Variations in Prescribing Rates of End-of-Life Medications Among Long-Term Care Residents in Alberta Compared with Ontario—a Retrospective Cohort Study*

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ABSTRACT

Background

Prescribing rates for subcutaneous medications may be an indicator of quality of end-of-life care in long-term care (LTC). It is not known if this system level measure is valid across jurisdictions. We compared prescribing rates of medications used for end-of-life symptom relief among LTC residents in Alberta and Ontario.

Methods

This retrospective cohort study of LTC residents compared those who died between January 1, 2017, and March 17, 2020 in Alberta, with a published cohort from Ontario. Prescribed end-of-life medications during a resident's last 14 days of life were extracted from administrative dispensation records. LTC homes were ranked into quintiles based on prescribing rates within each home, and the home characteristics were described. The proportion of residents who transferred out of LTC in the last 14 days of life was also determined, as another quality measure.

Results

We identified 10,038 decedents in 117 LTC homes. Among LTC decedents, 16.9% were prescribed ≥1 injectable end-of-life medication and 44.9% were prescribed at least one end-of-life medication by any route of administration, within the last 14 days of life. Across prescribing quintiles, there were no associations with transfer rates prior to death. Comparing Alberta to Ontario, there were markedly lower rates of injectable medicine prescribing (16.9% vs. 64.7%). Potential reasons and data limitations were explored.

Conclusions

Rates of injectable end-of life medication prescribing differed across Alberta LTC homes; however, current provincial data limitations impact the validity of using these rates as a comparative indicator of the quality of end-of-life care.

*This study with data from Alberta has not been previously published. It does reference and compare to data from Ontario in our previously published paper Tanuseputro P, Roberts RL, Milani C, et al. Palliative end-of-life medication prescribing rates in long-term care: a retrospective cohort study. J Am Med Dir Assoc. 2024 Mar 1;25(3):532–38. doi:10.1016/j.jamda.2023.11.026.

Key words: administrative health data, end-of-life medications, long-term care, nursing homes, health system measures, quality of care

INTRODUCTION

Long-term care (LTC) residents live with multiple holistic needs[1] and a high likelihood of death, with an approximately 25% mortality rate in the first year after admission and an 18 months median survival rate in Canada.[2] High quality end-of-life care is therefore required,[3,4] but system-level evaluation to measure and support continuous quality improvement for end-of-life care in LTC is challenging.[5] Resident-family outcomes and experiences are important measures, but at end-of-life, resident capacity, measurement burden, and timing (e.g., of interviews and surveys of grieving family members) are significant concerns.[6] Data collection responsibilities may fall on already overstretched LTC staff or require external auditors. In contrast, measurement using digital, administrative, system-wide data can provide less intrusive assessment of end-of-life care quality. Reducing reliance on direct data collection in LTC may also allow quality of end-of-life care to be tracked during systemic crises, such as COVID-19, when more than 60% of COVID-19 deaths in Alberta and Ontario occurred in LTC.[7]

Currently there are few administrative data variables that specifically relate to end-of-life care and are available for national reporting (e.g., those provided by the Canadian Institute of Health Information[8]). One potential metric could be the prescription rates of subcutaneously injectable, end-of-life medications among LTC residents.

Towards the end-of-life many people lose the ability to swallow and terminal symptoms such as pain, dyspnea, and delirium are commonly managed using non-oral routes of medication administration, typically subcutaneously. The use of subcutaneous medication during the end-of-life period requires effective care coordination—from identifying residents at risk; communicating among residents/family and providers and agreeing upon the use of medication; having processes for timely prescribing, pharmacy supply and bedside medication administration; to assessing the symptom response, and adjusting doses and frequencies.[9] Administrative dispensation rates of injectable end-of-life medications among LTC residents are one aspect of this complex process that we hypothesized might be a feasible, surrogate marker of the quality of end-of-life care.

Our recent, retrospective, health administrative cohort study of 55,916 decedents from 626 LTC homes in Ontario, Canada (January 1, 2017 to March 17, 2020, a pre-COVID-19 period), examined the pattern of end-of-life subcutaneous injectable medication prescriptions in LTC homes in the last 14 days of life.[10] The results identified significant variation in injectable end-of-life medication prescribing rates among LTC homes, and that lower prescribing homes had higher rates of transfer and death outside of LTC. In an associated qualitative study,[11] providers and caregivers described positive perceptions and concerns about the appropriateness and applicability of this metric. Taken together, the conclusions were that administrative data of rates of injectable end-of-life medication prescribing have value in providing system-wide insights into the quality of end-of-life care in Ontario's LTC homes.

