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ORIGINAL RESEARCH

Rural/urban differences in health care utilization and place of death for persons with respiratory illness in the last year of life

D Goodridge[1], J Lawson[2], D Rennie[2], D Marciniuk[3]

[1]*College of Nursing, University of Saskatchewan, Saskatoon, Saskatchewan, Canada*

[2]*Canadian Centre for Health and Safety in Agriculture, University of Saskatchewan, Saskatoon, Saskatchewan, Canada*

[3]*College of Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada*

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Goodridge D, Lawson J, Rennie D, Marciniuk D

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ABSTRACT

Introduction: Respiratory illness is a leading cause of death worldwide, with rates that will continue to escalate into the foreseeable future. Rural residents have an increased risk of dying from some forms of respiratory disease, although little is known about the healthcare utilization or location of death for persons with advanced respiratory illness in rural settings. The purpose of this study was to examine rural–urban differences in healthcare utilization and location of death for residents of Saskatchewan, Canada, with chronic obstructive pulmonary disease (COPD) or lung cancer in the last 12 months of life.

Methods: A retrospective cohort study was undertaken of 1098 patients who died in 2004 with a cause of death recorded as COPD or lung cancer in administrative health data from Saskatchewan Health. Decedents were classified as residents of rural/remote (≤9,999 population size), small urban or urban (≥100 000) locations and analysis conducted using this primary variable of interest. Comparisons were made between the three groups in terms of demographic characteristics, healthcare utilization (physician visits, length of stay, hospitalizations, institutional care, home care, transitions between care settings) and location of death (hospital, long-term care [LTC] or home).

Results: The study population was 57% male with a mean age of 77 years (SD=11). Demographic characteristics, underlying cause of death and number of comorbid conditions were similar between urban, small urban and rural/remote groups. After

adjustment for area of residence, underlying cause of death (UCOD), age group, sex, marital status, and comorbidity, urban, small urban and rural/remote residents were comparable in terms of the likelihood of: any hospitalizations, having had 5 or more transfers between settings, and dying in hospital. The proportion of home deaths in rural settings was 15.4%, and was comparable to the rate in urban settings (16.3%). Urban residents were more likely to have had 24 or more physician visits in the last year of life compared with small urban (OR=0.52, 95% CI=.37-.74) or rural/remote residents (OR=0.52, 95% CI=.40-.69), while rural/remote residents were more likely to have received any institutional LTC (OR=1.40, 95% CI=1.03-1.90) than the other groups. Hospital as a location of death was more likely for those with a UCOD of cardiovascular disease (OR=1.84, 95% CI=1.24-2.71), but was less likely for those aged 80-85 years (OR=0.46, 95% CI=.31-.69), those aged more than 85 years (OR=0.28, 95% CI=.19-.42) and those who had never married (OR=0.48, 95% CI=.29-.78). Residents of rural/remote areas were significantly less likely than those in urban or small urban settings to receive any home care (OR=0.74, 95% CI=.56-.97), any home palliative care (OR=0.29, 95% CI=.19-.45) or home physiotherapy services (OR=0.09, 95% CI=.03-.25). Rural/remote residents were, however, much more likely to receive home supportive care (OR=1.60, 95% CI=1.17-2.19) and home meal preparation (OR=2.51, 95% CI=1.44-4.39).

Conclusions: While the healthcare needs of persons with respiratory illness in the last year of life were likely to be similar between locations, rural-urban differences were apparent in the number of primary care physician visits and in access to and the nature of home care services provided. Significantly fewer physician visits were made by residents of small urban or rural remote locations compared with those in urban settings, although additional research is needed to determine the reasons for this discrepancy. The likelihood of receiving home care services and professional home care services such as palliative care and physiotherapy was significantly lower for persons in rural/remote locations. The challenges experienced by rural remote regions with supporting patients in the community may have led to the increased likelihood of admission to institutional LTC noted for this group compared with residents of urban and small urban settings. The low home death rates is both urban and rural settings may pose particular hardship for rural families who may need to travel extensively or temporarily relocate to be closer to the hospital where their loved one is dying. Further investigation of issues related to differences in quality of care and unmet health care needs between rural and non-rural settings will strengthen the evidence base to allow equitable care at the end of life.

Key words: end of life care, health care utilization, respiratory illness.

