HHS Public Access

Author manuscript

J Am Pharm Assoc (2003). Author manuscript; available in PMC 2022 September 01.

Published in final edited form as:

J Am Pharm Assoc (2003). 2021 ; 61(5): 555–564. doi:10.1016/j.japh.2021.04.007.

Impact of a pilot community pharmacy system redesign on reducing over-the-counter medication misuse in older adults

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Conflicts of Interest: None declared.

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Abstract

Background: No interventions have attempted to decrease misuse of over-the-counter (OTC) medications for adults older than 65 (older adults) by addressing system barriers. An innovative structural pharmacy redesign (the Senior Section™) was conceptualized to increase awareness of higher-risk OTC medications. The Senior Section contains a curated selection of OTC medications and is close to the prescription department to facilitate pharmacy staff/patient engagement to reduce misuse.

Objective: This pilot study examines the Senior Section's effectiveness at influencing OTC medication misuse in older adults.

Methods: A pretest-posttest non-equivalent groups design was used to recruit 87 older adults from three pharmacies. Using a hypothetical scenario, participants selected an OTC medication, which was compared to their medication list and health conditions, and their reported use was compared against the product labeling. Misuse outcomes comprised Drug/Drug, Drug/Disease, Drug/Age, and Drug/Label with five sub-types. Patient characteristics were compiled into a propensity-score matching logistic-regression model to estimate their effects on the Senior Section's association with misuse at pre-/post-implementation.

Results: Patient characteristic were uniform between pre-/post-implementation and, once entered into a propensity-score matching model, Drug/Label Misuse (Exceeds Daily-Dosage) significantly lessened over time ($z=-2.42$, $p=0.015$). In addition, the Senior Section reduced Drug/Label Misuse (Exceeds Single-Dosage) for both the raw score model ($z=-6.38$, $p=0.011$) or for the model

in which the patient characteristics propensity score was added (z=−5.82, p=0.011). Despite these limited statistical effects, misuse was found to decrease after implementation for 7 of 11 comparisons.

Conclusions: These nascent outcomes begin providing an evidence base to support a well-conceived pharmacy-based OTC aisles redesign for reducing older adult OTC medication misuse. The Senior Section, when broadly implemented, creates permanent structures and processes to assist older adults to access risk information when selecting safer OTC medications.

Keywords

Medication Safety; Medication Risk Awareness; Senior Section; Pharmacy System Barriers; Pharmacy Staff/Patient Engagement; Pretest-Posttest Non-Equivalent Groups Design

BACKGROUND

Over the last 15 years, there has been increasing interest in investigating and mitigating the misuse of over-the-counter (OTC) medications.[1–7] Empirical evidence gained from directly investigating OTC misuse coincides with published literature estimating the extent of adverse events among adults age 65 or older (older adults) while examining the general incidence of OTC use.[8,9] Currently, over a third of older adults take at least one OTC medication.[10] Assessments of national data indicate that older adults who report taking OTC medications are susceptible to using those medications unsafely. For example, concurrent use of OTC medications and prescription medications or dietary supplements is prevalent,[10] creating a potential for adverse medication interactions. In addition, OTC-related adverse drug events are implicated in emergency hospitalizations involving older adults.[9] In many cases, these undesirable health consequences represent an unanticipated result of the patients' polypharmacy.[11]

Harms resulting from OTC-related adverse events are often a function of medication misuse, which is uniquely high for the older adult population due to a variety of factors. Such factors include:

- increased risks related to certain medications based on a person's age (representing Drug/Age misuse),
- interactions with concurrent medications (representing Drug/Drug misuse),
- exacerbation of current health conditions (representing Drug/Disease misuse), and
- deviations from recommended usage instructions (representing Drug/Label misuse).[7,12]

Although these situations are possible to identify and address within a primary care setting, practitioners often remain unaware of their patients' OTC medication use.[1,13] To further complicate matters, patients frequently lack knowledge about the safety issues associated with the OTC medications that they choose to take without guidance from a healthcare professional.[14–16] However, recent evidence relating to patients in the U.S. is scarce.

