## ORIGINAL RESEARCH

# Regular Primary Care Lowers Hospitalisation Risk and Mortality in Seniors with Chronic Respiratory Diseases

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**BACKGROUND:** Exacerbations in chronic respiratory diseases (CRDs) are sensitive to seasonal variations in exposure to respiratory infectious agents and allergens and patient factors such as non-adherence. Hence, regular general practitioner (GP) contact is likely to be important in order to recognise symptom escalation early and adjust treatment.

**OBJECTIVE:** To examine the association of regularity of GP visits with all-cause mortality and first CRD hospitalisation overall and within groups of pharmacotherapy level in older CRD patients.

**DESIGN:** A retrospective cohort design using linked hospital, mortality, Medicare and pharmaceutical data for participant, exposure and outcome ascertainment. GP visit pattern was measured during the first 3 years of the observation period. Patients were then followed for a maximum of 11.5 years for ascertainment of hospitalisations and deaths.

**PARTICIPANTS:** We studied 108,455 patients aged ≥65 years with CRD in Western Australia (WA) during 1992–2006.

**MAIN MEASURES:** A GP visit regularity score (range 0–1) was calculated and divided into quintiles. A clinician consensus panel classified levels of pharmacotherapy. Cox proportional hazards models, controlling for multiple factors including GP visit frequency, were used to calculate hazard ratios and confidence intervals.

**KEY RESULTS:** Differences in survival curves and hospital avoidance pattern between the GP visit regularity quintiles were statistically significant (p= 0.0279 and p<0.0001, respectively). The protective association between GP visit regularity and death appeared to be confined to the highest pharmacotherapy level group (P for interaction=0.0001). Higher GP visit regularity protected against first CRD hospitalisation compared with the least regular quintile regardless of pharmacotherapy level (medium regular: HR=0.84, 95% CI=0.77–0.92; 2nd most regular: HR= 0.74, 95% CI=0.67–0.82; most regular HR=0.77, 95% CI=0.68–0.86).

**CONCLUSIONS:** The findings indicate that regular and proactive 'maintenance' primary care, as distinct from 'reactive' care, is beneficial to older CRD patients by reducing their risks of hospitalisation and death.

## INTRODUCTION

Chronic respiratory diseases (CRDs) are relatively common in Australia with 10–12% of the population aged over 15 years suffering from asthma[1] and 9–12% of those over 45 years suffering from symptomatic chronic obstructive pulmonary disease (COPD)[2]. These two conditions account for 80% of the total burden of CRDs in Australia[3], and together they place a significant burden on the health care system[1,4].

Primary medical care is delivered in Australia predominantly through general practice, where the Australian general practitioner (GP) is equivalent to a US family physician certified by the American Board of Family Medicine. The importance of general practice in the management of chronic diseases has been

strongly promoted in Australia for the last decade[5]. Some evidence exists indicating that the pattern of GP services can influence the risk of adverse health events requiring provision of emergency and inpatient health care. For example, Tsai et al. found that patients with a relatively high frequency of emergency department visits for COPD exacerbations were less likely to have regular contact with a GP provider[6], and Cree et al. found high continuity of care in asthma patients to be associated with a decreased risk of emergency department visits and hospitalisations[7]. GP accessibility was also found in several studies to protect against potentially preventable hospital admissions[8–12].

Older CRD patients have a substantial excess of all-cause mortality compared with the general population[13–16]. Since treatment with medications is the mainstay of CRD management[17–19], a sufficient frequency and, more salient still, a sufficient regularity of GP visits is likely to be an important marker of effective proactive disease management. Furthermore, since respiratory symptoms are sensitive to environmental variability such as seasonal variation, respiratory infections, air pollutants and allergens[20,21], regular GP contact—as opposed to sporadic and frequent GP contact—is likely to be important in order to adjust treatment and recognise symptoms escalation early. Scheduled regular GP visits could prevent exacerbations as opposed to sporadic and frequent GP contact that is more likely to happen as a consequence of worsening disease symptoms. Hence, regular GP contact is likely to be important for prevention of adverse disease outcomes. Our aim was thus to estimate the association of regularity of GP visits with all-cause mortality and first CRD hospitalisations overall and according to levels of pharmacotherapy in older CRD patients.