Introduction

Respiratory illness is a leading cause of death worldwide, with rates that will continue to escalate into the foreseeable future[1,2]. Rural residents have an increased risk of dying from some forms of respiratory disease, such as chronic obstructive pulmonary disease (COPD), compared with their urban counterparts[3]. The manner in which individuals interface with the healthcare system can provide insight into the quality of care they receive[4-7], although little is known about the healthcare utilization or location of death for persons with advanced respiratory illness. Equitable access to quality healthcare services for rural residents with advanced respiratory illness will require the development of a sound evidence base. The purpose of this study was to examine rural-urban differences in healthcare utilization and location of death for persons with COPD or lung cancer in the last 12 months of life.

Background

Over 4 million people died worldwide as a result of lung disease in 2002[1] and this number is projected to increase significantly as the impact of illnesses such as COPD and lung cancer continues to increase. In terms of contribution to global health burden, COPD will assume the position of fifth ranked contributor in 2020[8]. Chronic obstructive pulmonary

disease is a chronic and progressive respiratory illness, largely the result of smoking, that causes shortness of breath and activity limitation[2]. Globally and within Canada, rates of smoking in rural areas have consistently been reported to be higher than rates in urban areas[9-12], placing rural populations at higher risk for COPD. Patients with advanced COPD typically have significant interface with the healthcare system, averaging between one and 4 exacerbations per year, accounting for a high number of emergency room visits and being at substantial risk of re-admission to hospital and subsequent poor quality of life[2,13]. Lung cancer remains the most common cancer worldwide, with 1.2 million new cases diagnosed annually and accounting for 17.8% of all cancer deaths[14]. These data affirm the need to ensure that high quality end of life care is available for all individuals with advanced respiratory disease in the coming years.

Respiratory-related mortality tends to increase with increasing rurality among both men and women[3]. There were 47 deaths per 100 000 among men aged 45 to 64 years in the most rural areas (no commuters) compared with 33 deaths per 100 000 in urban areas, representing a 42% higher risk of death. However, the age-standardized mortality rate was lowest among men living in areas with moderate commuter flow (28 per 100 000)[3], suggesting that the gradient of effect is not stepwise, that is, the most rural and the most urban areas often have higher rates of adverse health effects[15]. Failure to account for degrees of rurality may explain discrepancies in reports of the relationship between residence and lung cancer, with one study reporting a lower prevalence of lung cancer for rural residents[16] and another reporting a higher prevalence for this group[3].

While there is increasing recognition of the ability of population-based indicators available from administrative databases to indirectly measure the quality of end of life care for people with cancer[4-7], there has been little work undertaken to identify potential quality indicators for those who die from chronic illness such as COPD. Analysis of indicators such as physician visits, hospitalizations, continuity of care measures (such as the number of care transitions between settings) and location of death are helpful in examining patterns of healthcare utilization near the end of life[4-6]. Location of death has been used as an indicator of quality of end of life care, given that home death is favored by the majority of terminally ill patients, caregivers, health professionals and the general public[17-19]. Transfers from home to hospital have been considered an indicator of potentially inappropriate care in the last days of life. Recent work examining transfers to hospital at the end of life by Menec and colleagues[20] reported that residents of rural and remote regions of Manitoba, Canada, with lower physician availability and fewer hospital beds had an increased risk of being hospitalized, suggesting that some rural and remote regions were disadvantaged in terms of access to appropriate care at the end of life.

In terms of overall healthcare access and utilization by rural residents, much of the research is inconclusive[21]. A number of studies have found no differences between rural and urban residents in use of physician services, hospitalization rates[22,23], unmet healthcare needs, number of days required to obtain appointments[24]. Rural residents were more likely than those in urban areas to have a usual source of primary care, but reported fewer visits to healthcare providers[25]. Fewer home care days were provided to residents of remote areas than metropolitan and other nonmetropolitan locations[26].

Laditka and colleagues[27] reported that increasing levels of rurality may be positively associated with hospitalizations for ambulatory-care sensitive conditions (ACSC) and concluded this may represent rural-urban disparities in access to primary health care. The ACSC are conditions, including COPD, can be potentially managed and controlled in community settings, possibly avoiding hospital admission[28]. Hospital admission rates for COPD in Australia were found to be higher in rural than metropolitan areas and were associated with socioeconomic status, smoking rates and remoteness of the area[29]. The concept of 'distance decay', or decreasing utilization of health services with increasing distance of patients from hospital, may be useful in analysis of healthcare use[30].

