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Corrigendum

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The authors advise that the fourth author's name is incorrect and should be Mary O'Loughlin.

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Preventable hospitalisations in regional Queensland: potential for primary health?

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Abstract

Objective. The aims of this study were to: (1) use local health data to examine potentially preventable hospitalisations (PPHs) as a proportion of total hospital separations and estimated costs to a large regional hospital in northern Queensland, including differences associated with Indigenous status; and (2) identify priority conditions and discuss issues related to strategic local primary health intervention.

Methods. A cross-sectional analysis was conducted using Queensland Hospital Admitted Patient Data Collection data (July 2012–June 2014) restricted to 51 087 separations generated by 29 485 local residents. PPHs were identified from the International Statistical Classification of Diseases and Related Health Problems 10th Revision Australian Modification (ICD-10-AM) and procedure codes using National Healthcare Agreement definitions. Age-standardised separation rates were calculated using Australian 2001 reference population and associated economic costs were estimated using Australian-refined diagnosis related groups.

Results. Eleven per cent ($n = 5488$) of all hospital separations were classified as PPH, and most were for common chronic ($n = 2486$; 45.3%) and acute ($n = 2845$; 51.8%) conditions. Because many acute presentations reflect chronic underlying disease, chronic conditions account for up to 76.5% of all PPHs. Age-standardised PPH rates were 3.4-fold higher for Indigenous than non-Indigenous people. Associated 2-year costs were AU$32.7 million, which was 10.7% of estimated total health care expenditure for hospital separations, and were higher for Indigenous (14.9%) than non-Indigenous (9.7%) people.

Conclusions. High hospitalisation rates and costs for common preventable chronic conditions represent opportunities for primary healthcare interventions. In particular, community-level health services need to be more responsive to the needs of local Indigenous families.

What is known about the topic? PPH rates are used as a measure of timely access to quality primary health care, and are incrementally higher in regional and remote areas than in major cities. Investment in primary healthcare services has been shown to significantly reduce costs associated with avoidable hospitalisations.

What does this paper add? This study used local health data to identify the most common PPH conditions presenting to a large regional hospital in northern Queensland, including estimation of costs and differences associated with Indigenous status. Recommendations are made to strengthen primary healthcare and reduce hospital-related costs.

What are the implications for practitioners? Interventions to address high PPH rates should be tailored to meet the needs of the local population. Primary health strategies targeting common chronic conditions provide the greatest opportunity to reduce avoidable hospitalisations and costs in this regional area. Investment in collaborative, evidence-based interventions is recommended and justified, especially for Indigenous Australians.

Additional keywords: Aboriginal and Torres Strait Islander, chronic disease, health economics, potentially preventable hospitalisation, primary health care.

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Introduction

Regional and remote hospitals have high rates of admission for conditions that should have been managed with timely access to quality primary and community health services.[1,2] Australia's National Healthcare Agreement defines these admissions as potentially preventable hospitalisations (PPHs).[3] Although debate remains around PPH definitions,[4] the Australian Institute of Health and Welfare (AIHW) routinely collects and analyses PPH data (sourced from hospital separation diagnosis and procedure codes) as a component of the National Health Performance Framework to monitor the quality and effectiveness of these services.

The PPH data are broadly classified into three types of conditions: vaccine preventable, chronic health and acute medical. The most recent AIHW report for 2014–15 found 493 347 PPHs were recorded in Australian public hospitals, accounting for 8.2% of all separations.[5] Rates per 1000 population remain incrementally higher in regional (inner = 25.7; outer = 29.3) and remote areas (remote = 39.8; very remote = 59.1) than in major cities (23.7).[5] The reason people living in regional and remote areas have higher PPH rates is a complex issue, but three factors are likely to contribute significantly: (1) higher levels of socioeconomic disadvantage;[6,7] (2) difficulty accessing health services;[8,9] and (3) a higher burden of disease and comorbidities.[10–14]

Since 2006, the Australian Health Ministers' Advisory Council has produced biennial reports against the Aboriginal and Torres Strait Islander Health Performance Framework. Over this time period, results have remained fairly consistent despite various improvements to coding rules. The most recent of these reports[15] found the rate of PPH for Aboriginal and Torres Strait Islander people is threefold higher than for non-Indigenous Australians, and this disparity generally increases with age and remoteness. The report indicates these rates likely reflect higher underlying disease burden, limited access to early detection and management of common chronic conditions and limited non-hospital alternatives in rural and remote areas.[15] This is supported, in part, by a recent Northern Territory study of 14 184 people living in remote Indigenous communities over the period 2002–11,[16] which found that higher primary healthcare utilisation was associated with a 60–85% reduction in common chronic PPH, and every AU$1 invested in primary health could produce savings of AU$3.95–11.75 in hospital costs, in addition to other health benefits for individuals.

