24/7 Registered Nurse Staffing Coverage in Saskatchewan Nursing Homes and Acute Hospital Use*

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RÉSUMÉ

La législation, dans de nombreuses juridictions, nécessite les établissements des soins de longue durée (SLD) d'avoir une infirmière en service 24 heures par jour, 7 jours par semaine. Bien que la recherche considérable existe sur l'intensité SLD de la dotation en personnel infirmier, il n'existe pas de la recherche empirique relative à cette exigence. Notre étude rétrospectif d'observation a comparé des installations en Saskatchewan avec 24/7 RN couverture aux établissements offrant moins de couverture, complétées par divers modèles de dotation des postes de nuit. Les ratios de risque associés à moins de 24/7 couverture RN complété de la dotation infirmière autorisé de nuit, ajusté pour l'intensité de dotation en personnel infirmier et d'autres facteurs de confusion potentiels, étaient de 1,17, IC 95% [0,91, 1,50] et 1.00, IC à 95% [0,72, 1,39], et avec moins de couverture 24/7 RN complété avec soin par aides personnels de nuit, les ratios de risque étaient de 1,46, IC 95% [1,11, 1,91] et 1,11, IC 95% [0,78, 1,58], pour les patients hospitalisés et de visites aux services d'urgence, respectivement. Ces résultats suggèrent que l'utilisation des soins de courte durée peut être influencée négativement par l'absence de la couverture 24/7 RN.

ABSTRACT

In many jurisdictions, legislation requires long-term care (LTC) facilities to have a registered nurse on duty 24 hours a day, seven days per week. Although considerable research exists on LTC nurse staffing intensity, no empirical research on this requirement exists. Our retrospective observational study in Saskatchewan compared facilities with 24/7 RN coverage to facilities with less coverage supplemented with various night-shift staffing models. Adjusted for nurse staffing intensity and other potential confounders, risk ratios associated with less-than-24/7 RN coverage supplemented with licensed practical nurse night-shift staffing were 1.17, 95% CI [0.91, 1.50] and 1.00, 95% CI [0.72, 1.39]; and with less-than-24/7 RN coverage supplemented with care aide night-shift staffing, risk ratios were 1.46, 95% CI [1.11, 1.91] and 1.11, 95% CI [0.78, 1.58], for inpatient hospital admissions and Emergency Department visits respectively. Findings suggest that acute services utilization may be negatively influenced by the absence of 24/7 RN coverage.

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Long-term care (LTC) facilities offer care for primarily elderly people requiring nursing and personal care on a 24-hour basis. Most LTC residents suffer from multiple complex chronic medical and/or psychiatric conditions (Canadian Institute for Health Information [CIHI], 2013). Typically, a team of staff delivers LTC care, including licensed registered psychiatric nurses and/or registered nurses (RNs), licensed practical nurses (LPNs), unregulated nurse/care aides (CAs) (in some parts of Canada referred to as personal support workers or PSWs), allied health professionals (e.g., dietitians, recreation, physical and occupational therapists), and other LTC employees (food service, laundry and housekeeping staff, administrative and management staff, etc.), each of whom is trained to a different skill-set.

CAs assist residents with their personal care and provide the majority of direct care to residents. CA training is limited to 30 weeks in Saskatchewan, and there is no licensing or regulation of this staff category (Bryan et al., 2010). There is an expectation that CAs work under the direction of RNs or LPNs. RNs and LPNs assess residents and provide nursing care to promote health and prevent and detect illness within their scopes of practice (Registered Psychiatric Nurses Association of Saskatchewan, the Saskatchewan Association of Licensed Practical Nurses, and the Saskatchewan Registered Nurses Association, 2000). RNs receive more extensive nursing education than LPNs (Bryan et al., 2010). Accordingly, these differences in education and knowledge define the practice expectations of RNs versus LPNs.

The type and number of nursing staff in facilities are influenced by the care level of the residents (such as resident acuity, physical and cognitive impairment, etc.) (Doupe et al., 2006), as well as by the LTC facility and its environment, including ownership (McGregor Tate, Ronald, McGrail, Cox, Berta, & Broemeling, 2010a), funding (Harrington, Swan, & Carillo, 2007), and regulatory requirements (Bowbliss, 2011).

However, the complexity of care in long-term care has increased over time (McGregor, et al., 2010a; Menec, MacWilliam, Soodeen, & Mitchell, 2002), and in 2013 the Saskatchewan government reported that complexity of care was a major issue, with 63 per cent of

LTC residents being assessed at care level 4, requiring the highest number of care hours (Government of Saskatchewan, 2013, p. 326). There is thus a growing need for evidence to inform decisions about the optimal number and mix of licensed nursing staff to provide leadership and support to direct care workers in caring for this challenging population.

In some jurisdictions in North America (including 8 Canadian provinces and 14 U.S. states), legislation requires LTC facilities to have an RN on duty 24 hours a day, seven days per week (i.e., 24/7) (Bryan et al., 2010, Harrington, 2008). The rationale for this is that, because of their more extensive training, RNs are best qualified to provide 24/7 clinical decision-making for the often complex needs of LTC residents (Harrington et al., 2000; Page, 2004; Wunderlich & Kohler, 2001; Wunderlich, Sloan, & Davis, 1996). However, a systematic review failed to identify empirical research to support the regulatory requirement for 24/7 RN on-site coverage (Bryan et al., 2010).

Furthermore, many facilities report difficulty recruiting and retaining RNs to work night shifts (Government of Saskatchewan, 2013). This has caused some health care decision-makers to ask whether night-shift substitution models in particular, such as replacing RNs with LPNs, are able to provide equivalent care quality (Bryan et al., 2010, 2013). The study described in this article is part of a larger study funded by the CIHR Evidence on Tap program to fund research on policy questions submitted by decision-makers. The study question, submitted by the Government of Saskatchewan Ministry of Health, was to examine the relation between 24/7 nurse staffing coverage and various night-shift substitution models in Saskatchewan LTC facilities and facility care quality.

