



Australian Government

Australian Institute of  
Health and Welfare

# Coordination of health care: patient and primary care factors associated with potentially preventable hospitalisations for chronic conditions



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associated with potentially  
preventable hospitalisations  
for chronic conditions**

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# Summary

This report uses the results from the Coordination of Health Care (CHC) study to examine aspects of continuity of care in patients aged 45 years and over. In particular, we look at what patient characteristics and care coordination measures are associated with potentially preventable hospitalisations (PPH), with a specific focus on PPH related to chronic conditions (CC-PPH).

The CHC study was developed by the Australian Institute of Health and Welfare (AIHW) in partnership with the Australian Bureau of Statistics (ABS) to fill an important data gap relating to continuity of care. The CHC study provided self-reported information on patients' experiences of coordination and continuity of care across Australia.

Those most likely to have a CC-PPH in the study period were:

- People in older age groups
- Individuals with worse self-rated health
- Individuals with an increased number of different types of medication taken on a regular or ongoing basis
- Individuals who spoke English as their main language at home
- Individuals who reported that they were frequent users of GP services

The characteristics associated with having CC-PPH are also associated with other types of hospitalisations, but there is evidence that CC-PPH may be more strongly associated with some of these factors than hospitalisations more generally. For example, older age, poorer health and polypharmacy were particularly more strongly associated with CC-PPH than other hospitalisations, likely due to the stronger association between chronic conditions and these attributes.

While no continuity of care measures emerged as significantly associated with CC-PPH in this analysis, one measure of access to health care did. People who did not see a GP when they needed to were more likely to have a CC-PPH, and the effect was specific to this type of hospitalisation.

The findings of this study broadly support the idea that the PPH concept captures health service needs (primary and hospital), regardless of how or why that need has arisen. This is consistent with other studies, which also find that the health of individuals is the most important factor driving PPH admissions, but they also point to the importance of access to GPs in chronic condition management.

# 1 Introduction

The potentially preventable hospitalisations (PPH) indicator is a national performance measure that uses hospital admissions for 22 conditions as an indicator of access to, and the effectiveness of, primary care services provided by health professionals such as general practitioners, nurses, and allied health practitioners. The rationale underpinning this is that with appropriate and timely primary care interventions, admissions for these conditions should not occur (Ansari et. al. 2002). This does not mean that the hospitalisations themselves were unnecessary when they occurred, but only that with appropriate management of patients' health in the primary care setting, they could potentially have been avoided (ACSQHC & AIHW 2017).

## Box 1.1 Potentially preventable hospitalisations

Potentially preventable hospitalisations are grouped into three broad categories: Vaccine-preventable, Acute, and Chronic conditions.

**Vaccine-preventable** conditions are hospitalisations due to diseases that can be prevented by vaccination (such as influenza, measles and whooping cough).

**Acute** conditions are those that generally have a quick onset and may not be preventable, but theoretically would not result in hospitalisation if timely and adequate care was received in the community (such as dental conditions, urinary tract infections and ear, nose and throat (ENT) infections).

**Chronic conditions** are long-lasting conditions that may be preventable through lifestyle change, but may also be managed in the community to prevent worsening of symptoms and hospitalisation. This category includes conditions such as diabetes complications, chronic obstructive pulmonary disease (COPD) and asthma.

This report focuses on PPH for chronic conditions (hereafter referred to as CC-PPH) as these conditions have need for primary care management, and may be the most influenced by care coordination. The report takes into account factors underpinning chronic disease, such as biological, socioeconomic factors, and health care access, which are complex and interwoven, and explores whether subjective experience of care, self-rated health and other experiences are associated with poorer health outcomes (i.e. whether an individual also has one or more CC-PPH during the survey period).

To answer these research questions, this study makes use of linked data: the Survey of Health Care, which includes information on personal experiences of health care, linked with hospital admission data. These data provide a unique opportunity to explore long standing data and knowledge gaps in relation to the relationship between primary care experiences and PPH.

### **Coordination of Health Care Study**

The AIHW and the Australian Bureau of Statistics (ABS) developed the Coordination of Health Care Study in 2018 to provide information on patients' experiences of coordination and continuity of care across Australia. This study is comprised of the 2016 Survey of Health Care experiences and administrative data from the broader health system (hospitals, the Medicare Benefits Scheme and the Pharmaceutical Benefits Scheme).

For more information about the survey and the linked data asset, please see the [technical supplement](#).

The PPH indicator has traditionally been used as a proxy for assessing primary care effectiveness. Reporting has shown increased rates of PPH in disadvantaged populations such as people living in low socioeconomic areas, those living in areas outside major cities, and among Indigenous Australians (e.g. AIHW 2020). While these studies provide useful information on patterns of PPH at the population level, they have been unable to explore the person-level patient and primary care experience factors that may contribute to PPH. Understanding how patient health and experiences with primary care may affect or be associated with CC-PPH provides valuable insights into the management of chronic conditions, and assists with the development of health policy and the interpretation of PPH indicator data in Australia.

### **For more background and discussion of the PPH indicator**

If you are interested in reading more about the PPH indicator and for recent reporting, please see the 2020 report Disparities in potentially preventable hospitalisations across Australia, 2012-13 to 2017-18 <<https://www.aihw.gov.au/reports/primary-health-care/disparities-in-potentially-preventable-hospitalisations-australia/contents/table-of-contents>>



## 2 What patient and primary care factors were associated with CC-PPH?

The purpose of this study was to investigate whether there are any patient health and primary care experience factors that more commonly occur in individuals who have a CC-PPH, as well as how these differ to individuals with other types of hospitalisations. We conducted a multinomial logistic regression model, which describes the likelihood (odds) of having a CC-PPH or another type of hospitalisation, as opposed to no hospitalisations, based on certain patient experience and demographic characteristics. It is important to note that these factors may not necessarily precede a CC-PPH or other hospitalisation, but rather describe the patient experience of care, their demographic information etc. in the period of time examined.

