

# Adherence devices in a community sample: How are pillboxes used?

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This project is part of a series of studies that address medication adherence issues and adherence device use in older community-dwelling adults.

*Ce projet s'inscrit dans une série d'études qui abordent des questions d'observance de la pharmacothérapie et des moyens d'encourager les personnes âgées vivant à domicile à suivre leur traitement.*

## Abstract

**Background:** Calendar-packaging devices such as pillboxes (dosettes) and blister packaging are often recommended to seniors, and are commonly used. However, little is known about how they are used. The goal of this project was to investigate how older adults in the community use calendar-packaging adherence devices.

**Methods:** A mail survey of a community sample was used. Analyses addressed 3 research questions. First, the respondents reported on what type of calendar packaging they used. Second, the characteristics of the individuals who used pillboxes and blister packs were compared. Third, the way in which calendar devices were used by these individuals was described.

**Results:** Respondents were 135 community-dwelling older adults (mean age  $\pm$  standard deviation = 73  $\pm$  9 years). The majority of respondents

in the survey (75%) used a pillbox at least some of the time, while a smaller number (13%) used blister packs for at least some of their medications. Respondents who used pillboxes were taking more medications than those who did not. Few of the respondents reported using pillboxes in the recommended way. Only 11% of pillbox users used boxes with multiple slots for each day and, while the majority of respondents (93%) filled their pillboxes themselves, most of these individuals (82%) depended solely on their memory for filling the pillbox and only one individual had a second person check the pillbox for errors.

**Conclusion:** Although pillboxes are often recommended and are widely used, the types of pillboxes chosen and the ways in which they are used may not be optimal to ensure medication adherence. *Can Pharm J* 2009;142:28-35.

## Introduction

The failure to follow a medication regimen can result in serious medical consequences for an individual<sup>1-3</sup> and dramatically increase health costs.<sup>4</sup> Indeed, 33%–69% of medication-related hospital admissions have been found to be due to poor medication adherence,<sup>1</sup> although other studies found substantially lower rates of hospital admissions to be due to nonadherence, at least in elderly populations.<sup>5,6</sup> Patient errors leading to actual or

potential adverse drug events have been found to be most often due to adherence errors.<sup>2</sup> In one large study that focused specifically on an ambulatory geriatric population, it was found that over 20% of preventable adverse drug events were linked to patient adherence errors.<sup>3</sup>

Measuring adherence rates accurately is very difficult, particularly in community samples.<sup>7</sup> Estimates of adherence rates in elderly populations vary from 26% to 59%,<sup>6,8</sup> and adherence rates have

been found to worsen with increasing length of time on a medication.<sup>9</sup> Older adults are more likely to suffer from multiple chronic illnesses that usually require the use of multiple prescription medications, and such complex medication regimens have been linked to a greater risk of nonadherence.<sup>8,10</sup> When combined with the physiological and cognitive declines that often accompany aging, this increase in complexity can place older patients at an increased risk for medication errors and related adverse drug events.<sup>2,10</sup>

Impairments in working memory and other executive functions may decrease the ability of patients to effectively integrate and implement medication regimens.<sup>11</sup> For example, a patient with these cognitive deficits may have difficulty combining instructions for different medications into a plan of action, and then integrating this medication plan into the activities of the day. Moreover, prospective memory (remembering to carry out an action in the future) and reality monitoring (remembering that an action has been carried out) are likely to play important roles in medication adherence.<sup>12,13</sup> Reality monitoring may be particularly challenging when an action has become part of a well-established routine.<sup>12</sup> In other words, if every morning is similar, a person who remembers taking his/her tablet this morning might actually be remembering taking it yesterday morning.

There have been many attempts to develop practical solutions for improving adherence by older adults. One of the most commonly recommended<sup>14,15</sup> and widely used<sup>16</sup> adherence devices is the pillbox, which aims to combat difficulties with prospective memory and reality monitoring. Pillboxes come in a variety of different sizes and shapes. The most commonly recommended is the 7-day format with 4 subcompartments per day, detailing the time of day. Other forms of the device may have 4 compartments (for multiple drug doses in a single day) or 7 compartments (1 for each day of the week) with no subcompartments.