Our study question was: "Does the on-site presence of an RN on the day, evening, and night shift, 7 days a week, 365 days a year (henceforth referred to as '24/7 RN coverage'), influence inpatient hospital admissions and ED visits when compared to facilities where there is less than 24/7 RN coverage and various nurse staffing substitution models on the night shift?" Our study hypothesis was that facilities without 24/7 RN coverage would have higher risks of inpatient hospital admissions and emergency department (ED) visits

compared to facilities with 24/7 RN coverage after adjusting for differences in levels of nursing staff intensity, facility size, resident demographics, and case mix.

We have focused on inpatient hospital admissions and ED visits as proxy measures of care quality, consistent with existing research (Arendts, Quine, & Howard, 2013; Dosa, 2005; Grabowski, Stewart, Broderick, & Coots, 2008; Konetzka, Spector, & Limcangco, 2008). Higher frequency of visits to the ED and admission to acute inpatient hospital care may be the result of poor care processes in the LTC facility (Arendts, Reibel, Codde, & Frankel, 2010; Kayser-Jones, Wiener, & Barbaccia, 1989; Intrator, Castle, & Mor, 1999; McGregor et al., 2011), differences in resident-level characteristics, and/or the result of a lower threshold for sending acutely ill residents to the hospital (Hirth, Grabowski, Feng, Rahman, & Mor, 2014). Inpatient hospital admissions and ED visits can put LTC residents at risk of iatrogenic infections (Boockvar et al., 2005; Quach et al., 2012), falls, delirium, and decline in functional status and quality of life (Gillick, Serrell, & Gillick, 1982).

Inpatient hospital admissions and ED visits are also both outcomes-sensitive to RN staff training levels where there is evidence in acute care settings that a lower proportion of baccalaureate-trained RNs is associated with "failure to rescue" (Aiken, Clarke, Cheung, Sloane, & Silber, 2003; Clark & Aiken, 2003; Needleman, Buerhaus, Mattke, Stewart, & Zelevinsky, 2002) and therefore higher mortality rates. The hypothesized mechanism for this is that RNs are better trained to identify a sudden change in patients' condition, allowing for earlier intervention and reversal of decline before it is too late.

Methods

Study Design and Data Sources

This is a retrospective observational study of Saskatchewan LTC facilities. Data were available for the time period April 1, 2007 to March 31, 2010. The unit of analysis was the facility by year. Inpatient acute hospital admission and ED visit occurrence and resident demographic and case mix data were extracted from the Resident Assessment Instrument Minimum Data Set 2.0 (RAI-MDS 2.0) assessment tool. Saskatchewan LTC facilities routinely collect data on their residents using this electronic data collection tool, now in widespread use in LTC facilities in Canada (CIHI, 2013). The full version of the MDS 2.0 assessment is completed by the regular RN staff at admission, at year anniversaries, and when a significant clinical change occurs. A shorter quarterly version containing a subset of the full assessment items is also completed by the regular RN at 3-month intervals.

For this research, we obtained de-identified MDS 2.0 data on all residents with stays of 14 days or longer for the period of April 1, 2007, to March 31, 2010. Annual staffing data on worked hours by shift were provided by the Saskatchewan Association of Health Organizations and collated by Ministry colleagues in Saskatchewan. Data on other facility characteristics (facility size and ownership) were provided by the Saskatchewan Ministry of Health. We then linked MDS 2.0 data, by LTC facility, to data on facility staffing, ownership, and organizational characteristics.

Study Population

We included 135 facilities where staffing, inpatient hospital admission, and ED visit data were available, representing 88 per cent of the 153 facilities in the province. Approximately 83 per cent of the included facilities were regional health authority owned, and the remaining 17 per cent were private non-profit facilities. Six for-profit facilities, eight non-profit facilities, and four health authority–owned facilities were not included due to missing staffing or MDS data. Excluded facilities were overall larger compared to included facilities (mean [SD] number of beds, 73 [67] vs. 53 [49], respectively), but had similar levels of occupancy. Facilities with missing MDS assessment or staffing data in one year were excluded for that year only and included for the remaining years where data were available.

Individual assessments were excluded if, for a given resident and quarter, the assessment was not the most recent assessment ($n = 3,127$, 4%), or the resident was assessed in another facility in the same quarterly period, consistent with transfers ($n = 6$).

Primary Study Variable and Outcomes

Research to date has focused on the impact of RN staff intensity (Carter & Porell, 2005; Horn, Buerhaus, Bergstrom, & Smout, 2005; McGregor et al., 2014; Xing, Mukamel, & Temkin-Greener, 2013). Staffing intensity examines RN hours in relation to the number of facility residents (usually as hours per resident day), whereas RN *coverage* looks at the presence of an RN unrelated to any denominator reflecting facility size. Although the two measures are related, RN staff *intensity* focuses more on the effect of RN hours and their impact on direct care to residents, whereas RN *coverage* focuses on the broader effect of RN leadership within a facility. The research question was concerned with types of nurse staffing coverage, and so we created a variable that could describe the nurse staffing coverage for each facility for each year. This staffing variable was based on RN, LPN, and CA "regular" (i.e., worked on-site) hours in three eight-hour shifts (i.e., daytime, evening,

and night). For the purpose of clarity we describe the following terms used in this article (see Table 1).

