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Using archival employee data to examine retention patterns for healthcare workers in non-metropolitan Australia: a survival analysis

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Abstract

Background Healthcare workers (HCWs) play a crucial role in the delivery of much-needed healthcare services globally. Outside major metropolitan centres (i.e., non-metropolitan areas including regional, rural, remote, and very remote), recruiting and retaining HCWs continues to be a challenge. Rural Australia already faces significant healthcare challenges and inequities. Stabilizing the healthcare workforce in these underserved areas is a national priority. This study aimed to examine median retention timeframes across medicine, nursing, midwifery, and allied health professions in the public health sector in rural southern Queensland (Australia). Further, it also aimed to understand the demographic, employment, and geographical variables that influence retention of the rural healthcare workforce.

Methods A 12-year administrative dataset from two public health services, servicing rural Queensland in Australia were examined. De-identified data were analyzed through descriptive statistical tests, survival analyses, and Andersen-Gill Cox proportional hazards regression.

Results Data from 6651 records linked to 5527 employees were included in the analysis. Sampled employees were predominately female (70.4%), employed permanently (86.3%), in a clinical role (97.6%), and in the public hospital sector (87.5%). The overall median survival time (i.e., time employed in one location) was 1.46 years [95% CI, 1.35–1.52 years], with 41% of employees remaining in employment in location after two years. Compared to those in nursing and midwifery, those employed in medical (HR: 1.91, 95% CI: 1.75–2.09) and allied health (HR: 1.38, 95% CI: 1.26–1.51) streams were at greater risk of leaving location. This effect was relatively small, though, compared to: (a) geographic location of employment, where, compared to those working in the regional city, there was greater risk of leaving location if working in rural (HR: 1.79, 95% CI: 1.66–1.94) or remote communities (HR: 2.64, 95% CI: 2.40–2.91); and (b) employment type, where compared to being employed in permanent part-time roles, there was greater risk of leaving location if employed in casual (HR: 1.76, 95% CI: 1.56–1.99), full-time (HR: 1.65, 95% CI: 1.51–1.79) or temporary roles (HR: 2.13, 95% CI: 1.78–2.55).

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Conclusions Understanding retention patterns of the healthcare workforce is crucial to developing and implementing supportive interventions to enhance HCW retention in rural areas. Our findings show that the overall retention rate in this population is comparable to international evidence and may be slightly better than some previously reported rates from other Australian studies. Our findings suggest that profession, employment type, sector type, age, and geographical remoteness influenced employee retention. Further research is needed to fully explore and understand the reasons for HCWs leaving their roles and supportive measures that enable reasonable HCW retention rates.

Keywords Healthcare workforce, Healthcare worker, Rural health, Recruitment and retention, Turnover

Background

Good health and wellbeing is one of United Nation's Sustainable Development Goals [1] and is reliant on recruiting and retaining a skilled workforce globally, including in rural locations. The World Health Organization (WHO), however, has estimated a shortfall of 18 million healthcare workers (HCW) to achieve universal health coverage by 2030 [2]. Healthcare workforce recruitment and retention is particularly problematic for rural and remote areas. Workforce shortages exacerbate health service access issues, contributing to poorer health outcomes for rural communities [3]. Numerous studies have identified professional, organizational, and personal factors associated with HCW recruitment and retention [4, 5], particularly in rural and remote areas [6–10]. Similarly, there have been considerable efforts to develop and evaluate initiatives to improve rural HCW recruitment and retention, although the strength of evidence supporting these initiatives remains limited [2, 11–13].

As with many high-income countries, rural and remote Australians experience poorer health outcomes compared to those living in urban areas, including higher rates of hospitalizations, chronic disease, injury, as well as premature death [14]. Only 28% of the Australian population live in rural and remote areas. Data from 2018 indicated that the total burden of disease and injury was lowest in major metropolitan cities and increased with remoteness. While there are greater health needs in rural and remote Australia, there are fewer HCWs working in these areas relative to population [14]. High workforce turnover in rural areas has been found to reduce effectiveness of care while also incurring significant costs for the healthcare system [15, 16]. For example, Wakerman and colleagues [15] found that, if staff turnover in remote Northern Territory clinics were halved, the potential savings would approximately be AUD $32 million per annum. Replacing a HCW in a rural area can be an expensive endeavor. Estimated replacement costs for rural medical staff associated with recruitment, induction, training, and relocation of individuals, and sometimes their partners and/or families, were estimated at $74,000 per professional [16]. For rural nurses and allied health professionals, these costs have been estimated at $21,000 and $22,000 respectively, nearly double that of replacing similar positions in a regional setting [17, 18]. Therefore, staff replacement costs increase as rurality increases.

The challenges associated with rural healthcare workforce retention have been exacerbated in recent years by the COVID- 19 pandemic, which has been associated with higher rates of mental health issues, burnout, and intention to leave the health profession [19–21], which has been shown to be a strong predictor of HCWs leaving a role [6]. Additionally, Australia, like many nations, is facing an ageing population, which is forecast to reduce the working age population and place increasing pressures on the healthcare system [22]. This demographic trend is predicted to be particularly prevalent and problematic in rural locations [22]. Strengthening the rural healthcare workforce and bridging the metropolitan-rural divide in healthcare outcomes remains a priority of the Australia Government, For example, it released its Stronger Rural Health Strategy, a ten-year strategy from 2018 to 2028, to improve the health of rural Australians through the supply of a quality health workforce that is distributed equitably across the country [23].