## METHODS

### Data Sources

We based the study on administrative, whole-population health data that were linked and extracted in de-identified form using the Western Australian (WA) Data Linkage System (WADLS), which is maintained by the WA Department of Health. The record linking is based on full name and address, phonetic compression algorithms and other identifiers, and has been estimated to be 99.89% accurate[22] (personal communication: Paul Stevens, data analyst, Hospital Morbidity Data Collection, WA Department of Health).

Linked data from 1 January 1992 to 31 December 2006 were extracted for individuals aged ≥65 years from the Hospital Morbidity Data System, the Death Registry, the Electoral Roll, the Medicare Benefits Scheme (MBS) and the Pharmaceutical Benefits Scheme (PBS). The MBS data fields included types of services provided by GPs that qualified for Medicare benefits[23,24]. The PBS data fields included type of medication prescribed. The Electoral Roll data were used to ascertain migration of the study population, since electoral registration is compulsory for all adult Australian citizens residing in the country.

### Study Population

Hospital, death, MBS and PBS data were combined to ascertain the study population. Individuals with a hospital or death record of asthma, COPD or emphysema (ICD-9-CM: 492-493.92, 496, 975.7, E945.7; ICD-10-AM: J43-J46, T48.6, Y55.6) or bronchitis (ICD-9-CM: 491-491.21, 491.8-491.9; ICD-10-AM: J41-J42) were identified. The MBS data were used to identify individuals undergoing a special asthma management plan in GP offices (asthma cycle of care) subsidised by the government (items 2546–2559 and 2664–2677). From the PBS data, a list of the most commonly used CRD medications in Australia was used to identify potential CRD patients. The list included beclomethasone, budesonide, fluticasone, eformoterol, salmeterol, terbutaline, salbutamol, ipratropium, tiotropium, nedocromil, theophylline and aminophylline.

We identified 116,983 individuals who had at least one record from any of the four databases. To exclude patients with acute bronchitis, we removed all individuals with only a bronchitis diagnosis or death record (n=386). We then excluded individuals who were not registered on the WA Electoral Roll during the study period (n=8,142). All other individuals were included in the study due to the high likelihood that they had CRD (n=108,455).

A clinical consensus panel comprising seven general practitioners, two geriatricians and three clinical pharmacists was appointed to develop guidelines for the classification of CRD pharmacotherapy level (Table 1). If a patient had been dispensed a combination of medications from different levels

**Table 1. Pharmacotherapy Levels for CRD Based on Medication Dose as Defined by a Clinical Consensus Panel**

| SAB | Low dose ICS[a] | Medium dose ICS±LAB[a] | High dose ICS±LAB±OS[a] |
|---|---|---|---|
| Terbutaline AND/OR Salbutamol AND/OR Ipratropium AND/OR Tiotropium AND/OR Nedocromil | <250 μg Beclomethasone AND/OR <400 μg Budesonide AND/OR <250 μg Fluticasone | 250–500 μg Beclomethasone AND/OR 400–800 μg Budesonide AND/OR 250–500 μg Fluticasone AND/OR Eformoterol AND/OR Salmeterol | >500 μg Beclomethasone AND/OR >800 μg Budesonide AND/OR >500 μg Fluticasone Eformoterol AND/OR Salmeterol AND/OR >1 prescription per year of hydrocortisone and/or prednisolone |

*SAB = short-acting bronchodilators*
*ICS = inhaled corticosteroids*
*LAB = long-acting bronchodilators*
*OS = oral steriods*
*[a]Doses represent daily doses*

during the observation period, the patient was assigned the level reflecting the highest pharmacotherapy.