Across Canada, policies, funding, standards, and administration of LTC vary under the legislation of provinces and territories.[12] Acknowledging these differences, we sought in this study to describe rates of injectable end-of-life medication prescribing using Alberta's administrative data and compared, these to Ontario to examine whether this metric could be used in another provincial context.

METHODS

Study Design, Data Sources, & Cohort

This retrospective cohort study followed the Ontario study methodology[10] and the STROBE checklist for observational studies.[13] It used administrative data to describe end-of-life medication prescribing patterns for residents in the last 14 days of life in LTC homes in Alberta.

The Alberta Continuing Care Information System (ACCIS)[14] database was used to identify LTC residents (aged 65+ at one month before death) who died between January 1, 2017 and March 17, 2020. This "pre-COVID period" was used to compare results with the Ontario study. An additional "COVID period" of decedents in LTC, (March 18, 2020 to December 31, 2020) was identified to explore whether the COVID-19 pandemic impacted prescribing rates.[15]

Linkage with the Pharmaceutical Information Network (PIN)[16] and Drug Optimization Sustainability and Evaluation (DOSE)[17] databases was done to obtain the end-of-life medication individual-resident prescription data. The PIN database provided information on prescription drugs dispensed from community pharmacies for residents in LTC homes (predominately those "privately" run, which comprises the majority of LTC homes in Alberta), and the DOSE database contains dispensation information from some LTC facilities operated by Alberta Health Services (AHS) or an AHS subsidiary. The cohort was also linked with the Discharge Abstract Database and the National Ambulatory Care Reporting System, to identify residents who were transferred to a hospital or Emergency Department in the last 14 days of life and who died outside of the LTC home.

Exclusions

Residents were excluded from the prescribing rate analysis if they had lived in LTC <one month prior to death, to allow time for identification of terminal decline and prescribing to have occurred. They were also excluded if they transferred and died outside of LTC in the last 14 days of life, because their end-of life medication prescribing may not have occurred in LTC. LTC homes were excluded from analysis

if they had fewer than 50% of residents with any prescribed medication in the databases, as this suggests the home was not consistently using medication dispensation that is captured in PIN or DOSE.

A waiver of consent was obtained for this ethics approval (Conjoint Health Research Ethics Board, University of Calgary REB 21-1035_MOD3) as this study used decedent data.

Outcomes—End-of-Life Medication Prescribing Rates

The rate of end-of-life medication prescription was defined as the percentage of decedent residents in each LTC home who were prescribed at least one medication of interest in the last 14 days of life. The medication classes were those explored in the Ontario study (determined by literature review and expert opinion) and were validated as medications on formulary in Alberta LTC[18] (Appendix A). In Alberta LTC, the subcutaneous route can be assumed used for end-of-life injectable medication because intravenous routes are not routinely available. "Any route" of end-of-life medications for this study refers to both injectable and non-injectable medications (predominantly oral and some sublingual, rectal, and topical).

LTC Home Characteristics

The home characteristics examined were the number of facility beds (1–50, 50–100, 100–150, and 150–500), the rurality of the home location (rurality defined as located outside of 17 largest municipalities in Alberta),[19] and whether AHS operated the facility.

Statistical Analysis

The proportion of residents with at least one injectable end-of-life medication prescription in the last 14 days of life within each LTC home was calculated, and the homes were grouped into the quintiles of prescribing rates. Descriptive statistics were calculated for the total sample and within each quintile. The prescription rate of individual injectable end-of-life drugs and drug classes for injectables and any route were calculated. Outcomes were compared to Ontario.

Sensitivity Analysis

The transfer-out rate from LTC homes was calculated across the prescribing quintiles for injectable end-of-life medication to examine whether transfer-out corresponds with these rates of prescribing.

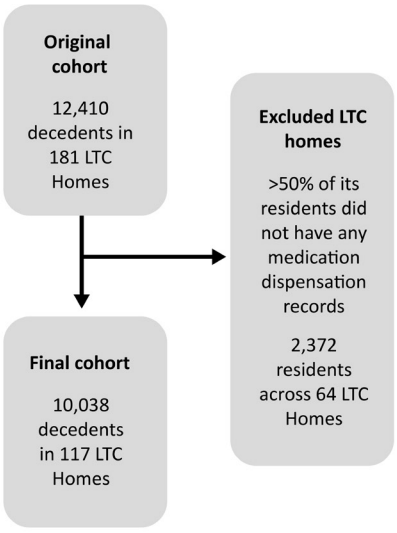
To explore whether the COVID-19 pandemic affected prescribing rates, monthly prescribing rates for "injectables" and "any route" were calculated for the pre-COVID and COVID period. Trends over time were plotted using monthly prescription rates of at least one injectable end-of-life medication during the study periods, across quintiles of homes.

