intentional nonadherence is described as when a patient consciously chooses not to follow the measures recommended to them by a healthcare professional by weighing the pros and cons of that medication and deciding whether to take it (Mukhtar et al., 2014; Carr-Lopez et al., 2014). For example, persons may intentionally choose not to follow their prescribed medication regimen because they do not agree with their physician’s recommendations or because they feel as though their medical condition has improved and no longer warrants the need for drug treatment (Brown & Bussell, 2011). Older adults frequently stop taking their medications because they consider them ineffective at treating their symptoms and are not noticing any benefits (Grant, Devita, Singer, & Meigs, 2003).

Despite the health concerns, not all intentional nonadherence is detrimental to the individual and sometimes the intentional behavior is considered rational (Vik et al., 2006). Vik et al. (2006) drew attention to intentional nonadherent behaviors that may occur as an attempt to avoid adverse drug effects that the individual is experiencing. Adverse drug effects are any undesirable or unexpected reaction produced by a medication. Many adverse drug events occur in older adults when it is believed that the drug’s benefits exceeded its risks and, as a result, experienced unpleasant symptoms from the medication (Steinman, Handler, Gurwitz, Schiff, & Covinsky, 2011; Grant et al., 2003). Adverse drugs events are extremely dangerous, especially for older adults due to age-related changes in physiology and the high prevalence of chronic disease. Whether a person will suffer harm from a medication or how severe that harm will be is difficult to predict (Steinman et al., 2011). Determining the reasons behind intentional nonadherent behaviors is extremely important when assessing the amount of risk that ensues as a result of that intentional behavior.
Understanding Barriers to Medication Adherence

Medication adherence is a challenging issue to address and improve upon. The reasons for nonadherence are not always clear and can be described in terms of an accumulation of factors (Chapman et al., 2008). In addition, the behaviors required for medication adherence are highly complex, impeded by several barriers, and are associated with many risk factors (Thiruchselvam et al., 2012; Chapman et al., 2008). Even though it is often difficult to generalize these barriers to the entire older adult population because medication adherence is a highly individualized process, it is beneficial to define what the common barriers are so that professionals can work to help individuals overcome them. Researchers and medical professionals need a better understanding of the barriers that older adults face and of approaches that are most effective for increasing adherence (Holt et al., 2014). Organization of potentially modifiable factors that influence adherence through a theoretical perspective could benefit patient health and well-being by providing medical professionals with insight into the complexities and interrelated levels of influence on medication nonadherence. Ecological systems theory is a theoretical framework that can be used to examine medication adherence, barriers to adherence, and ultimately how effective interventions are in increasing adherence. (Thiruchselvam et al., 2012; Zivin, Ratliff, Heisler, Langa, & Piette, 2010; Stokols, 1992)
THE ECOLOGICAL SYSTEMS MODEL

Health promotion programs, such as medication adherence increasing programs, often lack a clear theoretical foundation (Stokols, 1996). The ecological systems model can be applied to the barriers to adherence so that one can generate a better understanding of the elaborate connections between these barriers. Social ecology is considered an overarching framework that helps outline the interrelations among varying individual and environmental factors (Stokols, 1996). The ecological perspective, in terms of health and health promotion, focuses attention on both the individual and the social environment, as both play an active role in health management (McLeroy, Bibeau, Steckler, Glanz, 1988). It emphasizes the use of behaviorally focused and environmentally based strategies for health promotion, as opposed to solely individual oriented strategies to change behaviors that have been used in the past (Stokols, 1996). Increasing medication adherence is not just about changing the individual’s habits, but instead it involves changing levels of the environment to create a cohesive linkage between one’s personal and social well-being. The ecological systems model recognizes influences on an individual’s behavior at a broader scope and emphasizes the need to integrate and strengthen social supports in order to alter health behaviors suitable for effective health promotion (Stokols, 1996).

The ecological model has its roots in the works of Urie Brofenbrenner. The original purpose of the ecological model was to describe the ecology of human development and the interactions that influence an individual as they develop across the life span (Brofenbrenner, 1979). The term, ecology, pertains to the general interactions between organisms and their environments and therefore can be flexible in terms of its application (Stokols, 1992). Brofenbrenner (1979) distinguished multiple levels of influence that have an effect on an individual’s behavior across the life course. These levels include the micro-, meso-, exo-, and
macrosystem, beginning at the level most closely related to the individual and ending with the level furthest from the individual’s control (Brofenbrenner, 1979; McLeroy et al., 1988). Each succeeding level is comprised of the interrelations among the environments themselves and between the levels preceding it. See Figure I for a graphic representation.

From an ecological perspective, health promotion is viewed as a dynamic interaction between individuals and their environments, rather than a specific health set of behaviors of those individuals (Stokols, 1992). Variations of this perspective can be applied to medication adherence, and overall health promotion, as it recognizes that health behaviors and outcomes are influenced at multiple levels, beginning with an individual and their family and community, medical professionals, the healthcare system, and ending at the environmental or policy level (Holt et al., 2014; McLeroy et al., 1998). Thus, the ecological model is appropriate for examining the barriers to medication adherence in older adults because of the multifactorial nature of the barriers and how each barrier has varying influences on the individual.