## Study Period

The period of observation began at the date of the first CRD record, start date of continuous Electoral Roll registration or 1 January 1992, whichever came last. Patients were censored at the date of the last database record, end date of continuous Electoral Roll registration, date of death or first CRD hospitalisation or 31 December 2006, whichever came first.

The exposure period, where pattern of GP service delivery was ascertained, represented the first 3 years of each patient's observation period. GP visits were identified using 127 MBS service items for clinic attendance, out of surgery consultation and home visits[23,24]. We developed a regularity score (RS) to represent the regularity of GP visits during the exposure period, since entropy-related scores from other fields were unsuitable for our purpose[25]. This score was calculated as RS = $1/[1 + \text{Variance}(\Phi_i)]$ where $\Phi_i$ was the time interval between the (i-1)th and ith GP visits. The score ranged from 0 to 1—with 1 representing perfect regularity—and measured how regularly a person visited a GP, i.e. whether the time intervals in between GP visits were usually of the same length. The score was divided into quintiles for all analyses. Person-time of follow-up began 6 months after the end of the exposure period. This 'wash-out' period was applied to minimise the likelihood of immortal time bias[26,27].

## Statistical Analyses

Cox proportional hazards models were applied to calculate hazard ratios and confidence intervals for the effects of GP visit regularity on (1) all-cause death and (2) first CRD hospitalisation. Included in the analyses were those patients who were still alive at the end of the exposure and wash-out periods and who had not been hospitalised for CRD during those periods (hospitalisation analyses only). Interaction was assessed by including an interaction term between GP visit regularity and pharmacotherapy level in the models for the effect of (1) all-cause death and (2) first CRD hospitalisation. All models were adjusted for total number of GP visits during the exposure period (continuous), gender (dichotomous), age at start of follow-up (continuous), indigenous status (dichotomous), Charlson Index of Comorbidity (ordinal)[28], area-based socioeconomic status (categorical) and residential remoteness (categorical) (obtained from the Australian Census conducted every 5 years). We assessed the proportional hazards assumption for each covariate in each Cox model using an interaction term between the covariate and the natural logarithm of the person-time and found no basis to reject proportionality. We also used Cox proportional hazards regression to estimate survival and hospitalisation-free probability in each quintile of GP visit regularity. The curves were adjusted for all variables mentioned above by using in the model the average value of each of the adjusting variables (i.e., the mean of covariates method). The overall p-value for the variable GP visit regularity

in the Cox regression models represented the test for significance. All analyses were performed using the statistical software SAS version 9.1 (SAS Institute Inc., Cary, NC).

## RESULTS

Characteristics of the study population overall and by pharmacotherapy level are shown in Table 2. The number and regularity of GP visits was lowest in the short-acting bronchodilator (SAB) group, but progressively increased with increasing pharmacotherapy level. We observed 4,841 deaths during the 11.5 years of follow-up, of which almost one half was in the highest pharmacotherapy level group. At the end of follow-up, 7,331 patients had been hospitalised for CRD. The hospitalisation rate was lowest for patients in the SAB group, but increased with increasing pharmacotherapy level.

We show the characteristics of the 108,455 CRD patients by quintiles of GP visit regularity in Table 3. Number of GP visits and the percentage of females were lowest in the least regular group whilst the percentage of indigenous patients, percentage of patients from very remote locations and percentage of patients with over six comorbid diseases was highest in that group.

Figure 1 shows the adjusted survival functions for CRD patients within each quintile of GP visit regularity. Patients with the least regular GP visit pattern experienced relatively poor survival with 84.6% still alive at the end of follow-up, whereas the other groups of patients experienced slightly better survivals (2nd least regular 86.1%; medium regular 86.8%; 2nd most regular 86.0%; most regular 85.3%). The difference in survival patterns between the GP visit regularity quintiles was significant (global p=0.0279).