### What is multinomial logistic regression?

Logistic regression is used in statistics to estimate the probability of an event occurring—in this case, a certain type of hospitalisation—based on the underlying data used to create the model. The results for logistic regression analysis are generally presented as Odds Ratios.

A multinomial model compares multiple outcomes, in this study CC-PPH or other types of hospitalisations, against a reference outcome (no hospitalisations). This allows not only assessment of factors that may influence the study outcome (CC-PPH) but also whether these factors are specific to this outcome.

For example, it may be found that a factor that has a strong association with a CC-PPH also has an influence on admissions for other reasons – thus is associated with a hospital admission generally rather than being CC-PPH specific. This provides important context to the observed results.

The multinomial logistic regression model showed that there are a number of patient health and primary care experience factors that are associated with increased likelihood of also having PPH for chronic conditions (CC-PPH) or other types of hospital admissions. The variables with the strongest associations were those related to health status – such as increased age, number of medications, self-rated health, and frequency of GP access – and those relating to barriers to health service access, such as not seeing a GP when they felt they needed to see one.

Compared to patients with no hospital admission, and while holding other factors in the model constant, the following patient health and primary care experience factors were associated with an increased likelihood of having a CC-PPH:

- Increased age (OR=2.9 for ages 65-74, 3.7 for ages 75-84, and 6.0 for ages 85+ compared with individuals aged 45-54)
- Individuals with worse self-rated health (OR=2.5 for those rating their health as good, and 5.1 for those rating their health as fair or poor, compared with those who rated their health as excellent or very good).
- Individuals with an increased number of different types of medication taken on a regular or ongoing basis (OR=2.5 for those with 5-9 different medications, and 5.3 for those with 10 or more medications compared with those taking 0-4 different medications).

- Individuals who spoke English as their main language at home (OR=2.1 compared to those who predominantly spoke a language other than English at home).
- Individuals who reported that there was a time they felt they needed to see a GP but did not go (OR=1.6 compared to those who did not experience this).
- Individuals who reported that they were frequent users of GP services (OR=2.4 compared to those who did not identify as frequent users).

Surprisingly, individuals reporting that they received enough information about their own care or treatment were more likely to have a CC-PPH than those reporting they did not receive enough information (OR=2.2), and those reporting not needing information (OR=4.0). These ORs have been inverted from their original unrounded values for ease of interpretation. It is possible that people who provided these latter responses were healthier and were not at high risk of hospitalisation, particularly those who did not need information in the first place. However, these results require further investigation to clarify the nature of this relationship.

The factors found to be associated with CC-PPH were also associated with an increased likelihood of having other types of hospital admissions, but to a lesser extent than what was observed for CC-PPH (Figure 3.1, Table 3.1). For example, while there is a pattern of increased hospitalisation for increased age (compared to the reference age group 45-54), the increased odds are far smaller than observed for CC-PPH (OR=1.5, 1.8, and 1.9 for 65-74, 75-84 and 85+ years respectively).

### Interpretation of Odds Ratios

'Odds' is the numerical expression for the likelihood of the event occurring. The odds of an event occurring is defined as the ratio of the probability that the event will occur over the probability that the event will not occur.

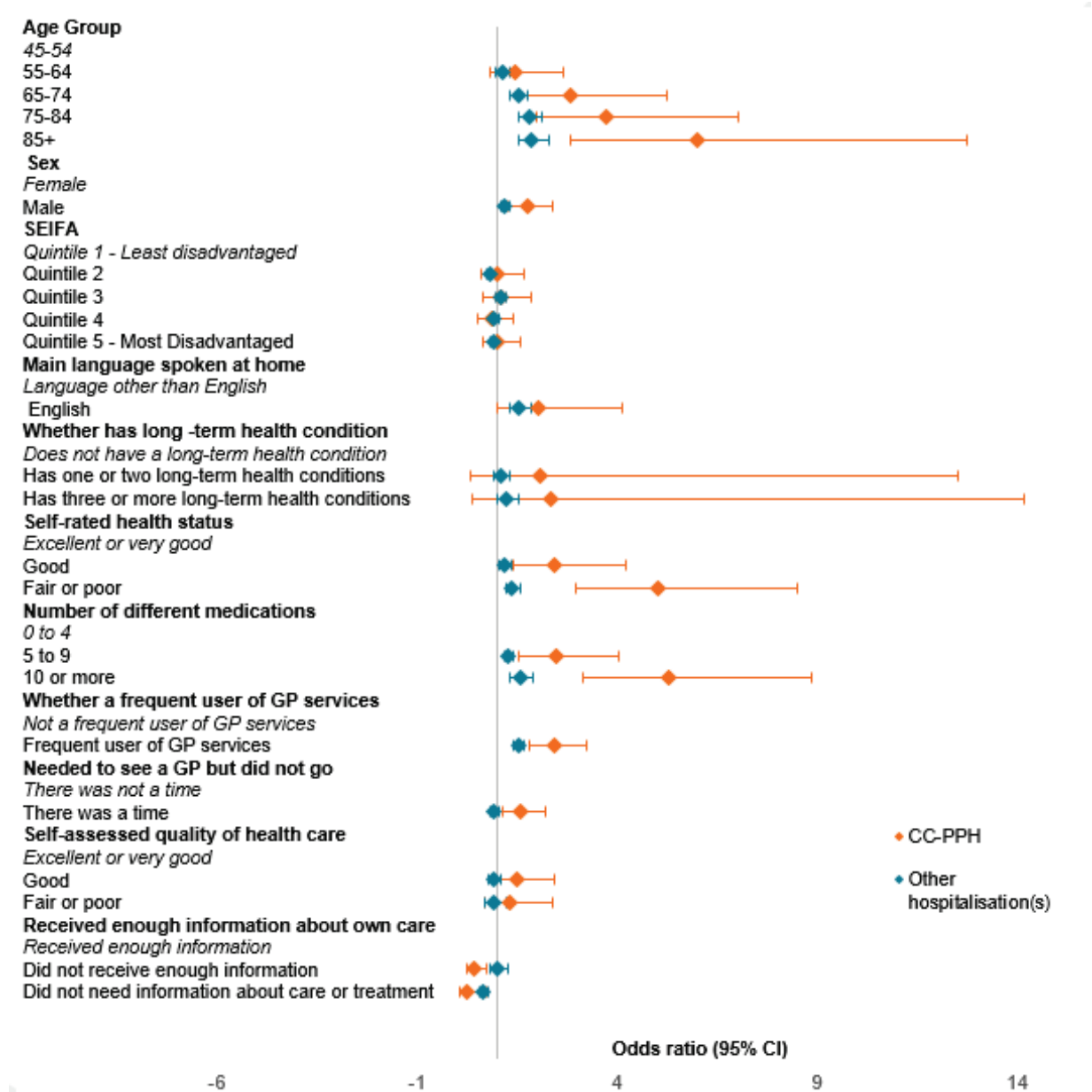
An odds ratio is used to measure the odds of an event occurring given an exposure or characteristic—for example, worse self-rated health—compared with the odds of the event or outcome occurring in the absence of that exposure. It also represents the magnitude of the association between the event and the exposure:

