

# Type of oral solid medication packaging and medication preparation time in nursing homes: A direct observation study

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## Summary

**What is known and objective:** Medication administration is a substantial portion of the workday in nursing homes, with the medication preparation step being the most time-consuming. However, little is known about how medication preparation time is affected by the type of packaging used for oral solid medications (ie, tablets/capsules). We examined the effects of two types of packaging. As fewer steps are associated with strip packaging compared to bingo card packaging, we hypothesized that the increase in medication preparation seconds per resident with each additional oral solid medication would be smaller when strip packaging was used.

**Methods:** A total of 430 medication preparations conducted by eight nurses during the regularly scheduled morning medication administration period in two nursing homes—using strip packaging and bingo card packaging, respectively—were observed. Each medication preparation observation was matched to its corresponding medication administration record and observations averaged across resident. Using the resident sample (N=149), we estimated three regression models (adjusting the standard errors for the clustering of resident by nurse). The first model regressed medication preparation seconds on the number of oral solid medications. The second model added the type of packaging used and the control variables (type of unit [long-term care, post-acute care], the number of one-half pills and the dosage form diversity in the preparation). To test our hypothesis, the third model added an interaction term between the number of oral solid medications and the type of packaging used.

**Results and discussion:** As hypothesized, all else equal, the number of oral solid medications tended to increase medication preparation time per resident in both nursing homes, but the increase was smaller in the strip packaging nursing home ( $P < .05$ ). Each additional oral solid medication in the bingo card packaging nursing home increased medication preparation by an average of 13 seconds ( $b = 13.077$ ), whereas each oral solid medication administered in the strip packaging nursing home increased medication preparation by an average of only 8 seconds ( $13.077 - 5.092 = 7.985$ ). This is a difference on average of about 5 seconds per oral solid medication.

**What is new and conclusion:** To our knowledge, we were the first to examine the effect of type of oral solid medication packaging on medication preparation time in nursing homes. Type of packaging matters. The time saved using strip packaging (vs bingo card packaging) has implications for quality of care and the movement towards person-centred care in the nursing home sector. Nurses (or other staff tasked with medication

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preparation) in nursing homes using strip packaging potentially have more time to devote to nurturing a relationship with the resident. However, time saved in medication preparation by strip packaging is counterproductive if a serious error results. Thus, future studies should investigate the effects of type of packaging on medication preparation errors.