We categorized nurse staffing coverage into five mutually exclusive groups (see Figure 1):

1. "RN ≥ 24/7": This group includes facilities that recorded 2,920 (i.e., 8 hours X 365 days) or more RN on-site hours per year on each of the 3 shifts.
2. "RN hours *plus* RN standby hours ≥ 24/7 'coverage', night shift supplemented with LPN coverage" (henceforth abbreviated as 2) RN + RN standby ≥ 24/7, + LPN night): This group excludes facilities in the first group, but includes facilities where the sum of RN standby hours and RN on-site hours was equal to or greater than 2,920 hours on all shifts throughout the year *and* that had 2,920 or more hours of on-site nurse staffing on the night shift when LPN on-site night shift hours and RN on-site night shift hours were combined.
3. "RN hours *plus* RN standby hours ≥ 24/7 'coverage', night shift supplemented with CA coverage" (henceforth abbreviated as 3) RN + RN standby ≥ 24/7, + CA night): This group excludes facilities in the first and second groups, but includes facilities where the sum of RN standby hours and RN on-site hours is equal to or greater than 2,920 hours on all shifts throughout the year *and* had 2,920 or more hours of on-site nurse staffing on the night shift when CA on-site night shift hours and RN on-site night shift hours were combined.
4. "RN hours *plus* RN standby hours < 24/7, night shift supplemented with LPN coverage" (henceforth abbreviated as 4) RN + RN standby < 24/7, + LPN night): This group excludes facilities in the first, second, and third groups but includes facilities that, when the RN on-site and standby hours were combined, had fewer than 2,920 hours per year on the night shift throughout the year, *and* had 2,920 or more hours of on-site nurse staffing on the night shift when LPN on-site night shift hours and RN on-site night shift hours were combined.
5. "RN hours *plus* RN standby hours < 24/7, night shift supplemented with CA coverage" (henceforth abbreviated as 5) RN + RN standby < 24/7, + CA night):

This category excludes facilities in the first, second, third, and fourth groups, but includes facilities that, when RN on-site and standby hours were combined, had fewer than 2,920 hours per year on the night shift, *and* had 2,920 or more hours of on-site nurse staffing on the night shift when CA on-site night shift and RN on-site night shift hours were combined.

We placed quotations around "coverage" in groups 2 and 3 to indicate how the meaning of this term differs from its use in the other groups because our formal definition of RN coverage requires an on-site presence of RN staff, which is not met by the standby groups.

The development of these staffing categories was an iterative process carried out in consultation with the research team and nursing decision-makers from the Saskatchewan Ministry of Health. Thus, although not formally validated, the consultative process provides the categories with some face validity.

Inpatient hospital admissions and ED visits are recorded in the MDS as the number of these events occurring in the 90 days prior to the assessment and are only gathered at the time of full (and not quarterly) assessment completion. Our outcome measures were, therefore, the proportion of full facility assessments with one or more inpatient hospital admissions, and one or more ED visits within the 90 days prior to assessment. ED visits were defined as outpatient visits to the hospital emergency department that did not result in an inpatient hospital admission. ED visits resulting in an inpatient hospital admission were not counted as an ED visit so these outcomes were mutually exclusive. Full assessments completed on admission to LTC were excluded because a high proportion of these residents are admitted to LTC directly from a hospital. An inpatient hospital admission recorded at this time cannot, therefore, be considered an "outcome" of their nursing home stay since it pre-dates the admission.

Table 1: Definition of terms

| Term	Definition
Coverage	This term refers to worked hours on-site at a given LTC facility.
24/7 coverage	We operationalized our definition of 24/7 coverage using a threshold of 2,920 worked hours or greater on each of the three shifts (day, evening, and night). That is, each of three shifts was assumed to be "covered" 24/7 in a given fiscal year if the on-site worked hours per shift reached or exceeded the threshold of 2,920: 24/7 coverage = 8 hours × 365 day shifts = 2,920 hours + 8 hours × 365 evening shifts = 2,920 hours + 8 hours × 365 night shifts = 2,920 hours.
Night shift	This refers to the 8-hour shift between midnight and 8 a.m.
Standby hours	A Saskatchewan nurse assigned to be on "standby" is not providing on-site duty, but must be available to respond to a request to report to duty without undue delay. That is, the "standby" hours reflect the hours during which a nurse is on standby only. These hours do not represent hours spent on-site or providing telephone advice. If a nurse was called back in to duty, his/her hours were then recorded as "regular" worked hours, and were not included in the "standby" category.
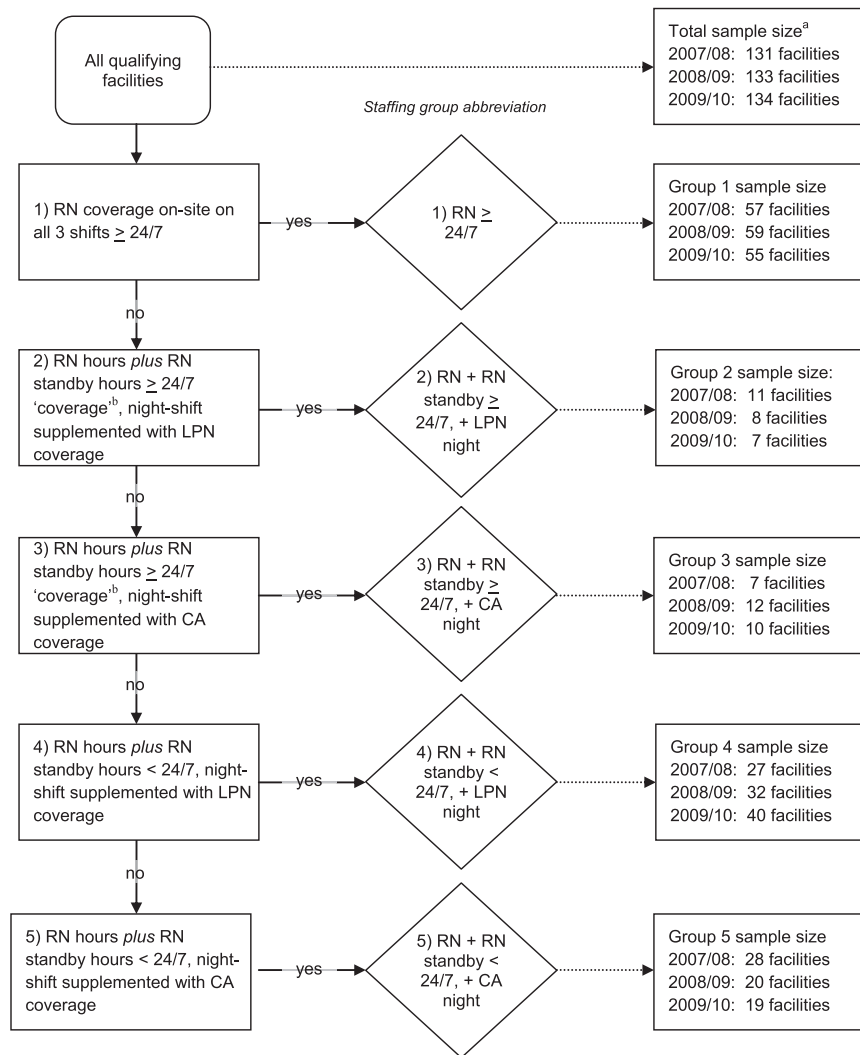
Figure 1: Categorization of nurse staffing coverage groups