To check the validity of PIN and DOSE data, we evaluated all medication prescriptions (not just end-of-life) in the last 14 days of life for all LTC residents. We also explored the rates of injectable end-of-life medication prescribed in the last 30 and 90 days, to identify pro-active or chronic orders.

RESULTS

Cohort Description

The pre-COVID cohort had 12,410 decedents from 181 Alberta LTC homes. After linking the cohort with DOSE and PIN databases for medication data, some homes had fewer than 50% of residents with any prescribed medication in the study period. These homes (n=64) were excluded from the analyses (Figure 1). The excluded homes were mostly rural and smaller (<100 beds).



Home characteristics	Included homes N=117	Excluded homes N=64
Medication data source:		
PIN	**96 (82.0)**	**NA**
DOSE	**21 (18.0)**	
Number of Beds – n (%)		
1-50	32 (27.4)	45 (70.3)
50-100	36 (30.8)	16 (25.0)
100-150	20 (17.1)	3 (4.7)
150-500	29 (24.8)	0 (0.0)
Rurality – n (%)	35 (29.9)	54 (84.4)
AHS Zones – n (%)		
Calgary	47 (40.2)	0 (0.0)
Central	10 (8.6)	33 (51.6)
Edmonton	39 (33.3)	0 (0.0)
North	13 (11.1)	20 (31.2)
South	8 (6.8)	11 (17.2)
AHS Operated LTC Site – n (%)	56 (47.9)	57 (89.1)

FIGURE 1. Flow chart and LTC home characteristics by exclusion criteria (medication data availability) in the study cohort (January 1, 2017, to March 17, 2020)

The final sample included 10,038 decedents from 117 LTC homes, 96 homes with PIN and 21 with DOSE data. The included LTC homes were primarily urban, from Calgary and Edmonton, and non-AHS-operated (Figure 1). Slightly less than half of the homes had >100 facility beds. The LTC home characteristics were stratified by the data source (PIN vs. DOSE), and no major differences were observed (Table 1).

End-of-Life Medication Prescribing Rates

In Alberta, 17% of the decedents across all homes were prescribed at least one injectable end-of-life medication in the last 14 days of life during the pre-COVID period (Table 2(a)). By contrast, in Ontario the prescription rate was much higher, at 65%. The most prescribed injectable medication class in Alberta was opioids (8.0%), of which hydromorphone was most common (4.8%). Opioids and hydromorphone were also the most prescribed injectable medications in Ontario, but at much higher rates (62.7% and 52.1%, respectively). Table 3 provides individual medication comparisons.

The variation in Alberta between the lowest and highest quintiles for injectable medications was notable among opioids, benzodiazepines, antipsychotics, and excess respiratory secretions. The rate of injectable end-of-life medication prescriptions varied across LTC homes from 0.5% in the lowest quintile homes to 45.6% in the highest quintile homes (Table 2(a)). Marked differences in injectable rate quintiles were also observed in Ontario data (Table 2(a) footnote), but in Ontario, the lowest injectable medication prescribing rate (37.6%) was close to the highest quintile rate in Alberta (45.6%).

TABLE 1.
Home characteristics and medication prescription rates according to the prescription data source

	PIN Homes N=96	*DOSE Homes N=21*
Home Characteristics		
Number of beds – n (%)		
1-50	21 (21.9)	11 (52.4)
50-100	32 (33.3)	4 (19.1)
100-150	20 (20.8)	0 (0.0)
150-500	23 (23.9)	6 (28.6)
Rurality- n (%)	24 (25.1)	11 (52.4)
AHS Zones – n (%)		
Calgary	32 (33.3)	15 (71.4)
Central	10 (10.4)	0 (0.0)
Edmonton	35 (36.5)	4 (19.1)
North	11 (11.5)	2 (9.5)
South	8 (8.3)	0 (0.0)
AHS Operated LTC Site – n (%)	36 (37.5)	20 (95.2)
Medication Prescription Rates		
Injectable end-of-life (%)	13.4%	35.2%
Any route end-of-life (%)	43.3%	53.2%
Non-end-of-life (%)	90.0%	92.8%

In Ontario, adding oral formulations to the injectables did not meaningfully increase the prescribing rate of any medication (Table 2(b). However, in Alberta, we observed that the prescription rates for any-route end-of-life medication markedly increased the frequency (from 16.9% to 44.9%).