The impact of healthcare workforce turnover on quality of care and healthcare expenditure means it is important to accurately measure retention rates in rural (i.e., non-metropolitan) settings. Russell and colleagues [12] proposed five key metrics to measure healthcare workforce turnover and retention in the rural Australian context, namely: crude turnover (separation) rates, stability rates, survival probabilities, median survival, and Cox proportional hazard ratios. However, there has been relatively little attention paid to the measurement of rural healthcare workforce retention in the literature, particularly using time-based retention measures [16, 17, 24, 25].

There is a lack of empirical literature on the impact of various demographic, employment, and geographical variables on rural healthcare workforce retention, both in Australia [16, 17, 24, 25] and in other high-income countries [26]. In particular, given the increasing pressures on the healthcare workforce, there is a need to examine recent retention patterns in this workforce. Previous work by Russell and colleagues [16] provides data and benchmarks for health professions concerning retention. These benchmarks are older, relate to primary rather than

public healthcare settings, and relate to time with health services rather than time in a given location (which is more closely related to continuity of care). Therefore, the aims of this study were to identify median retention timeframes across medicine, nursing, midwifery, and allied health professions employed in the public health sector in rural southern Queensland (Australia), and to understand the demographic, employment, and geographical variables that influence retention of the rural healthcare workforce.

Methods

Setting

This study was undertaken in two public health services in rural Queensland. Service 1 provides services to an area of 90,000 km^2, comprising a regional city with a population of 140,000 as well as surrounding outer regional and rural and remote communities with a population of approximately 160,000. It operates 28 facilities, including 15 hospitals, four multipurpose facilities, six residential aged care facilities, a community outpatient facility, an extended inpatient mental health service, and a community care facility [27]. Service 2 provides services across an area of 310,000 km^2 (an area slightly smaller than Germany), comprising a rural hub and outlying remote and very remote communities with a total population of around 26,000. It operates three hospitals, eight multipurpose health services, two residential aged care facilities, four community clinics, and nine general practices across a vast area servicing rural, remote, and very remote communities [28]. As of June 2023, Service 1 employed approximately 5,150 full-time equivalent staff and Service 2 approximately 830 full-time equivalent staff [27, 28].

Participants

Participants were public health service employees employed under health professional (i.e., allied health), medical, and nursing and midwifery (combined) employment streams in the identified health services, who commenced employment between January 2010 and December 2021. Those employed before January 2010 were excluded from the dataset. Allied health professions included in the study have been listed in Appendix 1. Only those employed for more than 50% of their time within the health service catchment areas were included. Those identified as being employed in locum positions were excluded to ensure that the high percentage of locum use in medicine did not underestimate retention rates for the medical profession when compared to nursing and allied health professions. All eligible employment records from the allied health, medical and Service 2 nursing and midwifery data streams were used in the data. Due to the large number of records and the time required to code a record from raw employment records, a pragmatic decision was made to include a random sample of nursing and midwifery records from Service 1. such that overall numbers of nursing and midwifery records were roughly comparable to the allied health and medical stream record numbers. Given this employee sample was selected randomly from all Service 1 nursing records, a sample of 40% the proportion of all records should be representative of the full Service 1 nursing employee dataset and be of sufficient size to provide robust conclusions [29] Moreover, adding extra records to a large sample produces diminishing returns for sensitivity of analyses [30].

Materials and derived variables

Records used were extracted on 23/05/2022 from the public service employee record system, the Decision Support System. All data was de-identified prior to coding and analysis. The time-based dependent variable (DV) used in the reported analysis was years in which the employee worked in a particular location (i.e., town). If an employee worked in more than one location simultaneously, the location of the first chronological employee record was used to determine location until that person ceased employment in that location. Given the definition of the DV, it was possible for an employee to have more than a single instance of employment across the observation window. A record of employment was regarded as complete if the employee: (a) left the health service; (b) left the town in which they were employed to work in another location; or (c) was absent from the health service for a period of 6 months or more before returning to employment. If there were eligible records for an employee after any of these events occurred, a new record for that employee was initiated.

Methods of analyzing time-to-event DVs enable all eligible records to be included in the analysis, including those for whom the event (i.e., leaving employment in a location) has not occurred inside the window of observation (i.e., right-censored cases) [31]. A censoring variable was derived from records to distinguish between right-censored records and records where the event occurred. As data gathered from employment records did not specifically identify locum positions, a locum proxy variable was created. Records were regarded as locum and omitted from eligible records if they lasted 60 days or less with some indicator in the employment records of locum-type status (i.e., terms such as "backfill relief", "short contract" or "rotation").

The primary covariates of interest derived from employee records were *geographic location* and *profession*. Geographic locations were coded according to the Modified Monash (MM).