Presented in Figure 2 are survival functions representing the probability of avoiding first CRD hospitalisation within each quintile of GP visit regularity. Survival increased with greater regularity of GP visits, with 69.8% of patients with the least regular GP visits still hospitalisation-free at the end of observation, compared with 72.0% (2nd least regular), 74.0% (medium regular), 76.7% (2nd most regular) and 76.0% (most regular). These differences in hospital avoidance between the GP visit regularity quintiles were statistically significant (global p<0.0001).

The likelihood of all-cause death or first CRD hospitalisation for increased GP visit regularity compared with the least regular quintile, overall and by pharmacotherapy level, is shown in Table 4. Increased GP visit regularity appeared to have a weak protective association against death, which was modified by pharmacotherapy level, where it was confined to the highest pharmacotherapy level group (P for interaction between GP visit regularity and pharmacotherapy level for the effect on all-cause death=0.0001). Higher GP visit regularity also showed a protective relationship against first CRD hospitalisation, with the statistically significant hazard ratios mostly decreasing with increasing regularity. This relationship was not modified by pharmacotherapy level (P for interaction between GP visit regularity and pharmacotherapy level for the effect on first CRD hospitalisation=0.9243). The unadjusted results for the relationship between GP visit regularity and all-

**Table 2. Characteristics of Patients Aged ≥65 years with CRD in WA 1992–2006, Overall and by Pharmacotherapy Level**

| Patient characteristic | All patients | SAB | Low dose ICS | Medium dose ICS ± LAB | High dose ICS ± LAB ± OS |
|---|---|---|---|---|---|
| Number of patients | 108,455 | 29,740 | 9,384 | 37,125 | 32,206 |
| Mean ag e ± SD at start of follow-up | 72.7±7.0 | 74.7±7.6 | 72.7±6.8 | 71.4±6.4 | 72.3±6.7 |
| % Female patients | 53.1 | 54.0 | 56.3 | 53.3 | 51.0 |
| % Indigenous patients | 0.6 | 0.8 | 0.4 | 0.5 | 0.6 |
| Mean ± SD GP visit number[a] | 30.2±23.7 | 26.7±22.3 | 28.8±22.1 | 29.3±22.1 | 34.9±26.4 |
| Median GP visit regularity [a,b] | 45.1 | 29.0 | 43.2 | 46.0 | 62.2 |
| All-cause mortality analyses | | | | | |
|   Number of patients included in analyses[c] | 66,390 | 14,159 | 5,985 | 23,849 | 22,397 |
|   Average years ± SD of follow-up | 4.8±3.2 | 4.2±2.9 | 4.9±3.3 | 4.6±3.1 | 5.4±3.3 |
|   Person-years of follow-up | 319,138.2 | 59,641.7 | 29,285.3 | 109,150.4 | 121,060.8 |
|   Number of deaths at the end of follow-up | 4,841 | 827 | 369 | 1,301 | 2,344 |
|   Mortality rate (per 100,000 PY) | 1,516.9 | 1,386.6 | 1,260.0 | 1,191.9 | 1,936.2 |
| First CRD hospitalisation analyses | | | | | |
|   Number of patients included in analyses[d] | 54,641 | 12,826 | 5,434 | 20,113 | 16,268 |
|   Average± SD years of follow-up | 4.4±3.1 | 4.2±2.9 | 4.8±3.3 | 4.1±3.0 | 4.6±3.2 |
|   Person-years of follow-up | 237,839.6 | 54,101.4 | 25,924.6 | 83,435.4 | 74,378.3 |
|   Number of first hospitalisations at the end of follow-up | 7,331 | 447 | 330 | 2,400 | 4,154 |
|   Hospitalisation rate (per 100,000 PY) | 3,082.3 | 826.2 | 1272.9 | 2876.5 | 5585.0 |

[a]*During the 3-year exposure period*
[b]*Multiplied by 100,000*
[c]*Patients who were alive at the end of the exposure and wash-out periods*
[d]*Patients who did not have a CRD hospitalisation during the exposure and wash-out periods and who were alive at the end of the two periods*
*SAB = short-acting bronchodilators*
*ICS = inhaled corticosteroids*
*LAB = long-acting bronchodilators*
*OS = oral steriods*
*PY = person-years*

cause death and first hospitalisation can be found in the online additional material.