- An odds ratio of 1 means that the exposure does not affect the odds of the event occurring. In the Figure below, 1 is represented by the vertical line.
- An odds ratio of greater than 1 means that the exposure is associated with higher odds (or higher likelihood) of the event occurring.
- An odds ratio of less than 1 means that the exposure is associated with lower odds (or less likelihood) of the event occurring. This can be inverted for ease of interpretation by dividing 1.0 by the unrounded OR (which is less than 1.0) to give the opposite ratio. For example, an initial OR of 0.5 would become 2.0 as  $1.0/0.5=2.0$ . This is interpreted as the reference group having twice the odds of the variable category.

Because this is a multinomial regression, it is also necessary to keep in mind that the odds for a CC-PPH are in comparison to having no hospital admissions at all. This means that the odds ratios presented here do not make any statistical comparison between having a CC-PPH or an admission for another reason.

It is important to note that the odds ratio is a point estimate derived through a statistical process. For this reason, we also include the confidence interval that shows the range in which this point estimate falls. A wide confidence interval indicates that the true point estimate may vary substantially from the reported estimate, whilst a narrow interval suggests greater reliability of the estimate. The confidence interval width is influenced by factors such as sample size.

**Figure 3.1 Adjusted odds ratios for patients with CC-PPH and patients with other hospitalisations, compared with people with no hospitalisations, 1st November 2014 to 31st October 2015**



Notes:

1. This model retains variables where  $p < 0.1$
2. Initial cohort of people who consented to CHC and APC linkage= 25,502
3. Model cohort =22,263 (3,239 missing responses removed, 12.7% loss)
4.  $R^2=0.1083$

Source: AIHW analysis of ABS Survey of Health Care 2016.

**Table 3.1 Adjusted odds ratios for patients with CC-PPH and patients with other hospitalisations, compared with people with no hospitalisations, 1st November 2014 to 31st October 2015**

	One or more CC-PPH			Other hospitalisation(s)		
	Odds ratio	Lower CI	Upper CI	Odds ratio	Lower CI	Upper CI
<b>Age Group</b>						
45-54	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
55-64	1.5	0.8	2.7	1.1	1.0	1.3
65-74	2.9	1.6	5.2	1.5	1.3	1.8
75-84	3.7	2.0	7.1	1.8	1.6	2.1
85+	6.0	2.8	12.7	1.9	1.5	2.3
<b>Sex</b>						
<i>Female</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
Male	1.8	1.3	2.4	1.2	1.1	1.3
<b>SEIFA</b>						
<i>Quintile 1 - Least disadvantaged</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
Quintile 2	1.0	0.6	1.7	0.8	0.7	1.0
Quintile 3	1.1	0.7	1.9	1.1	1.0	1.3
Quintile 4	0.9	0.5	1.4	0.9	0.8	1.1
Quintile 5 - Most Disadvantaged	1.0	0.7	1.6	0.9	0.8	1.0

Continued

**Table 3.1 Adjusted odds ratios for patients with CC-PPH and patients with other hospitalisations, compared with people with no hospitalisations, 1st November 2014 to 31st October 2015 (continued)**

	One or more CC-PPH			Other hospitalisation(s)		
	Odds ratio	Lower CI	Upper CI	Odds ratio	Lower CI	Upper CI
<b>Main language spoken at home</b>						
<i>Language other than English</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
English	2.1	1.0	4.1	1.6	1.3	1.9
<b>Whether has long -term health condition</b>						
<i>does not have a long-term health condition</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
has one or two long-term health conditions	2.1	0.4	12.5	1.1	0.9	1.3
has three or more long-term health conditions	2.4	0.4	14.2	1.3	1.0	1.5
<b>Self-rated health status</b>						
<i>Excellent or very good</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
Good	2.5	1.4	4.2	1.2	1.1	1.4
Fair or poor	5.1	3.0	8.5	1.4	1.2	1.6

Continued

**Table 3.1 Adjusted odds ratios for patients with CC-PPH and patients with other hospitalisations, compared with people with no hospitalisations, 1st November 2014 to 31st October 2015 (continued)**

	One or more CC-PPH			Other hospitalisation(s)		
	Odds ratio	Lower CI	Upper CI	Odds ratio	Lower CI	Upper CI
<b>Number of different medications</b>						
<i>0 to 4</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
5 to 9	2.5	1.6	4.1	1.3	1.2	1.4
10 or more	5.3	3.2	8.8	1.6	1.3	1.9
<b>Whether a frequent user of GP services</b>						
<i>Not a frequent user of GP services</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
Frequent user of GP services	2.4	1.8	3.2	1.6	1.4	1.7
<b>Whether there was a time in the last 12 months when felt needed to see a GP but did not go</b>						
<i>There was not a time when needed to see a GP but did not go</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
There was a time when needed to see a GP but did not go	1.6	1.2	2.2	0.9	0.8	1.1
<b>Self-assessed quality of health care received from usual GP or usual place of care in the last 12 months</b>						
<i>Excellent or very good</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
Good	1.5	1.0	2.5	0.9	0.8	1.1
Fair or poor	1.3	0.7	2.4	0.9	0.7	1.2