The purpose of this study was to examine rural-urban differences in healthcare utilization and location of death for persons with COPD or lung cancer in the last 12 months of life using administrative health data.

Methods

Study population and design

This retrospective study within the province of Saskatchewan, Canada (approximately 1 000 000 population) used Saskatchewan Health administrative databases to identify subjects who had either lung cancer (ICD-10 code C34.x) as the underlying cause of death (UCOD) or COPD (ICD-10 code J44.x) as either the UCOD or multiple cause of death (MCOD) and died in 2004. The index date was the date of death. Data related to home care, institutional care, outpatient physician visits, and hospitalizations as well as potential confounders were obtained from the Saskatchewan Health databases. These comprehensive databases[31] have been used successfully to conduct large previous epidemiological studies of respiratory health[32-34]. This study was approved by the University of Saskatchewan Biomedical Research Ethics Board.

Saskatchewan Health databases

Universal health care is provided by Saskatchewan Health to the majority of Saskatchewan residents (approximately 99%) with exceptions being persons insured by the federal government (federal inmates, Royal Canadian Mounted Police and Canadian Forces personnel). The provincial drug plan does not cover Registered Indians, because they receive prescription drug benefits from the federal government, so this population has been excluded from the present study.

Unique identifiers for each individual covered by Saskatchewan Health can be used to link the various databases. Prior to receiving the data from Saskatchewan Health, the unique identifier was de-identified. Saskatchewan Health provided the following databases: subject file, physician services file, physician visits file, hospital services file, home care file, institutional supportive care file and the vital statistics death file.

The subject file contains information regarding demographic variables including sex, year of birth, marital status, area of residence and dates of coverage. The physician services file includes dates of all physician services and fee-for-service codes (FSCs) for FSCs of interest, while the physician visits file includes the date of the visit, diagnosis, location of service and the approved payment amount for a visit. Dates of admission and discharge, diagnoses and diagnoses types, and procedures of interest undertaken during hospitalization are contained within the hospitalization services file.

The home care file includes dates of admission to and discharge from home care, months eligible for services, amount of time spent on specific types of home care duties and costs associated with home care. The definitions of home care were taken from the home care file (Fig1). Although healthcare coverage is considered universal, clients do pay fees for home care services. Saskatchewan home care clients paid user fees of $6.25-$6.36 per service for the first 10 units of services per month in 2004, with the remainder of fees assessed based on income to an annual maximum of $375-383[35]. No fee for home care services is charged to clients receiving palliative care.

The institutional supportive care home file includes dates of admission and discharge, program (long term care [LTC], temporary care), purpose of temporary care, level of care and type of facility. Funding to cover approximately 77% of overall LTC costs is provided by Saskatchewan Health, although an income-tested resident charge is applied[36]. Finally, the vital statistics file includes the date of death, UCOD and MCODs as well as the decedent's residence at the time of death (rural or urban). The independent variable of primary interest was the three-level variable indicating rural/remote (≤9999 population size), small urban or urban (≥100,000) where the urban group was considered the reference group.

Palliative: service provision to clients to improve quality of their remaining life, and for whom cure and prolongation of life are no longer appropriate objectives. Services address the physical, psychosocial and spiritual needs of the terminally ill and their families.
Acute: service provisions to clients who have experienced a health compromise, which is acute in nature and where full recovery and functionality is anticipated over a relatively short period of time.
Supportive: service provisions to clients who have experienced a health compromise, which is longer term in nature, where it is anticipated that the client will require services over a relatively long period of time.
Other home care: may include home maintenance, volunteer programs and any other service the health authority deems appropriate.
Personal home care: provision of personal care such as bathing by non-professional providers in the absence of requirements for other care.
Home care personal nursing: provision of personal care such as bathing by professional nurses in the absence of requirements for other care.

Figure 1: Definitions of home care services.

Statistical analysis

Prior to analysis, several variables including the number of physician visits, number of hospitalizations and hospitalization length of stay (LOS) were categorized because of a skewed distribution. These variables were dichotomized based on evidence from the literature[37] and medians calculated from the present data. The number of physician visits were classified as >24 visits or ≤24 visits in the year representing an average of 2 outpatient visits per month. The number of hospitalizations was categorized as >2 or ≤2 hospitalizations in a year while the mean LOS was categorized as >7 days or ≤7 days representing a full week in hospital. Because it is well-recognized that comorbidities such as cardiovascular disease are often listed on death certificates as the primary cause of death for those with advanced COPD[38], UCOD categories included lung cancer, COPD, cardiovascular disease and other conditions, comorbid conditions were classified based on the number of conditions as >1 or ≤1 based on the presence or absence of disease conditions included in the UCOD or MCOD. The number of transfers (discharge from one healthcare institution and same day admission to another) between healthcare settings as classified as <5 or ≥5.

