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Original Study

A Canadian Cohort Study to Evaluate the Outcomes Associated with a Multicenter Initiative to Reduce Antipsychotic Use in Long-Term Care Homes

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A B S T R A C T

Objectives: To evaluate the impact of a multicenter intervention to reduce potentially inappropriate antipsychotic use in Canadian nursing homes at the individual and facility levels.
Design: Longitudinal, population-based cohort study to evaluate the Canadian Foundation for Healthcare Improvement's Spreading Healthcare Innovations Initiative to reduce potentially inappropriate antipsychotic use in 6 provinces/territories.
Setting and Participants: Adults in nursing homes in 6 provinces/territories in Canada between 2014 and 2016. The sample involved 4927 residents in 45 intervention homes and 122,570 residents in 1193 control homes in the first quarter of the study.
Measures: Assessment data based on the Resident Assessment Instrument 2.0 were used in both settings to track antipsychotic use and to obtain risk-adjusters for a quality indicator on potentially inappropriate use.
Intervention: Quality improvement teams in participating organizations were provided with education, training, and support to implement localized strategies intended to reduce antipsychotic medication use in residents without diagnosis of psychosis.
Results: At the resident level, we found that the odds of remaining on potentially inappropriate antipsychotics were 0.75 in intervention compared with control homes after adjusting for age, sex, aggressive behavior, and cognition. These findings were evident within the pooled Canadian data as well as within provinces. At the facility level, the intervention homes had greater improvements in risk-adjusted quality indicator performance than the control homes, and this was true for the worst, median, and best-performing homes at baseline. There was no major change in the quality indicator for worsening of behavior symptoms.
Conclusions/Implications: The Canadian Foundation for Healthcare Improvement intervention was associated with a reduction in potentially inappropriate antipsychotic use at both the individual and facility levels of analysis. This improvement in performance was independent of secular trends toward reduced antipsychotic use in participating provinces. This suggests that substantial improvements in medication use may be achieved through targeted, collaborative quality improvement initiatives in long-term care.

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The need to reduce use of antipsychotics in nursing homes has become a focus of worldwide attention.[1–12] Their use may be justified in the presence of diagnoses such as schizophrenia or Huntington's disease, or with symptoms like hallucinations or delusions. However, antipsychotic use in the absence of those conditions is considered a quality problem in long-term care[13–16] because they are associated with increased risk for mortality[17–19] and adverse events like falls,

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fractures, and hospitalization.[20–26] Some of these risks are modified by dose, type of antipsychotic, and the presence of comorbidities.[23–27]

The factors associated with greater use of antipsychotics in nursing homes are diverse. These include both attributes of the resident[28,29] and structural factors such as physician availability,[30] staff attitudes/beliefs,[31] and facility characteristics.[2,6,32] The primary clinical rationale for off-label use of antipsychotics in nursing homes is the management of behaviors associated with dementia[33]; however, their overall effectiveness for this use is unclear.[34,35] Moreover, the belief that antipsychotics are useful tools to manage behaviors and concerns that behavior disturbances will increase with discontinuation are 2 important barriers to reduction of their use.[36,37]

Antipsychotic reduction efforts in nursing homes often include some combination of substituting alternative medications, educational strategies to encourage avoidance or reduction of their use, and use of nonpharmacologic interventions.[38] In addition, public reporting on antipsychotic use in nursing homes in Canada and the United States has raised awareness of the issue and has been followed by reduced rates in both countries.[39,40] The objective of our study was to evaluate the impact of a multicenter intervention aimed at reducing antipsychotic use in nursing homes.

Methods

We conducted a longitudinal, population-based cohort study to evaluate the Canadian Foundation for Healthcare Improvement's (CFHI) *Spreading Healthcare Innovations Initiative* to reduce potentially inappropriate antipsychotic use in British Columbia, Saskatchewan, Alberta, Ontario, Newfoundland, and Yukon Territories using clinical records based on the Resident Assessment Instrument (RAI) 2.0[41] from 48[1] homes included in the Canadian Institute for Health Information's (CIHI) pan-Canadian Continuing Care Reporting System (CCRS).