The relative paucity of primary and other community health services in regional and remote areas contributes significantly to high PPH rates, with local hospitals becoming the default service provider.[17] For example, factors such as adequate physician supply, long-term physician–patient relationships and general practitioner (GP) management plans have all been found to be important for reducing PPHs.[18] A recent report from the Grattan Institute identified northern Queensland as a 'hot spot' for PPHs, with rates at least 50% higher than the state average in every year for a decade.[19] The authors of that report recommend that geographical areas such as these represent persistent and costly health inequality, and should be prioritised for state and federal government investment to improve primary and other health services. The authors also recommend using local data to assist in identifying the health priorities of local communities and in developing, testing and evaluating tailored interventions over time.[19] The federal government is currently trialling the introduction of 'health care homes' throughout Australia,[20] the purpose of which is to strengthen the role of general practices and Aboriginal Community Controlled Health Services (ACCHSs) as the central care provider (rather than the hospital) by providing continuity of care for people with chronic and complex conditions. In addition to improvements in access, care processes and patient experience, it is hoped that this initiative will reduce unnecessary hospitalisations, including PPHs.

The purpose of the present study was to use local admissions data from a large regional tertiary care hospital in far north Queensland to examine PPHs (and estimated costs) as a proportion of total hospital separations and by Indigenous status. We also identify opportunities for local primary health services to reduce hospitalisations and discuss issues related to strategic intervention.

Methods

Study setting and population

Located in northern Queensland, Australia, the large public hospital provides tertiary care for over 275 000 people. Although the hospital services people living in very remote areas, it primarily caters for the large regional population in the surrounding 10 Statistical Local Areas (SLAs). Approximately 68 867 hospital separations were recorded between 1 July 2012 and 30 June 2014. Of these, 74.2% (51 087) were generated by people living in the 10 SLAs, and the results of the present study are based on these separations. The 10 SLAs 'map' to two larger Local Government Area (LGA) boundaries (Cairns (LGA/32070) and Yarrabah (LGA37600)). The Far North Queensland Human Research Ethics Committee approved the present study (HREC/13/QCH/131-880) and data were provided by Queensland Health.

Demographic and other factors of interest

Factors of interest were determined from raw Queensland Hospital Admitted Patient Data Collection (QHAPDC) data, including gender, age, Indigenous status, SLA, medical or unit record number (URN), length of stay (LOS), admission and discharge dates and final primary and secondary diagnoses. Socioeconomic disadvantage for each SLA was measured using the Index of Relative Socioeconomic Disadvantage (IRSD) calculated by the

Australian Bureau of Statistics[21] and based on 2011 Census data (http://www.abs.gov.au/AUSSTATS/abs@.nsf/Details-Page/2033.0.55.0012011?OpenDocument, accessed 4 February 2018). The IRSD was used because it provides a broad measure of disadvantage by ranking areas according to a range of social and economic conditions reported at the individual and household level within each SLA. Some of the factors of interest when measuring IRSD include income, educational attainment, unemployment and unskilled occupations. Lower IRSD scores indicate areas with greater disadvantage and higher scores indicate areas with least disadvantage.

Potentially preventable hospitalisations

PPHs were identified from discharge diagnosis codes using International Statistical Classification of Diseases and Related Health Problems 10th Revision Australian Modification (ICD-10-AM)[22] and relevant procedure codes using National Healthcare Agreement definitions.[23]

Estimation of costs

Costs associated with PPHs were estimated using Australian-refined diagnosis-related groups (AR-DRG). The AR-DRGs are sourced from the AIHW National Hospital Morbidity Database (NHMD) with diagnostic groupings based upon ICD-10-AM classifications. According to the AIHW, AR-DRG is an Australian admitted patient classification system that provides a clinically meaningful way of relating patient casemix to resources required by the hospital.[24] National average costs for each AR-DRG were provided by the Independent Hospital Pricing Authority (IHPA), including both total cost and disaggregated into main procedures and average LOS. This study selected costs relating to the financial year 2013–14 in order to align with the hospital's admission data.[25] These national average total costs for AR-DRGs were then converted into an 'average per day cost' by dividing the total cost by average LOS. To estimate hospital costs, this average per day cost was multiplied by the actual LOS taken from hospital records for each acute PPH patient admission. Total costs for each PPH and median patient cost, driven by LOS, were estimated.

Statistical analysis

Analyses were performed with STATA 13.1 (StataCorp, College Station, TX, USA). Records were linked to individuals using the unique URN and the number of separations per person was calculated as the number of separations per URN.

Crude rates per 100 000 population were calculated using two financial years of hospital separation data combined (1 July 2012–30 June 2014) and two financial years of population data for the same period. A 2-year period of hospitalisations was selected to reduce the effect of annual variability in separation rates. The population data were the estimated residential population sourced from the Queensland Regional Database maintained by the Queensland Government Statistician's Office (http://www.qgso.qld.gov.au/products/tables/qld-regional-database/index.php; accessed 15 April 2015). Data were extracted in 5-year age groups by Indigenous status for Cairns (LGA/32070) and Yarrabah (LGA37600).