The model also draws attention to the nested nature of structures that create spheres of influence on an individual’s behavior (Brofenbrenner, 1979). Each level of influence is as important as the other regarding behavior. An ecological analysis of health promotion behaviors emphasizes the transactions between the individual and the environment, the collective behaviors involved in the transactions, the health resources available, as well as the constraints that exist within each of the specific environments (Stokols, 1992). By using the ecological perspective to organize the barriers to medication adherence, one recognizes that the barriers exist at multiple levels. Also the ecological model recognizes from where issues arise and what factors contribute directly and indirectly to an older adult’s ability to adhere to a medication regimen. The model suggests that programs and interventions should employ strategies to alter the various levels of
influence on behaviors, rather than focusing on behavior out of context, in order to be effective at promoting healthy behaviors.
Figure 1: Ecological Systems Model for Health Promotion
Ecological Systems Theory and the WHO Model of Medication Adherence

Consistent with the ecological model, WHO describes common barriers to medication adherence for older adults in separate dimensions that recognize the complex levels of influence on an older adult’s ability to take their medication as prescribed (Sabaté, 2003). The barriers are classified into five dimensions, each with their own specific features. The dimensions include social and economic, health care system, medical condition-related, therapy-related, and patient-related barriers (Meyer, 2015; Brown & Bussell, 2011, Sabaté, 2003). Through examination of what each of those dimensions entail, the barriers can be applied to fit into the broader categories of interpersonal patient-related factors (microsystem), medical professional-related factors (mesosystem), healthcare system-related factors (exosystem), and environmental and policy factors (macrosystem) (Holt et al., 2014; McLeroy et al., 1988). These broader categories fit with the ecological model framework as the spheres decrease in direct influence on the individual with each outward level. Even though the factors are separated, medication adherence is still a complex and an interconnected process and there does exist some overlap across categories.

Patient-related factors. Patient-related factors and social and economic factors are combined into one encompassing category, along with some aspects of medical condition-related factors, because they fit into an individual’s microsystem when examining the barriers through an ecological model framework. Patient-related factors and behaviors are heavily influenced by intrapersonal and interpersonal interactions, as well as, an individual’s beliefs and understanding about their health (McLeroy et al., 1988). The barriers include a lack of understanding regarding the disease, lack of involvement in the decision-making process about an individual’s healthcare plan, lack of awareness of the long-term consequences of nonadherence, and inadequate medical literacy and knowledge (Brown & Bussell, 2011; Holt et al., 2014; Gazamararian et al., 1999).
Also, the lack of immediate health consequences associated with missing a dose is cited as an influential barrier to adherence (Holt et al., 2014). Patient barriers also include physical barriers such as impaired memory or cognition, poor dexterity, poor vision, hearing impairments, and discomfort swallowing pills (Barat, Andreasen, & Damsgard, 2001; Holt et al., 2014). Barriers also arise from the perceived lack of benefit of the medication, fear of potential side effects, stigmatization, psychological issues, or alcohol and substance abuse (Cutler & Everett, 2010; Holt et al., 2014; Meyer, 2015).

Specifically, cognitive impairment is cited as one of the most important risk factors and barriers to medication adherence in older adults residing in the community, especially deficits in the areas of memory and executive function (Insel, Morrow, Brewer, & Figueredo, 2006; Thiruchselvam et al., 2012). The risk of nonadherence is nearly three times as high for cognitively impaired individuals when compared to those with normal cognition (Okuno et al., 2001). Literature supports that older adults are likely to have a large number of drugs prescribed to them, and may lead to difficulty in adhering to their prescriptions due to common deficits in cognitive and memory (Lim et al., 2004). Proper memory encoding and storage are important in the retrieval of instructions for medication use, especially regarding the time and amount of each dosage. Those with cognitive impairment often have deficits in these areas which can lead to an increase in unintentional nonadherence behaviors (Stoehr et al., 2008).

Social and economic factors also fit within the individual’s microsystem and include, but are not limited to, low socioeconomic status, low level of educational attainment, and limited access to healthcare facilities as barriers to adherence (Meyer, 2015). Lack of social support and living conditions are also cited as contributors to medication nonadherence. Vik et al. (2006) found that the prevalence of nonadherence was higher for individuals who live in a private home
setting. Other studies have concluded that medication nonadherence is not only a bigger issue for those who live in a private home, but more of a concern for those who live in a private home alone, with little support from family or friends (Barat et al., 2001; Holt et al., 2014).

This level also includes some medical condition-related barriers as there exists an overlap of these factors. The medical condition directly affects the older adult and therefore some characteristics of the medical condition can act as barriers to nonadherence. Barriers that arise from the medical condition could be the manifestation of the symptoms, whether they are severe or mild, or that the medical condition itself is characterized by mental deficiencies or depressive symptoms, resulting in difficulty adhering to the medication regimen (Krousel-Wood et al., 2010; Meyer, 2015; Vik et al., 2006). Older adults are also likely to discontinue their medications if they feel as though their medical condition no longer warrants treatment (Holt et al., 2014).

**Medical professional-related factors.** Medical professionals, including physicians, nurses, pharmacists and other healthcare workers, play an active and large role in a patient’s ability to adhere to a specific medication regimen. Medical professionals work in direct contact with older adults, and therefore, would be consistent with mesosystem level influences within the ecological systems theory. Medical professionals are responsible for prescribing practices as they are the ones who typically diagnose medical conditions and prescribe medication therapy. Barriers related to medical professionals also encompass the dimensions of the overlapping medical condition-related factors from the previous dimension, therapy-related barriers, and some healthcare system-related barriers.

Open communication with one’s doctors is an important facilitator of adherence (Holt et al., 2014). However, Okuno et al. (2001) found that a substantial amount of older adults do not
adhere to medication regimens due to unaddressed concerns about the drugs they are prescribed. Many times medical professionals fail to recognize and address these issues of nonadherence in their patients (Brown & Bussell, 2011). This can arise from a poor relationship with the patient (Holt et al., 2014). A poor relationship can lead to a lack of communication between the medical professional and the patient (Meyer, 2015).