Model classification [32]. This system classifies areas according to town size, geographic remoteness, and access to services. For the reported analyses, the location of each record was classified as MM2 (regional), vs. MM4 - 5 (rural) vs. MM6 - 7 (remote/very remote). It is worth noting, no MM3 locations were present in the health service catchments. Profession was coded according to the public service pay stream in which the employee was classified (allied health, medicine, and nursing/midwifery).

Other covariates were developed for each identified record, using the following classifications:

- *Starting age*: For each record, the age of the employee at the start the record was coded into three discrete categories: (a) under 30 years; (b) 30 to 45 years; and (c) over 45 years.
- *Role type*: Clinical (providing clinical services) or non-clinical (e.g., environmental health, administration/management, clinical coding, research, education, training).
- *Position type*: Casual, permanent full-time, permanent part-time, or temporary.
- *Employment sector*: Public hospital, community health, or aged care. Within these classifications, multipurpose health services were classified as public hospitals, while community clinics were classified as community health.
- *Gender*: Male, female, or indeterminate.

In classifying *profession*, *role type*, *position type*, and *employment sector* variables, a predominance rule was used. For example, if an employee worked in both clinical and non-clinical roles while working at a particular location, the record was classified according to the role in which the employee worked for the greatest proportion of time.

Data analysis

Descriptive data, in the form of medians, 95% confidence intervals (CIs), and proportions were prepared using Microsoft Excel. Data analysis was carried out using Rstudio's (v4.3.0) "survival" library. Kaplan-Meier survival functions for strata within each of the seven covariates (*geographic location*, *profession*, *starting age*, *role type*, *position type*, *employment sector*, and *gender*) were prepared. The robust version of the log-rank test (to account for multiple records for some employees) was used to determine significant differences in median survival times across covariate strata. Kaplan-Meier survival curves for each stratum of the *profession* covariate, after adjusting for covariates with significant unadjusted relationships with survival time, were prepared. Covariates possessing univariate relationship at the level of $p < 0.05$ with median survival time were considered for entry into Cox regression analysis. This is consistent with variable selection recommendations for regression in large datasets [33].

In standard Cox proportional hazards regression, a participant contributes a single survival time to an analysis. The Andersen-Gill version of Cox regression is specifically designed to allow for multiple survival events from a single participant of interest [34, 35]. When multiple events occur, each even is treated as a separate record, and the model adjusts to account for correlations brought about by having some records from the same participant. Additionally, this form of Cox regression allows for gaps in observation periods, making it particularly suitable for the employment data used in this research [34].

This regression method was used to gain estimates of crude hazard ratios (and 95% CIs) for each variable. A multivariate Cox Regression model was then utilised to determine covariates that impacted the risk of leaving a location after adjusting for other covariates in the model. Estimated adjusted hazard ratios, with 95% CIs, from this model were then used to describe the strength and direction of the relationship between covariate strata and risk of leaving employment in a location. Goodness-of-fit of the model derived from the Cox regression was tested using the Cox-Snell test of residuals. Cox-Snell residuals analysis was used to assess the goodness of fit of the predicted cumulative hazard function of a model to that expected from a perfect fit, represented by a 1:1 diagonal line in Fig. 2. While mild deviations are not problematic, curvature or substantial deviations from the line of perfect fit, particularly at lower residual values, indicate potential issues [35].

Ogundimu and colleagues [36] recommend a minimum of 20 events/variable (EPV) for a stable Cox regression model. Given seven covariates in the design, the potential for correlation from recurrent events, and that events would occur in 70% of observed records, the minimum required sample size was set at 200.

Results

Data records

Table 1 shows the breakdown of the 6651 records obtained from the 5527 employees included in the sample, according to the demographic, geographical, and employment variables in the design and record event status for each profession. More than one record was contributed by 848 (15.3%) employees, with 640 employees contributing two records, 157 contributing three records and 51 contributing 4 or more records, with seven being the highest number of records per employee. Events occurred in 71.3% of records. Sampled employees were

Table 1 Summary of workforce characteristics and event status collected from employee records for each profession

Covariate	Category	Total (*N* = 6651)	Profession		
			Nursing and Midwifery (*N* = 2643)	Medicine (*N* = 2297)	Allied Health (*N* = 1711)
		n (col %)	*n* (col %)	*n* (col %)	*n* (col %)
Geographic Classification	MM2	3392 (51.0)	798 (30.2)	1706 (74.3)	888 (51.9)
	MM4-MM5	2080 (31.3)	1046 (39.6)	402 (17.5)	632 (36.9)
	MM6-MM7	1179 (17.7)	799 (30.2)	189 (8.2)	191 (11.2)
Position Type	Casual	698 (10.5)	545 (20.6)	57 (2.5)	96 (5.6)
	Permanent Full-Time	4303 (64.7)	1296 (49.0)	1845 (80.3)	1162 (67.9)
	Permanent Part-Time	1407 (21.2)	749 (28.3)	275 (12.0)	383 (22.4)
	Temporary	243 (3.7)	53 (2.0)	120 (5.2)	70 (4.1)
Starting Age	< 30 years	3066 (46.1)	1137 (43.0)	1022 (44.5)	907 (53.0)
	30 - < 45 years	2256 (33.9)	730 (27.6)	1059 (46.1)	467 (27.3)
	45 years and >	1329 (20.0)	776 (29.4)	216 (9.4)	337 (19.7)
Sex	Male	1926 (29.0)	302 (4.5)	1308 (56.9)	316 (18.5)
	Female	4705 (70.7)	2340 (88.5)	972 (42.3)	1393 (81.4)
	Other	20 (0.3)	1 (< 0.1)	17 (0.7)	2 (0.1)
Sector	Hospital	5790 (87.1)	2286 (86.5)	2129 (92.7)	1375 (80.4)
	Community	659 (9.9)	166 (6.3)	157 (6.8)	336 (19.6)
	Aged Care	202 (3.0)	191 (7.2)	11 (0.5)	0 (0.0)
Role	Clinical	6476 (97.4)	2534 (95.9)	2274 (99.0)	1668 (97.5)
	Non-clinical	175 (2.6)	109 (4.1)	23 (1.0)	43 (2.5)
Event Status	Completed	4740 (71.3)	1782 (67.4)	1730 (75.3)	1228 (71.8)
	Continuing	1911 (28.7)	861 (32.6)	567 (24.7)	483 (28.2)