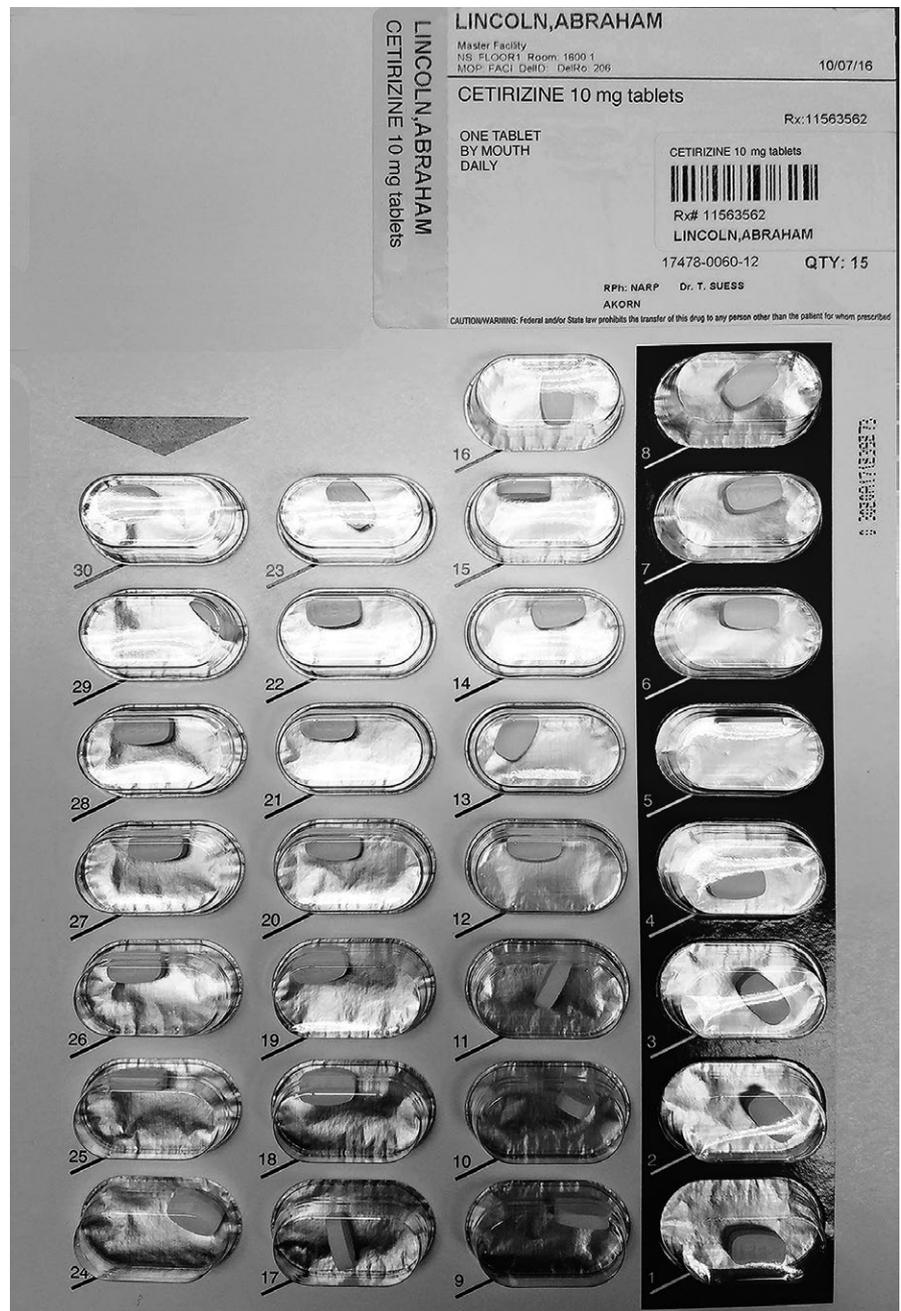
**KEYWORDS**

direct observation, medication administration, medication packaging, medication preparation time, nurses, nursing homes

**1 | WHAT IS KNOWN AND OBJECTIVE**

There is limited understanding about how nurses in the skilled nursing community setting spend their time, but a recent work sampling study

of nurses in a nursing home in Australia found that medication activities accounted for 18% of the workday, more than twice the time devoted to direct care activities (8%).<sup>1(p. 1911)</sup> Faced with time pressures, medication activities are viewed by nurses as part of their “must do”



**FIGURE 1** Illustration of oral solid medication bingo card packaging

work as opposed to their “should do” work, such as interacting with residents.<sup>2</sup> In the USA, the amount of time nurses spent on medication activities depends on who is assigned to administer medication. In some cases, state regulations allow medication aides to administer medications.

Medication administration is a multistage process,<sup>3,4</sup> but the medication preparation step is the most time-consuming.<sup>4</sup> The current study focuses on this step. Specifically, we examined the effect of type of packaging used for oral solid medications (ie, tablets/capsules) on the duration of medication preparation in two skilled nursing communities. The two communities used different types of packaging, bingo card packaging and strip packaging. The bingo card packaging consisted of a 15-count or 30-count single-dose blister card. As Figure 1 shows, each oral solid medication had to be punched out of the blister. Strip packaging, on the other hand, consisted of 7-day clear unit-dose strips printed with and sorted by resident, day and administration time (Figure 2). Tear-off dose packets on the strip could be opened singly by hand along one edge or several could be accordion-folded and cut with scissors. Figure 3 lists the medication preparation steps for each type of packaging. As strip packaging involves fewer steps, we hypothesized that the number of oral solid medications administered would increase medication preparation time per resident, but that this increase would be smaller in the strip packaging community. Although prior studies have examined the effects of different medication distribution systems on various aspects of the medication administration process,<sup>4-7</sup> to our knowledge, the current study is the first to isolate and compare the effects of bingo card packaging and strip packaging of oral solid medications on medication preparation time.