CFHI used an open call for proposals to recruit homes to the antipsychotic reduction initiative in the spring of 2014. Initially, 56 homes wished to participate, but 8 were excluded because they were not able to provide CCRS data. Participation was voluntary, but organizations were required to submit a proposed plan for participation that demonstrated leadership commitment, a link between the intervention and their organization's strategic priorities, organizational readiness to participate, sufficient resources and budget allocation, inter-professional collaboration, and full implementation of the RAI 2.0 at the time of application.

The intervention focused on education, training, and support to implement strategies that reduce antipsychotic medication use in residents without diagnosis of psychosis (Table 1). The strategies involved training and mentoring interprofessional teams to implement person-centered approaches to care to respond to behaviors associated with dementia, improve methods for staff collaboration, and improve medication review procedures with a specific focus on anti-psychotic use. Teams had access to a variety of education and networking activities including monthly webinars, 2 in-person workshops, 1:1 coaching with clinical and quality improvement experts, and an online information-sharing platform. All teams were required to submit quarterly data and reports according to common core RAI 2.0 variables and report templates specified by the main study mentor. The intervention did not require homes to adopt a single common protocol for reducing potentially inappropriate antipsychotic use. The focus was on education and mentorship that emphasized 5 key components for the approach to antipsychotic reduction: (1) stakeholder engagement related to causes and solutions for resident behaviors; (2) person-centered approaches to care; (3) regular medications reviews; (4) de-prescribing guidelines; and (5) collection, interpretation, and use of interRAI assessment data. This allowed homes to use approaches tailored to local needs while building on a shared commitment to change, use of data to inform decision-making, monitoring outcomes with a common metric, and sharing of information between participating organizations.

Table 1
Summary of Intervention

- Education and training related to appropriate use of antipsychotics
  - Two in-person workshops
  - Monthly webinars
  - Access to online learning resources
  - Emphasis on 5 foundational components
    - Stakeholder engagement related to causes and solutions for resident behaviors
    - Person-centered approaches to care
    - Regular medications reviews
    - Deprescribing guidelines
    - Collection, interpretation, and use of interRAI assessment data
- 1:1 Coaching
  - Interaction with clinical and quality experts
- Reporting assessment results and monitoring progress in antipsychotic reduction
- Engagement of full interdisciplinary teams
  - Nurses, personal support workers, recreation therapy, dietary, pharmacists, physicians
  - Leadership team

The characteristics of the participating homes and individuals in the study sample in the first fiscal quarter prior to initiation of the intervention are shown in Table 2. At the home level, the intervention group had more homes that were large facilities of 100+ beds than the control sites, and there were no small homes in the intervention group. However, the 95% confidence intervals for mean Resource Utilization Groups-III case-mix index overlapped, suggesting that there were no significant differences in case-mix between the intervention and control homes. When resident characteristics are

Table 2
Sample Characteristics

Characteristics	Intervention Homes*	Control Homes†	*P* Value
Resource Utilization Groups-III case-mix index (95% CI)	0.68 (0.68–0.69)	0.66 (0.65–0.68)	–
Facility size (%)			.03
1–29 beds	0.0	10.00	
30–99 beds	27.8	43.7	
100+ beds	62.2	46.4	
Provinces			<.0001
Alberta	3.9	11.5	
British Columbia	44.9	16.6	
Manitoba	0.0	4.4	
New Brunswick	4.2	0.0	
Newfoundland	9.9	1.0	
Ontario	33.3	63.1	
Saskatchewan	2.2	3.3	
Yukon Territories	1.6	0.1	
Female (%)	67.7	68.6	.18
Age group, y (%)			<.0001
<65	8.0	7.0	
65–74	13.4	10.7	
75–84	27.0	25.1	
85 and over	51.6	57.2	
Diagnosis (%)			
Alzheimer/other dementia	80.2	78.2	.007
Heart failure	12.0	12.5	.51
Emphysema/COPD	13.3	14.8	.09
Diabetes	24.0	25.1	.06
Cancer	10.5	9.1	.05
Stroke	20.1	20.9	.20
Schizophrenia/bipolar disorder	5.0	5.2	.64
Brain injury	2.1	1.4	.008