Age distributions for Indigenous and non-Indigenous separations were dissimilar. To enable comparisons of separation rates between groups, crude rates were directly age standardised[26] to the 30 June 2001 Australian standard population maintained by Australian Bureau of Statistics.[27]

Table 1. Characteristics of 51 087 hospital separations, according to potentially preventable hospitalisations (PPHs) from 1 July 2012 to 30 June 2014, local residents only

Data are given as *n* (%). IRSD, Index of Relative Socioeconomic Disadvantage

	PPH	Non-PPH	Total
Total hospital separations	5488 (10.7)	45 599 (89.3)	51 087 (100.0)
Gender			
Male	2653 (48.3)	23 871 (52.3)	26 524 (51.9)
Female	2835 (51.7)	21 728 (47.7)	24 563 (48.1)
Indigenous status			
Indigenous	1420 (25.9)	7961 (17.5)	9381 (18.4)
Non-Indigenous	4068 (74.1)	37 638 (82.5)	41 706 (81.6)
Age group (years)			
Infants and toddlers (0–4)	541 (9.9)	6849 (15.0)	7390 (14.5)
Children and early teens (5–14)	423 (7.7)	2278 (5.0)	2701 (5.3)
Teenagers and young adults (15–24)	429 (7.8)	3795 (8.3)	4224 (8.3)
Adults (25–44)	930 (16.9)	10 180 (22.3)	11 110 (21.7)
Middle-aged adults (45–64)	1347 (24.5)	11 784 (25.8)	13 131 (25.7)
Senior adults (65–84)	1412 (25.7)	8735 (19.2)	10 147 (19.9)
Elderly (≥85)	406 (7.4)	1978 (4.3)	2384 (4.7)
Arrived by ambulance	2633 (58.3)	13 515 (51.3)	16 148 (52.3)
IRSD			
Quartile 1 (most disadvantaged)	1327 (24.2)	9567 (21.0)	10 894 (21.3)
Quartile 2	2355 (42.9)	19 873 (43.6)	22 228 (43.5)
Quartile 3	1806 (32.9)	16 159 (35.4)	17 965 (35.2)
Quartile 4 (least disadvantaged)	0 (0.0)	0 (0.0)	0 (0.0)

Each hospitalisation in the dataset had an allocated diagnosis-related group (DRG). To estimate the cost of PPHs, each hospitalisation was allocated a monetary figure based on the corresponding DRG. These amounts were then aggregated based on PPH categories and the total and median costs were calculated by Indigenous status.

Results

Potentially preventable hospitalisations

In the two financial years 2012–14, there were approximately 51 087 separations generated by 29 485 people (Table 1). Of these separations, 10.7% (5488) were classified as potentially preventable. Half of all PPHs were for women (51.7%) and approximately one-third were for those aged ≥65 years (33.1%). Indigenous people represented 25.9% of all PPHs despite accounting for only 12.9% of the Cairns and Yarrabah LGA populations. Potentially preventable hospitalisation rates were substantially higher for Indigenous people across 5-year age groups, particularly in older age groups (Fig. 1).

Most PPHs were for chronic (45.3%) and acute (51.8%) conditions (Table 2). Most chronic conditions (93.2%) were for chronic obstructive pulmonary disease (COPD; $n = 640$; 25.7%), diabetes complications ($n = 432$; 17.4%), congestive cardiac failure (CCF; $n = 375$; 15.1%), angina ($n = 322$; 13.0%), iron-deficiency anaemia ($n = 289$; 11.6%) and asthma ($n = 258$l; 10.4%). Most acute conditions (95.8%) were for urinary tract infections (UTI; $n = 976$; 34.3%), convulsions ($n = 575$; 20.2%), ear, nose, throat (ENT) infections ($n = 438$; 15.4%), dental conditions ($n = 353$; 12.4%), cellulitis ($n = 257$; 9.0%) and gangrene ($n = 126$; 4.4%).

The top four conditions for Indigenous people were UTIs ($n = 201$; 14.2%), convulsions ($n = 182$; 12.8%), diabetes complications ($n = 178$; 12.5%) and COPD ($n = 156$; 11.0%). The top four conditions for non-Indigenous people were UTIs ($n = 775$; 19.1%), COPD ($n = 484$; 11.9%), convulsions ($n = 393$; 9.7%) and ENT infections ($n = 355$; 8.7%).

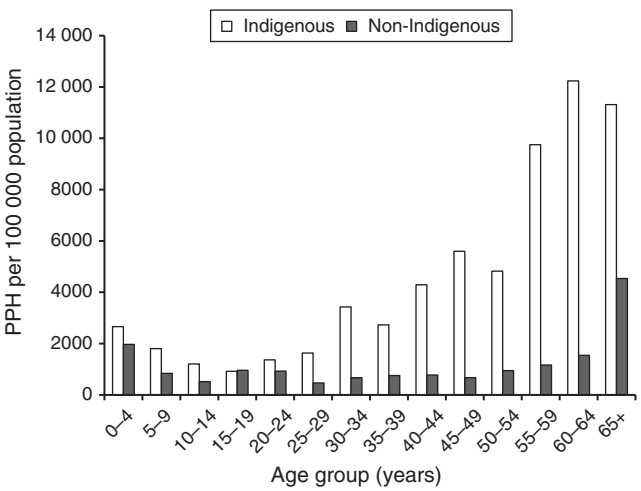

Fig. 1. Potentially preventable hospitalisation (PPH) rates for 5488 hospital separations, by Indigenous status and 5-year age groups, from 1 July 2012 to 30 June 2014, local residents only.

Age-standardised rate ratios

Age-standardised PPH rates were higher for Indigenous people across all PPH categories (Table 2). Overall, Indigenous people were 3.5-fold more likely to have a PPH than non-Indigenous people (age-standardised rate 3.4; 95% confidence interval (CI) 3.2–3.6). Age-standardised rates for Indigenous people were eightfold higher for vaccine-preventable PPHs (7.8; 95% CI 5.6–10.6)], fourfold higher for chronic PPH (4.1; 95% CI 3.7-–4.5), almost threefold higher for acute PPH (2.7; 95% CI 2.4–3.0) and nearly eightfold higher for diabetes complications (7.7; 95% CI 6.2–9.4).