Continued

**Table 3.1 Adjusted odds ratios for patients with CC-PPH and patients with other hospitalisations, compared with people with no hospitalisations, 1st November 2014 to 31st October 2015 (continued)**

	One or more CC-PPH			Other hospitalisation(s)		
	Odds ratio	Lower CI	Upper CI	Odds ratio	Lower CI	Upper CI
<b>Whether received enough information from any health professional about own care or treatment in the last 12 months</b>						
<i>Received enough information from a health professional about own care or treatment</i>	<i>(ref)</i>	-	-	<i>(ref)</i>	-	-
Did not receive enough information from a health professional about own care or treatment	0.5	0.3	0.8	1.0	0.8	1.3
Did not need information about care or treatment	0.3	0.1	0.7	0.7	0.6	0.8

Notes:

1. This table presents the odds ratio as rounded to one decimal point
2. This model retains variables where  $p < 0.1$
3. Initial cohort of people who consented to CHC and APC linkage= 25,502
4. Model cohort (all missing responses removed) =22,263 (3,239 cases removed, 12.7% loss)
5.  $R^2=0.1083$

Source: AIHW analysis of ABS Survey of Health Care 2016.

## Why did patients not see a GP when they felt they needed one?

Patients with a CC-PPH were more likely to have not seen a GP when needed compared to those who had other hospitalisation types (34.9% compared with 22.1%) and those who had no hospitalisations (21.2%).

The most commonly cited reason for not seeing a GP when a participant felt they needed to, regardless of hospitalisation status, was not being able to get an appointment when needed (Table 3.2).

Of the CC-PPH patients who reported they did not see a GP when they felt they needed to:

- 40.5% of patients reported not being able to get an appointment when needed
- 10.5% of patients cited cost as a reason
- 46.6% of patients listed reasons other than cost, GP nearby and/or GP availability.  
The survey does not further explain what these other reasons may be.

These findings were also observed in patients with other hospitalisations, thus the reasons for not seeing a GP when a participant felt they needed to did not differ by hospitalisation status.



**Table 3.2 Reported reasons why patients did not see a GP when they felt they needed one, by hospitalisation category**

<b>One or more CC-PPH<sup>(a)</sup></b>						
<b>Reported reason</b>	<b>N</b>	<b>Percent<sup>(b)</sup></b>	<b>SE</b>	<b>MOE</b>	<b>LCI</b>	<b>UCI</b>
<i>Cost</i>	13	10.5	3.2	6.3	4.2	16.8
<i>No GP nearby</i>	11	4.7	2.2	4.3	0.4	9.1
<i>Could not get appointment when needed</i>	61	40.5	4.8	9.3	31.1	49.8
<i>Other</i>	74	46.6	5.1	10.0	36.5	56.6
<b>Other hospitalisation(s) <sup>(a)</sup></b>						
<b>Reported reason</b>	<b>N</b>	<b>Percent<sup>(b)</sup></b>	<b>SE</b>	<b>MOE</b>	<b>LCI</b>	<b>UCI</b>
<i>Cost</i>	186	15.7	1.6	3.1	12.6	18.9
<i>No GP nearby</i>	97	4.9	0.8	1.5	3.4	6.4
<i>Could not get appointment when needed</i>	780	47.4	2.0	3.9	43.5	51.2
<i>Other</i>	673	44.2	1.7	3.4	40.8	47.7
<b>No hospital admission<sup>(a)</sup></b>						
<b>Reported reason</b>	<b>N</b>	<b>Percent<sup>(b)</sup></b>	<b>SE</b>	<b>MOE</b>	<b>LCI</b>	<b>UCI</b>
<i>Cost</i>	465	17.5	1.2	2.3	15.2	19.7
<i>No GP nearby</i>	159	4.2	0.5	1.0	3.2	5.2
<i>Could not get appointment when needed</i>	1,576	50.0	1.0	2.0	48.0	52.0
<i>Other</i>	1,372	43.7	1.3	2.5	41.2	46.2

a. Of patients in final model who reported not seeing a GP when needed.

b. Percent refers to the proportion of affirmative responses to an individual reason category

Notes:

1. Respondents could report more than one reason
2. Not stated responses have been omitted due to small numbers
3. SE: standard error
4. MOE: Margin of Error
5. LCI: Lower confidence interval
6. UCI: Upper confidence interval

### 3 Discussion and limitations

Our model shows that the factors most associated with having a CC-PPH in the study period were those relating to patient health (number of medications, self-rated health, and frequency of GP access), and not seeing a GP when they felt they needed one. The characteristics associated with having hospitalisations are similar for both CC-PPH and other types of hospitalisations, but there is evidence that CC-PPH may be more strongly associated with some of these factors than hospitalisations more generally. For example, older age, poorer health and polypharmacy were particularly more strongly associated with CC-PPH than other hospitalisations, likely due to the stronger association between chronic conditions and these attributes.

These findings broadly support the idea that the PPH captures health service needs (primary and hospital), regardless of how or why that need has arisen. Our finding that people with poor health have higher health system needs, however, does not address why these individuals are in poor health to begin with. Importantly, measures of primary care effectiveness, such as perceived quality of care provided or information sharing by the provider, do not appear to be associated with CC-PPH in this modelling. This suggests that the PPH indicator may not be a good proxy for primary care effectiveness in the context of chronic conditions (and the concepts measured in the survey), but rather reflective of health service need and utilisation.

The findings of our study are consistent with other studies, which also find that the health of individuals is the most important factor driving PPH admissions (Falster et. al. 2015, Tran et. al. 2014, Khanna, et. al. 2019, Youens et. al., 2019), but they also point to the importance of access to GPs in chronic condition management. Barriers to access such as cost or poor GP availability does not differ substantially by hospitalisation type (or for those without hospitalisations). That most patients cited 'other' as a reason for not attending a GP when they felt they needed to see one may potentially suggest more complex access issues or even that their need exceeds that of the primary care system, associations that are worthy of further investigation should more nuanced data become available. For example, both frequent users of GPs and people feeling they needed to see a GP (but did not) remained in the model. It may be that those with high GP usage may also have more instances of not being able to see a GP when they need one due to GP caseloads.