COPD, chronic obstructive pulmonary disease.
*n = 45 homes, 4927 individuals.
†N = 1193 homes, 122,570 individuals.

compared between intervention and control homes, many differences were significant at the 0.05 level as a result of the large sample size in our analyses (4927 residents in the intervention homes in the first quarter and 122,570 residents in control homes). The main differences were an over-representation of British Columbia, Newfoundland, and New Brunswick homes and an under-representation of Manitoba and Ontario homes in the intervention group compared with the controls. There was also a somewhat higher percentage of residents who were aged 85 years or more in the intervention group than controls. Although some differences in diagnosis rates were significant between the 2 groups, these differences were very minor in absolute terms (ie, no difference in rates between the 2 types of homes exceeded 2%).

A more detailed comparison of study homes at baseline is available in a description of the study protocol that has been published previously.[42] As reported in that publication, baseline 90-day discharge rates between the 2 types of homes differed by 1.3%, and baseline triggering rates for care planning protocols related to activities of daily living, delirium, falls, and medication use differed by less than 4% in absolute terms. Based on various interRAI scales,[43–47] compared with the control homes, the intervention homes had a 5.9% higher percentage of residents with severe cognitive impairment and 7.7% fewer residents with severe depressive symptoms. Other scale differences were smaller for physical functioning, aggressive behavior, and health instability. With respect to service use, the most substantively important difference between homes was in access to physical therapy, which was 27.8% in intervention homes compared with 42.8% in control homes. This difference is largely attributable to regional practice pattern differences with regard to access to physical therapy. There were no significant differences between homes with respect to baseline number of medications. With respect to quality indicators, the baseline median risk-adjusted rate for indicators related to delirium, restraint use, falls, bladder continence, activities of daily living, and cognition all differed by less than 3% between the 2 types of homes. Only the worsened mood quality indicator (QI) exceeded that value, with a median risk-adjusted rate of 17.6% in intervention homes compared with 23.9% in control homes. Thus, although intervention homes participated on a voluntary basis, their differences from control homes were almost always small in absolute terms and not substantively important for this study.[42]

For the comparison group, we included all CCRS nursing homes (1193 facilities[2]) that were not involved in the initiative in 2014. We used the most recent RAI 2.0 assessment submitted by the homes in the first fiscal quarter of 2014 and quarterly follow-up data available until the first quarter of 2016 to evaluate outcomes associated with the initiative. CIHI assisted with data preparation by attaching 2 variables to the CCRS data cut to identify residents in homes that were part of the intervention and the associated start date. CIHI provided these individual level data to the research team with individuals and homes deidentified, but still longitudinally trackable. No data cleaning was required for the data because CIHI data submission standards preclude missing items, out of range values, and incomplete records for CCRS data.

We based our facility-level analyses on risk-adjusted QIs[16] beginning with 5180 residents in the intervention homes and 122,792 residents in the control homes in the first quarter of 2014. All residents with RAI 2.0 data in the CCRS were included in the study, but residents discharged from intervention and control homes within less than 2 weeks of admission were excluded because they would not have had a RAI 2.0 completed. By the first quarter of 2015, the numbers of residents in the intervention and control groups were 5345 and 122,781 respectively, reflecting modest changes in the populations due to admissions and discharges over that period. We based all QI comparisons on the long-term care home as the unit of observation. We compared distributions of QIs using the median and first and third quartile values for the distributions of homes. We also reported the 20th and 80th percentile values because these are conventional cut-points for good or poor performance based on risk-adjusted interRAI quality indicators.