## 2 | METHODS

### 2.1 | Study design

To test the hypothesis, a direct observation study was conducted.<sup>3,4,8-10</sup> Specifically, nurses in both the post-acute care and long-term care units of two skilled nursing communities were observed as they prepared medications for each of their assigned residents during the regularly scheduled morning medication pass. For the analysis, the observation data were linked to the resident's medication administration record (MAR). Table 1 presents characteristics of the two skilled nursing communities participating in the study. The first nine items in the table were retrieved from archived public-use data at <https://data.medicare.gov/data/nursing-home-compare>. As the table shows, the two communities were similar on most characteristics, including location, type, staff rating and number of residents/beds. A slightly higher percentage of residents in the strip packaging community had a dementia diagnosis (24% vs 16%), but this difference was not statistically significant ( $P > .05$ ).

### 2.2 | Data collection

Eight nurses were observed over a period of 3-4 days, two in each unit per community. The observations took place during April and May in

2015. As Table 1 shows, although the nurses in the bingo card packaging community averaged about five more years nursing experience than the nurses in the strip packaging community, all of the nurses in the study had used their community's medication packaging system for over 1 year. The morning medication pass typically began around 8:00 AM, but ranged from 7:40 AM to 9:19 AM during the observation period. The median number of residents scheduled for each medication pass was 15 in both communities.

Two graduate students served as observers. They were instructed to explain the purpose of the study to the nurse, but to avoid further



**FIGURE 2** Illustration of oral solid medication strip packaging

Step	Strip packaging	Step	Bingo card packaging
1	Select resident and medication administration record (MAR)	1	Select resident and MAR
2	Locate resident's medications in cassette	2	Locate medication cart section containing resident's bingo cards
3	Tear all packets for this medication pass from resident's medication strip	3	Find the bingo card for first medication listed on resident's MAR
4	Compare each medication to the MAR and check off to document verification	4	a. Check to see whether reorder needed; if so, pull label and attach to reorder sheet b. Confirm no open bingo card is in use before starting a new card c. Repeat steps 3 and 4a-4b for each medication d. Compare each bingo card to the MAR
5	If medication listed on the MAR is not in the strip, check for a baggie, an original container, or take from house stock	5	If medication listed on the MAR is not present in a card, check for a baggie, an original container, or take from house stock
6	After accounting for all medications, open packets and pour oral solid medications into soufflé cup	6	After accounting for all medications, punch each oral solid dose from its card into soufflé cup
7	Document administration of all medications on the MAR	7	Return all bingo cards back to resident's section in the medication cart
		8	Document administration of all medications on the MAR

**FIGURE 3** Medication preparation steps per resident by type of packaging

interaction with the nurses, residents and family members. A copy of the data collection form used is provided in online Appendix S1. The observer timed the medication preparation for each resident, starting the timing device when the nurse selected the resident's MAR. The observer stopped the timing device after the nurse had documented the administration of all medications in the MAR and stepped away from the medication cart. The observer recorded the total elapsed time (seconds) for the medication preparation for each resident and the elapsed time of any interruptions to the medication preparation for that resident.

The observations were divided between the two observers by unit. However, the first observer observed only 84% of the medication preparations on the post-acute care unit, whereas the second observer observed the remaining 16% of the medication preparations on the post-acute care units, and 100% of the medication preparations on the long-term care units.

### 2.3 | Samples

As shown in Table 2, a total of 430 medication preparation observations were conducted, 217 in the strip packaging community and 213 in the bingo card packaging community. Slightly more (61%) of the strip packaging community observations were conducted on the long-term care unit than in the bingo card packaging community (53%). Medication preparation was observed 1 to 5 times per resident, with an average of 2.3 observations. A MAR was available for 311 of the observations. Medication preparation seconds from the 311 complete observations were averaged for each resident, yielding a sample of 149 residents.

### 2.4 | Data analysis

As suggested above, the outcome variable in the analysis, medication preparation seconds, was constructed in two steps. First, true medication preparation time was calculated by subtracting the number of seconds the nurse was interrupted from the total seconds he or she was observed. Next, medication preparation seconds were averaged across observations for each resident.

The key predictor variables in the analysis were number of oral solid medications (ie, tablets/capsules) scheduled for administration during the observation period and type of packaging. Number of oral solids was taken from the resident's MAR for the date of observation and averaged across medication preparation observations for each resident.\* Type of packaging was represented by an indicator variable coded 1 if the resident was part of the strip packaging community and 0 if he or she was part of the bingo card packaging community. To test the hypothesis that medication preparation time per oral solid medication was shorter for residents in the strip packaging community, we created an interaction term by multiplying number of oral solids by the type of packaging indicator variable.