Despite the decades-long availability of published resources such as the Beers Criteria,[17–22] prevention of misuse within the older adult population can be undermined by the types of both health professional and patient issues discussed above. This evidence suggests that practice-based interventions can be an important method in which to reduce the potential for patient harms through the inappropriate use of OTC medications. Unfortunately, clinical practice and research has not traditionally generated testable practice design interventions to address system barriers for decreasing misuse of high-risk OTC medications in older adults.

The Senior Section™

To meet this need, participatory design[23] and human factors engineering[24] frameworks were used to redesign a structural layout of the pharmacy (as described in the study protocol[12]). Community pharmacies were considered an ideal system for implementing an intervention in an attempt to prevent misuse, given their prominence in the community as an easily accessible source of OTC medications coupled with pharmacists' professional training and experience in medication safety. The re-designed structural layout (called the Senior Section, see Figure 1) aimed to increase awareness of higher-risk OTC medication categories (i.e., pain, cough/cold, allergy, and sleep), and to promote interactions between pharmacy staff and older adults for safer OTC medication decisions. The Senior Section has three features conceived to reduce OTC medication misuse. Specifically, it: (1) contains a curated selection of OTC medications with lower risk profiles within the higher-risk categories of pain, cough/cold, allergy, and sleep, (2) displays general signage that encourages older adults to ask a pharmacist for assistance as well as safety information related to the specific medication categories included in the section, and (3) is close to the prescription department to facilitate pharmacy staff/patient engagement around medication safety issues.

This pilot study was designed to examine the effects of an innovative pharmacy design change on the reported misuse of OTC medications by older adults. Two research questions guided this study: (1) Did implementing the Senior Section in a small sample of community pharmacies reduce occurrence of Drug/Age, Drug/Drug, Drug/Disease, and Drug/Label misuse, and (2) Did various patient characteristics influence the Senior Section's effect on these misuse outcomes? It was hypothesized that innovation implementation would decrease the frequency of OTC medication misuse, and that patient characteristics could moderate this effect.

This quantitative analysis is specific to the Senior Section's effect on the occurrence of standardized medication misuse classifications (see Misuse Analysis under Methods section). However, the overall project examining Senior Section implementation had multiple objectives and methods, including patient and pharmacy staff surveys, and has led to numerous publications describing different aspects and effects of the intervention. Resulting publications describe such distinct methods or topics as explanation of the participatory design influence,[25] description of the study protocol,[12] descriptive analysis of patient/pharmacist encounters defined through a study data collection form,[26] mixed-methods analysis of patient/pharmacist encounters,[27] and qualitative assessment of pharmacy staff reactions to the Senior Section.[28]

OBJECTIVE

This pilot study examines the Senior Section's effectiveness at influencing OTC medication misuse in older adults.

METHODS

A pretest-posttest non-equivalent groups design[29] was used to assess changes in the occurrence of misuse for older adults recruited from a small sample of community pharmacies within a single pharmacy organization.

Recruitment

Three community pharmacies from the same pharmacy chain were selected for project participation. The three pharmacies had the same physical layouts and demographically similar patient populations. Each pharmacy location generated a list of customers who were 65 years or older and received a prescription from that pharmacy within the last year. Older adults received an invitation letter to participate in the study, sent from the pharmacy manager at each site, explaining that the store was collaborating with University of Wisconsin researchers to learn more about how older adults select and use OTC medications. The letter stated that eligible participants were within a certain age category and had either purchased or considered purchasing an OTC medication in the past year to treat either pain, insomnia/sleep problem, cough/cold, or allergies. A decision was made to include all community-dwelling older adults, regardless of their cognitive capacity. Although a range of cognitive capacity could be expected, exclusions were not made because all non-institutionalized individuals comprise the OTC medication-purchasing population.