predominately female (70.4%), employed permanently (86.3%), in a clinical role (97.6%), and in the public hospital sector (87.5%).

Survival analysis and Cox regression

Overall median survival or retention time (i.e., time employed in one location) was 1.46 years [95% CI, 1.35–1.52 years], with 41% of employees remaining in employment in location after two years. Median survival rates and corresponding 95% CIs for profession and study covariates are presented in Table 2, along with robust log-rank statistics. All covariates except *role type* were observed to possess univariate crude relationships with survival time.

The Kaplan–Meier survival function is provided for each covariate stratum of the *profession* variable in Fig. 1, after adjusting for covariates with significant crude relationships with survival time (*geographic region*, *gender*, *position type*, *starting age*, and *sector*). Adjusted survival curves reflect longer survival times in location for those employed in the nursing and midwifery stream compared to those employed in the allied health and medical streams. The medical stream had the shortest survival times.

Employee records from those classified as "indeterminate" in the gender covariate were not sufficient to produce a stable Cox proportional hazards model. They were therefore omitted from the overall Cox regression. This left 6631 records for analysis. Crude and adjusted hazard ratios from Cox regressions are presented in Table 3. The final Cox regression demonstrated significant concordance (62.3%, Robust χ^2 (11) = 667.9, $p < 0.001$).

The size of effects varied widely with three of the covariates having much larger effects after adjusting for co-variates. Firstly, those employed in the medical and allied health streams were 1.91 times [95% CI 1.75–209%] and 1.38 times [95% CI 1.26–1.51] more likely to leave a position in location than those employed in the nursing and midwifery stream, respectively. Secondly, those employed in MM4 - 5 locations and MM6 - 7 locations were 1.79 times [95% CI 1.66–1.94] and 2.64 times [95% CI 2.40–2.91] more likely to leave a position in location than those employed in the MM2 regional centre, respectively. Thirdly, those employed in casual, permanent full-time, and temporary positions were 1.76 times [95% CI 1.56–1.99%], 1.65 times [95% CI 1.51–1.79] and 2.13 times [95% CI 1.78–2.55] more likely than those employed in permanent part-time roles to leave a position in location.

The remaining covariates had smaller effects. Those whose starting age was under 30 years, and 45 years and over, were 1.19 times [95% CI 1.11–1.27] and 1.15 times [95% CI 1.04–1.26%] more likely to leave a position in location than those aged between 30 and less than 45 years. Finally, those employed in aged care were 1.22 times [95% CI 1.01–1.46] more likely than those employed in the hospital sector to leave a position in location.

Table 2 Crude median survival times (in years), 95% CIs, and robust log-rank statistics for profession and study covariates

Factor	Variable	Median Survival [95% CI]	Robust Log-rank Test
Profession	Nursing and Midwifery	1.69 [1.58–1.80]	χ^2 (2) = 83.81***
	Medicine	1.06 [1.02–1.28]	
	Allied Health	1.28 [1.15–1.46]	
Geographic Region	MM 2	2.01 [1.98–2.05]	χ^2 (2) = 408.20***
	MM 4–5	1.19 [1.08–1.30]	
	MM 6–7	0.87 [0.77–1.00]	
Position Type	Casual	1.76 [1.57–2.00]	χ^2 (3) = 315.10***
	Permanent Full-Time	1.13 [1.07–1.23]	
	Permanent Part-Time	2.80 [2.57–3.19]	
	Temporary	0.98 [0.84–1.00]	
Starting Age	< 30 years	1.35 [1.22–1.48]	χ^2 (2) = 34.45***
	30 - < 45 years	1.68 [1.49–1.84]	
	45 years and >	1.31 [1.19–1.50]	
Sex	Female	1.50 [1.42–1.59]	χ^2 (2) = 19.57***
	Male	1.23 [1.07–1.45]	
Sector	Hospital	1.50 [1.41–1.58]	χ^2 (2) = 10.19**
	Community	1.21 [1.02–1.36]	
	Aged Care	1.19 [0.98–1.71]	
Role	Clinical	1.46 [1.36–1.53]	χ^2 (1) < 1
	Non-Clinical	1.25 [1.09–1.75]	