Age groups

Acute conditions were highest among younger age groups and generally decreased with age, whereas chronic conditions were lowest among younger age groups and increased with age. Vaccine-preventable conditions were fairly uniform across age groups. The pattern of PPH distribution across the lifespan was similar by Indigenous status except that the intersection point where chronic conditions start to outnumber acute conditions occurred one decade earlier for Indigenous people (41–50 years) than non-Indigenous people (51–60 years; Fig. 2). Diabetes complications appeared regularly in the top four PPH conditions across the lifespan for Indigenous people and COPD appeared at a younger age (Table 3).

Costs of PPH

All separations

Total PPH represented 5488 separations and an estimated AU $32.7 million, which was 10.7% of total hospital separation expenditure over the 2-year period (Table 4). The top three most expensive PPHs, in terms of total cost for all separations, were UTI (AU$4.9 million), COPD (AU$4.9 million) and diabetes (AU$4.5 million). Associated median costs (and median LOS) per separation types were: AU$3542 (1 day) for UTI, AU$5627 (3 days) for COPD and AU$6332 (3 days) for diabetes.

Non-Indigenous separations

Total PPHs in the non-Indigenous population represented 4068 separations and AU$23.8 million, which was 9.7% of total hospital costs for this group. The top three most expensive PPHs, in terms of total cost for all separations, were UTI ($4.0 million), COPD ($3.8 million) and CCF ($2.4 million).

Indigenous separations

Total PPHs in the Indigenous population represented 1420 separations and AU$8.9 million, which was 14.9% of total hospital costs for this group. The top three most expensive PPHs, in terms of total cost for all separations, were diabetes ($2.2 million), COPD ($1.1 million) and UTI ($1 million). Overall, the median cost per separation type tended to be slightly higher for Indigenous people, with diabetes the most notable with a median cost (LOS) of AU$11 546 (3 days) for Indigenous people compared with AU$4887 (2 days) for non-Indigenous people.

Table 2. Potentially preventable hospitalisations (PPHs) according to Indigenous status from 1 July 2012 to 30 June 2014, local residents only

Crude rates per 100 000 population were calculated using two financial years of hospital separation data combined (1 July 2012–30 June 2014) and two financial years of population data for the same time period. The population data were sourced from the Queensland Regional Database maintained by the Queensland Government Statistician's Office. Data were extracted in 5-year age groups by Indigenous status. COPD, chronic obstructive pulmonary disease; CCF, congestive cardiac failure; UTI, urinary tract infections; ENT, ear, nose and throat; CI, confidence interval

PPH conditions	Total no. (%)	Indigenous			Non-Indigenous			Age standardised rate ratio (95% CI)
		n	Rate (per 100 000)		*n*	Rate (per 100 000)		
			Crude rate	Age standardised (95% CI)		Crude rate	Age standardised (95% CI)	
Overall total	5488 (100.0)	1420	3141	4612 (4340–4885)	4068	1361	1359 (1318–1400)	3.4 (3.2–3.6)
Vaccine preventable								
Total	194 (3.5)	78	173	295 (221–369)	116	39	38 (31–45)	7.8 (5.6–10.6)
Other vaccine preventable	109 (2.0)	45	100	153 (104–201)	64	17	17 (13–22)	8.8 (5.6–13.6)
Influenza and pneumonia	85 (1.5)	33	73	143 (87–198)	52	21	21 (16–26)	6.9 (4.1–10.9)
Chronic								
Total	2486 (45.3)	652	1442	2456 (2247–2665)	1834	613	603 (576–631)	4.1 (3.7–4.5)
COPD	640 (11.7)	156	345	662 (551–773)	484	162	158 (144–172)	4.2 (3.4–5.1)
Diabetes complications	432 (7.9)	178	394	633 (529–737)	254	85	83 (72–93)	7.7 (6.2–9.4)
CCF	375 (6.8)	85	188	447 (343–550)	290	97	96 (85–107)	4.6 (3.5–6.0)
Angina	322 (5.9)	60	133	244 (177–311)	262	88	83 (73–93)	2.9 (2.1–4.0)
Iron-deficiency anaemia	289 (5.3)	47	104	178 (120–235)	242	81	80 (70–90)	2.2 (1.5–3.1)
Asthma	258 (4.7)	58	128	131 (91–171)	200	67	70 (60–79)	1.9 (1.3–2.6)
Bronchiectasis	63 (1.1)	34	75	60 (34–86)	29	10	9 (6–13)	6.4 (3.5–11.7)
Hypertension	59 (1.1)	12	27	54 (20–88)	47	16	16 (11–20)	3.4 (1.5–6.7)
Rheumatic heart disease	43 (0.8)	21	46	40 (21–58)	22	7	7 (4–11)	5.3 (2.7–10.6)
Nutritional deficiencies	5 (0.1)	1	2	8 (0–25)	4	1	1 (0–3)	6.2 (0.1–44.8)
Acute								
Total	2845 (51.8)	710	1570	1935 (1762–2109)	2135	714	723 (692–753)	2.7 (2.4–3.0)
UTI	976 (17.8)	201	445	750 (626–874)	775	259	264 (245–282)	2.8 (2.4–3.4)
Convulsions	575 (10.5)	182	403	458 (381–535)	393	131	131 (118–144)	3.5 (2.8–4.3)
ENT infections	438 (8.0)	83	184	153 (111–195)	355	119	124 (111–137)	1.2 (0.9–1.7)
Dental conditions	353 (6.4)	134	296	212 (173–250)	219	73	76 (66–86)	2.8 (2.2–3.5)
Cellulitis	257 (4.7)	40	88	112 (71–154)	217	73	72 (62–81)	1.6 (1.0–2.3)
Gangrene	126 (2.3)	40	88	159 (103–214)	86	29	27 (21–32)	6.0 (3.8–9.0)
Pelvic inflammatory disease	59 (1.1)	21	46	51 (28–73)	38	13	13 (9–17)	3.8 (2.1–6.8)
Perforated or bleeding ulcer	46 (0.8)	3	7	15 (0–33)	43	14	14 (10–18)	1.1 (0.2–3.3)
Pneumonia	15 (0.3)	6	13	26 (1–51)	9	3	3 (1–5)	8.9 (2.0–28.7)