The goal of pillbox use is to decrease adherence errors and thereby allow a senior to maintain an independent lifestyle.<sup>17</sup> Indeed, hospital admissions of seniors are often linked to adherence errors, and often lead to loss of independence after discharge.<sup>10</sup> However, filling a pillbox can prove to be a challenging task, as it requires the individual to possess a high level of understanding of his/her medication regimen, as well as the ability to integrate and organize this regimen across a one-week time frame. Research has shown that both seniors and health care professionals make errors when filling pillboxes.<sup>17,18</sup> Levings et al. have found that half of

the errors involving pillboxes were filling errors, and that most of these were made by nurses.<sup>17</sup> Carlson et al. have reported that almost one-quarter of patients from a high-functioning community sample were unable to correctly fill a pillbox with 2 medications.<sup>18</sup> Pillbox-filling errors are particularly dangerous, because they are likely to result in medication errors that are perpetuated during the whole week.<sup>2</sup>

Pharmacist-prepared compliance packaging (a blister pack) is also commonly used to aid adherence. With this device, each dosage is presented in a separate, clear-plastic bubble and sealed with foil. The patient pushes the tablet through the foil backing to retrieve the medication. Little research has been carried out on the effectiveness of blister packs,<sup>19</sup> particularly for the community-dwelling elderly. One advantage of blister packs is that they are prepared by a pharmacist rather than by the patient, and there have been suggestions that they are helpful in decreasing adherence errors.<sup>19</sup> However, concerns have been expressed that at least some seniors have difficulty opening the packages,<sup>19</sup> and that blister-pack users may be less knowledgeable about their medications.<sup>20</sup>

Despite being widely used, the effectiveness of packaging devices to reduce adherence errors in the general population has not been clearly established and more research is needed.<sup>16</sup> The present study investigates how these devices are used by a community sample of middle-aged and older adults.

## Methods

The study was conducted from January to June of 2005. The data collection tool was a survey directed at middle-aged and senior adults living in New Brunswick. Two hundred surveys were mailed to middle-aged and older adults who had participated in previous gerontology studies at Mount Allison University in New Brunswick. (These were psychology studies and were unrelated to medication and adherence-device issues). A further 178 surveys were distributed in the public areas of a medical centre located in Moncton, New Brunswick. Respondents under the age of 45 years were excluded from the analysis.

Participants were given or mailed a survey package, along with a pre-stamped and addressed envelope.

## Key points

- Medication-adherence devices such as pillboxes and blister packaging are often recommended to seniors, and are commonly used.
- This study explores how pillboxes and blister packs are used in the community. In the sample studied, pillboxes were far more commonly used than blister packs.
- Although pillboxes were found to be widely used, the types of pillboxes chosen and the ways in which they are used may not be optimal to ensure medication adherence.

lope to be used for returning the survey. The survey package contained a cover letter, demographic survey, questionnaire concerning pillbox use, questionnaire concerning blister-pack use and a form for listing all medications being taken and what adherence aid(s), if any, the participant uses for each.

In the demographic survey, participants were asked to self-report on gender, age, educational attainment and occupation. They also rated their health on a scale ranging from 1 (excellent) to 4 (poor); their organizational skills on a scale ranging from 1 (not at all organized) to 7 (extremely organized); and how important they consider it to take medication exactly as prescribed on a scale ranging from 1 (not at all important) to 7 (very important).

In the pillbox questionnaire, participants:

- Indicated why they began to use the pillbox (from a supplied list of reasons)
- Indicated whether their physician and/or pharmacist were aware that they use the pillbox
- Described their pillbox in terms of number of compartments and number of removable compartments
- Indicated how the pillbox is filled
- Described how they use their pillbox when they travel
- Rated the difficulty of removing pills from the pillbox
- Rated how effective the pillbox is in assisting them to take medications correctly on a scale ranging from 1 (not at all effective) to 7 (extremely effective)
- Indicated how often they missed taking medication when using the pillbox

A parallel version of this questionnaire was used for blister-pack use. The survey drew no distinction between pharmacist-prepared and manufacturer-prepared blister packs.

All respondents were asked to complete the demographic survey and medication form. Participants were asked to complete the pillbox and blister-pack questionnaires if they were using or had in the past used these aids. The study was approved by the Mount Allison University Research Ethics Board. Funding for this project was provided by a research grant from the New Brunswick Innovation Foundation to the first author.