Our person-level analyses involved the use of longitudinal generalized estimating equations (GEE) models for residents who were on an antipsychotic medication in their first observation in the data set. The outcome of interest was a binary variable for staying on vs discontinuing use of antipsychotic medications. We excluded residents not on an antipsychotic in their first observation to model cessation of antipsychotic use. We also excluded residents with diagnoses of schizophrenia or Huntington's disease and residents with hallucinations or delusions at the time of assessment in accordance with the technical specifications of the QI. Our analytic sample included 50,791 individuals with up to 18 longitudinal observations in 1272 homes in 7 provinces. We specified clustering to occur longitudinally for individuals and for the long-term care homes and used province as a covariate rather than as a clustering variable. The total number of observations was 190,385 assessments of which 63,875 assessments involved transitions to (or maintenance of) nonuse of antipsychotic medications.

Given the large size of the study sample [50,791 individuals; up to 18 observations each; 1272 clusters (homes); 190,385 observations], we made some adjustments to the GEE specifications to obtain stable models including (1) increasing the default Hessian Convergence Criterion to 0.1; (2) limiting the number of covariates used; (3) converting continuous independent variables to ordinal variables to reduce the complexity of the calculation; and (4) restricting the observation period to include only assessments done after January 1, 2014. We evaluated these models for all provinces combined and by province to determine whether the intervention was effective in participating jurisdictions.

We obtained ethics clearance for this study through the Office of Research Ethics at the University of Waterloo.

Results

Person-Level Analyses

We modeled the person-level longitudinal effects of the CFHI initiative on the tendency to remain on antipsychotics over time using GEE models with clustering at the person (longitudinal) and facility levels.

The odds ratios for the effect of intervention on remaining on antipsychotics from GEE models for provinces with multiple participating homes adjusted for age, sex, cognitive performance, and aggressive behavior, excluding residents with schizophrenia, Huntington's disease, delusions, or hallucinations at baseline assessment, ranged from 0.71 in Alberta to 0.82 in Newfoundland. For residents in intervention homes, there was a 30% reduction in the odds of staying on antipsychotics compared with the control homes.

Table 3 provides the combined results for all provinces in the study of a longitudinal GEE model for staying on antipsychotic medications for residents on those drugs in their first observation, but excluding residents with schizophrenia, Huntington's disease, delusions, or hallucinations. The adjusted odds for remaining on antipsychotics was 0.75 for intervention homes compared with control homes in Canada. Most of the other covariates had only modest associations with staying on these medications. Only advanced age had a similar impact on reduction of antipsychotics compared with the intervention (eg, the odds ratio for residents age 95 years+ was 0.71).

Facility-Level Analyses

Figure 1 shows the distributions of the risk-adjusted QI for antipsychotic medication use without a diagnosis or clinical symptoms

Table 3
Longitudinal GEE Model for Remaining on Antipsychotic Medications Using January 1, 2014 as Starting Point for Observation Period for All Participating Provinces With Intervention Sites (Excludes Persons With Schizophrenia, Huntington's Disease, Delusions, or Hallucinations)

Parameters	Estimate	Standard Error	95% Confidence Limits		Odds Ratio	Z	Pr > |Z|
Study group (ref = control homes)							
Intervention homes	−0.29	0.017	0.33	0.26	0.75	17.03	<.0001
Sex (ref = Male)							
Female	−0.03	0.005	0.04	0.02	0.98	−5.45	<.0001
Aggressive behavior scale (ref = 0)							
1–4	0.0	0.003	0.03	0.04	1.03	11.11	<.0001
5–12	0.081	0.005	0.07	0.09	1.08	17.29	<.0001
Cognitive Performance Scale (ref = 0)							
1–2	0.02	0.010	0.00	0.04	1.02	2.34	0.02
3–6	−0.01	0.011	0.03	0.01	0.99	−1.03	0.30
Age group, y (ref = 65–74)							
25–64	0.04	0.010	0.02	0.06	1.04	4.20	<.0001
75–84	−0.06	0.007	0.08	0.05	0.94	−8.71	<.0001
85–94	−0.18	0.008	0.19	0.16	0.84	23.33	<.0001
95+	−0.34	0.014	0.37	0.31	0.71	24.05	<.0001