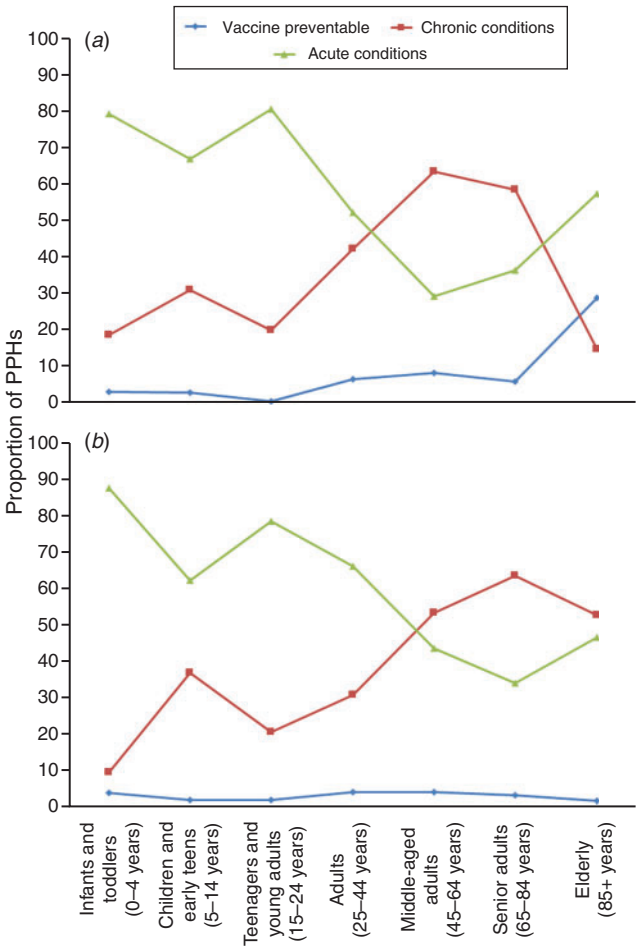

Fig. 2. Proportion of preventable hospitalisation (PPH) types according to age group in (*a*) Indigenous and (*b*) non-Indigenous people from 1 July 2012 to 30 June 2014.

Discussion

Chronic and acute conditions accounted for 97% of all PPHs to this large public hospital in regional north Queensland. Most chronic conditions were for COPD, diabetes complications, CCF, angina, iron-deficiency anaemia and asthma. Most acute PPH conditions were for UTIs, convulsions, ENT infections, dental conditions, cellulitis and gangrene. Although UTIs, dental conditions, cellulitis and gangrene present acutely, they often reflect a chronic underlying condition, such as diabetes. If this was taken into consideration, chronic conditions would account for 76.5% of all PPHs. Age-standardised rates for Indigenous people were consistently higher than those for non-Indigenous people, with diabetes complications appearing regularly in the top four PPH conditions across the lifespan and chronic conditions such as COPD appearing at a younger age. The financial costs associated with PPH were substantially higher for Indigenous people, and justify investment in strategic, collaborative, evidence-based primary health interventions aimed at addressing health inequalities experienced in northern Queensland.

PPH rates were found to be consistently higher for Indigenous people across the lifespan. These findings are consistent with a recent national report against the Aboriginal and Torres Strait Islander Health Performance Framework[28] that found these disparities also generally increased with remoteness. A recent Northern Territory study[29] found PPH rates per 100 000 population were 11 090 for Aboriginal people and 2779 for non-Aboriginal people for the 8-year period from 1998–99 to 2005–06. These rates are somewhat higher than those observed in the present study, but the Northern Territory study was based on hospitalisation data for the entire Northern Territory covering large areas considered to be remote or very remote, and remoteness has been shown to be consistently associated with higher PPH rates.[5] We attempted to remove these geographical differences by restricting the present study to only those people considered local residents surrounding the hospital. Although we observed relatively low rates of vaccine-preventable PPHs in our population, the rate of these PPHs for Indigenous people was nearly eightfold higher than for non-Indigenous people. This is consistent with national reports.[5] Aboriginal Medical Services and other health services in the area have invested considerable effort in recent years to improve historically low vaccination rates. In addition to existing clinic-based vaccination, services have engaged in strategies including education programs, outreach home visits and targeting of priority groups within the community.