## Results

### *Sociodemographic data*

A total of 135 of the 378 distributed surveys were returned, resulting in a response rate of 35.7%. The sample included 31 male and 103 female respondents, and one participant who did not report

his/her gender. Participants ranged in age from 49 to 94 years of age (mean  $\pm$  standard deviation [SD] =  $72.9 \pm 9.1$  years; 7 persons did not provide their age but were included in subsequent analyses). Participants had an average of 13.7 years (SD = 2.9 years) of education. In all, 50.3% of participants were working (or had worked) in either professional or semi-professional fields, 17% had (or had had) unskilled jobs and the rest were rated as having (or having had) skilled or semi-skilled positions.

When asked to rate their current health in relation to others of the same age, 82.9% of participants indicated that they were in either excellent or good health, while 16.3% reported that they were in either fair or poor health (one person did not respond to this question). Finally, participants were asked to report the number of medications taken. On average, participants were taking 6.5 medications (SD = 3.4), of which 4.3 (SD = 2.9) were prescription medications. Six individuals did not indicate how many prescription medications they were taking, and 37 individuals did not indicate how many medications in total they were taking.

### Statistical analysis

Data analyses were carried out using SPSS software.

Three main research questions were planned:

- How many individuals use adherence aids and what types of adherence devices are used?
- How do sociodemographic and health characteristics impact the aids chosen? (Groups were compared using one-way ANOVA with Tukey's post-hoc tests.)
- What are the reasons for and behaviours of adherence-aid use? (Simple descriptive statistics were used.)

An alpha level of 0.05 was used for all statistical tests.

### *Use of pillboxes and blister packs*

The first goal of this study was to identify how many respondents use pillboxes and blister packs and what types are used. Overall, 25 respondents (18.5%) used neither a pillbox nor a blister pack, 8 (5.9%) used blister packs at least some of the time, 10 (7.4%) used both a blister pack and a pillbox, and 92 (68.1%) used a pillbox (see Table 1). A total of 84 individuals reported more details related to their use of adherence aids or combinations of adherence aids. Participants used medications in a variety of forms (e.g., drops, inhalers, suppositories), and individuals received some of their prescription medications in blister packs and others in vials. While some participants would remove all of their medications from a blister pack and place them in a pillbox, others used both blister packs and pillboxes.

**TABLE 1 Participant breakdown by adherence device use vs no adherence device**

Aids used	Number of respondents (%)	Mean number of medications
Pillbox for all medications	32 (23.7)	6.4
Pillbox + vials	18 (13.3)	6.9
Pillbox + non-oral*	9 (6.7)	8.6†
Pillbox + non-oral + vials	4 (3.0)	8.0
Pillbox for medications dispensed in blister packs	3 (2.2)	6.8
Pillbox for travel only	2 (1.5)	7.0
Blister pack + pillbox	8 (5.9)	6.7
Blister pack + vials	6 (4.4)	7.8
Blister pack + pillbox + non-oral*	1 (0.7)	6.0
Blister pack + pillbox + non-oral* + vials	1 (0.7)	13.0
No adherence aids used	25 (18.5)	4.4‡
Pillbox (missing data for medication use)	24 (17.8)	—
Blister pack (missing data for medication use)	2 (1.5)	—
Total	135	6.5§

\*“Non-oral” includes inhalers, creams, suppositories, drops, injections and sprays.

†Because of non-completed surveys, this mean has been calculated for  $n = 7$ .

‡Because of non-completed surveys, this mean has been calculated for  $n = 16$ .

§Because of non-completed surveys, this mean has been calculated for  $n = 98$ .

*Impact of sociodemographic variables on choice of aids*

The second goal of this study was to examine the impact of the sociodemographic variables on the choice of aids. For this analysis, the individuals who used blister packs at least part of the time were combined to create 3 groups: pillbox users ( $n = 92$ ), blister-pack users ( $n = 18$ ) and the no-device group ( $n = 25$ ). Because of the small sample of individuals using blister packs, we included people who used both blister packs and pillboxes in this group. However, individuals who transferred their medications from prescription bottles or blister packaging to a pillbox were considered to be pillbox users.