For Gender = "Other", there were insufficient numbers to determine CIs

CI confidence interval, *MM* Modified Monash geographic classification

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

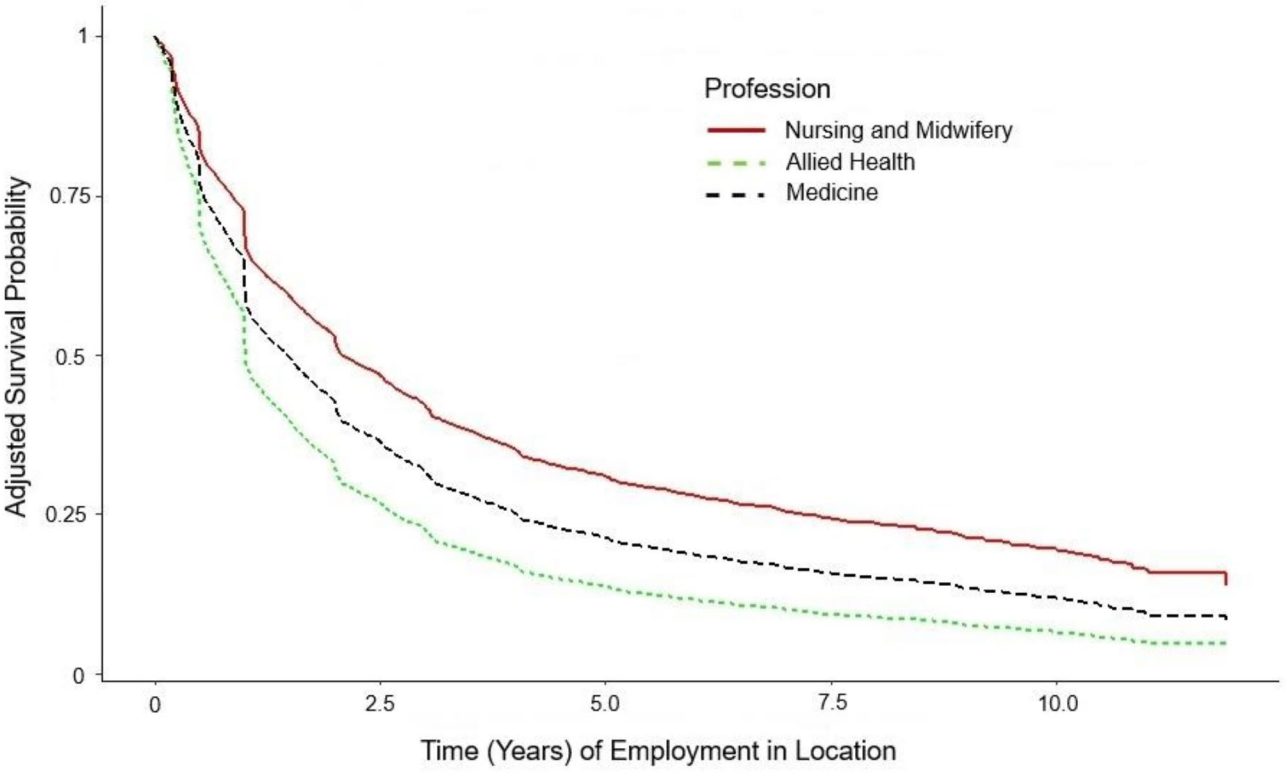

Fig. 1 Survival functions of time employed in location for each professional stream, after adjusting for covariates

Table 3 Crude and adjusted hazard ratios from Cox regressions

Variables	Categories	Crude Hazard Ratio [95% CI]	Adjusted Hazard Ratio [95% CI]
Profession	Nursing	1.00	1.00
	Medicine	1.36 [1.28–1.46]***	1.91 [1.75–2.09]***
	Allied Health	1.17 [1.09–1.26]***	1.38 [1.26–1.51]***
Geographic Region	MM2	1.00	1.00
	MM4 - 5	1.50 [1.41–1.61]***	1.79 [1.66–1.94]***
	MM6 - 7	2.07 [1.92–2.24]***	2.64 (2.40–2.91]***
Position Type	Permanent Part-Time	1.00	1.00
	Casual	1.63 [1.46–1.83]***	1.76 [1.56–1.99]***
	Permanent Full-Time	1.88 [1.74–2.03]***	1.65 [1.51–1.79]***
	Temporary	2.95 [2.51–3.46]***	2.13 [1.78–2.55]***
Starting Age	30 - < 45 years	1.00	
	< 30 years	1.20 [1.13–1.28]***	1.19 [1.11–1.27]***
	45 years and >	1.20 [1.11–1.30]***	1.15 [1.04–1.26]**
Sex	Female	1.00	1.00
	Male	1.15 [1.08–1.22]***	1.03 [0.95–1.11]
Sector	Hospital	1.00	1.00
	Community	1.12 [1.02–1.23]*	1.06 [0.95–1.17]
	Aged Care	1.20 [1.02–1.41]*	1.22 [1.01–1.46]*

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Cox-Snell residuals from the final model are shown in Fig. 2. Predicted residuals demonstrated appropriate goodness-of-fit with the model's observed residuals.