Aspects of primary healthcare that have been found to be important for reducing PPH include adequate physician supply, continuity of care, GP management plans, subsidised community health services and higher utilisation.[2,16,30] A recent preliminary report released for consultation on primary care services funded through the Medicare Benefits Schedule found that funding for urgent after-hours services in Queensland is far less in regional and remote areas like Far North Queensland than urban areas such as Brisbane.[31] Although there appears to be broad agreement that these types of services may increase access to primary healthcare, their role in reducing PPH is currently undetermined. Indeed, considerable concern exists among professional groups that these services may undermine the quality and safety of primary health through the provision of costly and fragmented care often by underqualified medical practitioners.[31–33]

Four recent publications have reviewed available evidence regarding primary health interventions and PPH, most of which has been focused on chronic disease-specific approaches (e.g. diabetes and COPD).[2,18,30,34] Overall, evidence for specific interventions to reduce PPHs is weak. Australian initiatives show promise rather than conclusive evidence.[30] The international review of 49 reports from high-income countries concluded that strong primary care (adequate primary care physician supply and continuity of care embodied in the 'medical home' approach, including self-management support as described in the Wagner Chronic Care Model[35]) reduces avoidable hospitalisations for chronic conditions.[18] The authors of that review also found that there is currently a lack of evidence for other interventions, such as disease-specific management programs. Although there are numerous examples of care coordination programs in Australia, their effect on reducing PPH rates is inconclusive and requires further investigation.[2] A recent report from the Grattan Institute identifying 'hot spots' with persistently high PPH rates recommends developing, testing and evaluating tailored interventions for local areas to address the health inequities that lead to higher PPH rates.[19] The authors of that report

Table 3. Most common potentially preventable hospitalisations, by age group and Indigenous status from 1 July 2012 to 30 June 2014, local residents only

Percentages are based on age group totals. COPD, chronic obstructive pulmonary disease; CCF, congestive cardiac failure; ENT, ear, nose and throat

Age groups (years)	Total		Indigenous		Non-Indigenous	
	Condition	No. separations (%)	Condition	No. separations (%)	Condition	No. separations (%)
Infants and toddlers (0–4)	Total	541 (100.0)	Total	159 (100.0)	Total	382 (100.0)
	ENT infections	194 (35.9)	Convulsions	44 (27.7)	ENT infections	161 (42.1)
	Convulsions	115 (21.3)	ENT infections	33 (20.8)	Convulsions	71 (18.6)
	Pyelonephritis	85 (15.7)	Dental conditions	27 (17.0)	Pyelonephritis	71 (18.6)
	Dental conditions	53 (9.8)	Bronchiectasis	16 (10.1)	Dental conditions	26 (6.8)
Children and early teens (5–14)	Total	423 (100.0)	Total	163 (100.0)	Total	260 (100.0)
	Dental conditions	117 (27.7)	Dental conditions	61 (7.7)	Asthma	69 (3.6)
	Asthma	82 (19.4)	ENT infections	21 (2.7)	Dental conditions	56 (2.9)
	ENT infections	71 (16.8)	Diabetes complications	16 (2.0)	ENT infections	50 (2.6)
	Convulsions	37 (8.7)	Asthma	13 (1.6)	Convulsions	26 (1.4)
Teenagers and young adults (15–24)	Total	429 (100.0)	Total	97 (100.0)	Total	332 (100.0)
	Pyelonephritis	133 (31.0)	Pyelonephritis	32 (3.2)	Pyelonephritis	101 (3.1)
	ENT infections	65 (15.2)	Dental conditions	18 (1.8)	ENT infections	58 (1.8)
	Convulsions	61 (14.2)	Convulsions	14 (1.4)	Convulsions	47 (1.5)
	Dental conditions	42 (9.8)	ENT infections	7 (0.7)	Asthma	29 (0.9)
Adults (25–44)	Total	930 (100.0)	Total	341 (100.0)	Total	589 (100.0)
	Convulsions	157 (16.9)	Convulsions	60 (2.5)	Pyelonephritis	108 (1.2)
	Pyelonephritis	153 (16.5)	Diabetes complications	53 (2.2)	Convulsions	97 (1.1)
	Dental conditions	94 (10.1)	Pyelonephritis	45 (1.8)	Iron-deficiency anaemia	75 (0.9)
	Iron-deficiency anaemia	93 (10.0)	COPD	24 (1.0)	Dental conditions	72 (0.8)
Middle-aged adults (45–64)	Total	1347 (100.0)	Total	490 (100.0)	Total	857 (100.0)
	COPD	222 (16.5)	COPD	109 (4.5)	Pyelonephritis	117 (1.1)
	Pyelonephritis	175 (13.0)	Diabetes complications	80 (3.3)	COPD	113 (1.1)
	Diabetes complications	174 (12.9)	Pyelonephritis	58 (2.4)	Angina	104 (1.0)
	Convulsions	144 (10.7)	Convulsions	46 (1.9)	Convulsions	98 (0.9)
Senior adults (65–84)	Total	1412 (100.0)	Total	163 (100.0)	Total	1249 (100.0)
	COPD	340 (24.1)	Pyelonephritis	38 (5.2)	COPD	318 (3.4)
	Pyelonephritis	269 (19.1)	CCF	32 (4.4)	Pyelonephritis	231 (2.5)
	CCF	185 (13.1)	COPD	22 (3.0)	CCF	153 (1.6)
	Angina	129 (9.1)	Diabetes complications	17 (2.3)	Cellulitis	121 (1.3)
Elderly (≥85)	Total	406 (100.0)	Total	7 (100.0)	Total	399 (100.0)
	Pyelonephritis	131 (32.3)	Pyelonephritis	4 (12.9)	Pyelonephritis	127 (5.4)
	CCF	84 (20.7)	Influenza, pneumonia	2 (6.5)	CCF	84 (3.6)
	COPD	47 (11.6)	COPD	1 (3.2)	COPD	46 (2.0)
	Iron-deficiency anaemia	33 (8.1)	–	–	Iron-deficiency anaemia	33 (1.4)