Poor communication can result in a lack of explicit directions for medication therapy, which is especially detrimental when the drug regimen prescribed is complicated or complex. As evidence supports, more complex drug regimens pose more risk of nonadherence as medication problems increase with the increasing number of medications a person is prescribed (Barat et al., 2001; Brown & Bussell, 2011). Additionally, in a recent study, patient perceptions of poor communication with physicians was associated with poor adherence specific to oral diabetes mellitus, lipid-lowering, and antihypertensive medications (Ratanawongsa et al., 2013).

Many medical professionals lack the understanding of how to communicate appropriately and effectively with older adults. Therefore, physicians and pharmacists do not always understand why the patient does not comprehend their prescribed regimen (Starr & Sacks, 2010). This can be due in part to the medical professional’s specialization, time of training, where they were trained, company affiliations, and the composition of their client base, as these factors influence their tendencies in prescribing practices, which can either facilitate or impede adherence.

The level of trust between the patient and the physician can act as a barrier to nonadherence. Adherence rates are nearly three times higher in primary care relationships characterized by high levels of trust (Martin, Williams, Haskard, & DiMatteo, 2005). This demonstrates the need for an effective dialogue between the medical professional and the patient.
Engaging and supporting patients in increasing adherence are critical to improving health outcomes (Cutler & Everett, 2010). Unfortunately, medical professionals are often bound by time constraints due to patient loads that inhibit them from spending the adequate amount of time with a single patient necessary for the development of a trustworthy and communicative relationship (Starr & Sacks, 2010). Also, the current healthcare system does not provide any incentive or support for medical professionals to be successful at effectively engaging and communicating with their patients so that all their needs are addressed (Cutler & Everett, 2010).

The medical condition an older adult has also contributes to this level. Some medical conditions require a complex medication regimen so that the symptoms can improve or be controlled. Typically, a high drug regimen complexity score is correlated with nonadherent behaviors (Vik et al., 2006). Thiruchselvam et al. (2012) stated that taking multiple medications often entails multiple dosing schedules, which leads to a complex medication regimen that is particularly difficult to manage. Their study also concluded that those who take four or more medications and have had at least one previous occurrence of medication nonadherence are at an increased risk (Thiruchselvam et al., 2012). Medical professionals can work to alleviate the complexity of medication regimens. However, in some cases, they are limited by the type of medical condition or by a lack knowledge regarding alternatives to specific regimens (Starr & Sacks, 2010).

**Healthcare system-related factors.** The factors and barriers associated with the healthcare system and medication nonadherence fall into the individual’s exosystem, as these barriers influence the individual, but indirectly. Medical professionals operate in accordance with the regulations and design of the healthcare system and are limited as a result in how they are able to interact with patients. The barriers in this category are closely associated with the current
fragmentation of the United States healthcare system which results in poor coordination of, and access to, patient care (Meyer, 2015; Brown & Bussell, 2011). The lack of coordination of care is a major factor as this affects medical professionals’ abilities to create regimens that are tailored to the individual in the most effective manner (Cutler & Everett, 2010).

Within this category, there is a general lack of communication between various medical professionals and healthcare providers including physicians, pharmacists, hospitals, primary care practices, and policymakers. Holt et al. (2014) concluded that the majority of older adults feel that communication with and between healthcare providers can affect adherence. In order to facilitate communication between these entities, research proposes the plausibility of health information technology as a resource to share health information across providers (Misono et al., 2010). However, health information technology is not widely available for the specific purpose of monitoring medications. This prevents healthcare providers from easily accessing information about a specific patient’s medication regimen (Brown & Bussell, 2011; Cutler & Everett, 2010). More research on the feasibility of the integration of health information technology is needed so that the potential of this technology can be reached, resulting in projected increases in medication adherence for patients (Misono et al., 2010).

Another factor relevant to this sphere of influence is the burden the healthcare system is under due in part to the large volume of patients seeking care. Medical professionals are sometimes scheduled to see a large number of patients without the necessary time and resources to do so. This results in improper assessments of medical conditions and medication-taking behaviors (Brown & Bussell, 2011). The overtaxing of the healthcare system and the professionals working in that system leads to the exacerbation of physician-related barriers, as well.
**Environmental and policy-related factors.** Environmental and policy-related factors address the barriers to medication adherence from a macro perspective. According to the ecological model, this level influences all other levels of systems, but has the least amount of direct influence on the individual. The healthcare policies in the United States are what shape our healthcare system. Medical professionals are bound by the restraints from the healthcare system, and the healthcare system is created by policies that determine how healthcare should be designed, delivered and reimbursed. The issues in this level involve the costs of medications, pharmacy use and convenience, and the current policies that are in place that influence how the services provided in healthcare system are constructed, delivered, and monitored (Cutler & Everett, 2010; Meyer, 2015).

Cost-related nonadherence is a pressing issue for older adults at not only the policy level, but the individual consumer level as well. People use more prescription drugs when the prices are lower (Cutler & Everett, 2010). However, between the years of 2002 and 2012, the percentage of individuals not receiving their medications due to cost rose from 7.6 percent to 9.4 percent (NCHS, 2014). Out-of-pocket expenses for prescription drugs are increasing for older adults and cost-related nonadherence is becoming a bigger issue (Holt et al., 2014). Cost-related nonadherence is impacted by social and economic barriers such as low income, lack of drug coverage, and high copayment burdens (Zivin et al., 2010). The costs of medications are heavily influenced by the drug companies and their influence on governmental policy at a national level. Their influence drives up the costs of medications at the expense of the consumer so that the company achieves maximum profit. Due to these high costs, older adults often admit that they have skipped a dose, cut pills, or have reduced their dose of a medication, in order to make the prescription last longer and not have to pay for a refill (Holt et al., 2013).
Marcum et al. (2014) described another environmental factor contributing to medication nonadherence involving the use of multiple pharmacies, which has been associated with deleterious effects on medication adherence across a range of chronic medications. Specifically, the use of multiple pharmacies is associated with 10 to 31 percent greater odds of medication nonadherence when compared to the use of a single pharmacy due to increases of confusion and a lack of communication between the various pharmacies used (Marcum et al., 2014). Not only does the use of multiple pharmacies act as a barrier to adherence, but so does the location and convenience of pharmacies (Meyer, 2015). This was particularly a concern for individuals who have no independent means of transportation and rely on other people to take them to the pharmacy (Holt et al., 2014). Based on this information, coordination between pharmacies through pharmacist-led interventions could potentially increase medication adherence. See Figure II for a representation of the intersection between the ecological systems model and the factors related to medication adherence as discussed.
Figure II: Ecological Systems Model for Health Promotion
Adjusted for application to medication adherence barriers for older adults.
**Conclusions from the Previous Literature**