The pharmacy manager at each site mailed a total of 1350 letters to eligible participants during the pre-implementation phase, while 450 were mailed to different participants during the post-implementation phase. It should be noted that post-implementation recruitment and patient participation was severely hampered by the unanticipated and rapid bankruptcy and closure of the pharmacy chain, which occurred during the project timeframe. Although an effort was made to accelerate recruitment efforts after the closure was announced, there was insufficient time to accumulate the anticipated number of completed patient interviews. As a result, the post-implementation sample size was lower than originally predicted, resulting in notably unequal sample sizes between time periods.

In addition to the mailed letters, study fliers also were placed near each pharmacy's pick-up window. Both letters and fliers contained instructions for potential participants to contact the study team to learn about the study. Pharmacy staff could also call the study team with contact information for potential participants, if that older adult preferred to be contacted directly. Interested participants were then phoned to be given information about the study requirements and, if desired, a date and time was scheduled to complete an interview at the pharmacy location at which they were a regular customer. Study materials were mailed prior to the interview. Participants were paid $20 for completing the study, and consented to be recorded during the interview. This recruitment method resulted in two separate cohorts

– one for pre-implementation and one for post-implementation. Non-equivalent groups were necessary due to the inability to observe and track changes for a given participant, but analyses were conducted to determine whether the demographic characteristics of participants from the pre- and post-intervention data collections were similar (see Results section). Recruitment occurred from March to September 2018. This study is a component of a larger research project that was approved by the University of Wisconsin Institutional Review Board.

Data Collection

Participants completed one pharmacy-based interview and two questionnaires. Prior to the interview, participants were mailed a questionnaire that assessed nine patient characteristics – health status (Likert scale, 1=poor, 5=excellent), health conditions (the Older Americans Resource Survey methodology), 30-day medication use (self-reported for prescriptions, OTCs, and dietary/herbal supplements), number of prescribers and pharmacies (self-reported), age, gender, education, and race. Participants brought the completed questionnaire with them to their scheduled interview. All participants (either pre- or post-implementation) completed the same data collection tools.

Participants were met by the interviewer near the store entrance. After collecting study materials and answering any participant questions, the participant was presented with three hypothetical scenarios. For this project, they were asked to choose one of the scenarios that most applied to them:

Scenario 1: Sleep

> Recently, you have been having (more) difficulty falling asleep or staying asleep. You are here at [name of store] to look for a medication that can help you sleep.

Scenario 2: Pain

> You are having a soreness and muscle aches. It is not bad enough to call your doctor. You have not taken any medication to help with these aches yet. You are here at [name of store] to look for a medication that can help you feel better.

Scenario 3: Cough/Cold or Allergy

> For the past three days you've had a runny nose, sore throat, felt "stuffy", and your head is congested. You don't have a fever and it is not bad enough to call your doctor. You have not taken any medication for your symptoms yet, but you are here at [name of store] to look for a medication that can help you feel better.

Participants were then asked to show and tell the researcher how they would address the hypothetical health issue described in the scenario by walking the interviewer through the store to the medication they would select. Occasional probes were offered during the interview, which included standardized and semi-structured questions such as "How did you decide to pick this particular medication?" or "What are you thinking about when you decided to pick this medication instead of other ones?" After selecting a medication, participants were asked to describe how they would use the medication they selected, including such questions as "How would you take this medication? How often? And what

time of day?" Interviews were audio and video recorded and professionally transcribed. On average, the in-person interview took about 30 minutes to complete. All pre- and post-implementation data were collected between July and December, 2018. Although post-implementation data collection was abbreviated by a month due to the aforementioned bankruptcy and closure of the pharmacy chain, it is important to note that recruitment had already commenced so the methods remained the same. Given that the patient interviews elicited details that were generally outside the scope of this analysis (occurrence of OTC misuse, below), complete details about the findings principal to these methods are contained in other publications.[26–28,30]