A comparison of the sociodemographic and health variables of the 3 groups is presented in Table 2. One-way ANOVAs showed that the groups did not differ in age, education, self-report of health, self-report of organizational skills or self-report of how important it is to adhere to medication regimens. The ANOVAs yielded significant effects for how many different medications are taken, how many times per day the medications are taken and how many tablets are taken in total each day. Tukey’s post-hoc tests showed that for these 3 variables, the only significant comparisons were between the pillbox users and the no-device users, with the pillbox users having higher scores for each

variable. Other comparisons were statistically non-significant.

*Reasons and behaviours associated with blister packs*

The third goal of this study was to describe the reasons and behaviours associated with adherence aids use. For this analysis, blister-pack users and pillbox users were treated separately. Eighteen participants completed the blister pack survey. Three respondents (17%) said they had difficulty taking their medications correctly, 7 (39%) said blister packs were convenient, 3 (17%) said they were easier to open than pillboxes, 6 (33%) said their pharmacist had recommended a blister pack, 5 (28%) said their physician had recommended a blister pack, 3 (17%) said they had complicated medication regimens and 7 (39%) said there were other reasons for using a blister pack.

On a scale ranging from 1 (not at all effective) to 7 (very effective), participants rated the effectiveness of the blister pack in helping them take their medication correctly at 5.33 (SD = 1.9). However, in answering a separate question, 5 respondents (28%) said there was little or no improvement in adherence since they began using the packaging and 9 respondents (50%) still reported forgetting to take their medication 1 to 3 times per week.

When asked to rate how difficult it was to remove the tablets from the blister packages on a scale ranging from 1 (not at all difficult) to 7 (extremely difficult), patients gave an average rating of 2.3 (SD = 2.0). Nonetheless, 3 respondents (17%) reported that they found removing their tablets from the packaging very or extremely difficult. Finally, 11 respondents (61%) reported taking the blister pack with them when they were away from home, but 3 respondents (17%) transferred the medication to a pillbox and 1 (6%) transferred it to a plastic bag or tissue. Three respondents did not answer this question.

#### *Reasons and behaviours associated with pillboxes*

A total of 102 respondents (75%) reported using a pillbox at least some of the time. This included 10 individuals who used both a blister pack and a pillbox. Two people did not report on behaviours associated with using the pillbox. Respondents were asked to select from a list their reasons for adopting the pillbox. Eighty-nine respondents (89%) listed convenience, 34 (34%) said a pillbox was easier to open, 20 (20%) said they had difficulty taking their medication at the right time, 7 (7%) said they had begun to use a pillbox because of complicated regimens, 6 (6%) said the pillbox was recommended by a pharmacist, 4 (4%) said the pillbox was recommended by a physician and 12 (12%) said they had other reasons for adopting the pillbox.

Survey respondents reported, for the most part, positive experiences with their pillboxes and reported that they were useful for helping to remember regimens and take medications correctly

(see Table 3). Although 55 (55%) of pillbox users said they never missed a dose and 5 respondents (5%) said they did so hardly ever, 39 pillbox users (39%) reported missing a medication dose or taking a dose substantially later than expected 1 to 3 times a week. Data were missing for 1 individual. Twelve (12%) and 10 respondents (10%) stated that their pharmacist and physician, respectively, were aware that they used a pillbox. When they travelled for a few days, 88% took the pillbox with them, while 4% of respondents said they moved their medication to a tissue or plastic bag. Eight people did not answer this question. Finally, only 29% of the sample stated that they owned a pillbox where the slots for one day could be separated from the rest of the box.

In the pillbox survey, we also asked respondents to describe the type of pillbox they used. Only 11 of the 99 pillbox users who described their pillbox owned a 7-day organizer with 4 subcompartments for the times of day (28 slots in total). Indeed, exploratory cross-tabulation analyses showed that of the 30 pillbox users who reported having to take medications 3 or more times a day, only 6 people used a 28-slot pillbox; of the 35 people who took medications twice a day, only 3 individuals used a weekly pillbox with more than 1 slot per day (Table 4). This means that the majority of pillbox users are placing medications that need to be taken at different points during the day into the same slot, and depending on visual recognition of the tablet to decide which tablet is to be taken at what time of the day.