Despite the abundance of published research and knowledge regarding the predictors of utilization and barriers to medication adherence, there is an inadequate amount of clinically useful interventions aimed at increasing medication adherence among older adults (Ruppar et al., 2008). In order for more recognition at the policy level, health improvements, and more healthcare cost savings, the breadth of the literature regarding medication adherence needs to be expanded so that the creation of evidence-based programs for intervention can occur. Several authors argue that interventions to improve medication adherence among older adults deserves this immediate attention as it warrants a serious problem among this growing segment of the population (Cutler & Everett, 2010; Osterberg & Blaschke, 2005; Simpson, 2006).

WHO states that “increasing the effectiveness of adherence interventions may have a far greater impact on the health of the population than any improvement in specific medical treatments” (Sabaté, 2003, p. 14). Older adults with better medication adherence have better health outcomes and a decreased risk of mortality (Simpson et al., 2006). In fact, for the four most common chronic conditions;—hypertension, diabetes, hyperlipidemia, and heart failure; higher levels of medication adherence have been found to be associated with lower hospitalization rates (Carr-Lopez et al., 2014). Furthermore, evidence strongly suggests that the benefits attributed to improved medication adherence and self-management of chronic disease could lead to a cost-to-savings ratio of approximately 1:10 across the population of the United States (AHRQ, 2012).

There exists a lack of consensus regarding the guidelines for intervention strategies as the research and literature on the topic is limited. Most reviews and studies have been conducted with a narrow focus on a specific disease or a single strategy as opposed to an all-encompassing
approach that warrants the potential to be useful for a variety of medical conditions (Atreja, Bellam, & Levy, 2005). However, the literature that does exist provides initial information about strategies that can be implemented.
RESEARCH QUESTION

This systematic literature review examines what programs or interventions have been implemented and evaluated with a goal of improving medication adherence in older adults. It seeks to determine what strategies are useful at improving medication adherence in older adults and what levels of influence these strategies address based on an ecological systems model of health promotion.
METHODS

The methods sections contains information about the search strategy and the inclusion and exclusion criteria used for the systematic literature review.

Search Strategy

A literature search was conducted to identify original articles reporting on programs and interventions with the primary goal of increasing medication adherence among the older adult population. A literature search was conducted seeking for the terms medication AND adherence or compliance AND older adults or elderly AND interventions or programs, within the abstracts of the empirical articles. The following databases were utilized: CINAHL, Medline, Medline with Full Text, Health Source: Nursing/Academic Edition, SocIndex, and PsychINFO. Search results were limited to publication in an academic journal between the years of 2000-Summer 2015. Even though adherence is the more widely accepted term, compliance is still used as a term to describe following a medication regimen. It is used across many disciplines and in the literature, and therefore it is included as a search term to avoid excluding potential articles.

Two hundred and sixty-one articles were identified using the search terms. Excluding duplicates, there were 181 remaining for preliminary analysis. Out of these 181, 38 studies were selected for further review to determine their fit in meeting the inclusion criteria.

Inclusion and exclusion criteria. The inclusion criteria for original articles included: 1) a focus on older adults in the programming or intervention strategies; 2) participant mean age of at least 60 years or older; 3) a focus on increasing medication adherence or compliance as the primary or a major component of the empirical study; 4) intervention is directed at self-management of medications by older adults (e.g. excludes interventions directed at caregivers responsible for administering medications to an older adult care recipient). Articles were
excluded if they did not meet the criteria, did not have the complete results from the intervention published in the article, or if after further examination, medication adherence was not a central component of the intervention. This search resulted in a total of 13 articles. See Figure III for a depiction of the flow of the systematic review process.
Search Terms:
medication AND adherence or compliance
AND older adults or elderly AND interventions or programs

261 articles found using the search terms

181 articles reviewed for relevance based on abstracts

80 exact duplicate articles excluded

143 non-relevant articles excluded

38 articles selected for review to determine their fit in meeting inclusion criteria

25 articles excluded because they did not meet inclusion criteria

13 articles included for full analysis

Figure III: Flow Chart of Literature Search
RESULTS

The results for the systematic literature search are presented in Table I. The table includes the name of the author or authors, the purpose of the study, a brief description of the study’s subjects, a brief summary of the intervention implemented, the major results, and the level or levels of influence within the ecological model that the intervention addressed.