We included three control variables in the analysis to account for the potential effects of other factors on the timing of medication preparation per resident. Type of unit, coded 1 for long-term care and 0 for post-acute care, was included because we expected medication preparation time to be shorter on a long-term care unit as its nurses are likely to be more familiar with its residents due to their typically

\*We used the number of oral solid medications *scheduled* instead of administered because the MARs provided by the bingo card packaging community did not show this information.

Characteristic	Community	
	Strip packaging	Bingo card packaging
Geographic location	Chicago, IL area	Chicago, IL area
Ownership type	Non-profit, corporation	For profit, individual
Certification	Medicare, Medicaid	Medicare, Medicaid
In a hospital	No	No
Continuing care retirement community	No	No
Special focus facility	No	No
Federally certified beds	Approximately 200	Approximately 200
Residents in federally certified beds	Approximately 120	Approximately 170
RN staffing rating	5 stars (highest score)	5 stars (highest score)
Nurses observed, long-term care unit	2	2
Nurses observed, post-acute unit <sup>a</sup>	2	2
Mean (SD) years nursing experience	7.3 (6.4)	11.8 (9.2)
Used med packaging system over 1 y	Yes	Yes
Observation dates, long-term care unit	May 4,11-13,19,22	April 8-10,15-17
Observation dates, post-acute unit	May 12-13,15,19,20,22	April 7,13-15,17,20,23
AM med pass start time (range)	7:43 AM-8:06 AM	7:40 AM-9:19 AM
Median AM med pass start time	7:58 AM	8:02 AM
Mean (SD) residents per AM med pass	17.9 (5.4)	15.5 (5.0)
Median (range) residents per AM med pass	15.0 (8-27)	15.0 (12-29)
Per cent residents with dementia diagnosis	23.5%	15.6%

IL, Illinois; SD, standard deviation; Med, medication; AM, morning.

The first nine items were retrieved from archived public-use data at <https://data.medicare.gov/data/nursing-home-compare> for the dates of the study period in 2015. These data are used by the Medicare.gov "Nursing Home Compare" website and are provided by the Centers for Medicare and Medicaid Services. The remaining items were collected as part of the current study.

<sup>a</sup>Six medication preparations observed during the AM medication pass on April 14 and 11 observed during the AM medication pass on April 23 at the bingo card packaging community in the post-acute unit were conducted by a trainee nurse supervised by the regular nurse. These observations were excluded from further analysis.

longer stays and more stable medical conditions. We also included the average number of one-half tablets scheduled for administration across medication preparation observations for each resident to account for the time spent halving the tablet.

Finally, we controlled for dosage form diversity. Although 82% of the medications prepared for administration during the regularly scheduled morning medication pass were oral solids, 11 other dosage forms were also prepared, including oral liquid (7%), subcutaneous (4%), oral powder (3%), assessment (2%), nebulization (1%), inhalation (<1%), intravenous (<1%), intradermal (<1%), intranasal (<1%), eye-drops (<1%) and pudding (<1%). Medication preparations involving a variety of dosage forms were expected to take longer. The dosage form diversity in each medication preparation was measured by the

**TABLE 1** Characteristics of the two skilled nursing communities in the study

"concentration index," a measure of diversity used widely across content and disciplines.<sup>11</sup>

$$1 - \sum_{i=1}^c p_i^2$$

where  $c$  is the number of dosage forms across all observed morning medication preparations (ie, 12) and  $P_i$  is the proportion of medications in the  $i$ th dosage form category. The index's value is a probability between 0 (when only 1 of the 12 dosage forms is present) and near 1. Specifically, the index's value is the probability that two randomly selected medications from a medication preparation will be different dosage forms. Thus, a higher value (ie, probability) indicates a greater degree of dosage form diversity. For the analysis, we used the average

**TABLE 2** Medication preparation and resident samples by type of packaging and unit

Sample	Total	Strip packaging community		Bingo card packaging community	
		Long-term care	Post-acute care	Long-term care	Post-acute care
Medication preparation sample					
Total observed	430	132	85	112	101
No feeding tube	417	131	85	101	100
No trainee nurse participation	401	131	85	101	84
No missing times	399	130	85	100	84
MAR available	311	113	66	69	63
Resident sample					
Total observed	185	65	39	43	38
No feeding tube	182	65	39	41	37
No trainee nurse participation	181	65	39	41	36
No missing times	181	65	39	41	36
MAR available	149	55	30	34	30

dosage form diversity across medication preparation observations for each resident.