Table 4. Potentially preventable hospitalisations (PPHs), according to diagnosis-related group costs and Indigenous status from 1 July 2012 to 30 June 2014, local residents only

Median costs refer to median costs per episode. LOS, length of stay; UTI, urinary tract infection; PID, pelvic inflammatory disease; COPD, chronic obstructive pulmonary disease; CCF, congestive cardiac failure; ENT, ear, nose and throat

	All separations				Indigenous				Non-Indigenous			
	n	Median cost (AU$)	Median LOS (days)	Total cost (AU$)	*n*	Median cost (AU$)	Median LOS (days)	Total cost (AU$)	*n*	Median cost (AU$)	Median LOS (days)	Total cost (AU$)
All separations	51 085	3613	1	305 230 597	9381	3631	1	59 839 032	41 704	3613	1	245 391 565
Total PPH	5488	3542	1	32 731 177	1420	3807	1	8 887 962	4068	3542	1	23 843 216
Vaccine-preventable												
Total	194	6719	4	2 493 597	78	6767	4	672 888	116	6719	4	1 820 708
Influenza and pneumonia	97	6719	4	1 628 888	33	6719	4	254 269	64	6719	3	1 374 619
Other vaccine preventable	97	7103	4	864 709	45	8211	4	418 620	52	6791	4.5	446 089
Chronic												
Total	2479	5627	2	16 129 737	647	5627	2	4 922 296	1832	5627	2	11 207 441
COPD	640	5627	3	4 898 375	156	5627	2	1 064 785	484	5627	3	3 833 591
Diabetes complications	432	6332	3	4 477 878	178	11 546	3	2 182 059	254	4887	2	2 295 819
CCF	375	5763	4	3 246 101	85	5763	3	815 529	290	5763	4	2 430 572
Angina	322	2837	1	1 367 499	60	2837	1	234 038	262	2837	1	1 133 461
Iron-deficiency anaemia	289	1524	1	669 292	47	1524	1	103 409	242	1524	1	565 883
Asthma	258	2625	1	813 460	58	2625	1	203 518	200	2625	1	609 942
Bronchiectasis	63	5627	5	410 495	34	5627	3	200 997	29	5627	7	209 498
Hypertension	59	3098	1	260 022	12	3098	1	65 399	47	3098	1	194 623
Rheumatic heart disease	43	2790	3	192 349	21	2790	2	89 032	22	2790	3	103 316
Nutritional deficiencies	5	15 043	20	75 213	1	15 043	26	15 043	4	15 043	13	60 171
Acute												
Total	2815	3542	1	14 107 844	695	3336	1	3 292 778	2120	3542	1	10 815 067
UTI[A]	976	3542	1	4 949 213	201	3542	1	982 927	775	3542	1	3 966 286
Convulsions	575	3200	1	2 778 679	182	3200	1	844 024	393	3200	1	1 934 655
ENT infections	438	2938	1	1 300 260	83	2938	1	241 113	355	2938	1	1 059 146
Dental conditions	353	2994	1	1 120 949	134	2994	1	411 517	219	2994	1	709 432
Cellulitis	257	4000	5	1 573 544	40	4000	3.5	225 413	217	4000	5	1 348 131
Gangrene	126	14 741	9	2 203 245	40	16 581	10.5	699 697	86	14 741	8	1 503 548
PID	59	3414	1	240 474	21	3414	2	81 554	38	3414	1	158 920
Perforated or bleeding ulcer	46	6154	3	444 994	3	5721	6	26 295	43	6587	3	418 699
Pneumonia	15	6719	5	111 827	6	4925	4	32 535	9	6719	5	79 292

[A]Including pyelonephritis.

include a collaborative approach in their strategy, whereby primary health networks are supported financially and otherwise by federal and state governments to lead targeted intervention research with primary and other health services within their jurisdiction. However, the federal government currently funds primary healthcare and the state governments fund hospital care. Consequently, there are likely to be considerable financial challenges ahead in achieving the strategic development (and sustained financing) of the innovative interventions required.