[a] The total sample size numbers includes two staffing groups that were excluded from the analyses because of small numbers. In 2007/08, there was one facility with RN hours plus RN standby hours ≥ 24/7, with RN night-shift coverage. In 2008/09 and 2009/10, there were, respectively, two and three facilities with RN coverage < 24/7, with RN night-shift coverage.
[b] We placed quotations around "coverage" in Groups 2 and 3 to indicate how the meaning of this term differs from its use in the other groups because our formal definition of RN coverage requires an on-site presence of RN staff, which is not met by the standby group.

Co-variates

We controlled for differences in facility characteristics by adjusting for facility ownership (Regional Health Authority owned vs. private non-profit) and total number of beds. We controlled for staffing intensity by dividing the total worked hours in each facility for a given staffing category (RN, LPN, and CA) by the total residents in the facility and then by 365.25 to yield hours per resident day (hprd). Standby hours were excluded from total worked hours in this calculation. These variables were available by shift on an annual basis.

We further adjusted for facility differences in the distribution of resident demographic variables and case mix variables, based on admission, quarterly, and full MDS assessments, and described in Table 2.

Statistical Analysis

We described the distribution of facility characteristics, RN, LPN, and CA intensity and outcomes (inpatient hospital admissions and ED visits) and the distribution of outcomes by the facility RN coverage models averaged over the three-year time period. The facility (by year) was the unit of analysis. We reported the risk of outcomes averaged over the three years of the study. The relation between RN coverage and our outcomes of interest was modeled by log-binomial regression

Table 2: Resident case mix characteristics

Case mix Variables	Description	Abbreviation	Measurement Scale and Interpretation
Proportion ADL long score ≥ 15[a]	Activities of Daily Living – Long form: measure of physical dependency including dressing, personal hygiene, toilet use, locomotion, transfer, bed mobility, and eating	ADL_long	Ordinal measure; ranges from: 0 = independent, to 28 = total dependence
Proportion CHESS score ≥ 15[a]	Changes in Health, End-stage disease, and Signs and Symptoms Score: detects frailty and instability in health (e.g., weight loss, shortness of breath, edema, vomiting, dehydration, etc.)	CHESS	Ordinal measure; ranges from: 0 = Not at all unstable, to 5 = Very high health instability. Higher scores are predictive of adverse outcomes such as mortality, hospitalization, pain, etc.
Proportion CPS score ≥ 15[a]	Cognitive Performance Scale: rates cognitive status of residents (e.g., short-term memory, decision-making and communication skills)	CPS	Ordinal measure; ranges from 0 = intact, to 6 = very severe impairment. A score of 3 or higher indicates moderate to severe impairment, equivalent to MMSE of approximately 15.
Facility proportion of residents with high medication use[a]	Medication counts: counts the number of different medications actually administered and received by the resident over the past seven days.	highMedCount	Categorical measure; impute: 0 = No, uses less than 9 different medications; 1 = Yes, uses 9 or more different medications
Facility proportion of residents with congestive heart failure[b]	Congestive heart failure	CHF	Categorical measure; impute: 0 = No, does not have CHF; 1 = Yes, has CHF
Facility proportion of residents with chronic obstructive lung disease[b]	Chronic obstructive pulmonary disease	COPD	Categorical measure; impute: 0 = No, does not have COPD; 1 = Yes, has COPD
Facility proportion of residents with diabetes[b]	Diabetes	Diabetes	Categorical measure; impute: 0 = No, does not have diabetes; 1 = Yes, has diabetes

[a] Data collected with the Resident Assessment Instrument Minimum Data Set 2.0 (RAI-MDS 2.0) quarterly assessment tool.
[b] Not collected by with the quarterly assessment tool and so imputed using the prior RAI-MDS 2.0 full assessment.

with a random effect for facility (Wacholder, 1986; Blizzard & Hosmer, 2006), adjusted for facility and resident characteristics with 24/7 RN coverage as the reference category.

We also conducted several sensitivity analyses. First, we varied the threshold of hours that defined a shift being covered. This was varied to allow total hours to be within 2 per cent, 5 per cent, and 10 per cent of 2,920 hours. Second, we excluded facilities in fiscal years where MDS submissions were defined as inconsistent, that is, two or three of the following were present in a given year: (a) the coefficient of variance of the four quarters in the given year of the facility was greater than 0.2, or the standardized range of the four quarters in the given year of the facility was greater than 0.4; (b) the number of assessments in the given year of the facility was 25 per cent less than the total number of beds; and/or (c) the number of assessments in the given year of the facility had a 25 per cent change from at least one of its adjacent quarters and that an adjacent quarter had a number of assessments greater than 10.

Third, we ran models that adjusted for the proportion of assessments that had a "do not resuscitate" order and that excluded assessments with a "do not hospitalize"

order because both these variables have been demonstrated to affect transfers to hospital (McGregor, Pare, Wong, Cox, & Brasher, 2010b). Fourth, we included only full MDS assessments to approximate the risk profile of residents. Finally, we combined nurse staffing groups that were arguably "RN led" (i.e., Group 1. RN ≥ 24/7 and Groups 2 and 3 that had RN hours *plus* RN standby hours ≥ 24/7). Results are reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for improving the quality of reporting of observational studies (Vandenbroucke et al., 2007).