Descriptive and bivariate statistics were used to characterize the distributions of the variables in the sample. To test the study's hypothesis, three ordinary least-squares regression models were estimated. The first model regressed medication preparation seconds per resident on the number of oral solid medications scheduled for administration to the resident during the regularly scheduled morning medication pass. The second model included the type of packaging used and the control variables. The third model added the interaction term. The standard errors of the unstandardized regression coefficients were adjusted for the clustering of residents by nurse in all three models. Diagnostics revealed no problem with multicollinearity, with tolerance values for the predictors in the main effects model ranging from 0.82 to 0.95.

### 3 | RESULTS

#### 3.1 | Descriptive analysis

A total of 62,286 seconds, or approximately 17 hours and 18 minutes, of medication preparations (minus any recorded interruptions) were observed. As Table 3 shows, the average amount of time nurses spent preparing medications per resident was 151 seconds (SD=74 seconds). The distribution was slightly positively skewed (median=136 seconds), with the longest medication preparation time being nearly 6 minutes. Medication preparation per resident averaged 44 seconds fewer in the strip packaging community ( $P<.05$ ). Using the median, the time saved in the strip packaging community was even greater, about 1 minute per resident.

The number of one-half tablets scheduled for administration was slightly higher in the bingo card packaging community ( $P<.05$ ). However, neither the total number of oral solid medications scheduled for administration to the resident nor his or her dosage form diversity

differed by type of packaging ( $P>.05$ ). The average resident across both communities was administered about 7 tablets/capsules (SD=4) during the regularly scheduled morning medication pass and had a score of .25 on the index of dosage form diversity. Thus, there was a 25% chance that any two randomly selected medications from a resident's medication preparation were different dosage forms.<sup>†</sup>

#### 3.2 | Regression analysis

Table 4 presents the regression results. As Model 1 shows, the number of oral solid medications scheduled for administration to the resident during the regularly scheduled morning medication pass explained about 27% of the variation in medication preparation seconds per resident ( $R^2=0.273$ ) and had the predicted positive effect on the outcome variable ( $b=10.569$ ,  $P<.001$ ). Specifically, each additional oral solid medication scheduled for administration to the resident added, on average, about 11 seconds to the time it took the nurse to prepare his or her medications.

The oral solid medication effect did not change with the addition type of packaging and the control variables in Model 2 ( $b=10.491$ ,  $P<.001$ ). However, their addition significantly improved the model, increasing the percentage of the variation explained to 41% ( $R^2=0.406$ ). The number of one-half tablets scheduled for administration tended to increase the time it took the nurse to prepare the resident's medications. That is, each pill that the nurse needed to halve during a resident's medication preparation added on average 37 seconds ( $b=37.386$ ,  $P<.05$ ). Similarly, greater dosage form diversity led to increases in medication preparation time ( $b=86.237$ ,  $P<.01$ ).

To test the study's hypothesis, Model 3 adds the interaction between number of oral solid medications scheduled for administration

<sup>†</sup>Results revealed that multitasking, in which nurses prepared medications at the same time as performing another activity,<sup>1</sup> also occurred and slightly increased medication preparation time, more so for the bingo card community ( $P<.05$ ) and especially for the post-acute care units ( $P<.05$ ).