Misuse Analysis

Three pharmacists with geriatric clinical experience comprised a misuse analysis team. Prior to the misuse evaluation, information about the participant and OTC medication selected was de-identified and entered into RedCap. This information included participant's self-reported medication list and health conditions, and the selected OTC and reported OTC use (which included direct portions of the interview transcript and use summaries prepared by the research team). Data were extracted from the transcripts to ensure that the misuse analysis team would be unable to identify whether the interview occurred before or after Senior Section implementation. Also included were photographs of the OTC medication (front, back, and top to capture all product labeling information) as reference for the misuse analysis team. A random-number generator was applied to the participant list, which assigned all participants to one of three different batches for evaluation. Randomization and blinding ensured that the misuse analysis team would be unable to identify whether the interview occurred pre- or post-implementation. Misuse was first evaluated independently by each reviewer, and responses were then consolidated in preparation for group discussion, and discrepancies between reviewers were noted. The misuse study team, supported by study researchers (JAS, MAC, and KZX), then met as a group to review independent comments, facilitate discussion about discrepancies (which commonly resulted from misuse analysis team members' interpretation of the drug facts information on the label or what patients meant when describing their use), and achieve consensus about final misuse classifications (Morris AO, Stone JA, Xiong K, Breslow R, Walbrandt Pigarelli D, Welch L, Chui MA, unpublished data, 2021).

Four misuse outcomes were operationalized by the misuse analysis team through these group discussions:

1. Drug-Age Misuse was identified using the 2015 Beers Criteria list[21] for older adults, where any selected OTC medication included on the list is considered misuse, except NSAIDs that are only used to temporarily treat acute pain (characterized by self-reported use less than 90 days).
2. Drug-Drug Misuse was measured using LexiComp risk ratings of medication interactions,[31] and resulted in the following domains that carried enough risk to be considered misuse:
    a. Type C (monitor therapy),

   b. Type D (consider therapy modification), and
   c. Type X (avoid combination).

3. Drug-Disease Misuse was determined by identifying potential interactions between medications and disease states designated as high-risk in Beers Criteria, a condition listed in product labeling, or other (e.g., clinical knowledge of the pharmacist).
4. Drug-Label Misuse considers the following deviations between patients' reported use of an OTC medication and its product labeling recommendations:
   a. over daily dosage,
   b. exceeds single dose,
   c. dose timing/frequency,
   d. use duration, and
   e. inappropriate indication.

As already indicated, Drug-Drug misuse was indicated with LexiComp risk ratings of medication interactions, and did not require clinical judgment. Alternatively, for Drug-Age, Drug-Disease, and Drug-Label misuse, the final determinations were based on evaluations and consensus by the misuse analysis team and was measured as the frequency of misuse per participant.

Statistical Analysis

To estimate binary treatment effects in a non-experimental statistical setting, when units' non-random assignment to treatment is due to selection based on observations, reweighting is a valuable approach.[32] That is, when the treatment is not randomly assigned, it is expected that the treated and untreated units present very different distributions of their observable characteristics. To account for this assumption, an initial propensity score was estimated based on the treatment condition using a Logit model to compute the predicted probability (π). Using the pi score, the following weights were constructed: $1/\pi$ for the treated observations, and $1/(1-\pi)$ for the untreated observations. It was then possible to calculate the average treatment effect by comparing the weighted means of the two groups. All estimates were conducted using the "teffects" and "treatrew" routines in Stata v.16.[33] Logistic regression initially was used to determine similarity of patient characteristics before and after the Senior Section was implemented. These variables were then compiled into a propensity-score matching model to estimate their combined effects on the Senior Section's association with various misuse types. For each type of OTC misuse, a series of regression models were used to assess the effect of pre-post conditions either adjusting for covariate imbalance using propensity score weighting or absent that adjustment. Even given the small post-implementation sample size, we controlled for the rate of Type I errors in null hypothesis testing when conducting multiple comparisons. Specifically, we used the positive false discovery rate (pFDR) to adjust the raw alpha levels.[34–35]

RESULTS

Findings are based on recruitment rates of 5% at pre-implementation (72/1350) and 3% at post-implementation (15/450), although the post-implementation rate was influenced by the store closures. Patient demographic characteristics are provided in Table 1, and revealed few notable differences in patient samples between pre- and post-implementation. At pre-implementation, no patient had an educational level below high school, but one patient reported education up to eighth grade at post-implementation. The number of medications that patients reported taking also was narrower at post-implementation (pre-implementation min/max: 1–33 vs. post-implementation min/max: 6–18), but this did not translate into any distinction between means. In addition, over 60% of patients had a total health rating of very good/excellent prior to Senior Section implementation, while only a third of patients had the same rating at post-implementation. Despite these slight differences, Table 2 shows that, when examined individually, no patient characteristic varied significantly between pre-/post-implementation. Such findings suggest that the patient samples can be considered homogeneous for these characteristics across the two assessment endpoints.