Although we included a number of patient experience terms in the initial development of the model, many of these did not affect the likelihood of also having a CC-PPH. This suggests that aspects of patient primary care experiences (such as being involved in decisions about own care, or medication reviews) may not be important contributing factors to the risk of CC-PPH. However, it is important to bear in mind that our study focused on a cohort of people with high health services needs and all participants needed at least one GP visit in the previous 12 months to be eligible to participate. This means that the bias in our study towards people with high health needs may potentially obscure the impact of good patient experiences and care coordination in preventing hospitalisations among patients with lower health needs, as well as the influence of known risk factors such as remoteness or level of support for daily living, and so findings must be interpreted with caution.

These findings are in line with research that reviews the use of the PPH as a proxy for primary care effectiveness in the Australian health system by utilising linked-data to examine patient pathways in the lead up to hospitalisation. These studies, which largely rely on the 45 and up study, found that increased primary care activity often preceded PPH (Falster et. al. 2015). The predominant drivers of PPH admissions were factors such as health status and health needs rather than poor primary care access or utilisation (Falster et. al. 2015, Tran et. al. 2014, Khanna, et. al. 2019). This is not to say that poor access or utilisation has no role in CC-PPH, rather that poor health status or high health needs appear to have a greater association, and may themselves be associated with access issues.

The finding that poor health status and/or high health needs are associated with CC-PPH is further supported in an examination of a cohort of patients with chronic disease, which found that patients did not perceive their hospitalisation as preventable (Longman et. al. 2018), and in another study in which those with PPHs generally had increased primary care activity in the lead up to a hospitalisation (Falster et. al. 2015). In addition, a recent study by Johnston et. al. (2020) found that, whilst patient satisfaction with primary care was important to patients admitted to hospital for diabetes complications, it was predominantly social and economic factors that drove these PPH rates rather than primary care access. Although this was not assessable in our study, research by Youens et. al. (2019) found that while regular primary care access was somewhat protective against emergency department admission, having a usual place of care and a usual care provider was associated with a higher likelihood of hospitalisation. This latter finding is likely due to the increased likelihood of individuals with poor health having a usual place of care and/or a usual care provider in addition to having a higher need for hospital services as part of their condition management.

These studies, in conjunction with our study, may suggest that the patterns we are observing (i.e. frequent GP usage but also increased likelihood of experiencing hospitalisation) may reflect best care practices and appropriate escalation of treatment in line with self-management education by GPs and other providers when exacerbations occur that are beyond the scope of primary care. They also suggest that the issues of chronic disease development and progression may not be entirely manageable within the primary care system under current models of care and level of resourcing for chronic condition management. It is also likely that some social and economic drivers of poor health, such as poverty and inequality, are unable to be rectified by the primary care sector. While the patient and primary care factors associated with PPH rates may be amenable to interventions to reduce PPH rates and ensure optimal management in primary care, once chronic conditions develop or reach a given level of severity, hospitalisations may not be avoidable simply by improving access to primary care, despite the best efforts of the sector.

## **Study limitations**

This study has some limitations, particularly the high non-response rate (71%), limited sample size and highly specific cohort population. For example, further analysis of access barriers by remoteness or other factors was not possible due to the limited sample size, whilst some variables exploring allied health specifically had too few responses for inclusion in the model.

In addition, the exclusion of individuals without a usual GP (in order to explore coordination of care measures) may have limited factors thought to be associated with GP access barriers - such as remoteness, socioeconomic status, and Indigenous status – thus making the cohort more homogenous.

Further, the survey only captures individuals who have had at least one GP visit in the previous 12 months prior to the survey period, thus eliminating those who have not had contact with a GP. Again, there may be underrepresentation of individuals facing disadvantage who could not access a GP when needed (a potential risk for CC-PPH, and hospitalisation in general).

The tendency to report 'mid-range' options on subjective measures, such as good or fair rather than excellent or poor, may also prevent clearer patterns of association emerging. Small numbers of responses for some measures, which subsequently necessitated grouping of responses, has a similar effect.

Despite these limitations, this study has shown that PPH may be a valuable measure for understanding health service need at the hospital level as well as the primary care level. This may prompt a shift in PPH reporting and utilisation of findings to better allocate resources to areas with higher health burden, or to better understand population groups with higher health needs and their requirements at all stages of their care

# Appendix A. Technical supplement

## Study cohort and model

### Survey of Health Care (SHC)

More than 35,000 people responded to a survey on health care experiences and perceived care coordination between health care providers such as specialists and GPs. To ensure valid estimates for those with high health-care needs, the survey oversampled people who had seen a GP 12 or more times in the previous 12 months.

The survey responses were from a representative sample of 124,000 people selected from the 8.8 million Australians aged 45 and over who had seen a GP in the 12 months between November 2014 and November 2015. This represents a response rate of 29%.

Examples of the survey questions include whether or not:

- the GP had an understanding of the patient's health-care history
- their results were available at appointments
- the GP seemed informed about specialist care or hospital care
- arrangements were made by hospitals for any services needed after leaving hospital.

A full list of the questions asked in the survey can be accessed at:

[www.abs.gov.au/ausstats/abs@.nsf/mf/4343.0](http://www.abs.gov.au/ausstats/abs@.nsf/mf/4343.0)

### Health system data

In addition to completing the Survey of Health Care, as part of this study participants were invited to take part in a health system data linkage. Just over 25,000 study participants consented to linkage of information about the hospital and emergency department services they used between 1 January 2014 and 30 June 2018 to their 2016 Survey of Health Care records. This linked-data population differs from the Australian population distribution in terms of age, sex, SEIFA, Indigenous status, and geographic location, with weighting applied to account for these differences (ABS, 2017).