Results

Characteristics of the LTC Facilities and Resident Population

The study cohort consisted of 135 LTC facilities with 15,214 residents, 77,573 quarterly assessments, and 17,041 annual full assessments. Over the 3-year time period, the total number of beds varied across facilities from 8 to 390, with an average facility size of 53 beds (*SD* = 49). The average occupancy rate was 0.95 (*SD* = 0.08). The mean age of the residents was 82 years

and two thirds were female. Over one half had dementia (data not shown) and more than half were on nine or more medications. Other resident characteristics are described in Table 3.

Nurse Staffing Characteristics

The mean (*SD*) hours per resident day (hprd) of RNs, LPNs, and CAs, averaged over the three-year time period, were 0.99 (0.73), 0.43 (0.48), and 2.47 (0.62), respectively. Some facilities reported zero hours of LPN because they did not employ LPNs. See Table 4 for more information on the median and range of nursing staff hours per resident day.

A substantial minority of facilities had 24/7 on-site RN coverage (43% of the total sample for Group 1). The combined RN regular (on-site) and standby hours added up to 2,920 on all shifts over the year in a small number of facilities (see Figure 1). Averaged over the three years, Group 2 (LPN night-shift supplementation model) and Group 3 (CA night-shift supplementation model) comprised 7% and 8% of the total sample respectively.

The remaining facilities did not meet the criteria for 24/7 on-site RN coverage (see Figure 1). Among these facilities, the most frequent nurse staffing coverage model when RN coverage was less than 24/7 was that of LPNs providing supplemental coverage on the night shifts (25% of the total sample for Group 4), with the group having CAs providing supplemental coverage on the night shifts close behind (17% of the total sample for Group 5).

Relation between Nurse Staffing Coverage and Outcomes

Among the 17,041 full post-admission assessments, there were 1,259 (7.4%) inpatient hospital admissions

in the 90 days prior to reporting. Less than 0.9% of assessments (150 of 17,041 assessments) had two or more inpatient hospital admissions. Ninety-day crude rate of inpatient hospital admissions for facilities with Group 1 (RN ≥ 24/7) coverage was 6.9 per cent (see Table 5). The ninety-day crude rate in Group 4 facilities (RN + RN standby < 24/7, + LPN night) was 8.3 per cent, and in Group 5 facilities (RN + RN standby < 24/7, + CA night) was 9.0 per cent (see Table 5).

After adjusting for nurse staffing intensity, facility size, ownership, and resident case mix characteristics, the risk ratio for Group 4 facilities (RN + RN standby < 24/7, + LPN night), versus Group 1 facilities (RN ≥ 24/7), was 1.17, 95 per cent CI [0.91, 1.50] for inpatient hospital admission (see Table 5). Adjusted risk ratio for Group 5 facilities (RN + RN standby < 24/7, + CA night), versus Group 1 facilities, was 1.46, 95 per cent CI [1.11, 1.91] for inpatient hospital admissions.

Among the 17,041 full post-admission assessments, there were 745 (4.4%) ED visits in the 90 days prior to reporting. Ninety-day crude rate of ED visits for facilities with 24/7 RN coverage was 4.2 per cent (see Table 6). The ninety-day crude rate in Group 4 facilities (RN + RN standby < 24/7, + LPN night) was 4.3 per cent, and in Group 5 facilities (RN + RN standby < 24/7, + CA night) was 3.8 per cent (see Table 6).

After adjusting for nurse staffing intensity, facility size, ownership, and resident case mix characteristics, risk ratios for Group 4 facilities (RN + RN standby < 24/7, + LPN night), versus Group 1 facilities (RN ≥ 24/7), was 1.00, 95 per cent CI [0.72, 1.39] for ED visits (see Table 6). Adjusted risk ratios for Group 5 (RN + RN standby < 24/7, + CA night), versus Group 1 facilities, was 1.11, 95 per cent CI [0.78, 1.58] for ED visits (see Table 6).

The results for all of the sensitivity analyses were in a similar direction to the original analysis. In particular, when only full MDS assessments were included to approximate the risk profile of residents, the results

Table 3: Distribution of facility residents' demographic and case mix characteristics among 135 facilities

Characteristics	M	SD
Proportion female at assessment	0.67	0.07
Average age at assessment	82.27	3.46
Proportion ADL score long ≥ 15 at assessment	0.49	0.12
Proportion CHESS score ≥ 3 at assessment	0.14	0.08
Proportion CPS ≥ 4 at assessment	0.34	0.11
Proportion with 9+ different medications	0.55	0.12
Proportion with diabetes	0.19	0.07
Proportion with CHF	0.15	0.08
Proportion with COPD	0.08	0.05

ADL = activities of daily living; CHESS = Changes in Health, End-stage disease, and Signs and Symptoms; CPS = Cognitive Performance Scale; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease.

Table 4: Distribution of facility nursing staff intensity among 135 facilities

Facility Staffing Characteristics	M	SD	Median	Range
RN/RPN hprd	0.99	0.73	0.74	0.001–6.31
LPN hprd	0.43	0.48	0.33	0.00–4.48
CA hprd	2.47	0.62	2.44	0.34–4.54

hprd = hours per resident day, calculated as: hprd = [total hours of care by staff position in year/total number of residents]/365.25 days; RN = registered nurse; RPN = registered psychiatric nurse; LPN = licensed practical nurse; CA = care aide.