Table 3 demonstrates differences between the means for the various types of misuse before the Senior Section was implemented compared to post-implementation. For these samples, the means for OTC medication misuse frequencies tended to be low overall, with only one mean (for Drug/Drug Misuse-Type C at pre-implementation) approaching 1.50 and most being below 0.50. Seven of the 11 comparisons also showed expected patterns of effects, where the frequency of misuse at post-implementation was lower than at pre-implementation (indicated by italics in Table 3). However, for the four types of misuse with higher means after intervention implementation, the difference between means was no more than 0.073.

When entering these combined characteristics into a propensity-score matching model, statistical effects also differed as a function of the type of misuse (see Table 4). Regardless of entering the patient characteristics propensity score into the model, the Senior Section intervention did not statistically change Drug/Age or Drug/Disease Misuse or the three elements of Drug/Drug Misuse (C, D, and X), although there were fewer instances of most of these behaviors at post-implementation. As such, the cumulative covariates had little if any adjusting effect on those outcomes.

For Drug/Label Misuse, the Senior Section’s influence varied according to sub-type, with Daily-Dosage Misuse achieving significant reductions only by statistically accounting for patient characteristics in the model. Single-Dosage Misuse decreased notably after the intervention, as represented in both regression models (with/without the propensity score influence). Exceeding either the timing/frequency of medication use instructions or medication use duration, or using medication for an inappropriate indication, did not demonstrate statistically significant differences at post-implementation, regardless of whether controlling for the patient demographic characteristics.

DISCUSSION

Pilot results begin to provide support for the conviction that a simple but well-conceived redesign of the OTC aisles in a small number of community pharmacies can reduce some categories of older adult OTC medication misuse. Comparing data from homogenous samples over time, each of which were involved in the same interview process, these analyses begin to show an effect. That is, the Senior Section can influence the frequency of misuse, with the degree of change depending on the specific type of misuse and the combined effects of patient characteristic effects. In particular, patients who were involved in the system redesign were much less likely to demonstrate a propensity for Drug/Label Misuse. Drug/Label Misuse (Exceeds Daily-Dosage) became significant only after the patient demographic covariate was added to the model; the covariates comprising the patient demographic propensity score had an adjusting impact, making the effect of the intervention more sensitive. Despite the limited number of significant findings, almost 70% of all misuse comparisons (from all models, excluding or including the propensity score) were in the direction of anticipated effects, with lower frequencies occurring at post-implementation (see Table 3).

Although it was originally hypothesized that the Senior Section would diminish all misuse types, in retrospect there are clear reasons that may undermine this expectation. Drug/Age Misuse, based on the Beers Criteria list, likely did not change statistically because of two factors. Unlike diphenhydramine, which has an absolute recommendation to avoid using in older adults,, ibuprofen remained in the Senior Section inventory because of its benefits for treating a variety of short-term symptoms, even though the Beers Criteria contains a recommendation to avoid its chronic use for pain management. Further, it was often difficult to ascertain Drug/Age Misuse occurrence, because a patient's acute or chronic use determination was required, and may have presented a mixed message to older adults about whether ibuprofen was safe to use. Alternatively, for Drug/Drug Misuse, the Senior Section's cautionary signage did not include warnings about specific drugs or potential interactions. When implementing the Senior Section in a broader network of pharmacies, which is being planned, modifications will be necessary to determine the best approach to address a greater variety of misuse types.