## DISCUSSION

Our results indicate that a pattern of more regular GP visits rather than a sporadic pattern decreases the likelihood of all-cause mortality for older CRD patients in the highest pharmacotherapy level group and first CRD hospitalisation in patients overall.

This whole-population-based, retrospective study used linked administrative medical data for exposure and outcome ascertainment. The methodology possessed advantages in terms of minimising loss to follow-up and decreasing various forms of information bias. Furthermore, being able to collect data from a whole population meant that *prima facie* the study results have strong external validity. Nevertheless, a few concerns need to be addressed. Firstly, a potential reason for caution in interpreting our results was the method used to ascertain patients with CRDs. Around 70% of the patients were identified based solely on medication use without confirmation by hospital, death or MBS records. This case ascertainment strategy may have overestimated the cases of CRD in this population. However, based on data analysed by our group from 12 general practices in WA that included diagnostic information, out of 23,850 CRD prescriptions prescribed by GPs, 92% had CRD as reason for visit or prescription (unpublished data). Also, we re-performed all of our analyses separately for these 70% of patients and for the remaining 30%

and found no difference between the results of analyses of the two separate groups and the aggregate analysis. Thus, by using this selection strategy we can be reasonably confident that with considerable specificity we have included all CRD cases in the older WA population who have ever seen a doctor for breathing problems. This is not surprising given that the majority of medications prescribed for CRDs do not have alternative therapeutic indications.

Secondly, immortal time bias can occur in health services research when the increased amount of health services that are needed to deal with the early symptoms of the study outcome create a false association between the services and the outcome[26,27]. We endeavoured to reduce this bias by applying a 6-month 'wash out' period between the exposure period and the follow-up and thus excluding from the study those GP visits directly related to the early symptoms of the outcome. Applying a 'wash out' period of 6 months has been considered adequate to control immortal time bias in other analogous research[26]. However, the possibility remains that a 6-month or even longer period may not be sufficient to remove all immortal time bias in circumstances akin to the study. Residual immortal time bias could explain the tendency for our results to show a loss of apparent advantage of high regular GP contact against mortality.

Thirdly, the PBS database was limited to dispensed medications that were subsidised by the Australian Government. However, this was unlikely to have adversely affected the study because all inhaled corticosteroid and long-acting bronchodilator medications were subsidised by the PBS, and short-acting bronchodilator medication and oral corticosteroids were consistently subsidised for pensioners[29]. The latter point is especially relevant to our study as it was restricted to patients aged 65 or more years. Short-acting bronchodilator medication