Articles were examined to determine what strategies for improving medication adherence were embedded into the design of the intervention, how the intervention was delivered, what barriers were being addressed, and how effective the strategies were at improving adherence.
<table>
<thead>
<tr>
<th>Author</th>
<th>Purpose</th>
<th>Subjects</th>
<th>Intervention</th>
<th>Results</th>
<th>Level of Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnason et al., 2010</td>
<td>To determine the impact of a hospital to home transition intervention to promote medication use (medication adherence, medication use barriers management, &amp; medication use skills) for older adults with heart failure who are at risk for impaired medication adherence after hospitalization.</td>
<td>n=40</td>
<td>Nurse-led interviews; health literacy screenings; creation of individualized interventions; 2 telephone delivered educational &amp; coaching sessions by nurse; modules for self-care skills, self-regulation, &amp; managing barriers to self-care</td>
<td>IG had higher levels of medication adherence with adherence defined as ≥88% of medications taken as prescribed; significantly fewer barriers; both statistically &amp; clinically significant improvements in medication adherence compared to CG</td>
<td>Microsystem Mesosystem</td>
</tr>
<tr>
<td>Climente et al., 2007</td>
<td>To assess drug treatment compliance in institutionalized elderly patients, identifying reasons for poor compliance &amp; introducing measures to reduce its prevalence.</td>
<td>n=62</td>
<td>Review of drug treatments; patient interviews for individualized information; education (verbal &amp; written); appropriate use of blister packet checks; providing doctor with information about problems</td>
<td>Non-significant decrease in poor compliance; notable improvement in understanding of &amp; trust in the healthcare system</td>
<td>Microsystem Mesosystem</td>
</tr>
</tbody>
</table>

\( \bar{x} \)-mean age of participants  
\( b \)-IG-Intervention Group  
\( c \)-CG-Control Group
<table>
<thead>
<tr>
<th><strong>Table I (Continued)</strong></th>
<th><strong>Goeman, Jenkins, Crane, Paul, &amp; Douglass, 2013</strong></th>
<th><strong>Goldstein et al., 2014</strong></th>
<th><strong>Insel &amp; Cole, 2004</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To improve the asthma control &amp; adherence to asthma preventer medication of older people using the Patient Asthma Concerns Tool (PACT) to identify &amp; address unmet needs &amp; patient concerns.</strong></td>
<td><strong>n=124</strong>&lt;br&gt;( \bar{x} = 67.4 )&lt;br&gt;SD=6.4</td>
<td><strong>n=58</strong>&lt;br&gt;( \bar{x} = 69.3 )&lt;br&gt;SD=10.9</td>
<td><strong>n=27</strong>&lt;br&gt;( \bar{x} = 78 )</td>
</tr>
<tr>
<td>Person-centered education based on baseline PACT questionnaire; self-management checklist; asthma control device education; repeated assessments</td>
<td><strong>Statistically significant improvement in IG adherence to medication measured by tracking device monitors; 80% adherence at 3 months</strong></td>
<td><strong>Device type was not significantly associated with medication adherence; overall adherence was high; neither device improved adherence; full adherence was not achieved</strong></td>
<td><strong>Improvement in adherence suggested that older adults benefit from individually tailored cues</strong></td>
</tr>
<tr>
<td><strong>Microsystem</strong></td>
<td><strong>Microsystem</strong></td>
<td><strong>Microsystem</strong></td>
<td><strong>Microsystem</strong></td>
</tr>
<tr>
<td>Study Authors, Year</td>
<td>Objective</td>
<td>Sample Size</td>
<td>Intervention Details</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lam, Elliott, &amp; George, 2011</td>
<td>To assess the impact of a self-administered medication program (SAMP) on elderly hospital inpatients’ competence to manage medications &amp; their medication adherence behaviors.</td>
<td>n=24</td>
<td>3 intervention stages: education, progressing to supervised self-administration, &amp; independent administration</td>
</tr>
<tr>
<td>Mira et al., 2014</td>
<td>To design, implement, &amp; evaluate a medication self-management app (called ALICE) for elderly patients taking multiple medication with the intention of improving adherence &amp; safe medication use</td>
<td>n=99</td>
<td>App with personalized prescription information, reminders, &amp; medication monitoring capability; user-friendly interface, images, sounds, &amp; notifications</td>
</tr>
<tr>
<td>Moral et al., 2015</td>
<td>To evaluate the effectiveness of motivational interviewing (MI) in improving medication adherence in older patients being treated by polypharmacy</td>
<td>n=147</td>
<td>MI training program &amp; review of patient treatments by health care providers; understanding motivations, listening to patient, and empowerment of patient</td>
</tr>
</tbody>
</table>
| Ownby, Hertzog, & Czaja, 2012 | To evaluate the effect of two interventions in improving medication adherence in older adults being treated for memory problems | n=27  
\bar{x}=79.93  
SD=5.34  
Automated Reminding: daily recorded phone calls with reminder message; Tailored Info: computer input provided a written response to address patient concerns; use of MEMS | Both Automated Reminding & Tailored Info groups had higher levels of medication adherence compared to the CG | Microsystem |
|---|---|---|---|---|
| Ruppar, 2010 | To test a behavioral feedback intervention aimed at improving medication adherence & blood pressure (BP) control among older adults on treatment for hypertension | n=15  
\bar{x}=71  
SD=13  
IG=10  
\bar{x}=72.5  
SD=16.75  
CG=5  
\bar{x}=70  
SD=13  
Nurse-delivered medication adherence feedback, medication-taking skills development, habit adjustment, disease information; use of MEMS | Intervention group’s medication adherence rate was 96.4% compared to the control group’s 16.4%; medication adherence increased | Microsystem Mesosystem |
| Sirey, Bruce, & Kales, 2010 | To test the impact of a psychosocial intervention, the Treatment Initiation & Participation (TIP) program, to improve antidepressant adherence & depression outcomes among older adults prescribed pharmacotherapy | n=70  
\bar{x}=76  
SD=9  
IG=33  
CG=37  
Brief, individualized program aimed at modifying psychosocial factors related to medication adherence; initial interview; education; empowerment; follow-up telephone calls | TIP participants had higher rates of adherence than the control group; 80% adherence with significant group differences maintained across 6, 12, & 24 weeks | Microsystem Mesosystem |
<table>
<thead>
<tr>
<th>Study</th>
<th>Objective</th>
<th>n</th>
<th>μ</th>
<th>SD</th>
<th>Intervention Details</th>
<th>Outcomes</th>
<th>Systemic Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Song, Yong, &amp; Hur, 2014</td>
<td>To promote health related quality of life (HRQoL) &amp; self-care adherence among elderly patients with COPD.</td>
<td>n=40</td>
<td>μ=66.6</td>
<td>SD=11.1</td>
<td>3-session comprehensive self-care support intervention with motivational interviewing</td>
<td>Self-care adherence to medications scores were significantly higher after two months &amp; had an increasing effect on HRQoL</td>
<td>Microsystem</td>
</tr>
<tr>
<td>Taylor, Frazier, Shimp, &amp; Boyd, 2003</td>
<td>To explore the feasibility of a pharmaceutical care service in an inner city pharmacy with specific aims to impact medication compliance</td>
<td>n=8</td>
<td>μ=62.9</td>
<td>SD=7.1</td>
<td>Pharmacist-delivered intervention; culturally competent pharmaceutical care over 6 month period; medication histories of all participants &amp; changes made if needed; compliance encouraged &amp; supplemented with lifestyle modifications</td>
<td>All patients were compliant based on refill records post intervention</td>
<td>Microsystem, Mesosystem, Exosystem</td>
</tr>
</tbody>
</table>
Analysis