The present study has identified opportunities to reduce PPHs in this large regional hospital in northern Queensland. We found that 76.5% of all PPHs were either chronic conditions (COPD, diabetes complications, CCF, angina, iron-deficiency anaemia and asthma) or likely related acute conditions such as UTIs, dental conditions, cellulitis and gangrene. As such, we suggest targeting these specific conditions because they are likely to be conducive to trials involving collaborative primary healthcare interventions and potentially deliver the most cost savings and individual benefit. One-third of all PPHs in the present study were for people aged ≥65 years. Targeting programs at high-risk age groups is therefore justified. Several promising projects are currently underway in the region aiming to improve the integration of care for elderly people living with complex conditions. The local region is not without other strategies to address conditions favourable to primary healthcare management, although historically many of these strategies have been implemented without proper consideration for effective evaluation. The local public hospital currently provides a suite of services that have been shown to reduce PPH for specific conditions,[19] including a specialist diabetes out-patient clinic, physiotherapy and rehabilitation clinics for cardiac and pulmonary conditions and nurse-led case management of people with complex health needs. Initiatives such as the integrated electronic medical record and telehealth have also been evolving to enhance access, communication and continuity of care between health services. However, the results of the present study indicate that more could be done, especially for Aboriginal and Torres Strait Islander people living in the region.

Initiatives to reduce PPHs specifically for Indigenous people are still rare.[30] Much of the work is performed by the local Aboriginal Medical Services using Medicare Item 715 as remuneration for annual health checks.[36] These are designed to promote early detection, diagnosis and management of many conditions associated with PPHs. There are also specific remuneration arrangements for GP management plans for chronic diseases. Aboriginal Medical Services also initiate programs targeting areas of high community need, although these are often challenging for the organisation to fund and resource. These initiatives may target specific health issues such as influenza vaccination, diabetes, oral health and sexually transmissible infections, or be focused on broader upstream issues such as maternal and child health, social and emotional well-being and alcohol and drug support. Future success in lowering PPH rates is likely to involve collaborative design and implementation of multifactorial programs targeting the common conditions and high-risk subgroups with complex needs identified in the present study. Programs should include: (1) early detection, early treatment and symptom management; (2) creation of supportive environments; (3) self-management support; (4) service delivery and coordination; (5) local liveability; (6) socioeconomic opportunity;[37,38] and (7) respectful, community-led collaboration.[39]

Key to lowering PPH rates in northern Queensland is likely to be further development of primary healthcare services, including Aboriginal Medical Services. A promising reform in this area is the federal government's introduction of 'health care homes' throughout Australia. Clinicians from participating primary healthcare services will become responsible for the overall coordination of chronic disease management of their patients, regardless of where the treatment occurs.[20,40] In exchange for this, practices will receive an annual complexity-based payment of between AU$591 and AU$1795 per patient, and a single grant to support training and establishment.[20] Whether this model will work in rural and remote areas is yet to be seen. Evidence from implementation studies of the Medical Home in the US has demonstrated some improvement in preventative care service delivery for people with chronic conditions, although results are mixed and insufficient for service provision (including accessibility and coordination of care), clinical outcomes, in-patient utilisation[41] and patient experience.[42] Diversity in the primary care setting has challenged implementation of the Medical Home care model, indicating a need for setting-specific approaches to address the healthcare needs of distinctive population subgroups.

The present study has numerous strengths and also limitations. Analysis was based on a 2-year QHAPDC dataset for the major regional public hospital servicing a discrete area in northern Queensland. The dataset was complete and analysis was carefully restricted to local residents living in 10 SLAs surrounding the hospital. However, the results are subject to error inherent in any secondary administrative dataset. For example, errors in defining the local population within SLAs immediately around the hospital may have occurred from incorrect information collected relating to residential postcode and suburb. Similarly, PPHs used in our analyses were defined using National Healthcare Agreement definitions.[23] These include relevant ICD-10-AM discharge diagnosis and procedure codes, both of which have been shown to have limited accuracy.[43,44]

Some controversy exists as to whether current PPH conditions truly reflect hospitalisations that are potentially preventable. As such, PPH definitions are frequently revised and are recommended to be used as performance indicators only.[4] In addition, accuracy in identifying Indigenous status in Australian public hospitals has been shown to vary by geographical location, with only 93% of Indigenous and 98% of non-Indigenous separations correctly identified in outer regional settings such as ours.[45] Consequently, the true number of Indigenous separations in our dataset and age-standardised estimates are likely to be higher than reported here. The costing analysis was essentially a 'top-down' approach using national average costs for AR-DRG and applying to the hospital by adjusting for actual LOS. This is appropriate for analysis at a population level. However, the costs are approximations. A more refined method would be, for example, a microcosting approach to directly access the hospital's medical and financial records to cost each acute admission. However, this approach was not practicable, nor deemed necessary, for this population-level analysis.

Conclusion

The results of the present study suggest that opportunities exist to improve local hospital and primary health services to reduce hospitalisation for common preventable conditions in regional north Queensland. In particular, community-level health services need to be more responsive to the needs of local Indigenous families. Future research should be visionary and committed to improvements over the long term. Initiatives need to involve formal coordinated collaboration between primary health networks, Queensland Health and ACCHSs supported by secure funding and other resources from federal and state governments. Trialling and prospective evaluation of these initiatives would provide timely evidence regarding efficiency and cost-effectiveness for both local and national use.

Competing interests

The authors declare they have no competing interests.

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