Discussion

This study sought to determine retention (i.e., survival) rates for health care workers (HCWs) in two public health services across a 12-year observation window, examining the influence of profession, geographic location, and other derived covariates on risk of leaving a location. Six key messages emerge from our findings.

First, patterns in the sampled employees are reflective of those observed in the greater Australian rural and remote health workforce, with: (a) employees being predominately female, employed permanently, and employed in hospital-based roles; (b) higher percentages of male employees in the medical stream compared to those in nursing and midwifery and allied health streams; (c) higher percentages of nurses employed in rural and remote areas, being in casual employment, in non-clinical positions, in the older age category, and in the aged care sector; and (d) low involvement of allied health and medical streams in the aged care sector. This comparability means our findings are generalisable.

Second, median retention time across all employees was not quite 18 months, with 41% staying employed in location for two years, with profession, geographic location and position type having larger effects than the other co-variates. Nurses and midwives were at less risk of leaving a location than allied health professionals, with medical practitioners being at most risk. Geographic location of employment and type of employment were the most influential factors in the data. Those employed in rural and remote locations (MM4 - 5 and MM6 - 7) were about twice as likely to leave a location compared to those employed in the regional centre (MM2). Those employed in permanent full-time, casual, or temporary positions were at greater relative risk of leaving a location than those employed in permanent part-time positions. Relatively small effects were observed for starting age in location, with younger and older employees being at higher relative risk than middle aged employees, and sector of employment,, and those employed in the aged care sector being at greater relative risk of leaving a location than those working in the hospital sector. These differences in strength of covariates on retention points to the need for intervention strategies to focus on factors with the greatest effects.

Third, while retention rates among HCWs can be influenced by a myriad of factors including personal, organizational, policy-related, and community-level factors [37, 38], this study brings a few factors to the fore and points to the need to take account of particular geographic settings. Nearly 60% of HCWs had left their roles before serving two years. This is largely consistent with findings of a rapid review of the international literature, which reported that the total annual HCW attrition rate was between 3 and 44% [39]. The retention rate in our study is higher than that reported by Russell and colleagues in 2017 [25]. Their study found that only 20% of nurses and allied health professionals remained working in a specific remote clinic in the Northern Territory 12 months after commencing, and half of the participants left within four months [25]. It is noteworthy that Northern Territory

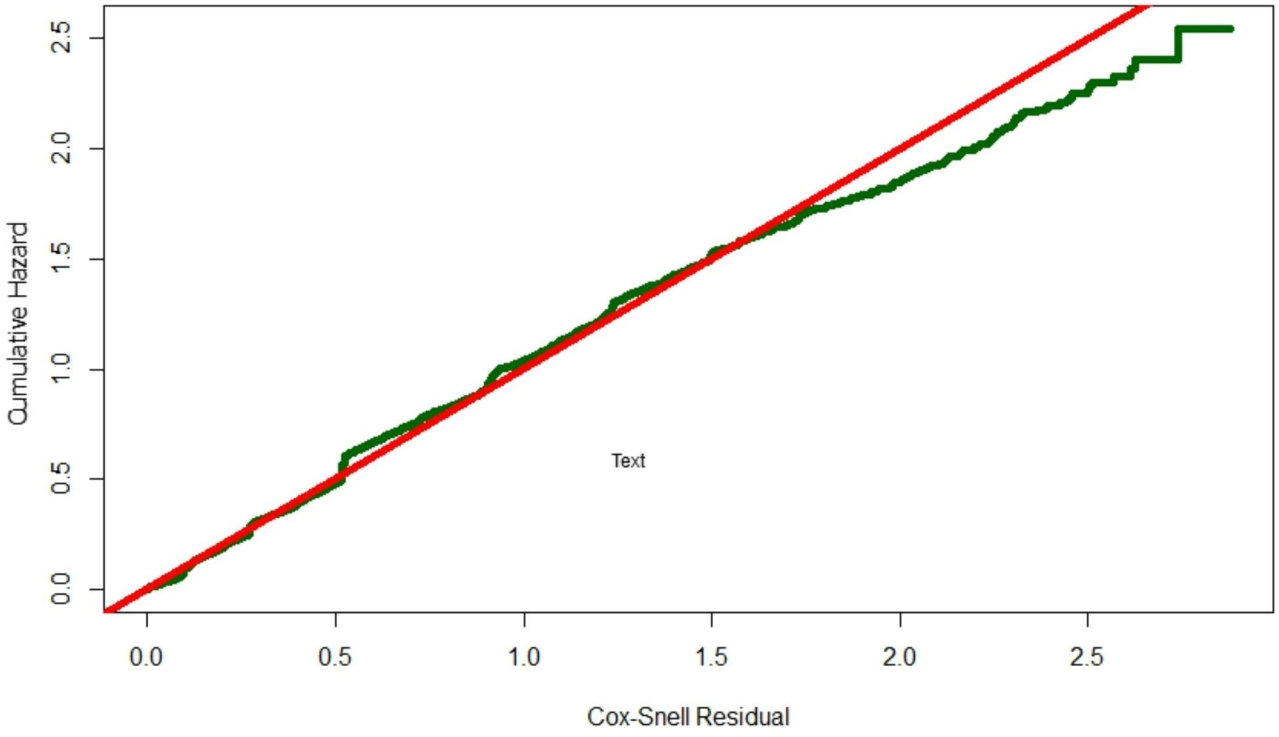

Fig. 2 Observed and predicted Cox-Snell residuals from final Cox regression model, risk hazards for Profession

is more remote than our study sites in Queensland, and has historically experienced more severe workforce challenges, which may have contributed to the higher turnover rates reported in that study.