Statistical analysis was completed using SPSS 16.0 (SPSS Inc; Chicago, IL, USA; www.spss.com), with the level of significance (σ) set at 0.05. Descriptive analyses included reporting the mean and standard deviations (SD), medians and inter-quartile range (IQR), and counts and proportions where appropriate. Comparisons between the three groups in terms of demographics and healthcare utilization were completed using analysis of variance (ANOVA) with Scheffe post-hoc tests and χ^2 tests of proportion where appropriate. In situations where the assumptions for these tests were not met, the Kruskal Wallis test (with multiple Mann-Whitney tests adjusted with Bonferroni corrections for post hoc analysis) and Fisher's exact tests were used, respectively.

Associations between residence and specific healthcare utilization outcomes were assessed using multivariate logistic regression. The strength of association was measured by the odds ratio (OR) and 95% confidence intervals (CI). Healthcare utilization outcomes of interest included the following binary variables (yes/no): >24 physician visits, any hospitalization, any institutional care, any long term institutional care, any temporary institutional care, any home care, home care services for previous 12 months, palliative home care, 5 or more transitions between care settings, hospital as place of death, LTC institution as place of death, home as place of death, and length of stay (LOS). Interaction terms of clinical importance were assessed and when significant, a stratified analysis was completed.

Results

De-identified data were obtained for 1098 beneficiaries of Saskatchewan Health eligible for prescription drug benefits who had been identified as having either lung cancer (*n*=483) as their UCOD or COPD (*n*=615) as their UCOD or MCOD cause of death. Chronic obstructive pulmonary disease was identified as the UCOD for 287 persons (47.7%). Sixty-three decedents had diagnoses of both lung cancer and COPD, leaving 433 with lung cancer only and 602 with COPD only. All cases are reported in this article.

The average age of decedents was 77 years (SD=11 years) and just over half (57%) were male. Most of the population were married or lived common-law (45.5%) and had more than one comorbid condition (52.2%). All decedents with lung cancer had this diagnosis as their UCOD, while the decedents who died with a diagnosis of COPD had UCODs attributed to COPD, cardiovascular disease or another diagnosis. Demographic characteristics, underlying cause of death and number of comorbid conditions were similar between urban, small urban and rural/remote groups (Table 1).

In terms of healthcare utilization in the year prior to death, a number of statistically significant differences among urban, small urban and rural/remote groups emerged (Table 2). Higher proportions of urban residents had 24 or more physician visits within the past 12 months, compared with both small urban and rural/remote counterparts, although urban residents made less use of temporary care than the other groups. While the proportions of persons receiving any home care were similar between the areas of residence in the crude analysis, decedents in rural/remote areas received proportionately more home care of a year's duration than either urban or small urban groups. The number of care transitions between healthcare settings and the place of death were similar for urban, small urban and rural/remote decedents. Hospitals were the most common location of death across all three groups. Home deaths accounted for less than one-fifth of all deaths and were consistent between the groups.

Table 3 provides the bivariate analyses of the specific home care services received by decedents in each of the areas of residence. Significantly higher proportions of urban residents received palliative home care and physiotherapy services than either small urban or rural/remote residents, while significantly lower proportions of urban residents received supportive services and meal preparation than rural/remote residents. Personal nursing service was received by very few urban residents in comparison to either semi-urban or rural/remote residents.

After adjustment for UCOD, age group, sex, marital status, and comorbidity (Table 4), urban, small urban and rural/remote residents were comparable in terms of the likelihood of: any hospitalizations, having had 5 or more transfers between settings, and dying in hospital. Urban residents were more likely to have had 24 or more physician visits in the last year of life compared with small urban (OR=0.52, 95% CI=.37-.74) or rural/remote residents (OR=0.52, 95% CI=.40-.69), while rural/remote residents were more likely to have received any institutional LTC (OR=1.40, 95% CI=1.03-1.90) than the other groups.