Overall, this pilot study evidenced encouraging effect patterns, which were demonstrated even with a relatively small post-implementation sample size. This intervention, if more broadly implemented in other pharmacy corporations, would create new permanent structures and processes promoting pharmacy staff/patient engagement that could improve the quality and availability of information for older adults as they approach the OTC aisles. Such information could lead to greater risk awareness, and help older adults more easily determine their own risk levels and to select safer OTC medications with confidence. Further research must evaluate the generalizability of the intervention's results and the sustainability of post-implementation improvements in different pharmacy environments. Physically redesigning OTC aisles may also be tested in different vulnerable populations, such as pediatric patients. Taken together, these preliminary outcomes support the Senior Section as a valuable tool for pharmacy staff to improve patients' safe OTC medication use through heightened awareness and education efforts.

Strengths and Limitations

The principal strength of this pilot study was its innovation. It was the first to empirically evaluate implementation of a pharmacy redesign intervention on the prevalence of the reported misuse of OTC medications in homogenous samples of older adults, as well as evaluating OTC selection and use within a naturalistic setting.

Despite insights gained from this analysis, various limitations warrant consideration beyond the limited generalizability of this small sample of community pharmacies. First, most patient characteristics were self-reported (e.g., health status, 30-day medication use, and number of prescribers and pharmacies seen), so future data collection efforts should attempt to employ existing health systems databases. Second, the patient sample size was limited (n=87 cumulatively between pre- and post-implementation). However, the statistical approach and p-value adjustment method were chosen to accommodate this sample size and compute valid results. Third, patients were not randomly selected but rather were chosen through recruitment methods. Fourth, this study was designed to evaluate the situation only of older adults who used the Senior Section, but did not consider those patients who were involved solely with the normal OTC aisles. Fifth, patient interview responses were based on reactions to a hypothetical health scenario and may not represent “real world” behaviors. Sixth, results could vary based on which scenario the participant selected (i.e., pain, cough/cold, allergy, or sleep). Additional research is necessary on a larger participant sample to determine the influence of medication category on misuse types. Finally, as mentioned previously, the Senior Section may not be sufficient to address certain misuse types, such as Drug/Drug Misuse and Drug/Age Misuse, and future research should consider the intervention features constructed specifically to reduce a broader array of misuse.

CONCLUSIONS

This pilot study provides initial insights into the extent that a pharmacy system redesign reduced potential patient uses of OTC medications that were indicative of misuse (e.g., selecting and using an OTC that differed from product dosage labeling). That is, increased opportunities for pharmacy staff engagement with patients around medication safety issues, along with more visible cautionary signage and an OTC inventory comprising lower-risk medications, decreased the occurrences of some types of misuse. However, intervention implementation in more and different pharmacies, as well as assessing its impact on more patients, is warranted before the Senior Section can be considered a translatable and broadly valuable approach. At present, the Senior Section represents a promising approach to enhance patients’ awareness of OTC risks and promote safe use of these medications through timesaving and effective pharmacy staff/patient interactions[26–27] – a method that this research team is committed to continually evaluating and refining to achieve more universal application and sustained positive effect.

Acknowledgements:

Study data were collected and managed using REDCap electronic data capture tools hosted at the University of Wisconsin-Madison, School of Medicine and Public Health (see Paul A. Harris, Robert Taylor, Robert Thielke, Jonathon Payne, Nathaniel Gonzalez, Jose G. Conde, Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support, *J Biomed*

Inform. 2009 Apr;42(2):377–81, for example). REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources.

Funding: This work was supported by the Agency for Healthcare Research and Quality [grant number R18HS024490]; and the Clinical and Translational Science Award (CTSA) program, through the National Institutes of Health's National Center for Advancing Translational Sciences (NCATS) [grant UL1TR000427 (now UL1TR002373)]. The content is solely the responsibility of the authors and does not necessarily represent the official views of either the Agency for Healthcare Research and Quality or the National Institutes of Health.