The results of this systematic literature review will be discussed and analyzed in terms of the major research question examining the design and outcomes of interventions designed to increase medication adherence. Then, the results will be examined to determine how they address the different levels of influence on behavior based on the ecological systems model.

Of the 13 articles examined, six articles addressed microsystem level barriers, six addressed mesosystem and microsystem level barriers, and one addressed microsystem, mesosystem, and exosystem level barriers. None utilized any strategies to offset barriers associated with macrosystem level influences.

**Microsystem.** Strategies that were used consistently throughout the reviewed articles to target microsystem, patient-related barriers included educational, reminding, motivational, self-management, informational, and health promotion strategies. These techniques mainly focused on the individual older adult’s role in managing their own medications. They sought to modify the older adults’ behaviors at an individual level. By employing educational, informational, and motivational interventions, medication adherence improved (Barnason et al., 2010; Climente et al., 2007; Goeman et al., 2013; Insel & Cole, 2004; Lam et al., 2011; Sirey et al., 2010). Through education, the interventions provided the older adults with the appropriate knowledge and skills necessary for them to be effective self-managers when taking their medications. These techniques were especially effective if they involved patient-specific or individually tailored information to address the specific nature of each older adults’ varying medication regimens (Insel & Cole, 2004; Ownby et al., 2012). Person-centered approaches, such as these, were shown to be most effective at increasing medication adherence by taking into account factors
specifically catered to the individual themselves and designing an educational or motivational intervention to address those factors.

More specifically, behavioral interventions also targeted towards microsystem related barriers. These involved behavior modification through motivational interviewing to encourage safe self-management behaviors and daily routine modification to incorporate taking medications into the older adult’s everyday routine (Moral et al., 2014; Song et al., 2014). Directly changing one’s behaviors poses potential for increasing medication adherence, as well as increasing the likelihood of long-term medication adherence. Once one integrates good medication taking behavior as one of their behavioral skill sets, it is likely these behaviors are internalized, and thus become a habit.

The specific barriers that were addressed by the articles examined included a lack of knowledge about one’s medication regimen or medical condition, forgetfulness, poor health literacy, lack of involvement in the decision-making processes of taking medications, and poor self-management. Addressing these levels at an individual level were effective, however, according to the ecological systems framework, these interventions would need components to target environmental factors as behavior is not controlled completely by the individual themselves, but by transactions between the various levels of influence.

**Mesosystem.** Mesosystem influences are presumed to address microsystem influences as well, because the mesosystem is directly interrelated with the individual. Only a few studies incorporated medical professionals as major aspects of the intervention program. Interventions that did include an element to address mesosystem barriers did so by involving a medical professional in the process of delivering the intervention, such as providing the education or collecting the data for medication adherence measurements. Involving a medical professional
connected the individual’s mesosystem and microsystem as the professionals directly working with the older adults helped facilitate behavioral change while becoming a stronger source of social support. These interventions did result in increases in medication adherence and did so mainly through face-to-face, motivational and medical condition education from a medical professional with a specific curriculum for each older adult (Barnason, Zimmerman, Hertzog, & Schulz, 2010; Climente et al., 2007; Lam, Elliot, & George, 2011; Moral et al., 2015; Ruppar, 2010; Sirey, Bruce, & Kales, 2010).

The interventions tackled both microsystem and mesosystem barriers through involving elements from the mesosystem in the intervention to deliver education to the older adult. Most of these interventions had a self-management portion to help encourage the older adult to take control following the culmination of the intervention and termination of involvement by the medical professional. Specifically, the barriers that were addressed included lack of individualized time between the medical professional and older adult, lack of information about specific medical conditions or prescription regimens, and poor communication. Also, these interventions addressed the lack of trust between older adults and their medical providers and helped to establish a more cohesive relationship that encouraged conversation between the two entities.

**Exosystem.** Limited articles were found to have exosystem-related components in them to address medication adherence. These components of the interventions that did address exosystem barriers included ones that used individually tailored information to address medication nonadherence behaviors in addition to the use of medical professionals, such as pharmacists, to act as a liaison between the physician and the patient to ensure proper prescribing practices (Taylor, Frazier, Shimp, & Boyd, 2003). These practices helped to make the healthcare
delivery system more person-centered and less fragmented in terms of relaying information from the physician to the patient.