Fourth, events occurring in particular time periods need to be recognised. Our dataset spans the COVID- 19 onset period, and the legislation of the National Disability Insurance Scheme [40], both of which have triggered staff turnover in the Australian public healthcare sector and may have at least partly contributed to reduced retention in this study. The specific impact of COVID- 19 on retention rates is outside the scope of this manuscript and will be examined separately.

Fifth, several of our findings are consistent with past research regarding the effects of profession, geographic location and age. Medical practitioners and allied health workers have a greater risk of leaving location than nurses and midwives. Also, HCWs in remote areas appear more vulnerable to leaving location compared to HCWs in rural areas, and both these populations appear to at greater risk of leaving location than those working in MM2 (i.e., regional) locations. Russell and colleagues [16], in a study of Australian rural and remote primary healthcare services, found that allied health professionals were 78% more likely to leave than nurses, and HCWs in remote locations were 23% more likely to leave than those in rural locations. In our study, those aged between 30 and 45 years when starting a position appeared less likely to leave location than younger and older cohorts. Chisholm and colleagues [17] found a similar relationship in their study of allied health workers (dietitians, occupational therapists, physiotherapists, podiatrists, psychologists, social workers, and speech pathologists) in Western Victoria, where those aged under 30 years of age at commencement of employment had lower retention rates than those aged over 35 years. McGrail and colleagues [26] analyzed geographical mobility among rural primary care physicians in the USA and found that biennial turnover was about 17% among those aged 45 or younger, compared with 9% among those aged 46 to 65 years. In our study, the most stable age group was those between 30 and 45 years. This, along with the finding that those in permanent part-time roles had most stability, could indicate that this age group could be raising families and satisfied with work-life balance, hence staying longer in their roles and location. This proposition, however, needs to be confirmed in a prospective study. Our findings that those working in the aged care sector are at greater risk of leaving location is consistent with a nation-wide pattern [41], despite the majority of HCWs working in aged care being employed in the nursing stream, the stream with the lowest risk of leaving location across the workforce.

It is worth noting, though, that some of those classified as having part-time roles may have been working

in more than one position. While it is hard to be certain, we suspect that the nature of HCW roles, particularly in rural and remote areas are often part-time, but it also suggestive of variety of roles and scope being important in retention, which is a factor often mentioned in rural workforce retention literature [37].

Finally, our study found a sharp drop off in retention after the initial six months and 12 months after employment in a location, with 18%, 23% and 30% drop-off after six months, and 32%, 42% and 51% drop-off after 12 months, for nurses and midwives, allied health professionals, and medical practitioners, respectively. Findings highlight that it is imperative to particularly support a HCW in their initial stages of employment in a rural area to enhance retention. In a study of HCWs in rural New South Wales, Cosgrave and colleagues [6] found that participants' turnover intention was decided early on, generally within 12 to 18 months of commencing work. This study, and another study of social workers in British Colombia [42], have highlighted that the initial experiences of HCWs relocating into rural centres include feelings of displacement, alienation, and social disconnection, making one *feel out of place*. Our data does not indicate reasons for staff leaving, such as organizational factors (e.g., use of short-term contracts) and other factors identified in previous research such as social isolation [6, 42]. We suspect, from the relatively steady drops in retention, followed by sudden drops in survival time at six and 12 months, it is likely to be a combination of factors. Regardless, findings indicate that the first year, and particularly the first six to 12 months, is a crucial period for organizations and communities to consider modifying contractual arrangements and/or targeting employment support for HCWs, particularly for medical practitioners and allied health workers, and for HCWs in rural and remote areas, where retention issues appear most prevalent and intent to leave is likely to be formed [6]. Healthcare organizations play a crucial role in developing the HCW's sense of belonging in an organization, as well as more broadly, in acquiring connection-to-place including social relationships [43].

Implications for research, policy and practice

Existing empirical literature highlights various reasons for turnover in the healthcare workforce and further research will be advanced by adopting theoretical frameworks that aim to unpack the challenges of HCW turnover specifically in rural areas, with the intent to enable organizations and policy makers to develop solutions to enhance retention rates.

One such framework is the Whole-of-Person Retention Improvement Framework (WoP-RIF) was proposed by Cosgrave in 2020 [37] to provide an accessible evidence-informed framework to address the complexity surrounding rural workforce retention and enable development of retention strategies. The WoP-RIF consists of three domains namely, Workplace/Organizational, Role/Career, and Community/Place. Each domain sets out the preconditions for enhancing workforce retention through strengthening job and personal satisfaction of the HCW. Specifically, the Workplace/Organizational domain entails working in a friendly, supportive, and inclusive workplace. The Role/Career domain entails having opportunities to build skills and career pathways (i.e., professional development). The Community/Place domain entails feeling settled in, being socially connected, and having a sense of belonging. These factors can also be enabled at personal, organizational, and policy-related levels, thus collectively enhancing retention rates [38].