LTC Home Characteristics

Alberta homes with lower rates of injectable end-of-life medications tended to be smaller and more rural than the homes with higher prescribing rates (Quintile 1: 85.7% had <150 beds, 39.3% rural vs. Quintile 5 homes: 75% with <150 beds and 17.9% rural). Compared to Ontario (Table 4), Alberta had higher number of rural (7.9% more) and smaller bed capacity homes (17.7% more).

Sensitivity Analysis Results

Transfer Out

In the last 14 days of life, 13.5% (1,569 out of 11,607) of Alberta residents transferred and died outside of LTC (Table 5). The transfer rates were similar between the lowest prescribing quintile (12.9%) and the highest prescribing quintile (14.8 %). In contrast, the transfer rate in Ontario was higher overall (18.8%), with a 17.6% difference between the lowest and highest prescribing quintiles.

COVID-19 and Trends Over Time

There are no apparent trends in prescribing rates in the pre-COVID quintiles, nor between the pre-COVID-19 and COVID-19 period (Figure 2(a)). The overall injectable end-of-life prescription rate during the pandemic was 18.4% (vs. 16.9% pre-pandemic). This again contrasts with Ontario data, where homes in the lowest injectable prescribing quintile pre-COVID had 9.6% increase in prescribing during COVID-19.[14] In Alberta, the any route end-of-life drug prescribing COVID-19 period also had a similar pattern as the pre-COVID-19 period (46.6% vs. 44.9%, respectively), and the distinction between the quintiles of homes was less evident than that with injectable prescribing rates (Figure 2(b)).

PIN and DOSE Data Check

To check whether there were general PIN and DOSE data issues that could account for the lower prescribing rates in Alberta, we analyzed the rates of all non-end-of-life medication prescriptions. Non-end-of-life medication prescribing was high (90.5%), and consistent between prescribing quintiles (4% difference). The Ontario study did not report non-end-of-life prescribing frequencies. As in Ontario, rates of injectable end-of-life medication prescribed in the last 30 and 90 days, showed no appreciable difference in prescribing compared to the last 14 days of life (data not shown).

DISCUSSION

This study found only 17% of decedents were prescribed at least one end-of-life subcutaneous injectable medication

in the last 14 days of life across Alberta LTC homes. This overall prescribing rate was significantly lower than in Ontario, and remained lower even after including any route of end-of-life medication. Alberta rates of end-of-life medication prescriptions were also much lower than those reported by other international studies (~62–74%).[20,21]

TABLE 2a.
Rates of prescribing of at least one end-of-life injectable medicine in the last 14 days of life among decedents in LTC between January 1, 2017, and March 17, 2020, compared with injectable and any route of end-of-life medication and non-end-of-life medication by Quintile(Q)[a]; the overall rates of end-of-life injectable medication are compared with Ontario data

Medication	*Alberta*						*Ontario*
	Among residents in Q1 (28 homes) N=1,997 %	*Among residents in Q2 (20 homes) N=1,974 %*	*Among residents in Q3 (19 homes) N=1,876 %*	*Among residents in Q4 (22 homes) N=1,917 %*	*Among residents in Q5 (28 homes) N=2,274 %*	*Among all residents N=10,038 (117 homes) %*	*Among Residents from all homes N=55,916 %*
Injectable end-of-life medication	0.5	2.8	8.5	22.9	45.6	16.9	64.7[b]
Any route end-of-life medication	33.9	38.2	37.4	48.5	63.7	44.9	70.3
Non-end-of-life medication (any route)[c]	86.5	90.5	90.3	90.6	94.0	90.5	
Injectable Drug Class:							
Opioids	0.1	0.7	2.3	14.7	20.4	8.0	62.7
Pain (non-opioid)	0.05	0.3	0.2	0.6	0.4	0.3	0.2
Benzodiazepines	0.2	0.9	1.3	3.1	9.0	3.1	20.4
Antipsychotics	0.2	0.9	2.3	2.8	15.9	4.7	19.3
Sedatives	0.0	0.0	0.1	0.2	0.04	0.1	0.1
Excess respiratory secretions	0.0	0.5	3.7	6.9	23.5	7.5	31.2
Pulmonary edema	0.0	0.0	0.2	0.3	0.4	0.2	0.7
Nausea	0.05	0.05	1.2	1.1	3.9	1.3	1.2

[a]Homes were grouped into quintiles of prescribing rates of at least one injectable medication for all decedent residents within the study period.
[b]Mean prescribing rate in LTC quintiles for injectable end of life medications in Ontario: Q1-37.6%; Q2- 59.8%; Q3- 69.1%; Q4- 74.8%; Q5-82.9%.
[c]Ontario data did not include this analysis.