In terms of filling the pillbox, 93 (93%) of par-

**TABLE 2 Device user groups**

Variable	Pillbox users (n = 92), mean ± SD	Blister pack users (n = 18), mean ± SD	No device (n = 25), mean ± SD	ANOVA*	Effect size, n <sup>2</sup>
Age (years)	73.5 ± 9.1	74.1 ± 9.3	70.1 ± 8.7	F(2,127) = 1.4	0.02
Education (years)	13.5 ± 2.8	13.6 ± 3.4	14.4 ± 3.4	F(2,121) = 0.9	0.01
Self-report of health on a scale of 1–4	1.9 ± 0.7	1.8 ± 0.7	1.8 ± 0.9	F(2,133) = 0.7	0.01
Self-report of organizational skill on a scale of 1–7	5.3 ± 1.0	4.8 ± 1.6	5.2 ± 0.9	F(2,132) = 1.3	0.02
Self-report of adherence importance on a scale of 1–7	6.8 ± 0.6	7.0 ± 0	6.8 ± 0.5	F(2,132) = 1.5	0.02
Number of medications taken	6.8 ± 3.4	7.1 ± 3.2	4.4 ± 3.3	F(2,94) = 5.6†	0.07
Number of times/day medications taken	2.2 ± 1.1	2.2 ± 1.1	1.5 ± 0.9	F(2,130) = 3.9†	0.06
Total number of tablets taken/day	6.3 ± 3.8	6.0 ± 5.4	3.8 ± 3.3	F(2,125) = 4.0†	0.06

\**p* < 0.05.

†Degrees of freedom vary across variables because some participants chose not to respond to all items on the survey.

ticipants reported that they fill their own pillbox, 3 (3%) have it filled by a pharmacist, and 4 (4%) have it filled by a family member or friend. Of the 93 respondents who filled their own pillboxes, 92 reported never or rarely asking a second person to check that the medications were correctly placed into the device. Of the 93 respondents who filled their own pillboxes, 1 used a medication calendar to do so, 16 referred to the written labels or instructions and the rest stated they knew their medication regimen “by heart.” When asked to rate how difficult it was to fill the pillbox correctly, the average rating was 1.32 (SD = 1.0) on a scale ranging from 1 (not at all difficult) to 7 (extremely difficult).

## Discussion

Overall, the results of this study suggest that calendar packaging, particularly in the form of a pillbox, is very frequently used by middle-aged and older adults in the community. The results also suggest that the practices surrounding pillbox use may often be problematic. Thus, these findings may begin to explain why calendar packaging is not always found to reduce adherence errors and improve clinical outcomes.<sup>16</sup>

The results of this study indicate that many middle-aged and older adults are using multiple forms of packaging, and are therefore juggling a complex set of adherence aids. For example, some medications are packaged in blister packs and others in vials. Some patients cope with this situation by using both blister packs and pillboxes at the same time, a strategy that may increase the complexity of the regimen. Other patients transfer their medications from the blister pack to their pillbox. This practice could be dangerous if patients have medication forms that are unstable outside the original packaging. It is possible that this risk could be avoided if physicians and pharmacists were aware of a patient’s use of pillboxes. However, very few respondents in this study reported that their health care providers were aware of their use of pillboxes to organize their medications.

A large majority of the participants indicated that they fill their own pillboxes, rather than having a family member or pharmacist perform this task. This independence and control over one’s own medication administration is important and may contribute to feelings of self-sufficiency for many seniors. However, errors made while filling a pillbox can be particularly dangerous because they are likely to extend over a full week.<sup>2</sup> Few of the respondents had a second person check to ensure that their device was filled correctly. Additionally, the majority of participants reported that they rely on

**TABLE 3 Opinions concerning pillbox use\***

Variable	Mean score ± SD	Number of respondents who replied “not at all”
Useful for remembering time and day of dosage ( <i>n</i> = 99)	5.4 ± 2.2	13 (13.1%)
Useful for remembering correct amount ( <i>n</i> = 98)	5.9 ± 1.9	8 (8.2%)
How difficult to fill ( <i>n</i> = 98)	1.3 ± 1.0	84 (85.7%)
How difficult to remove pills from a slot ( <i>n</i> = 98)	1.5 ± 1.1	76 (77.6%)
Overall effectiveness in helping take medications correctly ( <i>n</i> = 98)	6.4 ± 1.3	2 (2%)
Improvement since use started ( <i>n</i> = 93)	5.3 ± 2.1	12 (12.9%)

\* Participants rated their responses on a Likert scale with 1 being “not at all” and 7 “extremely.” Sample sizes vary across variables because of missing data.