Hospital as a location of death was more likely for those with a UCOD of cardiovascular disease (OR=1.84, 95% CI=1.24-2.71), but was less likely for those aged 80-85 years (OR=0.46, 95% CI=.31-.69), those aged more than 85 years (OR=0.28, 95% CI=.19-.42) and those who had never married (OR=0.48, 95% CI=.29-.78).

Marital status appeared to exert a substantial and independent effect on several types of healthcare utilization. Widowed persons were less likely to have had 24 or more physician visits in the previous 12 months (OR=0.66, 95% CI=.46-.94), while persons who had never married (OR=0.36, 95% CI=.19-.67) or were separated/divorced (OR=0.62, 95% CI=.38-1.00) were less likely to have had any hospitalizations. Married persons had a higher likelihood of having had 5 or more care transitions between settings in

the preceding 12 months than any of the other marital status groups. Separated/divorced persons were more likely to have had any institutional long-term care in the previous year (OR=1.47, 95% CI=1.04-2.08) than persons in the other marital status categories, while persons who had never married were much less likely to die in a hospital setting (OR=0.48, 95% CI=.29-.78).

Multivariate analysis was also conducted to examine the associations with type of home care received (Table 5). Residents of rural/remote areas were significantly less likely than those in urban or small urban settings to receive any home care (OR=0.74, 95% CI=0.56-0.97), any home palliative care (OR=0.29, 95% CI=0.19-0.45) or home physiotherapy services (OR=0.09, 95% CI=0.03-0.25). Rural/remote residents were, however, much more likely to receive home supportive care (OR=1.60, 95% CI=1.17-2.19) and home meal preparation (OR=2.51, 95% CI=1.44-4.39).

Discussion

Our findings demonstrate a number of key differences in health service utilization in the last year of life between persons with respiratory illness living in rural/remote, small urban and urban areas, particularly in terms of physician visits and home care services. Place of death, hospitalizations, and number of care transitions were comparable between the groups.

Hospitals were the place of death for the majority of decedents, regardless of rurality. Only 14.5%–16.3% of all deaths within this study occurred at home, which are lower proportions of home deaths than the 24.3% reported in Flanders[39] and 22% in the US[40]. Given that rural hospitals are often located a significant distance from the patient's home, families of rural residents who die in a hospital may experience a disproportionate burden compared with families in urban settings. Rural families may need to relocate and live in temporary accommodation close to the hospital (often for a protracted period of time) and may experience associated financial burden of accommodations and lost employment income. In addition, the absence of usual social supports in this new environment can represent significant hardships to the families of rural patients who are dying.

Persons residing in rural/remote and small urban settings were significantly less likely than those in urban areas to have a high number of physician visits (24 or more over 12 months), in spite of the fact that their healthcare needs during the last year of life were likely quite similar. There may be several possibilities that help to account for the difference in number of physician visits. One may be Laditka and colleagues'[27] assertion that there is a disparity between rural and urban settings in terms of the primary care services available. A second possibility is that there is a differential perception of need and a reduced expectation for primary care among rural residents[41,42]. Higher levels of community support in rural settings[43,44] and rural residents' personal traits of self-reliance and independence[45] may also have played a role in reducing the number of physician visits. Access may also be influenced by the ability of older, sicker people to get to the physician, depending on their degree of isolation.

The likelihood of receiving home care, and in particular, specialized services such as palliative care or physiotherapy, was significantly lower for persons in rural/remote areas. Because non-professional home care services such as supportive care and meal preparation were used by a much higher proportion of rural/remote residents compared with small urban and urban residents, proximity to providers per se does not appear to be the primary limiting factor. Physiotherapists and palliative care specialists did not appear to be widely available in the rural/remote areas. Interestingly, urban residents had a much lower likelihood of receiving personal care from a professional nurse than residents in the other two settings. The reason underlying this resource allocation discrepancy between settings is not clear, although it can be speculated that it is the result of distance. Nurses may have been more proximate to clients requiring personal care than non-professional staff and were thus assigned to provide this care. Difficulty recruiting and

retaining professional healthcare providers has been a key barrier to delivery of quality palliative care in rural areas noted internationally[46,47]. Future mixed methods research might examine whether there are differences in the quality of end of life care or subjective perceptions of unmet needs between rural/remote and other settings given the variation in physician visits and differing nature of home care service provided.