TABLE 2b.
Average prescribing rates for injectable vs. any route end-of-life medication (according to medication classes) for LTC residents in Alberta from January 1, 2017 to March 17, 2020; and comparison with Ontario rates

Medication Class	*ALBERTA*		*ONTARIO*	
	Injectable end-of-life medication %	*Any route end-of-life medication[a] %*	*Injectable end-of-life medication %*	*Any route end-of-life medication %*
Opioids	8.0	16.0	65.4	66.1
Pain (non-opioid)	0.3	1.1	0.3	0.9
Benzodiazepines	3.1	6.6	22.5	30.9
Antipsychotics	4.7	6.0	20.0	20.5
Sedatives	0.1	0.2	0.1	0.1
Respiratory secretions	7.5	7.8	34.2	38.2
Pulmonary edema	0.2	22.6	0.8	0.8
Nausea/Vomiting	1.3	3.5	1.3	1.3

[a]Alberta included topical fentanyl and atropine, not included in Ontario.

TABLE 3.
Rates of prescribing end-of-life injectable medicines in the last 14 days of life among decedents in LTC between January 1, 2017 and March 17, 2020, compared with injectable by drug class and individual medication

Injectable Medication Class and specific medications	*Alberta*						*Ontario*
	Among residents in Q1 (28 homes) N=1,997 %	*Among residents in Q2 (20 homes) N=1,974 %*	*Among residents in Q3 (19 homes) N=1,876 %*	*Among residents in Q4 (22 homes) N=1,917 %*	*Among residents in Q5 (28 homes) N=2,274 %*	*Among all residents N=10,038 (117 homes) %*	*Among Residents from all homes N=55,916 %*
Opioids	**0.1**	**0.7**	**2.3**	**14.7**	**20.4**	**8.0**	**62.7**
Morphine	0.05	0.3	0.9	5.7	8.3	3.2	11.4
Hydromorphone	0.05	0.3	1.5	8.9	12.0	4.8	52.1
Fentanyl[a]	0.0	0.05	0.05	0.5	0.6	0.3	
Pain (non-opioid)	**0.05**	**0.3**	**0.2**	**0.6**	**0.4**	**0.3**	**0.2**
Dexamethasone	0.05	0.3	0.2	0.6	0.4	0.3	0.2
Benzodiazepines	**0.2**	**0.9**	**1.3**	**3.1**	**9.0**	**3.1**	**20.4**
Lorazepam	0.0	0.1	0.2	0.5	3.3	0.9	6.2
Midazolam	0.2	0.8	1.1	2.7	5.6	2.2	14.7
Antipsychotics	**0.2**	**0.9**	**2.3**	2.8	**15.9**	**4.7**	**19.3**
Haloperidol	0.05	0.2	1.5	2.0	11.7	3.4	13.3
Methotrimeprazine	0.1	0.8	0.9	0.9	4.7	1.6	7.6
Sedatives	**0.0**	**0.0**	**0.1**	**0.2**	**0.04**	**0.1**	**0.1**
Phenobarbital	0.0	0.0	0.1	0.2	0.04	0.1	0.1
Excess respiratory secretions	**0.0**	**0.5**	**3.7**	**6.9**	**23.5**	**7.5**	**31.2**
Scopolamine	0.0	0.3	1.4	0.6	3.1	1.2	26.9
Glycopyrrolate	0.0	0.2	1.8	4.5	10.3	3.6	4.8
Atropine[a]	0.0	0.1	0.5	1.8	10.5	2.9	
Pulmonary edema	**0.0**	**0.0**	**0.2**	**0.3**	**0.4**	**0.2**	**0.7**
Furosemide	0.0	0.0	0.2	0.3	0.4	0.2	0.7
Nausea	**0.05**	**0.05**	**1.2**	**1.1**	3.9	**1.3**	**1.2**
Metoclopramide	0.05	0.05	1.2	1.1	3.9	1.3	1.2

[a]Ontario data did not include this specific medication.