### Study population

Individuals who consented to having their survey data linked to hospital admission data formed the basis for the study population for this report. However, the study population was further restricted to those with valid responses to a subset of survey questions about the quality, accessibility and inclusiveness of their primary care provision (22,263 individuals). This resulting study cohort are divided into three outcome categories – those with one or more CC-PPH, those with other hospitalisation(s) only, and those with no hospital admission during the study period. Due to the cross-sectional nature of the survey (i.e. capturing a point in time), exploration of hospital admissions for the study cohort was limited to the survey period (1<sup>st</sup> November 2014 to 31<sup>st</sup> October 2015). This approach ensures the information captured by the survey about primary care experiences relates to the same period of time that the likelihood of having a PPH, or hospitalisations more generally, is examined.

## Limitations

The SHC only includes patients aged 45 and over, thus removing some of the greatest contrast in age-based health outcomes, and has a far smaller cohort than ordinarily explored in administrative dataset reporting of PPH. In addition, only individuals with at least one GP visit in the 12 month study period are included, which has limited the capacity to explore GP access issues. The study is also biased towards those with high GP usage, potentially increasing the likelihood of requiring hospital care and having higher care needs.

The demographic distribution in the study population is detailed in Table A.1

**Table A.1 Demographic distribution of study cohort<sup>(a)</sup>**

	One or more CC-PPH hospitalisation		Other hospitalisation(s)		No hospital admission	
	N	Per cent	N	Per cent	N	Per cent
<b>Indigenous status (b)</b>						
<i>Indigenous</i>	15	3.2	103	1.3	206	1.3
<i>Non Indigenous</i>	459	96.8	7,720	98.7	16,193	98.7
<b>Age group (c )</b>						
<i>45 to 54</i>	31	6.5	817	10.4	2,865	17.3
<i>55 to 64</i>	65	13.6	1,652	21.0	4,451	26.9
<i>65 to 74</i>	159	33.3	2,632	33.5	4,982	30.1
<i>75 to 84</i>	161	33.7	2,215	28.2	3,354	20.3
<i>85+</i>	62	13.0	540	6.9	877	5.3
<b>Sex</b>						
<i>Female</i>	196	40.0	3,932	49.0	8,984	53.5
<i>Male</i>	294	60.0	4,090	51.0	7,798	46.5
<b>SEIFA (d)</b>						
<i>1 (least disadvantaged)</i>	86	17.6	1,815	22.7	4,088	24.4
<i>2</i>	97	19.8	1,273	15.9	2,929	17.5
<i>3</i>	86	17.6	1,668	20.8	3,104	18.5
<i>4</i>	96	19.6	1,658	20.7	3,140	18.7
<i>5 (most disadvantaged)</i>	125	25.5	1,600	20.0	3,493	20.9
<b>Remoteness areas (2016)</b>						
<i>Major cities</i>	247	50.4	4,222	52.6	8,755	52.2
<i>Areas outside major cities</i>	243	49.6	3,800	47.4	8,027	47.8

a. These 25,294 individuals include records with missing or invalid responses to other variables that are excluded from the final regression model

b. 598 missing/ not stated responses

c. 431 missing/ not stated responses

d. 36 missing/ not stated responses

Notes: Socio-Economic Indexes for Areas (SEIFA) is an ABS product that ranks areas in Australia according to relative socio-economic disadvantage (the IRSD). For more information, please see < 2033.0.55.001 - Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia, 2016 (abs.gov.au)>

Source: AIHW analysis of ABS Survey of Health Care 2016.

## Model methodology

The study examined which patient health and primary care experience factors are associated with CC-PPH using a weighted multinomial logistic regression model. The definition of a CC-PPH comes from the national PPH indicator.

(<https://meteor.aihw.gov.au/content/index.phtml/itemId/716530>).

A subset of questions from the Coordination of Health Care Study relating to primary care experience, patient involvement in their own care, and patient health status were selected as model variables (i.e. factors that may influence the likelihood of having a CC-PPH). This multinomial model also assessed the likelihood of having one or more hospitalisation for reasons that are not CC-PPH to allow a more nuanced exploration of hospitalisation risks more broadly, versus those that are predominantly related to CC-PPH admissions.

The following survey questions were included in the initial model and variables were removed if they did not meet the threshold for retention ( $p < 0.1$  in this model). The subset of survey questions included in the model development were as follows:

- Health status
- Whether has three or more long-term health conditions (Comorbidity)
- The number of different ongoing medications taken by patient (Polypharmacy)
- Whether patient has had a medication review in past 12 months
- Frequency of GP access
- Whether there was a time in the last 12 months when felt needed to go to a GP but did not go
- Whether usual GP or others in usual place of care seemed aware of patient's health care history in the last 12 months
- How often patient was involved in decisions about care or treatment for own long-term condition(s)
- Whether there was a time in the last 12 months when felt needed to go to a specialist doctor but did not go
- Whether received enough information from any health professional about own care or treatment in the last 12 months
- Whether patient had a health professional who had a good understanding of patient's health, health care needs and preferences in last 12 months
- Number of people who could help with activities of daily living if required (social support)
- Years with usual GP and/or place of care.

Demographic questions including age, sex, socioeconomic area (SEIFA - IRSD), Remoteness areas (2016 definition), main language spoken at home, and Indigenous status were also included in the modelling.

Variables were recoded to exclude 'not applicable' and 'not stated' answers, and where necessary, variable levels were grouped to provide sufficient numbers for logistic regression analysis. The full listing of survey questions as they were coded for the model, and how the model was built, are detailed in the technical supplement

The final minimal model included the following variables:

- Age group (10 year age groups from age 45 to 85+)
- Sex
- SEIFA
- Main language spoken at home
- Whether has long-term health condition
- Self-rated health status
- Number of different medications
- Whether a frequent user of GP services
- Whether there was a time in the last 12 months when felt needed to see a GP but did not go
- Self-assessed quality of health care received from usual GP or usual place of care in the last 12 months
- Whether received enough information from any health professional about own care or treatment in the last 12 months.