Lengths of stay in hospital, number of hospitalizations, number of transfers and location of death were similar across rural/remote, semi-urban and urban settings, suggesting some similarity in end of life care management approaches for respiratory patients with advanced illness. More than half of the deaths of persons with respiratory illness still occurred in hospitals, regardless of area of residence, suggesting there may be quality improvement opportunities in facilitating desired home deaths in all settings. The burden on families that is associated with hospital death may be more onerous than that experienced by urban families who are geographically closer to the hospital. Similarly, close to half of the decedents underwent 5 or more care setting transitions in the last 12 months of life. In the absence of contextual data, these transitions may have been appropriate, although the risks previously discussed bear consideration. Our findings did not support the notion of 'distance decay', in which there is decreasing utilization of health services with increasing distance of patients from hospital.

Strengths and limitations

The strengths of this study included access to 12 months of healthcare data for an entire cohort of decedents in a geographically large and diverse province in 2004, including acute care and home care. The data includes a relatively large number of rural residents. The dataset was robust, with little missing data, and captured care that occurred across multiple settings, thus reflecting the broad nature of treatments provided and care received.

The constraints inherent in using an administrative database, such as potential inaccuracy of coding and lack of contextual detail, were a limitation of this study. The administrative data represent one Canadian province only and regional variation in practice may affect the generalizability of the findings. Further, the data analyzed in this report did not allow for assessment of the quality of life, or the appropriateness and adequacy of care for those who died with respiratory illness.

Conclusion

For persons with respiratory illness in the last year of life, rural-urban differences were apparent in the number of primary care physician visits and in access to and nature of home care services provided. Significantly fewer physician visits were made by residents of small urban or rural remote locations compared with those in urban settings, although additional research is needed to determine the reasons for this discrepancy. From a health systems perspective, the discrepancy in number of physician visits between locations suggests the need to compare health outcomes and patient satisfaction with care between the groups. For example, if outcomes were similar, perhaps fewer physician visits but additional supports for patients at the end of life might result in both cost savings and increased satisfaction.

The likelihood of receiving home care services and specialized home care services such as palliative care and physiotherapy were significantly lower for persons in rural/remote locations. The reduced ability to support patients in their homes may have led to the increased likelihood of admission to institutional LTC noted for the rural remote residents compared with urban and small urban groups.

Table 1: Demographic characteristics, underlying cause of death and comorbidity by area of residence (percentage)

Characteristic	Area of residence		
	Urban (≥100 000) *n*=423	**Small urban (10 000–99 999) *n*=207**	**Rural/remote (≤9999) *n*=468**
Age group (years)			
≤70	22.7	24.6	23.7
71–79	33.6	21.3	29.9
80–85	22.5	26.1	20.1
>85	21.3	28.0	26.3
Sex			
Male	56.3	58.9	59.6
Female	43.7	41.1	40.4
Marital status			
Married/common-law	44.4	44.4	47.0
Never married	5.9	7.7	9.8
Separated/divorced	29.3	29.5	22.6
Widowed	20.3	18.4	20.5
Underlying cause of death			
Lung cancer	46.6	44.0	41.7
COPD	24.1	28.0	28.2
Cardiovascular disease	17.7	14.5	18.6
Other	11.6	13.5	11.5
Co-morbidity conditions			
0–1	45.4	49.3	49.1
≥2	54.6	50.7	50.9

COPD, Chronic obstructive pulmonary disease.

Table 2: Healthcare utilization in the last year of life by area of residence

Health care	Area of residence		
	Urban (≥100 000) *n*=423	**Small urban (10 000–99 999) *n*=207**	**Rural/remote (≤9999) *n*=468**
Physician visits			
Median number (IQR)	32 (25)	25 (24)	25 (22)
% with >24	67.8*†	47.8	48.3
Hospitalization			
Median average LOS (IQR)	6.5 (9.5)	6.6 (3.02)	6.0 (7)
% with mean LOS>7 days	46.1	45.9	39.7
Median total LOS (IQR)	17.0 (29)	18.0 (32)	17 (30.5)
% with any	86.8	81.2	87.6
% with >2	41.1	39.1	46.6
Institutional care			
% with any	34.3	39.6	41.7
% with LTC	28.1	31.4	27.6
% with temporary	8.7*	15.5	22.6
Care transitions			
% with ≥5	44.4	43.0	49.6
Home care			
% with any	56	53.1	48.1
% with 1 year of	15.8†	17.9‡	24.8
% palliative care	25.5*†	18.4‡	10.9