**Macrosystem.** None of the articles examined in this systematic review included components to address macrosystem environmental and policy-related barriers. These interventions would have included some sort of program to reduce the cost of medications for the older adult or by increasing the collaboration between pharmacies, physicians, and hospitals to alleviate some fragmentation within the healthcare system. The intervention that tapped somewhat into these barriers was the one conducted by Taylor et al. (2003) in which the intervention implemented a culturally competent program that streamlined the delivery and monitoring of medications to African American older adults through the use of a pharmacist who helped to educate the individual about their medications, as well as contacted the individual’s prescribing physician to make changes if necessary. However, many components of this individual intervention fit more accurately into the exosystem level and is not included as a macrosystem intervention because it did not work to alter the overarching environment or policies related to medication adherence for those individuals.
DISCUSSION

This systematic review of the literature revealed that specific medication adherence increasing programs and interventions are limited in their existence in terms of empirical articles. Most interventions are created with the purpose of improving a medical condition through a focus on medication adherence, rather than improving the level of medication adherence overall. In other words, medication adherence improvement is often a component included in various programs and interventions with multiple goals, but is not often the sole focus of an individual program or intervention. While medication adherence has been examined as part of an overarching aspect of chronic disease management intervention, it has not often been examined in terms of its individual contribution to increasing health and wellness outcomes. This makes it difficult to extract what elements of the program specifically had the most impact on medication adherence.

Not only are they limited in number, but they are limited in the amount of barriers they address from an ecological perspective. The majority of articles targeted microsystem and mesosystem level barriers and none targeted macrosystem level barriers. As this review has shown, the reduction of barriers associated with medication adherence can occur at multiple levels, however, with varying effectiveness depending on the level or levels targeted. Thus, in order for medication adherence to increase, interventions and programs must be targeted at eliminating or alleviating the effect of the barriers within the multiple levels of influence.

Many of the interventions reviewed followed the typical strategy of modifying individual behaviors in hopes of increasing adherence. However, the ecological systems model calls not only for behavioral modification, but environmental modification as well. Interventions then should focus not only on the individual, but the individual’s environments and social supports in
order to increase adherence. Only a few interventions worked to integrate and strengthen multiple environments to make them conducive for generating good medication taking behaviors (Barnason et al., 2010; Climente et al., 2007; Lam et al., 2011; Moral et al., 2015; Ruppar, 2010; Sirey et al., 2010). Interventions that did this only delved into the environments or levels of influence most closely related to the individual, such as the mesosystem and exosystem. These intervention strategies increased adherence, but did not attempt to change one’s overarching environmental influences in the macrosystem.

The ecological systems model and health promotion assumes that efforts can be enhanced through the development of effective strategies that target both personal and collective well-being (Stokols, 1992). Thus, a situation is influenced by multiple facets of both the physical and social environment represented through the various levels of influence. Based on previous literature and this systematic review, programs and interventions should address the multidimensional and complex nature of one’s environment and its influence on their health behaviors in order to be most effective at promoting healthfulness. Specifically, interventions that address barriers within multiple levels of influence are effective at increasing medication adherence by altering the environment overall as opposed to just changing the individual’s behavior. In order for individual behaviors to change, the entire ecological system must be altered in some way to encourage the longevity of the effects from the behavioral changes.

The interventions that included changes in supports from varying levels of influence demonstrated effectiveness on increasing medication adherence. For example, interventions that involved medical professionals and counseling in addition to education on behavioral modification techniques were effective (Barnason et al., 2010; Climente et al., 2007; Lam et al., 2011; Moral et al., 2015; Ruppar, 2010; Sirey et al., 2010; Taylor et al., 2003). This is because
another level of influence was altered besides the microsystem, thus increasing the intervention’s effectiveness on modifying the individual’s environment. It is not just modifying the behaviors, its modifying the environments that influence and cause those behaviors.

The interventions reviewed provided several examples of strategies that are useful at improving medication adherence among older adults. Consistent with a review by Cutrona et al. (2010), computer-administered interventions were effective at improving medication adherence with various modes of delivery. Many of the articles examined included computer and technology based interventions such as: computers programs (Ownby et al., 2012); smartphones (Goldstein et al., 2014); electronic pillboxes and pill bottles (Goldstein et al., 2014; Insel & Cole, 2004; Mira et al., 2015; Ownby et al., 2012; Ruppar, 2010); and automated medication trackers (Goeman et al., 2013). The use of technology and computers helps to lessen the complexity of the intervention by making the monitoring of multiple patients easier for medical professionals. It also gives more control to the patient as they are able to self-manage their own behaviors through the specific device. The rise in studies testing technology-based programs is also reflective of the growing reliance on technological advancements in our society as a whole. Computer and technology-based can be explored more in depth to determine its utility at increasing medication adherence among the older adult population.

Technology and its utility at increasing medication adherence has the potential to reach beyond the first three levels of influence relevant to the articles in the review and address macrosystem barriers. Interventions using technology for individuals to self-manage their medications through a device of some sort were shown to be effective. Providing person-centered information via medical professionals directly may be difficult and not cost-effective for the healthcare system as it is involved and requires a lot of resources. However, computers
and other forms of technology are an efficient way of providing information to older adults. With both reminding systems and educational and informational strategies, computer-based programs can reduce the cost of providing these services as they automate the intervention into a systematic process. Reducing the cost of these specific interventions would address the cost-related barriers in the macrosystem as it would result in improving medication in a cheaper, more efficient manner, thus decreasing some costs in the healthcare system trickling down to the cost to the patient themselves.

However, technology-based interventions such as these that do not involve any type of follow up with a medical professional or outside personnel can be considered too simple. Managing behaviors through a device does not involve any environmental supports and therefore may not be effective for maintaining long-term adherence according to the ideologies associated with the ecological perspective. In order for behaviors to change and for those changes to last, more barriers need to be addressed through the intervention technology to ensure modification across environmental levels to influence the older adults at an individual level.