TABLE 4.
LTC home characteristics by quintiles of prescribing rates of at least one injectable end-of-life medication in deceased residents in 117 LTC homes in Alberta between January 1, 2017 and March 17, 2020; the overall rates are compared with Ontario

Home Characteristics	*Alberta*						*Ontario*
	Q1 homes, N=28 %	*Q2 homes, N=20 %*	*Q3 homes, N=19 %*	*Q4 homes N=22 %*	*Q5 homes N=28 %*	*All homes N=117 %*	*All homes N=626 %*
Number of beds							
1-50	28.6	25.0	31.6	18.2	32.2	27.3	9.6
50-100	39.3	25.0	31.6	22.7	32.1	30.8	31.6
100-150	17.8	20.0	10.5	27.3	10.7	17.1	25.4
150-500	14.3	30.0	26.3	31.8	25.0	24.8	33.4
Rurality	39.3	35.0	36.8	22.7	17.9	29.9	22.0
AHS Operated LTC Site	39.3	20.0	63.2	45.5	60.7	47.9	N/A

TABLE 5.
Rates of transfer out in the last 14 days of life among LTC residents in Alberta between January 1, 2017 and March 17, 2020; the proportions between Alberta and Ontario are compared

	Residents From Homes In Quintiles Of Injectable End-Of-Life Medication					
Alberta	Q1 N=2,292 %	Q2 N=2,277 %	Q3 N=2,096 %	Q4 N=2,273 %	Q5 N=2,669 %	All homes N=11,607 %
Transfer out (n=1,569)	12.9	13.3	10.5	15.7	14.8	13.5
Ontario	Q1 N=12,504 %	Q2 N=12,324 %	Q3 N=12,822 %	Q4 N=15,580 %	Q5 N=15,623 %	All homes N=68,653 %
Transfer out (n=12,937)	30.3	20.5	17.1	15.6	12.7	18.8