**TABLE 3** Descriptive and bivariate statistics for variables in the analysis

Variable	Mean or %	SD	Median	IQR	Min	Max
Both communities (N=149)						
Medication preparation seconds	151.3	73.7	135.7	95.8	18	342.5
Number of tablets/capsules scheduled	7.2	3.6	6.5	5.0	0	16
Type of packaging used						
Strip	57.0					
Bingo	43.0					
Unit						
Long-term care	59.7					
Post-acute	40.3					
Number of one-half tablets scheduled	0.13	0.33	0	0	0	1
Level of dosage form diversity scheduled	0.25	0.18	0.26	0.25	0	0.67
Strip packaging community (N=85)						
Medication preparation seconds	132.4***	67.7	106.7	72.0	18	337.3
Number of tablets/capsules scheduled	6.7	3.5	6.0	4.7	1	16
Unit						
Long-term care	64.7					
Post-acute	35.3					
Number of one-half tablets scheduled	0.05**	0.22	0	0	0	1
Level of dosage form diversity scheduled	0.27	0.19	0.28	0.28	0	0.67
Bingo packaging community (N=64)						
Medication preparation seconds	176.4***	74.3	175.5	93.7	22.7	342.5
Number of tablets/capsules scheduled	7.8	3.8	7.3	6.0	0	14.3
Unit						
Long-term care	53.1					
Post-acute	46.9					
Number of one-half tablets scheduled	0.24**	0.42	0	0.33	0	1
Level of dosage form diversity scheduled	0.23	0.17	0.25	0.31	0	0.61

SD=standard deviation; IQR=interquartile range.

N=149.

\* $P < .05$ , \*\* $P < .01$ , \*\*\* $P < .001$  (chi-squared and two-tailed  $t$  tests for community differences).

and type of oral solid medication packaging used. The effects of the control variables did not change, and the interaction is statistically significant ( $b = -5.092$ ,  $P < .05$ ). As hypothesized, the number of oral solids tended to increase medication preparation time per resident in both communities, but the increase was smaller in the strip packaging community. Each additional oral solid in the bingo card packaging community increased medication preparation by an average of 13 seconds ( $b = 13.077$ ), whereas each oral solid medication administered in the

strip packaging community increased medication preparation by an average of only 8 seconds ( $13.077 - 5.092 = 7.985$ ). This is a difference on average of about 5 seconds per oral solid medication.

Figure 4 shows the relationship between the predicted number of medication preparation seconds per resident and number of oral solid medications for the "average" resident (ie, with all control variables set equal to their sample means). When the number of tablets/capsules to be administered was between 0 and 2, the predicted medication

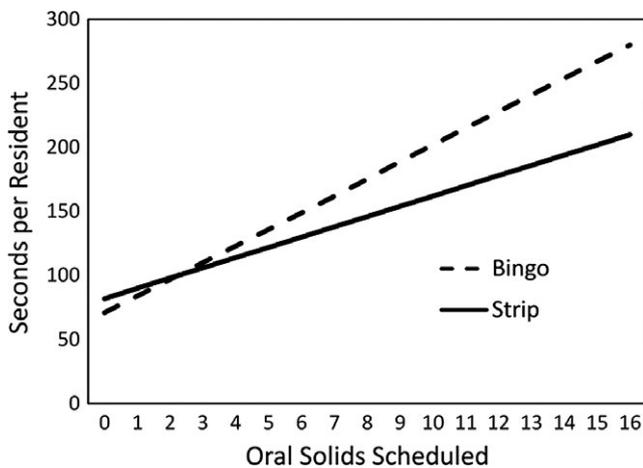
**TABLE 4** Results of regressions of medication preparation seconds per resident on number of oral solid medications scheduled for administration, type of packaging used and selected controls

Predictor	Model 1		Model 2		Model 3	
	<i>b</i>	(SE)	<i>b</i>	(SE)	<i>b</i>	(SE)
Number of tablets/capsules scheduled	10.569***	(1.786)	10.491***	(1.515)	13.077***	(1.257)
Type of packaging used (strip=1; bingo card=0)			-26.675	(22.941)	10.975	(22.779)
Unit (long-term care=1; post-acute care=0)			-20.564	(22.705)	-21.655	(22.735)
Number of one-half tablets scheduled			37.386*	(16.324)	39.244*	(15.387)
Level of dosage form diversity scheduled			86.237**	(24.581)	77.739**	(26.086)
Number of tablets/capsules x type of packaging					-5.092*	(2.444)
Constant	75.602***	(8.974)	76.737**	(21.355)	58.812**	(21.277)
R <sup>2</sup>	0.273		0.406		0.421	
Model F	35.03***		13.56**		38.74***	
Model degrees of freedom	1, 7		5, 7		6, 7	

*b*=unstandardized regression coefficient with standard errors (SE) (adjusted for the clustering of residents by nurse) in parentheses.

N=149.

\**P*<.05, \*\**P*<.01, \*\*\**P*<.001 (one-tailed tests for *b*'s).