Table 2 Cont'd

Health care	Area of residence		
	Urban (≥100 000) *n*=423	**Small urban (10 000–99 999) *n*=207**	**Rural/remote (≤9999) *n*=468**
Place of death			
Hospital	57.4	54.1	59
LTC institution	26.2	31.4	25.6
Home	16.3	14.5	15.4

IQR, Inter-quartile range; LOS, length of stay; LTC, long term care.
**P*<0.05 between the urban and small urban groups groups using the Chi-square tests for proportions with a Bonferonni correction; †*p*<0.05 between the urban and rural/remote groups using the Chi-square tests for proportions with a Bonferonni correction; ‡*p*<0.05 between the small urban and rural/remote groups using the Chi-square tests for proportions with a Bonferonni correction.

Table 3: Receipt of specific home care services in the last year of life by area of residence

Home care service	Area of residence		
	Urban (≥100 000) *n*=423	**Small urban (10 000–99 999) *n*=207**	**Rural/remote (≤9999) *n*=468**
Palliative	25.5*†	18.4‡	10.9
Acute	9.2	9.2	6.8
Supportive	22.9†	26.1	49.8
Meal preparation	4.5†	7.2	10.3
Other	25.1	20.3	18.4
Personal	22.7	23.2	24.1
Physiotherapy	8.5*†	2.9	0.9
Home care personal nursing	0.2*†	15.5	10.7
Home care of any type	56	53.1	39.4

**P*<0.05 between the urban and semi-rural groups using the Chi-square tests for proportions with a Bonferonni correction; †*p*<0.05 between the urban and rural/remote groups using the Chi-square tests for proportions with a Bonferonni correction; ‡ *p*<0.05 between the semi-rural and rural/remote groups using the Chi-square tests for proportions with a Bonferonni correction.

Novel uses of innovative technologies by specialist home care providers need to be investigated to ensure that care at the end of life is equitable for persons dying with respiratory illness in rural/remote areas. This may include designing healthcare services in such a way as to maximize their efficiency and reach in rural areas, and making greater use of telehealth technology. Further investigation of issues related to differences in quality of care and unmet healthcare needs between rural and non-rural settings will strengthen the evidence base to improve care at the end of life.

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Table 4: Multivariate† analysis examining associations between demographic characteristics, underlying cause of death and comorbidity with physician visits, hospitalization and institutional care (*n*=1098)

Characteristic	>24 Physician visits OR (95% CI)	Any hospitalization OR (95% CI)	5 or More transfers OR (95% CI)	Any institutional long term care OR (95% CI)	Death in hospital OR (95% CI)
Area of residence					
Urban	1.00	1.00	1.00	1.00	1.00
Small urban	0.52 (.37-.74)*	0.74 (.46-1.18)	0.99 (.70-1.40)	1.13 (.77-1.66)	.96 (.67-1.38)
Rural/remote	0.52 (.40-.69)*	1.21 (.79 -1.83)	1.29 (.98-1.69)	1.40 (1.03-1.90)*	1.14 (.86-1.52)
Underlying cause of death					
COPD	1.00	1.00	1.00	1.00	1.00
Lung cancer	0.89 (.62-1.24)	1.67 (1.00-2.80)	1.37 (.99-1.89)	0.76 (.53-1.09)	1.08 (.77-1.51)
Cardiovascular	1.04 (.72-1.52)	0.69 (.43-1.11)	0.91 (.62-1.33)	0.71 (.48-1.06)	1.84 (1.24-2.71)*
Other	1.53 (.97-2.43)	0.74 (.42-1.32)	1.15(.70-1.39)	0.95 (.60-1.51)	1.26 (.81-1.97)
Age group (years)					
≤70	1.00	1.00	1.00	1.00	1.00
71–79	0.87 (.69-1.38)	1.02 (.52-2.00)	1.32 (.94-1.86)	1.76 (1.15-2.7)*	1.05 (.72-1.52)
80–85	0.97 (.66-1.42)	0.48 (.25-.90)*	1.27 (.87-1.85)	4.13 (2.64-6.44)*	.46 (.31-.69)*
>85	0.73 (.49-1.08)	0.24 (.13-.46)*	0.76 (.51-1.13)	9.21 (5.78-14.66)*	.28 (.19-.42)*
Sex					
Male	1.00	1.00	1.00	1.00	1.00
Female	1.61 (.89-1.51)	1.01 (.69-1.49)	.88 (.68-1.14)	1.35 (1.01-1.8)*	.89 (.56-1.01)
Marital status					
Married/common-law	1.00	1.00	1.00	1.00	1.00
Never married	0.74 (46-1.19)	0.36 (.19-.67)*	0.59 (.37-.95)*	1.63 (.97-2.73)	.48 (.29-.78)*
Separated/divorced	1.14 (.83-1.57)	0.62 (.38-1.00)*	0.70 (.51-.95)*	1.47 (1.04-2.08)*	.81 (.59-1.12)
Widowed	0.66 (.46-.94)*	0.89 (.53-.150)	0.70 (.49-1.00)*	1.21 (1.21-2.18)	.98 (.68-1.41)
Comorbidity conditions					
0–1	1.00	1.00	1.00	1.00	1.00
2 or more	1.35 (1.04-1.77)*	0.96 (.64-1.43)	1.07 (.82-1.39)	1.62 (1.21-2.18)*	.89 (.68-1.18)