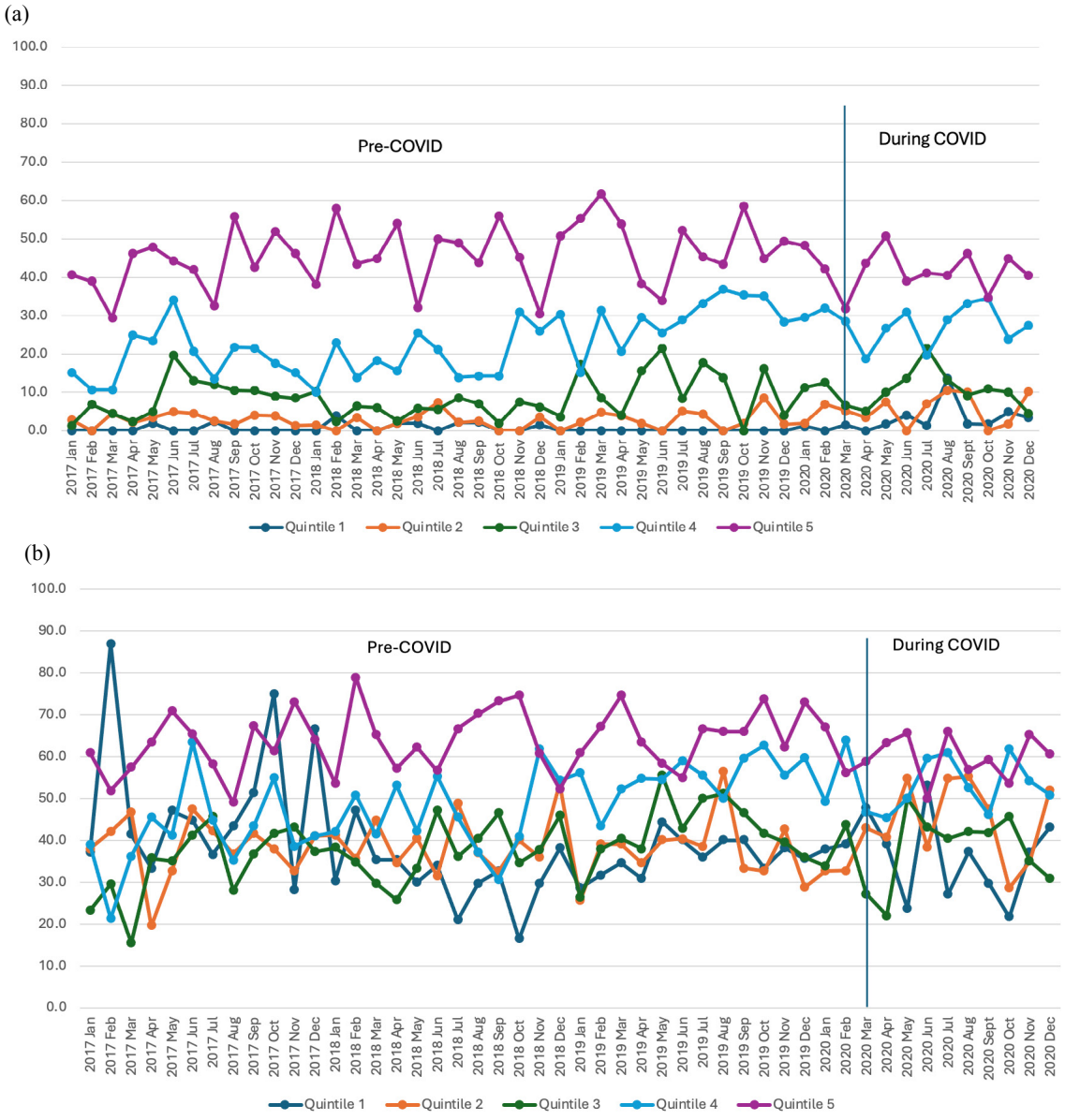


FIGURE 2. (a) Rates of Injectable end-of-life medication prescribing by quintile, over time during both pre-COVID and COVID pandemic periods (between January 1, 2017, and December 31, 2020); (b) Rates of any route end-of-life medication prescribing by quintile, over time during pre-COVID and COVID pandemic periods (between January 1, 2017, and December 31, 2020)

The variance between the two provinces—and across quintiles of homes in Alberta—could suggest systematic differences in prescribing practices or a culture of managing end-of-life symptoms with less symptom-relieving medication. An alternative explanation relates to issues with Alberta's tracking of prescribed end-of-life medications. One hard-to-track data source that is in use in Alberta LTC homes is contingency "ward stock" medication. Nursing staff can administer urgently needed medications directly from a stock of medications, and this dispensation information is not available at the per-patient level in PIN or DOSE. Estimated stock use from the quantities of some end-of-life injectable medications ordered by LTC homes in AHS Calgary Zone suggests about 43% (range 4% to 100%) of use may come from ward stock (AHS pharmacist lead, personal communication, April 12, 2023). Ward stock refill data were not accessible and could be misleading because expired, unused medications are also restocked. Ward stock use may be especially frequent in rural homes run by AHS, where the LTC is co-located with a community hospital and, as such, staff has ready access to stock medication. Alberta homes with lower prescribing rates were indeed mainly smaller and situated in rural areas. Private LTC prescribing data captured in PIN is likely more comprehensive, but most still have access to ward stock. There were 64 homes excluded from our analysis because all or most of their decedents had no DOSE or PIN prescriptions. The excluded homes were mostly smaller, rural, and AHS run facilities and, hence, likely using ward stock medication rather than external pharmacies.

This issue of incomplete access to prescribing data in Alberta LTC was noted in an AHS report of antipsychotic prescribing rates in LTC: "PIN data does not reflect approximately one-third of long-term care dispensations which are obtained from non-community-based pharmacies or acute care pharmacies."[22] Use of ward stock is considered an appropriate adaption to limited community pharmacy access both in distance and hours of operation, and cannot be interpreted as reflecting poorer anticipation of patient decline or lower quality of care.

Caution must also be applied in interpreting the low rates of end-of-life injectable prescribing in Alberta as representing lower quality end-of life-care because these rates were not correlated with another potential quality-of-care metric, namely, the rate of transfer and death outside of LTC.[23] In Ontario, lower prescribing rates were associated with higher rates of transfer and death outside LTC, but this was not the case in Alberta. Similarly, COVID-19 pandemic impacted prescribing in Ontario LTC, but neither injectable nor any route end-of-life prescription rates showed changing trends before or during the COVID-19 pandemic in Alberta.

Although there were measured differences in injectable end-of-life care medication prescribing across quintiles, the data limitations described, and the lack of correlation with transfer rates or changes with the COVID-19 pandemic, suggest that rates of injectable end-of-life prescribing in LTC are not ready for use as a quality indicator in Alberta.

Strengths and Limitations

Existing, individual LTC facilities' paper health records or internal electronic records of medication prescription and administration are not readily accessible for system level research. A strength of using the DOSE and PIN dispensation administrative databases was that individual LTC home or resident consent was not required, thus avoiding potential selection bias and burden on research participants. The major limitations, however, is that these administrative records do not provide information about whether the medication was administered, appropriate, or effective in managing residents' end-of-life symptoms, or aligned with the resident and their families' goals or preferences for their care. A provincial electronic health record (Connect Care) is currently being implemented in all AHS facilities.[24] In future, if system-wide, digital, patient-specific medication orders are available, for both public and private LTC facilities, then end-of-life medication prescribing rates, routes, and administration could be re-examined for their potential as a quality-of-care indicator.