## **Model development**

This multinomial logistic regression model was built to explore hospital admission (for a one or more CC-PPH, for reasons other than CC-PPH, or no admission at all) as influenced by sociodemographic and primary care experience factors.

These factors were assessed using the responses to the following 2016 Survey of Health Care questions and information.

### **Sociodemographic:**

- Age
- Sex
- Indigenous status
- Socio-Economic Indexes for Areas (SEIFA) - The Index of Relative Socio-Economic Disadvantage (IRSD)
- Main language spoken at home
- Remoteness areas

### **Health status:**

- Whether has three or more long term health conditions
- Self-assessed health status
- Number of different medications currently taking on a regular and ongoing basis

### **How primary care is used:**

- Whether was a frequent user of GP services

### **Primary care access barriers:**

- Whether there was a time in the last 12 months when felt needed to see a GP but did not go



- Whether there was a time in the last 12 months when felt needed to see a specialist doctor but did not go

### **Care coordination:**

- Self-assessed quality of health care received from usual GP or usual place of care in the last 12 months
- Whether usual GP or others in usual place of care seemed aware of patient's health care history in the last 12 months
- Whether a health professional reviewed all medication taken in the last 12 months
- Whether patient had a health professional who had a good understanding of patient's health, health care needs and preferences in last 12 months
- Whether received enough information from any health professional about own care or treatment in the last 12 months

### **Social support:**

- Number of people who could help with activities of daily living if required

These items were selected due to their relevance to care coordination and known risk factors for CC-PPH. For demographic information, the reference variable was determined using the variable with the lower risk of PPH (See the 2020 report *Disparities in potentially preventable hospitalisations across Australia, 2012-13 to 2017-18* for more detail). For the survey questions, the most positive response formed the reference.

Preliminary analysis was performed to ensure no occurrences of quasi separation would occur, and that inclusion of a variable would not cause undue loss of records due to missing or not stated responses. Where variables contained small numbers across levels, these were grouped to reduce the impact of this. Where recoding was unable to ameliorate issues of high record loss or insufficient numbers, these variables were excluded from analysis.

Collinearity was also assessed using a correlation matrix and values resulting in high collinearity (i.e. a Pearson's  $r$  of greater than 0.7 or less than -0.7) were slated for removal, however no variables were found to have sufficiently high collinearity to warrant removal. The following proposed variables were removed due to small numbers and/or high record loss:

- Whether usual GP/place of care seemed informed of follow-up needs or medication changes after most recent emergency department visit
- Whether usual GP/others at usual place of care seemed informed about follow-up needs or medication changes after recent hospital admission.

## **Recoding of variables for model**

For the model, the survey questions were coded as follows:

### **Age:**

1. Ages 45 to 54 (reference)
2. Ages 55 to 64
3. Ages 65 to 74
4. Ages 75 to 84
5. Ages 85 and over

### **Sex**

1. Female (reference)
2. Male

### **Indigenous status (identification as):**

1. Non-Indigenous (reference)
2. Aboriginal only, Torres Strait Islander only, both Aboriginal and Torres Strait Islander

### **SEIFA - Index of Relative Socio-Economic Disadvantage (IRSD):**

1. Decile 9 and 10 – lowest levels of disadvantage (reference)
2. Decile 7 and 8
3. Decile 5 and 6
4. Decile 3 and 4
5. Decile 1 and 2 – highest levels of disadvantage

### **Main language spoken at home**

1. English (reference)
2. Language other than English

### **Self-assessed health status**

1. Excellent, Very good (reference)
2. Good
3. Fair, Poor

### **Whether has three or more long-term health conditions**

1. Does not have long-term health condition (reference)
2. Has one or two long-term health conditions
3. Has three or more long-term health conditions

### **Number of different medications currently taking on a regular and ongoing basis**

1. None, 1 to 4 (reference)
2. 5 to 9

3. 10 or more

**Whether was a frequent user of GP services**

1. Not a frequent user of GP services (reference)
2. Frequent user of GP services

**Self-assessed quality of health care received from usual GP or usual place of care in the last 12 months**

1. Excellent, Very good (reference)
2. Good
3. Fair, Poor

**Whether usual GP or others in usual place of care seemed aware of patient's health care history in the last 12 months**

1. Yes: Always, Yes: Usually (reference)
2. Yes: Sometimes
3. No: Never

**How often usual GP or others in usual place of care involved patient in decisions about own health care**

1. Always, Usually (reference)
2. Sometimes, Never

**Whether there was a time in the last 12 months when felt needed to see a GP but did not go:**

1. There was not a time when needed to see a GP but did not go (reference)
2. There was a time when needed to see a GP but did not go

**Whether there was a time in the last 12 months when felt needed to see a specialist doctor but did not go**

1. There was not a time when needed to see a specialist doctor but did not go (reference)
2. There was a time when needed to see a specialist doctor but did not go

**Whether a health professional reviewed all medication taken in the last 12 months**

1. Health professional reviewed all medication taken in the last 12 months (reference)
2. Health professional did not review all medication taken in the last 12 months

**Whether received enough information from any health professional about own care or treatment in the last 12 months**

1. Received enough information from a health professional about own care or treatment (reference)
2. Did not receive enough information from a health professional about own care or treatment
3. Did not need information about care or treatment

## **Number of people who could help with activities of daily living if required**

1. More than one (reference)
2. One
3. None

## **Model selection**

The model was developed by first exploring all explanatory variables to determine likely record loss, and whether sample size could be improved through regrouping of levels within these variables. All records with missing responses to these explanatory variables were removed and the remaining cohort was fitted to an initial multinomial model. Each variable was then ranked by their p-value (least significant to most significant) in this model. All variables with p-values greater than 0.1 were removed individually, with the model re-run each time to assess impact of removal. This was done until only variables with a p-value of less than 0.1 remained.