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Key Points:

What was already known:

- OTC misuse often contributes to harms from OTC-related adverse events
- Older adults are at greater risk for various types of OTC misuse
- Pharmacy system redesigns have not been employed to mitigate OTC misuse in the older adult patient population

What this study adds:

- Successful implementation of the study's pharmacy redesign intervention has clear individual and organizational implications
- Easier and more direct access to common OTC medications with lower risk profiles for older adults, and proximity of these medications to pharmacists and pharmacy staff to promote counseling opportunities with patients, can lead to safer medication use
- The study intervention creates permanent structures and processes to assist older adults to access risk information when selecting safer OTC medications, and helps reduce various types of medication misuse

Figure 1.
Senior Section.

Table 1:

Patient Demographic Characteristics (Pre-Implementation and Post-Implementation)

	Pre-Implementation (n=72)	Post-Implementation (n=15)
Participants from each pharmacy		
Pharmacy 1	24 (33.3%)	5 (33.3%)
Pharmacy 2	24 (33.3%)	5 (33.3%)
Pharmacy 3	24 (33.3%)	5 (33.3%)
Age	72.51 ± 6.021 (min/max: 65–88)	73.80 ± 7.233 (min/max: 66–87)
Gender		
Female	47 (65.3%)	10 (66.7%)
Male	25 (34.7%)	5 (33.3%)
Race		
White	68 (94.4%)	13 (92.9%)
Non-White	4 (5.6%)	1 (7.1%)
Education		
Up to 8th grade	0 (0%)	1 (6.7%)
Some high school	0 (0%)	0 (0%)
High school or GED	13 (18.1%)	4 (26.7%)
Some college or technical school	16 (22.2%)	2 (13.3%)
College or technical school graduate	43 (59.7%)	8 (53.3%)
Number of Prescribers	2.275 ± 1.396 (min/max: 0–6)	2.800 ± 1.373 (min/max: 1–6)
Number of Pharmacies	1.292 ± 0.592 (min/max: 0–3)	1.533 ± 0.834 (min/max: 1–3)
Number of Medications	9.68 ± 5.804 (min/max: 1–33)	9.67 ± 3.266 (min/max: 6–18)
Health Status (OARS scores)	3.71 ± 2.210 (min/max: 0–8)	3.73 ± 1.831 (min/max: 1–7)
Total Health		
Poor	0 (0%)	0 (0%)
Fair	10 (14.1%)	0 (0%)
Good	18 (25.4%)	10 (66.7%)
Very Good	33 (46.5%)	4 (26.7%)
Excellent	10 (14.1%)	1 (6.7%)

Note: GED = General Equivalency Diploma; OARS = Older Americans Resource Survey methodology

Table 2.

Logistic Regression Comparing Patient Characteristics in Pre- and Post-Implementation Samples (n=87)

	Odds Ratio	Stand. Error	p-value	95% Confidence Interval	
				Lower Bound	Upper Bound
Health Status	1.021	0.441	0.962	0.437	2.382
Total Health	0.880	0.159	0.479	0.618	1.254
Age	0.990	0.053	0.846	0.892	1.098
Gender (male)	0.715	0.510	0.639	0.177	2.897
Education	0.621	0.214	0.168	0.315	1.222
Race (non-white)	1.119	1.420	0.929	0.093	13.463
No. of Prescribers	1.518	0.413	0.125	0.891	2.588
No. of Pharmacies	1.530	0.688	0.345	0.633	3.696
No. of Medications	0.998	0.072	0.980	0.867	1.149

Table 3.

Frequency of Types of Misuse: Pre-Implementation Compared to Post-Implementation (n=87)