CI, Confidence interval; COPD, chronic obstructive pulmonary disease.

†Adjusted for all the variables in the table.

**P*<0.05.

Table 5: Multivariate† analysis examining associations between demographic characteristics, comorbidity and underlying cause of death with types of home care (*n*=1098)

Characteristic	Type of home care				
	Any OR (95% CI)	Palliative OR (95% CI)	Supportive OR (95% CI)	Meal preparation OR (95% CI)	Physiotherapy OR (95% CI)
Area of residence					
Urban	1.00	1.00	1.00	1.00	1.00
Small urban	0.91 (.65-1.28)	0.62 (.38-1.00)	1.15 (.77-1.72)	1.59 (.79-3.25)	0.31 (.13-.75)*
Rural/remote	0.74 (.56-.97)*	0.29 (.19-.45)*	1.60 (1.17-2.19)*	2.51 (1.44-4.39)*	.09 (.03-.25)*
Underlying cause of death					
COPD	1.00	1.00	1.00	1.00	1.00
Lung cancer	1.61 (1.16-2.22)	23.05 (9.16-58.01)*	0.49 (.37-.70)*	1.23 (.65-2.29)	0.61 (.27-1.36)
Cardiovascular	0.73 (.50-1.07)	0.00	0.77 (.52-1.14)	1.14 (.58-2.24)	0.71 (.30-1.68)
Other	1.26 (.82-1.93)	7.78 (2.66-22.76)*	0.79 (.50-1.25)	1.27 (.59-2.74)	0.56 (.19-1.66)
Age group (years)					
≤70	1.00	1.00	1.00	1.00	1.00
71–79	1.61 (1.13-2.26)*	0.85 (.56-1.31)	2.35 (1.48-3.73)*	0.97 (.47-2.04)	1.79 (.65-4.92)
80–85	1.57 (1.07-2.30)*	0.63 (.37-1.09)	3.25 (2.00-2.57)*	1.69 (.81-3.53)	2.40 (.83-6.95)
>85	1.19 (.80-1.76)	0.39 (.18-.81)*	2.89 (1.76-4.73)*	1.56 (.73-3.30)	1.94 (.62-6.05)
Sex					
Male	1.00	1.00	1.00	1.00	1.00
Female	1.19 (.92-1.54)	1.21 (.82-1.77)	1.15 (.86-1.55)	1.19 (.73-1.93)	2.29 (1.19-4.44)*
Marital status					
Married/common-law	1.00	1.00	1.00	1.00	1.00
Never married	1.08 (.67-1.72)	0.65 (.29-1.27)	1.51 (.90-2.52)	3.36 (1.57-7.21)*	1.23 (.39-3.89)
Separated/divorced	0.67 (.49-.91)*	0.49 (.31-.78)*	1.26 (.88-1.81)	2.37 (1.28-4.37)*	0.55 (.24-1.24)
Widowed	0.79 (.56-1.53)	0.46 (.26-.84)*	1.24 (.84-1.82)	1.89 (.96-3.75)	0.65 (.28-1.53)
Comorbidity condition					
0–1	1.00	1.00	1.00	1.00	1.00 (.69-2.69)
2 or more	.92 (.70-1.20)	.59 (.39-.89)*	1.05 (.78-1.42)	1.25 (.75-2.07)	1.36

CI, confidence interval; COPD, chronic obstructive pulmonary disease.
†Adjusted for all the variables in the table
**P*<0.05.

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