Using this final list of variables, the final study cohort was created by exclusion of individuals with missing or not stated responses to final list of variables:

- Age group
- Sex
- SEIFA (IRSD)
- Main language spoken at home
- Whether has greater than three long term conditions
- Self-rated health status
- Number of different medications
- Whether there was a time in the last 12 months when felt needed to see a GP but did not go
- Whether a frequent user of GP services
- Self-assessed quality of health care received from usual GP or usual place of care in the last 12 months
- Whether received enough information from any health professional about own care or treatment in the last 12 months

The final cohort size was 22,263 i.e. 3,239 cases removed (12.7% loss) from the total linked survey cohort of 25,502.

The final model, as determined by the above process, was then fitted to this final cohort with no missing responses. All models were created using the survey weights and replicate weights in the SURVEYLOGISTIC procedure in SAS 9.4.

The model fit was assessed using the likelihood ratio test and the Wald chi-squared test. The model also produced a set of odds ratios for each level of each variable, and includes confidence intervals. A difference between estimates was considered statistically significant when the 95% confidence intervals around the estimates did not overlap.

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# Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
CHC	Coordination of Health Care
GP	General practitioner
PPH	Potentially preventable hospitalisations
CC-PPH	Potentially preventable hospitalisations for chronic conditions

# Glossary

**confidence interval:** A range determined by variability in data, within which there is a specified (usually 95%) chance that the true value of a calculated parameter lies.

**confounding:** Confounding occurs when a third variable, called a confounder, distorts the real association between an exposure variable and an outcome variable. Confounding is a common occurrence in observational studies and can be controlled for by adding it into a logistic regression (or other type) model.

**continuity of care:** The relationship between a single practitioner and a patient that extends beyond specific episodes of illness or disease.

**coordination of care:** The deliberate organisation of patient care activities between 2 or more participants involved in a patient's care to help the appropriate delivery of health-care services.

**exposure:** An exposure can be broadly applied to any factor that could be associated with an outcome of interest.

**odds:** The odds of an event occurring is defined as the ratio of the probability that the event will occur over the probability that the event will not occur.

**odds ratio:** A measure of the odds of an event occurring given an exposure, or characteristic, compared with the odds of the event or outcome occurring without that exposure.

**outcome:** A broad term that can be used to define a disease, state of health or health-related event.

**remoteness:** Regions are divided up in each state and territory based on their relative accessibility to goods and services (such as GPs, hospitals, and specialist care) as measured by road distance. These regions are based on the Accessibility/Remoteness Index of Australia, and defined as remoteness areas by the Australian Statistical Geography Standard (2016). The 5 remoteness areas are *Major cities*, *Inner regional areas*, *Outer regional areas*, *Remote areas* and *Very remote areas*. *Remote* and *Very remote* areas have been combined for analyses in this report, due to smaller numbers of patients in these areas compared with other areas. This is described further at: [www.abs.gov.au/ausstats/abs@.nsf/mf/1270.0.55.005](http://www.abs.gov.au/ausstats/abs@.nsf/mf/1270.0.55.005).

**socioeconomic areas:** A population grouping that indicates how 'well off' a group of people are. In this report, socioeconomic areas are mostly reported using the Socio-Economic Indexes for Areas, typically for 5 groups—from those living in the lowest socioeconomic area (worst off) to those living in the highest socioeconomic area (best off). The index value reflects the overall or average level of disadvantage of the population of an area; it does not show how individuals living in the same area differ from each other in their socioeconomic areas. This report uses the Index of Relative Socio- Economic Disadvantage 2016, available at: [www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001](http://www.abs.gov.au/ausstats/abs@.nsf/mf/2033.0.55.001).

**usual GP:** The general practitioner whom a person visits for most of their health care.

**usual place of care:** The usual place to which people go if they are sick or need advice about their health. Examples of usual place of care settings include a clinic with GPs only, a clinic with GPs and other health professionals, a community health centre, an Aboriginal Medical Service, or, for some patients, a hospital emergency department.

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## Related publications

This report is the fifth in a series of reports using the Coordination of Health Care Study. The previous four reports can be found on the AIHW website:

- AIHW (2018). Healthy Communities: coordination of health care: experiences with GP care among patients aged 45 and over 2016. Cat. no. CHC 2. Canberra: AIHW <<https://www.aihw.gov.au/reports/primary-health-care/coordination-of-health-care/experiences-2016/contents/summary>>
- AIHW (2019). Coordination of health care: experiences of information sharing between providers for patients aged 45 and over 2016. Cat. no. CHC 3. Canberra: AIHW <<https://www.aihw.gov.au/reports/primary-health-care/coordination-of-health-care/experiences-ofinforma/contents/summary>>.
- AIHW (2020). Coordination of health care: experiences of barriers to accessing health services among patients aged 45 and over 2016. Cat. no. CHC . Canberra: AIHW <<https://www.aihw.gov.au/reports/primary-health-care/coordination-of-health-care/experiences-barriers/summary>>
- AIHW (2021). Coordination of health care for patients aged 45 and over by Primary Health Networks. Cat. no. CHC 7. Canberra: AIHW <Coordination of health care for patients aged 45 and over by Primary Health Networks, Summary - Australian Institute of Health and Welfare (aihw.gov.au)>

Other publications relating to coordination of health care that might also be of interest are:

ABS (Australian Bureau of Statistics) (2017). Survey of health care, Australia, 2016. ABS cat. no. 4343.0. Canberra: ABS.

ABS (2018). Coordination of Health Care Study: use of health services and medicines, Australia, 2015–16. ABS cat. no. 4343.0.55.001. Canberra: ABS.

AIHW (2018). Survey of Health Care: selected findings for rural and remote Australians. Cat. no. PHE 220. Canberra: AIHW.





This study investigates the relationship between aspects of a patient's health and primary care experiences and their likelihood of also having a potentially preventable hospitalisation (PPH) for a chronic condition during the survey period. While patient health measures (self-rated health status, being a frequent user of GP services, significant polypharmacy) were associated with chronic condition PPH, patient perceptions of experiences (such as GP awareness of the patient's health care history, GP involving the patient in care decisions) generally were not.

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