	Mean	Standard Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Drug/Age Misuse				
pre-implementation	0.069	0.030	0.009	0.129
post-implementation	*0.067*	*0.067*	*−0.066*	*0.199*
Drug/Drug Misuse				
pre-implementation	1.931	0.249	1.436	2.425
post-implementation	*1.333*	*0.374*	*0.590*	*2.076*
Drug/Drug Misuse_(avoid combination)				
pre-implementation	0.056	0.044	−0.031	0.142
post-implementation	*0*	--	--	--
Drug/Drug Misuse (consider therapy modification)				
pre-implementation	0.444	0.103	0.241	0.648
post-implementation	0.467	0.192	0.085	0.848
Drug/Drug Misuse_(monitor therapy)				
pre-implementation	1.431	0.181	1.071	1.791
post-implementation	*0.867*	*0.236*	*0.397*	*1.337*
Drug/Disease Misuse				
pre-implementation	0.667	0.091	0.487	0.847
post-implementation	*0.333*	*0.187*	*−0.038*	*0.705*
Drug/Label Misuse (Exceeds Daily-Dosage)				
pre-implementation	0.167	0.044	0.079	0.255
post-implementation	*0.067*	*0.067*	*−0.066*	*0.199*
Drug/Label Misuse (Exceeds Single-Dosage)				
pre-implementation	0.361	0.057	0.248	0.474
post-implementation	*0*	--	--	--
Drug/Label Misuse (Exceeds Timing/Frequency)				
pre-implementation	0.194	0.047	0.101	0.288
post-implementation	0.267	0.118	0.032	0.502
Drug/Label Misuse (Exceeds Use Duration)				
pre-implementation	0.056	0.027	0.002	0.110
post-implementation	0.067	0.067	−0.066	0.199
Drug/Label Misuse (Inappropriate Indication)				
pre-implementation	0.042	0.024	−0.005	0.089
post-implementation	0.067	0.067	−0.066	0.199

Note: Expected patterns of effects are indicated by italics at post-implementation.

Table 4.

Examining Types of Misuse Using Regression Models with Propensity-Score Matching: Pre-Implementation Compared to Post-Implementation (n=87)

Models with or without PS	Coef.	Stand. Error	p-value	95% Confidence Interval	
				Lower Bound	Upper Bound
Drug/Age Misuse					
(post vs. pre)	−0.003	0.071	0.969	−0.142	0.136
(PS, post vs. pre)	−0.049	0.047	0.404	−0.142	0.043
Drug/Drug Misuse					
(post vs. pre)	−0.597	0.438	0.369	−1.455	0.260
(PS, post vs. pre)	−0.457	0.372	0.401	−1.186	0.273
Drug/Drug Misuse_(avoid combination)					
(post vs. pre)	−0.556	0.043	0.369	−0.141	0.030
(PS, post vs. pre)	−0.049	0.043	0.401	−0.134	0.036
Drug/Drug Misuse (consider therapy modification)					
(post vs. pre)	0.022	0.212	0.969	−0.392	0.437
(PS, post vs. pre)	0.049	0.151	0.817	−0.246	0.345
Drug/Drug Misuse_(monitor therapy)					
(post vs. pre)	−0.564	0.291	0.286	−1.133	0.006
(PS, post vs. pre)	−0.457	0.267	0.191	−0.980	0.066
Drug/Disease Misuse					
(post vs. pre)	−0.333	0.202	0.359	−0.729	0.620
(PS, post vs. pre)	−0.407	0.195	0.102	−0.790	−0.248
Drug/Label Misuse (Exceeds Daily-Dosage)					
(post vs. pre)	−0.100	0.080	0.369	−0.253	0.053
(PS, post vs. pre)	−0.160	0.066	0.015	−0.291	−0.030
Drug/Label Misuse (Exceeds Single-Dosage)					
(post vs. pre)	−0.361	0.057	0.011	−0.472	−0.250
(PS, post vs. pre)	−0.358	0.062	0.011	−0.479	−0.273
Drug/Label Misuse (Exceeds Timing/Frequency)					
(post vs. pre)	0.072	0.123	0.877	−0.170	0.314
(PS, post vs. pre)	0.284	0.132	0.102	0.026	0.542
Drug/Label Misuse (Exceeds Use Duration)					
(post vs. pre)	0.011	0.070	0.969	−0.126	0.148
(PS, post vs. pre)	0	0.061	0.999	−0.120	0.120
Drug/Label Misuse (Inappropriate Indication)					
(post vs. pre)	0.025	0.069	0.969	−0.109	0.159
(PS, post vs. pre)	−0.012	0.025	0.759	−0.061	0.037

Note: PS = Propensity Score Matching; both the raw and the propensity-adjusted p-values were adjusted for multiple comparisons using the pFDR