**FIGURE 4** Conditional effects of number of oral solid medications scheduled on medication preparation seconds per resident by type of packaging

preparation seconds per resident did not differ by type of packaging. For example, the predicted medication preparation seconds for the “average” resident who was scheduled for 2 tablets/capsules was about 97 seconds in both the strip packaging and bingo card packaging communities.

However, for the “average” resident who was scheduled for 7 tablets/capsules, there was a difference. In the bingo card packaging community, the predicted medication preparation seconds for such a resident was 162 seconds, whereas the corresponding number for the

strip packaging community decreased by 24 seconds to 138 seconds. For a medication pass with 15 “average” residents, this represents a savings of approximately 6 minutes. The time saved grows as the number of oral solid medications increases.

## 4 | DISCUSSION

The study has some limitations. First, the results may not apply to all nursing homes. This is especially true for states or countries that do not require nurses to prepare and administer medications. In addition, only medication preparations during the regularly scheduled morning medication pass were observed. Preparation may differ for medication passes scheduled during other shifts and for off-schedule or “as needed” medications, with respect to both the number of medications prepared and interruptions experienced.<sup>1,4</sup>

Furthermore, it is possible that being observed may have influenced the behaviour of the nurses. Similarly, because interrater reliability was not formally assessed, observer bias could be an issue. Despite evidence from studies that suggests that observer bias is unfounded,<sup>12</sup> our efforts to minimize observer bias included uniform training, using a standardized data collection form and adding a control for type of unit (since one of the observers only observed in the acute care units) in the regression models.

Matching MARs were not available for 22% of the medication preparation observations, reducing the sample of residents by 18%. The problem of missing MARs was fairly well distributed across

community and unit, with it being only slightly worse in the post-acute care unit of the strip packaging community. No explanation for the missing MARs was provided by the communities. However, the lag between the observation period and obtaining the MARs in the communities may have had an impact. As far as we know, the missing MARs did not affect the results.

Additionally, we used the number of oral solid medications *scheduled* instead of administered because the MARs provided by the bingo card packaging community did not show this information. A comparison (not shown) of scheduled and administered oral solid medications for the strip packaging community suggested that our results were not affected by using scheduled rather than administered medications. Only about 6% of oral solid medications in the strip packaging community were scheduled to be administered "as needed." However, in 13% of cases, an oral solid medication scheduled for administration was not administered. About 54% of the time the reason an oral solid medication was not administered was because it was unavailable. It is not clear from the data available to what extent non-administration and unscheduled administration may have affected the results of our analysis, if at all.

Finally, we did not examine medication errors. Time saved is counterproductive if harmful errors result. A recent direct observation study found fewer, and less serious, errors after strip packaging was implemented.<sup>13</sup> In contrast, two studies based on voluntary reports found an increase in errors after implementation, with investigators concluding that strip packaging facilitated the early detection and reporting of certain errors, such as omitted and wrong dose, and, thus, enhanced resident safety.<sup>5,14</sup> Clearly, further study is needed, including identifying any unanticipated errors associated with the implementation of new packaging types.<sup>15</sup>

## 5 | WHAT IS NEW AND CONCLUSION

Despite the limitations described above, the analysis showed that type of oral solid packaging matters. To our knowledge, we were the first to investigate the effects of packaging type on medication preparation time in the skilled nursing community. As hypothesized, we found that the number of oral solid medications administered increased medication preparation time per resident in both the bingo card packaging and strip packaging communities, but this increase was smaller in the strip packaging community. Specifically, each additional oral solid medication administered added, on average, 5 seconds less to medication preparation in the strip packaging community compared to the bingo card packaging community, resulting in a time savings of about 6 minutes for a medication pass consisting of 15 "average" residents. Time saved has implications for quality of care and the "culture change" movement towards person-centred care in the nursing home sector,<sup>16-20</sup> allowing nurses to budget more of their time for "should do" work, such as talking with and getting to know the residents, or "see[ing] the whole person."<sup>2 (p. 490)</sup>

Although this type of interaction with residents is a major component of the person-centred model of care, other components include

resident comfort and safety and staff empowerment and satisfaction.<sup>16-20</sup> Thus, future studies should not only use larger samples and improved designs that address limitations of our study to verify its findings, but also examine the effects of type of packaging on medication preparation errors and staff involved in the medication preparation process.

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## CONFLICT OF INTEREST

None.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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