**TABLE 4 Type of pillbox used by number of daily doses**

Type of pillbox used	Number of patients per regimen			Total number of respondents
	1 dose/day	2 doses/day	≥3 doses/day	
Daily (1 slot)	2	3	1	6
Daily (3 slots)	1	0	3	4
Weekly (7 slots)	21	29	20	73*
Weekly (28 slots)	2	3	6	11
Total	26	35	30	94†

\*Three patients using a weekly (7-slot) pillbox did not report dosages/day.

†Six patients did not report the type of pillbox used.

memory when filling the pillbox and do not refer back to prescription labels or calendars. This finding is particularly worrisome, as research has shown that both seniors and health care professionals encounter difficulties when filling pillboxes, and it is commonly recommended that a second person check one’s work.<sup>17,18</sup> It is important not to underestimate the complexity of filling a pillbox. Additionally, relying strictly on memory may be dangerous, as the colour and shape of certain medications may change and incorrect medication schedules can be perpetuated over subsequent weeks.

In this survey, the most commonly used pillbox format was a 7-day organizer, with no compartments for different times of the day. However, this device may lead to more errors as patients are faced with a number of tablets, all in one slot, that are to be taken at different times of the day.<sup>8,20,21</sup> This is of particular concern because the majority of respon-

## Points clés

- On recommande souvent aux personnes âgées de se servir d'outils qui les aident à observer leur médication comme les boîtes à pilules et les emballages-coque, et un grand nombre d'entre elles les utilisent.
- Cette étude explore la façon dont les personnes âgées vivant dans la collectivité utilisent les boîtes à pilules et les emballages-coque.
- Selon l'échantillon étudié, les boîtes à pilules sont beaucoup plus utilisées que les emballages-coque. Néanmoins, le type de boîte à pilules choisi et la façon de l'utiliser ne sont pas toujours appropriés pour garantir que les personnes observent leur médication.

dents took medications at more than one occasion during the day and yet used the one-slot-per-day pillbox. Finally, despite the large number of missed doses reported, the respondents believed that their pillboxes and blister packs were effective adherence aids. Future research is needed to evaluate the efficacy of pillboxes and blister packs as adherence aids.

This study has many limitations. First, the sample consisted of individuals who had previously agreed to participate in gerontology studies or who accepted a survey handed to them in a public

location. The individuals who participated in this study therefore included highly functioning seniors who chose to participate in a research project and who were comfortable with written materials. The response rate was also relatively low, although it is comparable to recent surveys on nutrition<sup>22</sup> and health services<sup>23</sup> that were carried out in Canada. The respondents in the present study may thus share sociodemographic characteristics that also influence adherence levels and adherence-aid use.<sup>7</sup> Another limitation of the study is that respondents

were only asked about pillboxes and blister packaging. It is possible that at least some of the respondents used other adherence aids, and that this affected the way they used the aids investigated here. Finally, the use of self-report measures is also likely to be problematic, particularly in terms of overestimating adherence levels.

## Conclusion

A large number of community-based adults in this study were using pillboxes as their adherence aid of choice. Although the sample obtained here is relatively small, the study did have some interesting findings. The results from this and previous studies suggest that pillboxes should perhaps be viewed as a targeted intervention, and one that is appropriate for some individuals but not for others.<sup>16,20</sup> It is important that pillboxes and blister packs are not considered a panacea for all older patients who present with adherence problems. Their use may be more complex than believed, and may not be appropriate for all patients. Indeed, clinicians have reported that blister packaging can increase confusion and have observed blister cards with medication doses taken out at random.<sup>24</sup> The results of this study suggest that the use of pillboxes by many community-based seniors may not be as straightforward as one might imagine. Findings such as these may help to explain why calendar packaging is not always found to successfully reduce adherence errors and enhance clinical outcomes.<sup>16</sup> ■

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