Table 5: Relation between 24/7 nurse staffing (RN) coverage and inpatient hospital admissions among Saskatchewan LTC facilities from 2007/08 to 2009/10

| Nurse Staffing Coverage Groups | Assessments with Inpatient Hospital Admissions | Original Analysis | Sensitivity Analyses | | | |
| | | | Redefined Threshold for Coverage within 10%[b] | Excluded Inconsistent MDS data[c] | Adjusted for DNR and Excluded DNH[d] | Included full MDS Assessments Only[e] |
	%	Adjusted[a] RR [95% CI]	Adjusted[a] RR [95% CI]	Adjusted[a] RR [95% CI]	Adjusted[a] RR [95% CI]	Adjusted[a] RR [95% CI]
(1) RN ≥ 24/7	6.9	1.00	1.00	1.00	1.00	1.00
(2) RN + RN standby ≥ 24/7, + LPN night	7.2	0.89 [0.64, 1.24]	1.20 [0.91, 1.58]	0.92 [0.66, 1.28]	0.87 [0.62, 1.21]	0.91 [0.65, 1.28]
(3) RN + RN standby ≥ 24/7, + CA night	5.4	0.90 [0.59, 1.37]	0.97 [0.65, 1.44]	1.02 [0.63, 1.65]	0.89 [0.59, 1.36]	0.89 [0.58, 1.36]
(4) RN + RN standby < 24/7, + LPN night	8.3	1.17 [0.91, 1.50]	1.29 [1.00, 1.66]	1.20 [0.92, 1.57]	1.15 [0.89, 1.47]	1.15 [0.89, 1.48]
(5) RN + RN standby < 24/7, + CA night	9.0	1.46 [1.11, 1.91]*	1.46 [1.05, 2.03]*	1.54 [1.15, 2.06]*	1.39 [1.06, 1.83]*	1.49 [1.14, 1.94]*

RN = registered nurse; LTC = Long-term care; RR = relative risk; CI = confidence interval; MDS = Minimum Data Set; DNR = do not resuscitate; DNH = do not hospitalize; LPN = licensed practical nurse; CA = care aide; hprd = hours per resident day; ADL = activities of daily living; CHESS = Changes in Health, End-stage disease, and Signs and Symptoms; CHF = Congestive Heart Failure; CPS = Cognitive Performance Scale; COPD = chronic obstructive pulmonary disease.

[a] Models adjusted for: Facility RN, LPN, CA staffing intensity (hprd), facility ownership, total number of beds, average age, proportion female, average ADL long score, average CHESS score, average CPS score, proportion with diabetes, proportion with high medication, proportion with CHF, and proportion with COPD.

[b] Redefined a shift being covered as within 10 per cent of the 2,920-hour threshold.

[c] Facilities were excluded if they had inconsistent MDS data submissions, determined by the presence of at least two of the three inconsistency criteria in a given year. See "Methods" for further details.

[d] Adjusted for the proportion of assessments that had a "do not resuscitate" order and excluded assessments with a "do not hospitalize" order.

[e] Only full MDS assessments used to approximate risk profile of residents in model adjustment.

* Statistical significance at the 5% level.

were similar: adjusted risk ratios for Group 5 facilities (RN + RN standby < 24/7, + CA night), versus Group 1 facilities (RN ≥ 24/7), were 1.49, 95 per cent CI [1.14, 1.94] and 1.14, 95 per cent CI [0.80, 1.62] for inpatient hospital admissions and ED visits respectively (see Tables 5 and 6 respectively).

The results of the sensitivity analysis of varying the threshold of hours that defined a shift being covered (i.e., within 2% and 5% of the 2,920 hour threshold) were also in a similar direction to the original analysis (details available from author). Further sensitivity analysis was also conducted by combining the nurse staffing groups. We started with combining the groups that were arguably "RN led" (i.e., we combined Groups 2 and 3; and we combined Groups 1, 2, and 3). We also compared Group 1 with all the other four groups combined, and we combined Groups 4 and 5. The results of these additional sensitivity analyses were in a similar

direction to the original analysis. The results of the combination of Groups 4 and 5 (RN + RN standby < 24/7, + LPN or + CA night) compared to the combination of the "RN led" groups (1, 2, and 3) was statistically significant: the adjusted risk ratio for inpatient hospital admission was 1.34, 95 per cent CI [1.10, 1.63] (details available from author). Other relationships are described in Tables 5 and 6.

Discussion

This study is the first, to our knowledge, to explore the empirical evidence for the regulatory requirement for a 24/7 RN coverage model in relation to facility risks of inpatient hospital admissions and ED visits after factoring in the staffing intensity of both licensed and unlicensed nurse staffing groups. We found that the risk of inpatient hospital admissions was significantly

Table 6: Relation between 24/7 nurse staffing (RN) coverage and ED visit rates among Saskatchewan LTC facilities from 2007/08 to 2009/10

Nurse Staffing Coverage Groups	Assessments with ED Visits[a] %	Original Analysis Adjusted[b] RR [95% CI]	Sensitivity Analyses			
			Redefined Threshold for Coverage within 10%[c] Adjusted[b] RR [95% CI]	Excluded Inconsistent MDS Data[d] Adjusted[b] RR [95% CI]	Adjusted for DNR and Excluded DNH[e] Adjusted[b] RR [95% CI]	Included Full MDS Assessments Only[f] Adjusted[b] RR [95% CI]
(1) RN ≥ 24/7	4.2	1.00	1.00	1.00	1.00	1.00
(2) RN + RN standby ≥ 24/7, + LPN night	5.0	1.23 [0.81, 1.87]	1.26 [0.88, 1.81]	1.25 [0.82, 1.91]	1.20 [0.79, 1.83]	1.23 [0.81, 1.87]
(3) RN + RN standby ≥ 24/7, + CA night	3.5	1.02 [0.60, 1.73]	1.13 [0.68, 1.89]	1.24 [0.68, 2.25]	1.02 [0.60, 1.73]	1.02 [0.60, 1.72]
(4) RN + RN standby < 24/7, + LPN night	4.3	1.00 [0.72, 1.39]	1.15 [0.82, 1.62]	1.04 [0.74, 1.47]	0.99 [0.72, 1.37]	1.00 [0.72, 1.39]
(5) RN + RN standby < 24/7, + CA night	3.8	1.11 [0.78, 1.58]	0.93 [0.58, 1.50]	1.15 [0.79, 1.69]	1.07 [0.75, 1.53]	1.14 [0.80, 1.62]

RN = registered nurse; LTC = Long-term care; RR = relative risk; CI = confidence interval; MDS = Minimum Data Set; DNR = do not resuscitate; DNH = do not hospitalize; LPN = licensed practical nurse; CA = care aide; hprd = hours per resident day; ADL = activities of daily living; CHESS = Changes in Health, End-stage disease, and Signs and Symptoms; CHF = Congestive Heart Failure; CPS = Cognitive Performance Scale; COPD = chronic obstructive pulmonary disease.