Educational interventions and care management programs offer the most consistent evidence on improvements in medication adherence across varied clinical conditions (AHRQ, 2012; Simpson, 2006). Self-management and self-care programs were evident in the articles examined. These programs encouraged older adults to take control of their medications by changing their behaviors and accessing information to educate themselves about their specific medical condition. The results from this review suggest that an intervention utilizing a form of technology that can be easily used by an older adult to provide them with the necessary information and skills to be effective medication adherers would be effective at addressing the levels of influence associated with the barriers to adherence.
Multiple education programs were seen across the articles reviewed (Barnason et al., 2010; Climente et al., 2007; Goeman et al., 2013; Lam et al., 2011; Ownby et al., 2012; Ruppar, 2010; Sirey et al., 2010). Educating older adults about their medications decreases the chance the older adult will make an error in the medication regimen by closing the knowledge gap. This places the responsibility of medication adherence on the individual patient. However, medication adherence is not only the responsibility of the patient, there are others that have control of the medication adherence process such as, physicians and other healthcare providers. A program that taps into all people involved in the process by including them as a part of the intervention itself poses the potential of being effective at increasing medication adherence among older adults.

Motivational interviewing and behavior modification programs to encourage the older adult to be proactive in self-managing their medications, as well as make changes to their routines to cue the initiation of taking medications pose an even greater potential for future interventions (Moral et al., 2015; Song et al., 2014). Long-term adherence is more likely to be effected by modifications in behavior and habits than education alone (Ruppar, 2010). Interventions that motivate the older adult to make changes in their overall behaviors, such as motivational interviewing and person-centered education, showed great improvements in medication adherence (Insel and Cole, 2004; Moral et al., 2015; Sirey et al., 2010).

This is not to discount the worth of education on improving medication adherence, but to reiterate that behavioral modification in light of education has the potential to impact medication adherence at higher rates. One can fully educate a patient on medication adherence and their medications, but what that patient does with that information is going to determine their level of adherence. One must use the information in a way that modifies their behaviors so that they are cohesive with good medication-taking habits. Once the behavior is learned and internalized, then
it is logical to predict that medication adherence will improve as those behaviors have now become routine. Modifying one’s behaviors puts them in a position of control and allows them to self-manage their medications without reliance on daily reminders or other individuals to tell them to take their medications.

A combination of the multiple forms of individually effective intervention strategies evaluated in this review pose the potential of reaching across the levels of influence to break down barriers and increase medication adherence among the older adult population. By combining multiple strategies, such as education, motivational interviewing, patient tailored information, and technology, the program could address barriers at multiple levels. More studies integrating these ideals and intervention strategies need to be conducted to test the effectiveness of this program design.

Techniques to change attitude and to acquire habits consistent with good adherence can be beneficial to health. This demonstrates that the patient-related barriers regarding a lack of understanding of their medical condition, medication regimen, or drug itself can be improved upon simply through increased education from a medical professional. Physicians, pharmacists, and case managers are well-equipped with the knowledge to educate older adults about their medications and medication therapy, and therefore, have the potential to be huge contributors to the improvement of medication adherence among this population. Pharmacists are in an ideal position for intervening with a patient in order to detect and resolve drug-related problems and other issues related to adherence (Jameson, VanNoord, & Vanderwoud, 1995). Working with an interdisciplinary team to tackle medication nonadherence and other drug-related problems pose as a viable solution when creating programs and interventions aimed at increasing the amount to which older adults take their medications as prescribed. An interdisciplinary approach has the
potential to address several barriers within the levels of influence in the ecological model framework.

While the ecological model offers a promising approach to increase adherence, there is a risk of creating a program or intervention that is too complex. To increase medication adherence, the development of simple interventions have been found to be the most promising, especially those that incorporate a multidisciplinary approach (van Dulmen et al., 2008). To address this issue, more multi-faceted intervention approaches specifically aimed at medication adherence need to be tested to determine best practice models for integrating multiple strategies into one all-encompassing adherence program. Suggestions for these programs include involving medical professionals to streamline the delivery of the intervention, simple behavioral modifications that the older adult can quickly learn and implement in their own lives, and the use of an individualized form of technology to act as a medication reminder log and communication tool with peers in the program and their medical professionals. In this way, the barriers to good medication adherence can be addressed at multiple levels of influence and the older adult’s environment can be modified to support good medication-taking behaviors. Overall, the strategies examined in this systematic review provide valuable insight for future interventions and programs aimed at increasing medication adherence in older adults by addressing barriers to good adherence from an ecological systems model framework.
CONCLUSION

The ecological model is a useful tool for understanding the barriers related to medication adherence in older adults. The model suggests that health promotion behaviors are not only modified at an individual level, but at multiple levels of the individual’s environment as well. The interventions and programs examined in this systematic review provided useful examples of strategies that aimed to increase medication adherence in older adults by addressing barriers at various levels of influence on the individual. The ecological model suggests that interventions aimed at increasing medication adherence should work to modify levels beyond the individual to facilitate and reinforce behaviors from a larger perspective. Thus, simple interventions that focus on integrating strategies to target specific barriers and the level of influence in combination with a multidisciplinary delivery approach pose potential to be most effective. Further studies need to be conducted using the interventions in the articles that were effective at improving medication adherence to a specific medication so that their feasibility and potential for success can be expanded beyond that of the specific medication in the original study.

The various types of strategies utilized suggests that there is no one all-encompassing intervention strategy that will work for every older adult. It also suggests that even though improving medication adherence is linked to better health outcomes overall, this still may not be true for every individual that participates in a program. The multifaceted issue of medication adherence is challenging to address, especially for older adults due to their high prevalence of chronic conditions and use of multiple prescription drugs. Overall, medication nonadherence among the older adult population requires additional attention from healthcare providers at a policy and program level to help eliminate the obstacles preventing proper medication-taking behaviors.
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