**Table 3. Characteristics of 108,455 WA CRD Patients ≥65 years 1992–2006 by Groups of GP Visit Regularity**

| | Least regular | 2nd least regular | Medium regular | 2nd most regular | Most regular |
|---|---|---|---|---|---|
| Percent | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 |
| Mean age ± SD at start of follow-up | 74.4±7.5 | 71.8±6.9 | 71.1±6.3 | 71.7±6.5 | 73.0±7.0 |
| % Female patients | 45.0 | 52.0 | 56.0 | 59.1 | 63.5 |
| % Indigenous patients | 0.79 | 0.74 | 0.43 | 0.48 | 0.43 |
| Mean ± SD GP visit number[a] | 7.8±6.3 | 18.8±10.2 | 26.1±10.8 | 36.6±12.1 | 61.9±26.7 |
| Socioeconomic status quintile (%) | | | | | |
| Least disadvantaged | 20.1 | 19.9 | 20.3 | 19.7 | 19.4 |
| 2nd least disadvantaged | 19.6 | 20.3 | 19.9 | 19.5 | 20.2 |
| Medium disadvantaged | 20.6 | 19.5 | 20.1 | 20.2 | 19.8 |
| 2nd most disadvantaged | 19.9 | 20.5 | 20.6 | 20.6 | 19.0 |
| Most disadvantaged | 19.8 | 19.8 | 19.2 | 20.0 | 21.6 |
| Residential remoteness (%) | | | | | |
| Major cities | 73.5 | 70.9 | 73.2 | 76.9 | 84.1 |
| Inner regional | 12.5 | 14.5 | 14.9 | 13.2 | 9.4 |
| Outer regional | 10.5 | 11.6 | 9.7 | 8.3 | 5.3 |
| Remote | 2.9 | 2.6 | 1.9 | 1.5 | 1.2 |
| Very remote | 0.6 | 0.4 | 0.2 | 0.1 | 0.1 |
| Charlson Index of Comorbidity (%) | | | | | |
| 0 | 20.9 | 29.6 | 30.0 | 25.5 | 17.2 |
| 1–2 | 26.8 | 29.7 | 31.3 | 31.7 | 28.4 |
| 3–5 | 26.1 | 22.8 | 22.8 | 25.6 | 31.1 |
| 6+ | 26.2 | 17.9 | 15.9 | 17.3 | 23.4 |

*During the 3-year exposure period

may have been purchased 'over the counter', but it was cheaper in Australia for pensioners to purchase them with a doctor's prescription due to the PBS subsidy.

Lastly, smoking is a potential confounder in this study since it is strongly related to mortality and hospitalisation, and there is a reason to believe it is also related to the regularity of GP visits. We did not have information on smoking in our study, but our results were adjusted for a number of factors associated with smoking, such as socioeconomic status, residential remoteness, gender, indigenous status and comorbidity. Hence, although smoking status was not measured

directly, its potential to cause a confounding effect was limited. Given this partial control mechanism, we do not consider that confounding by smoking is an important source of systematic error in the results.

Asthma was designated as a National Health Priority Area by the Australian health ministers in 1999. This resulted in a national Asthma Management Program commencing in 2001–2002 with an aim to improve the quality of care provided by GPs to people with moderate to severe asthma[5]. Many state governments, including in Western Australia, have since then implemented strategies to encourage health professionals to
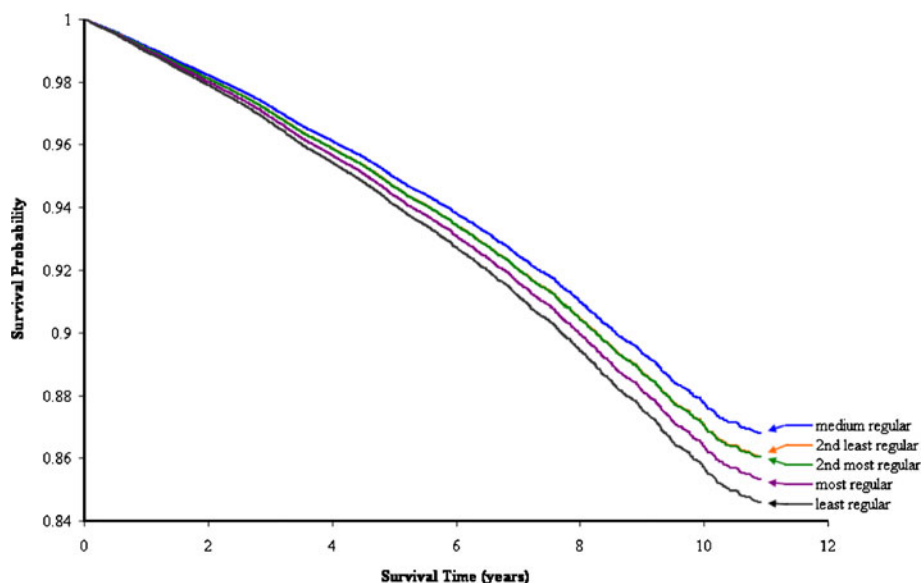