[a] ED visits resulting in a hospital admission were not counted as an ED visit so these outcomes are mutually exclusive.

[b] Models adjusted for: Facility RN, LPN, CA staffing intensity (hprd), facility ownership, total number of beds, average age, proportion female, average ADL long score, average CHESS score, average CPS score, proportion with diabetes, proportion with high medication, proportion with CHF, and proportion with COPD.

[c] Redefined a shift being covered as within 10 per cent of the 2,920-hour threshold.

[d] Facilities were excluded if they had inconsistent MDS data submissions, determined by the presence of at least two of the three inconsistency criteria in a given year. See the "Methods" section of this article for further details.

[e] Adjusted for the proportion of assessments that had a "do not resuscitate" order and excluded assessments with a "do not hospitalize" order.

[f] Only full MDS assessments used to approximate risk profile of residents in model adjustment.

higher (by 46%) in facilities with less than 24/7 RN coverage and where night-shift coverage was attained with a combination of RN and CA on-site hours (Group 5). One possible mechanism for the observed statistically significant increase in inpatient hospital admissions may be that CAs are less confident in dealing with health crises arising on the night shift when there is less trained nursing staff present. Training CAs in clinical skills and leadership roles beyond those they are currently trained for, combined with stronger decision support for this staffing group, was seen as a high priority in recent focus group research conducted among human resource experts in home and community care (Berta, Laporte, Deber, Baumann, & Gamble, 2013).

Although not statistically significant, for the other night staffing models, relative risks were, for the most part, greater than one in facilities with less than 24/7

RN coverage compared to facilities that had a 24/7 on-site RN presence. While these results need to be interpreted with caution, they suggest there may be some empirical evidence to support 24/7 RN on-site presence in LTC facilities.

There are a number of hypothesized mechanisms for this protective effect. First, it is possible that the 24/7 on-site presence of an RN allows for greater capacity to detect signs of illness earlier on in the course of the illness, thereby allowing earlier intervention to avert a transfer to hospital (Shanley et al., 2011). It is also possible that the 24/7 presence of an RN enables facilities to manage acute illness in the facility with a greater degree of confidence (Arendts et al., 2010; Ouslander et al., 2010). Finally, it is possible that RNs, by virtue of their training, are more confident in communicating with facility physicians when a resident is ill and a physician assessment is required (Young, Barhydt,

Broderick, Colello, & Hannan, 2010; Young, Inamdar, Dichter, Kilburn, & Hannan, 2011), thereby averting a transfer to hospital.

The finding that 7.4 per cent of facilities had one or more 90-day inpatient hospital admissions reported on full assessment (excluding the first assessment) is higher compared to 2011/12 statistics from British Columbia, Alberta, Manitoba, and Ontario, where this figure ranged from 4.0 per cent to 5.6 per cent. However, the 4.4 per cent rate of Saskatchewan facilities having one or more ED visits reported on full assessments (excluding the first assessment) is slightly lower than the range of rates observed in these four provinces: 5.0 per cent to 6.3 per cent (J. Poss, personal communication, December 1, 2014).

Although reduced inpatient hospital and ED visit use for this population is only one measure of nursing home care quality, this outcome is important for a number of reasons. First, the nursing home population is arguably one of the frailest populations that, except in specific circumstances, has little to gain and may be harmed from exposure to acute care services (Sloan, 2009). Research has documented an increased risk of infection (Quach et al., 2012), pressure ulcers (Allman et al., 1986), deconditioning, delirium, and iatrogenesis (Potts et al., 1993; Gillick et al., 1982) associated with inpatient hospital admission of frail seniors. Furthermore, concerns about patient dignity (Mah, 2009) and ED overcrowding (Harnett, 2012; Kramberger, 2012) are highly relevant for this group whose average life expectancy after admission to long-term care (as measured by length of stay), has declined dramatically over the past 20 years (Menec et al., 2002).

We chose inpatient hospital admissions and ED visits as indicators in this particular study first because these outcomes may logically be influenced by 24/7 RN availability. When a resident falls ill or is injured in an LTC facility, the decision to transfer to hospital requires clinical assessment and nursing skills developed through the type of training received by RNs.

Second, inpatient hospital admissions and ED visits, unlike other outcome measures, may be more objectively measurable (e.g., the resident was hospitalized or not) and are thus less subject to reporting imprecision or bias. Measures, such as pressure ulcer incidence and the prevalence of pain, have a potential for bias through the differences in nurses' assessment practices (Mor et al., 2003).

Although there is no literature that specifically examines 24/7 RN coverage in relation to these outcomes, prior research has shown the sensitivity of acute services use (inpatient hospital admissions and ED visits) to RN staffing intensity (Carter & Porell, 2005; Horn

et al., 2005; McGregor et al., 2014; Xing et al., 2013) and RN staffing ratios (Intrator, Zinn, & Mor, 2004; Kim, Harrington, & Greene, 2009). Lower rates of hospital admissions have also been found to be associated with the presence of nurse practitioners (Carter & Porell, 2005; Intrator et al., 1999; Xing et al., 2013). Moreover, U.S. expert panel members were of the opinion that RNs providing care (versus an LPN or CA) would have been very or somewhat helpful in preventing potentially avoidable hospital admissions (Ouslander et al., 2010). Likewise, Australian LTC Nurse Managers reported that nursing homes with RNs available 24/7 were "more likely to keep the resident in the facility and try some preliminary treatment while they wait for a medical visit, rather than send them straight to hospital" (Shanley et al., 2011, p. 2901). A recent interview study of LTC caregivers also revealed a concern that inadequate staffing intensity and staffing mix, particularly at night, compromised the capacity of staff to make the right decision regarding ED transfers (Arendts et al., 2010). It is, therefore, reasonable to hypothesize that the presence of an RN on-site 24/7, even after controlling for the hours per resident day (intensity) of RNs, LPNs, and CAs working in the facility, may have an impact on residents' risk of inpatient hospital admission and ED visits.