related to psychosis in 9 quarters for the intervention homes. There were substantial improvements in all aspects of the risk-adjusted antipsychotic QI distribution in intervention homes during the 2014–2015 intervention phase. The median, 80th and 20th percentiles for this indicator fell consistently over this time. This means that the "typical" homes improved in their performance on this indicator, but so did the best *and* the worst performing homes. In addition, the range between the best and worst performing homes narrowed in that period. Over the following year, the clear overall reduction for all the points in the distribution was maintained.

Figure 1 shows that there was also improvement for this indicator in the control homes, but the changes were not as pronounced as for the intervention homes (Figure 1A). Where the control homes began with better performance on the antipsychotic QI, the 2 types of homes ended the first 5 quarters with the same median rates, but the best and worst performing intervention homes were better than their counterparts among the control homes. Over the next year, the modest improvement in this indicator continued in those homes.

Table 4 shows the changes from the first observation to last observation period in the study and shows that for all 3 benchmarks in the QI distribution (ie, 20th percentile, median, 80th percentile), the change in the intervention homes was greater than in the control homes. Although the medians at the end of the next year were still very similar, the best and worst performing intervention homes still performed better than the control homes.

Table 4 also shows that, by first quarter 2016, there were no clinically meaningful changes in the risk-adjusted rates of behavior worsening in intervention homes based on the median QI rates (10.2% vs 9.8% in Q_1 2014) and the rates for homes in the 80th percentile (13.9% vs 14.7% in Q_1 2014) and the 20th percentile (5.9% vs 6.6% in Q_1 2014). In the control homes, there was also little change in this indicator, but their performance was consistently slightly worse than intervention homes.

Discussion

Our study demonstrated that a multicenter initiative to reduce antipsychotic use in Canadian nursing homes can result in dramatic improvements in care to vulnerable older adults. Results at the long-term care home level (using risk-adjusted QIs) and the individual level (using longitudinal models of transition rates) showed a pronounced impact of the intervention on antipsychotic use that was independent of historical trends, provincial initiatives, and individual level risk factors. The intervention's impact varied somewhat by province, but it was associated with a substantial increase in the odds that these medications would be discontinued among residents without a relevant diagnosis or mental health symptoms after controlling for various clinical covariates.