**Figure 1. Estimated survival functions for chronic respiratory disease patients in strata of GP visit regularity quintile with all-cause death as outcome. The functions are adjusted for number of GP visits, gender, age at start of follow-up, ethnicity, area-based socioeconomic status, residential remoteness, the Charlson Index of Comorbidity and indigenous status. The survival curves for 2nd least regular and medium regular merge together.**
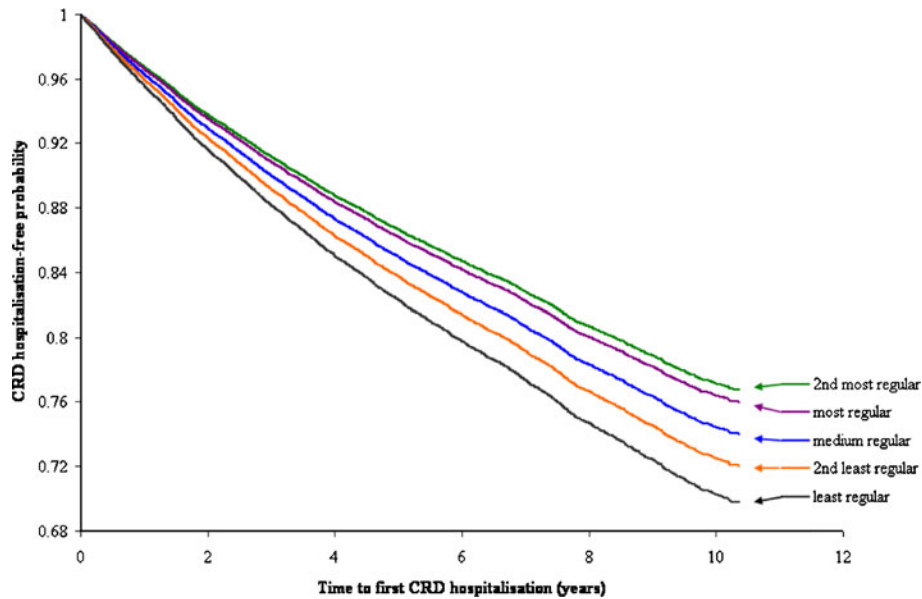
**Figure 2.** Estimated survival functions for CRD patients in strata of GP visit regularity quintile with first CRD hospitalisation as outcome. The functions are adjusted for number of GP visits, gender, age at start of follow-up, ethnicity, area-based socioeconomic status, residential remoteness, the Charlson Index of Comorbidity and indigenous status. CRD = chronic respiratory disease.

improve asthma care[1]. The initiative was justified given the fact that GPs play a pivotal role in the management of CRDs within the Australian health care system[30]. GP visits for CRDs rarely result in referrals to secondary/tertiary care in Australia, with previous reports indicating that only 1% of patients in 2004–2007 were referred to hospitals or emergency departments[1]. The importance of primary medical care in the management of CRDs has been supported by previous studies indicating that access to and patterns of GP contact can influence risk of adverse health events[6,8–12]. For example, higher primary care physician density has been associated with a lower risk of potentially preventable hospital admissions[12], whilst individuals without a primary care physician[8], individuals reporting fewer physician visits[9], individuals living in primary medical care shortage areas[10], or individuals with less access to primary care[11] have been found to experience

more preventable hospitalisations. In addition, Tsai et al. found that patients without a primary medical care provider were more likely to visit emergency departments for COPD exacerbations[6].