CONCLUSION

This study found lower rates of prescribing end-of-life symptom-relieving injectable medications in Alberta LTC homes compared to Ontario, but Alberta's administrative databases may not have identified all injectables prescribed. With this current limitation, it is not feasible to use administrative data of injectable end-of-life prescribing as a cross-provincial end-of-life, quality-of-care indicator.

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CONFLICT OF INTEREST DISCLOSURES

We have read and understood the *Canadian Geriatrics Journal*'s policy on disclosing conflicts of interest and declare the following interests: JS is the Medical Director, Palliative and End of Life Care, Alberta Health Services, Calgary Zone. PT was supported by PSI Graham Farquharson Knowledge Translation Fellowship. SB receives an Academic Protected Time Award from the Department of Medicine, University of Ottawa, Ottawa, Canada.

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APPENDIX A. List of end-of-life medications

Drug Din	*Medication Class*	*Medication Name*	*Route Administered*
026384 2098660	Excess respiratory secretions	atropine sulfate	oral
328154 392693 497231 497266 2094681 2094703 2426277 2432196 243515 243523 497258 705535 2426269 2426285 2432188 392782 497223 705500 2472171	Excess respiratory secretions	atropine sulfate	Injectable
2261081 1964976 1964968 2279363 2250055 1964070 2528584 1946897	Pain (non-opioids)	dexamethasone	oral
2387743 664227 1977547 783900 874582 2204274 2204266	Pain (non-opioids)	dexamethasone	Injectable
2314630 2314649 2314657 2314665 2341387 2341395 2341409 2341417 2275856 2327155 2327163 2330121 2330148 2330156 2386852 2386879 2386887 2396726 2396734 2396742 9857577 9857579 9857580 9857581 9857582 9857584 9857585 9857587 9857588 9857589 9857590 9857592 2386895 1937413 2386844 2280345 2341379 2275848 1937405	Opioids	fentanyl	Patch
2506963 2384124 2240434 2385406 2501554 2496143 2496151 2496178 2496186	Opioids	fentanyl	Injectable
2224720 2224755 765953 2466775 2351447 707570 337749 2466767 2351439 362166 337730 2466759 2351420 396788 397792 496723 667080	Pulmonary edema	furosemide	oral
217743 366854 1988832 1996436 2224739 2384094 2461404 2480530 380024 401633 527033 565040 2360365 2360446 2382539 2387360 2466945 2488868 2513439 2527499 2527502 9857208	Pulmonary edema	furosemide	Injectable
2382857 2473887 2039508 2043610 2382849 2473879 2473895 2479273 2513749 9857212 9857266 9857521	Excess respiratory secretions	glycopyrrolate	Injectable
363650 363669 363677 363685 396796 396818 396826 396834 463698 552135 552143 552429 587702 587788 587796 647969 713449 728292 728306 745561 759503 761745 761753 761761 768820 2239216 2239217 2239218 2239219 2239220	Antipsychotics	haloperidol	oral
17574 2366010 2406411 2493993 2130297 2130300 9853758 808652	Antipsychotics	haloperidol	Injectable
786535 1916386 2125390 2125382 2243562 2125366 2359510 2125331 2359502 2125323 885428 786543 2364158 885401 125121 2364131 885436 125083 2364123 885444 705438 2364115	Opioids	hydromorphone	oral
2145901 2145928 2145936 2146126 2460602 2244797 2460610 2469413 2468468 2382636 2485532 2485540 2514435 2529645 2491680 2491699	Opioids	hydromorphone	Injectable
348325 348333 399124 637742 637750 655643 655651 655678 655740 655759 655767 711101 728187 728195 728209 865672 865680 865699 2041413 2041421 2041448 2240725 2240726 2240727 2245784 2245785 2245786 2298201 2298228 2298236 2347733 2347741 2347768 2351072 2351080 2351099 2429802 2429810 2429829 557757 722138 2041456 2041464 2041472 2410745 2410753 2410761	Benzodiazepines	lorazepam	oral
557773 2243278 2388669 2041405 2438704 9857216	Benzodiazepines	lorazepam	Injectable
2238404 2238403 2238405 2238406	Antipsychotics	methotrimeprazine	oral
1927698	Antipsychotics	methotrimeprazine	Injectable
2230433 2230431 842826 2517795	Nausea/vomiting	metoclopramide	oral
2185431 9857224 2243563 2510790	Nausea/vomiting	metoclopramide	Injectable
2240285 2240286 2242905 2382342 2382350 2382873 2423766 2529300 2529319 2242904 2382377 2382385 2382903 2423758 2498022 9857225 9857436 9857438 9857479	Benzodiazepines	midazolam	Injectable