We found that most of the adjusted relative risks associated with less than 24/7 RN coverage inpatient hospital admission and ED visits were greater than one; consistent with the hypothesized direction of the effect. However, the magnitude of this effect was not large and in most cases failed to reach statistical significance. There are several possible reasons for this. First, our analysis was done at a facility level which is likely to reduce the power of the analysis. Second, the data are observational and therefore subject to unintended bias and confounding that may result in a "watering down" of the effect. For example, if there is systematic admission of sicker residents to facilities with 24/7 RN coverage, then the "protective effect" of this characteristic may be diluted by the greater frequency of inpatient hospital admission simply because of the higher acuity of residents, despite our best attempts to control for this. Third, our outcomes (inpatient hospital admissions and ED visits) were based on the subset of data for which a completed assessment was available only after residents had lived in the facility for a full 12 months.

Given that most inpatient hospital admissions for this population occur in the first six months of admission (Doupe et al., 2006) and many of the most unstable patients may have died before the 12-month assessment date, the subset of survivors and/or more stable patients on which our analysis is based may contribute to an underestimation of the observed effect. Finally, our

operationalization of coverage as defined by 2,920 hours does not necessarily mean that all shifts were actually covered. While total numbers of hours for the year were reported for each shift type, information on how the hours were distributed each day of the year was not available so it is not possible to determine if, for example, one shift had two RNs working while another shift had none. Moreover, the night-shift coverage categories did not distinguish the extent to which the night shift was covered by the non-RN nurse staff category and/or shared with an RN, allowing for considerable within-group variation and thereby potentially reducing the magnitude of the expected effect.

Although most of the facilities in our study fit into groups that either had or did not have a 24/7 RN coverage, a small number of facilities had a "hybrid" model of 24/7 coverage whereby the RN coverage did not meet the criteria for 2,920 worked hours per year on all shifts except when RN standby hours was added to RN coverage. In these models, relative risks were below one for inpatient hospital admissions and above one for ED visits. None of the effect estimates were statistically significant.

These results are difficult to interpret. First, standby hours are the number of hours paid to an RN to "carry the pager" and be available to show up at a moment's notice. They do not reflect the number of worked hours. We therefore have no way of knowing how often these standby RNs were actually called to go in to work, under what circumstances, and for how long. It is possible these facilities are able to use standby RNs to mitigate the absence of a 24/7 on-site presence by being available to work during high needs times when staff is sick, there is a facility outbreak, or other periods when facilities experience a high volume of new admissions. Even if we assume that "standby RNs" is not a marker for some other mechanism "protective" of hospitalization but rather a true effect, the deployment of standby RNs still poses the facility challenge of finding enough RNs, whether to come in to work or to be on standby. This perceived RN shortage, at least in the province of Saskatchewan, is one important rationale for the commissioned report on which this study was based.

Beyond the limitations described earlier, the study has a number of other limitations. First, our study did not factor in the facility distance to hospital and the rural/urban location of facilities. Prior research has demonstrated an association of these factors with acute services use (Levy, Fish, & Kramer, 2004). Second, the payroll data obtained from Saskatchewan Association of Health Organizations (SAHO) did not include the facility managers' hours of work, length of service, or information on their qualifications (i.e., whether they were RNs, or social workers, etc.). Prior research has found an association between LTC management staff and other measures of facility quality (Castle 2001; Castle & Lin, 2010). It is possible the variation in their role and presence may likewise influence inpatient hospital admissions and ED visits.

Third, we were not able to explore whether facilities have different protocols for a decision to transfer to hospital in the absence of RNs and whether such features have an impact. Fourth, there are a number of other facility-level characteristics that prior research has found to influence quality and that the current study was unable to measure. Facility team functioning (Barry, Brannon, & Mor, 2005; Rantz et al., 2004), physician access and continuity of care (Intrator et al., 1999; McGregor et al., 2011; McGregor et al., 2014), the presence of specialized nursing staff and other allied health professionals (Carter & Porell, 2005; Intrator et al., 1999; McGregor et al., 2014; Xing et al., 2013), and facility use of advanced directives (Levy et al., 2004; Molloy et al., 2000) have all been found to influence acute hospital use and/or broader measures of facility care quality. Further research into the relative importance of these factors would be an important line of future research.

Fifth, it should be noted that the mean staffing intensity of 3.89 total worked hprd in Saskatchewan facilities is relatively high compared to some jurisdictions. An Ontario study reported direct care staff hours consistently below 3.0 hprd (Berta, Laporte, & Valdmanis, 2005), and in British Columbia, with the exception of health-region owned and hospital-based facilities, total direct nurse staffing levels in 2006 were below 3.0 hprd (McGregor et al., 2010). It is likely that staff intensity interacts with RN coverage, which is something we did not explore in the current study and that may limit generalization of our findings.

A further limitation is the small sample size, especially of the second and third categories of staff coverage. However, although this may result in a failure of the models to reach statistical significance, it should not change the noted direction of the effect estimates.

Finally, it should be noted that care quality is multidimensional and acute service use is only one measure of this. Although the literature has examined structural, process, and outcome measures (Donabedian, 1966, 1988), no one measure is able to sum overall quality, and good performance in one dimension is not necessarily correlated with performance in another (Castle & Ferguson, 2010; Mor et al., 2003). Moreover, arguably the most important measure – resident- and family-reported experience of care and outcomes – is still not a routine part of care quality evaluation (Kane et al., 2003; Ramage-Morin, 2006).

Despite these limitations, to our knowledge this is the first study that attempts to examine whether there is empirical evidence to support the 24/7 RN coverage regulation currently present in some jurisdictions. Findings suggest that acute services utilization may be negatively influenced by the absence of 24/7 RN coverage especially when night shift coverage is attained through a combination of RN and CA hours. Further studies are necessary before drawing any conclusions about this staffing policy requirement one way or another.

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