Contained within the CRD management role of the GP are the functions of disease assessment, patient education, management of acute exacerbations and prescription of regular medications[1]. Since medications are the mainstay of CRD management[17–19], the planning of therapies and education of the patient in their use represent two of the most important roles of the GP. In spite of this, CRDs have been found to be under-treated in the elderly[31–34], which has been associated with elevated risks of all-cause mortality and hospitalisation[35–38]. Moreover, poor patient knowledge about asthma[39,40] and the absence of an asthma management plan[41,42] have been found to increase hospital emergency department visits for

**Table 4.** Association between GP Visit Regularity of Patients with CRD and Risk of Death and First CRD Hospitalisation, Overall and by Pharmacotherapy Level

| GP visit regularity quintile | All patients | SAB | Low dose ICS | Medium dose ICS ± LAB | High dose ICS ± LAB ± OS |
|---|---|---|---|---|---|
| | HR (95% CI)[a] | HR (95% CI)[a] | HR (95% CI)[a] | HR (95% CI)[a] | HR (95% CI)[a] |
| All-cause mortality | | | | | |
| Least regular | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2nd least regular | 0.90 (0.79–1.01) | 0.85 (0.62–1.16) | 1.05 (0.68–1.61) | 1.03 (0.82–1.30) | 0.84 (0.71–1.00) |
| Medium regular | 0.84 (0.75–0.95) | 0.95 (0.70–1.29) | 0.81 (0.53–1.23) | 0.93 (0.74–1.17) | 0.79 (0.67–0.93) |
| 2nd most regular | 0.90 (0.80–1.01) | 1.17 (0.87–1.57) | 0.81 (0.53–1.23) | 0.95 (0.75–1.20) | 0.81 (0.69–0.96) |
| Most regular | 0.95 (0.83–1.08) | 1.34 (0.97–1.86) | 0.91 (0.57–1.44) | 1.13 (0.86–1.50) | 0.75 (0.62–0.91) |
| First CRD hospitalisation | | | | | |
| Least regular | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2nd least regular | 0.92 (0.83–1.00) | 0.82 (0.58–1.17) | 1.29 (0.81–2.06) | 0.93 (0.79–1.09) | 0.97 (0.86–1.10) |
| Medium regular | 0.84 (0.77–0.92) | 0.66 (0.46–0.94) | 1.20 (0.76–1.91) | 0.87 (0.74–1.02) | 0.90 (0.80–1.02) |
| 2nd most regular | 0.74 (0.67–0.82) | 0.51 (0.34–0.76) | 1.04 (0.64–1.69) | 0.72 (0.60–0.85) | 0.82 (0.72–0.94) |
| Most regular | 0.77 (0.68–0.86) | 0.72 (0.46–1.12) | 0.90 (0.50–1.62) | 0.72 (0.58–0.89) | 0.84 (0.71–0.99) |

[a]Adjusted for number of GP visits, gender, ethnicity, age, socioeconomic status, residential remoteness and Charlson Index using Cox multivariate regression.

HR = hazard ratio; 95% CI=95% confidence interval; SAB = short-acting bronchodilators; ICS = inhaled corticosteroids; LAB = long-acting bronchodilators; OS = oral steriods

asthma. In light of these previous findings, the results of our study underline the importance of at least a minimum level of regular 'maintenance' primary medical care, as distinct from sporadic and 'reactive' medical care, in older patients with CRDs to manage their disease adequately and reduce the likelihood of hospitalisation and death.

## CONCLUSIONS

In this study of 108,455 older patients with CRD in WA, we found that regular GP visits—as opposed to sporadic visits—appeared to decrease the likelihood of all-cause mortality for patients in the highest pharmacotherapy level and first CRD hospitalisation in all patients. The findings suggest that regular primary medical care is important for the effective treatment of CRDs. Not only does it appear to be important for patients to visit a GP, but it also seems to be imperative that they do so regularly on a proactive basis and not merely at times when their symptoms are at their worst.

**Conflict of Interest:** *None disclosed.*

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