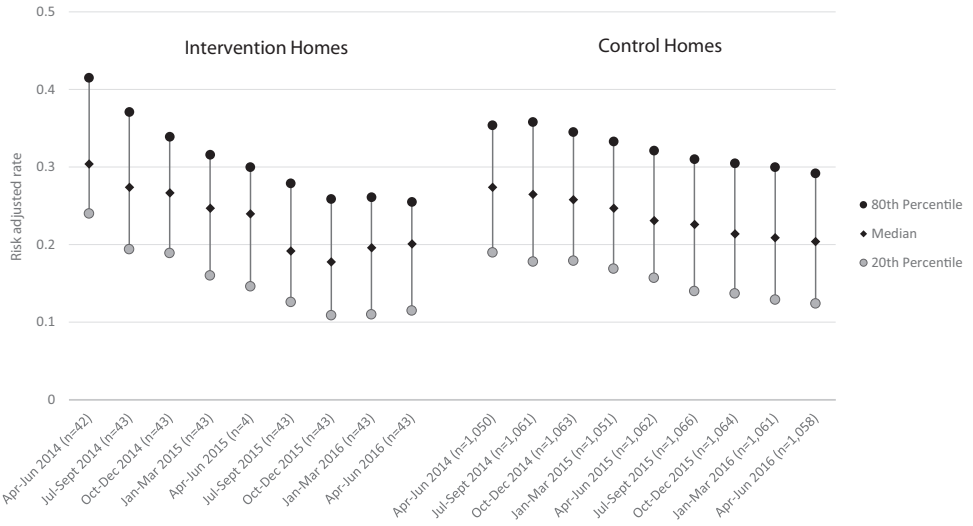

Fig. 1. Proportion of residents in intervention and control homes triggering risk adjusted quality indicator for potentially inappropriate antipsychotic use.

Table 4
Changes in QI Distributions in Intervention and Control Homes Over Duration of Study (Q_1 2014–Q_1 2016)

Percentiles	First Study Quarter		Last Study Quarter		Difference	
	Intervention Homes	Control Homes	Intervention Homes	Control Homes	Intervention Homes	Control Homes
QI: Percentage of residents with potentially inappropriate antipsychotic use						
20th percentile	23.9	19.1	11.5	12.4	−12.4	−6.7
Median (50th)	30.4	27.3	20.1	20.4	−10.3	−6.9
80th percentile	41.4	35.4	25.5	29.2	−15.9	−6.2
QI: Percentage of residents with worsened behavior symptoms						
20th percentile	6.6	6.8	6.6	6.8	0.0	0.0
Median (50th)	9.8	12.5	10.2	11.8	0.4	−0.7
80th percentile	14.7	18.4	13.9	17.7	−0.8	−0.7

An equally important result from the current analyses is that other quality indicators either improved or remained stable over the entire study period. There was no evidence that intervention homes experienced worsening of behavior symptoms or substituted physical restraints with the reduction of antipsychotics. Moreover, the effect of the intervention was present over and above the impact of other contemporaneous provincial initiatives (British Columbia, Alberta, and Ontario had additional formal initiatives underway during the CFHI collaborative).

It was important to do these analyses at 2 levels because they show that quality improved with respect to prescribing practices at the home level; however, there were also clear benefits realized at the individual level by residents in intervention homes. That is, the performance improvement noted here was not simply an artifact of changes in the compositions of the resident populations in the study homes. In addition, these effects persisted after controlling for potential confounding variables at the person, home, and provincial levels.

This initiative demonstrated the ability to take innovations employed in 1 jurisdiction (Winnipeg Regional Health Authority) and implement them across Canada in a sustainable way wherein achievements were maintained over time. This approach exemplifies the best aspirations of collaborative quality improvement initiatives that seek to diffuse innovations from leading organizations to those serving comparable populations.

A major factor that allowed the intervention to be implemented and evaluated was the availability of a common assessment standard in participating homes across Canada.[41] By employing the same assessment system, it was possible for the participating homes to target the same residents for the intervention and to compare the impact of the intervention using the same risk adjusted quality indicators.

The primary limitations of our study arise from constraints associated with the analyses of data holdings of this size. It would have been useful to explore a greater range of covariates or to parcel out effects at the organizational or provincial levels. However, current statistical software does not have the capacity to examine multilevel longitudinal data of this size (ie, 1272 nursing homes, 50,791 unique individuals, 190,385 observations) using newer statistical modeling techniques (eg, mixed-effects logistic regression).

Future research should continue to examine the extent to which the intervention's effect on antipsychotic use persisted over longer periods and investigate new jurisdictions where the organizational improvements are just beginning. In addition, it would be useful to determine whether less intensive versions of the initiative can reduce antipsychotic use or whether the full model employed here is required to achieve the desired effect.

Conclusions/Implications

The CFHI intervention was associated with a reduction in potentially inappropriate antipsychotic use at both the person and facility levels of analysis. This improvement in performance was independent of secular trends toward reduced antipsychotic use in participating provinces. This suggests that substantial improvements in medication use may be achieved through targeted, collaborative quality improvement initiatives in long-term care.

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