While evidence on the HCW retention rates and supportive intervention strategies are building, more research and action is needed, especially in developing interventions targeted to particular contexts. The WHO [22] updated their guidelines for the healthcare workforce development, attraction, recruitment, and retention in rural and remote areas and recommended education, regulation, support, and incentive interventions. However, a Cochrane review on the effectiveness of interventions aimed at increasing the proportion of HCWs working in rural and other underserved areas found limited reliable evidence on the effects of interventions aimed at addressing the inequitable distribution of HCWs [11]. Further review of the international literature on retention strategies for HCWs found three main themes. These were targeted enrolment into training and appropriate education designed to produce a competent, accessible, acceptable, and *fit-for-purpose* workforce; addressing broader health system issues that ensure a safe and supportive work environment; and providing ongoing individual and family support [15]. However, another review on recruitment and retention of nurses has noted the need for further evidence on the effectiveness of initiatives involving leadership and support, ongoing professional development, recognition, work environment, and flexible scheduling [13].

It is timely for organizations, policy makers, and communities to consider factors that influence retention and a framework such as the WoP-RIF [37] may enable a holistic and targeted approach. This approach includes strategies such as building an organizational culture that is friendly, supportive, and inclusive of staff (i.e. Workplace/Organizational domain); orchestrating opportunities continuing professional development opportunities (i.e. Role/Career domain); and enabling the employee to settle in, connect socially with the local community, and foster a sense of belonging (i.e. Community/Place domain). Buddying new employees with someone that

has worked and lived longer in the community may also be a helpful strategy to provide support to settle in. Mentoring and clinical supervision programs for staff can also support staff and enable the development of their leadership skills and career pathways. Organizations could explore ways to maximize flexibility in work arrangements to support better work-life balance for staff, as well as investigate incentives that could support staff staying longer in their roles. Improved retention rates will enhance the consistency of service delivery, quality of care, quality of the relationship between the client and the HCWs providing services, and ultimately, the health outcomes of communities. The importance of having consistent, comparable measures of HCW worker retention, and the creation of locally relevant benchmarks for health services to aim towards, are also integral and imperative to these efforts. A further prospective qualitative study is needed to understand why staff leave and what factors would support them to stay in their roles for longer. Another area of further research could be an investigation of measures that have been implemented to date and an assessment of how the study findings relate to both successes and failures of these measures.

Strengths and limitations

Our study adds evidence from recent data on workforce retention patterns among rural HCWs working in the public sector. Its strength lies in the utilization of a large sample providing 12 years of data and the development of a time-dependent variable that focuses on time in location, which is important for continuity of care, particularly for vulnerable rural and remote communities. By including allied health, medicine, nursing and midwifery, and through utilizing rigorous analytical methods, robust evidence applicable to a wide array of professions has been made available.

It must be recognized, however, that the allied health category encompassed many individual and varied professions, differences between which could not be covered here. We were also unable to include data from those that did not identify as male or female, due to small numbers. Further, our dataset was administrative in nature and lacked complete information on the reasons for staff leaving. Other potential limitations with using administrative datasets apply here as well, such as entries being made by multiple personnel across different health services [44]. For example, we cannot guarantee that the classification of locum positions was the same in Service 1 and Service 2, as inconsistent data entry may have influenced classification. This must be recognized as a limitation to future studies in this area that use administrative datasets, but this caution must be tempered by the ability to access large amounts of available data. Independent collection of data would be prohibitive in terms of cost. While recognizing limitations, we must also recognize that information available from this study is only possible through utilization of this archival data. It does consolidate the importance of health services having consistent and well-managed health service data collection.

Conclusions

Understanding retention patterns of the healthcare workforce is crucial to developing and implementing supportive interventions to enhance HCW retention in rural areas. Our study examined a large pre-existing dataset of allied health professionals, doctors, nurses and midwives, working in two health services in rural and remote Queensland. The overall retention rate in this population is comparable to international evidence and may be slightly better than some previously reported rates from other Australian studies. Despite that, it remains a concern, given the costs of rehiring to vacant roles, and impacts on the continuity of care and service delivery. Our findings showed that geographic location, profession and employment type, had the strongest influence employee retention, ahead of age and sector of employment.

Further work is needed to fully unpack the reasons for HCWs leaving their roles and the supportive measures in place that have enabled attainment of reasonable retention rates, while still recognizing that retention rates do not meet established benchmarks. We found the first 12 months to be the most crucial period and call for enhanced organizational support of rural HCWs especially in this initial period to further boost retention rates.

Appendix 1

Allied health professions

Anaesthetic Technician
Audiologist
Clinical Measurement Technician
Dental Technician
Dental Therapist
Dietitian
Exercise Physiologist
Occupational Therapist
Oral Health Therapist
Paramedical Officer
Pharmacist
Physiotherapist
Podiatrist
Psychologist
Radiographer/Sonographer
Social Worker
Speech Pathologist
Speech Therapist

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Authors' contributions
Conceptualization – TF, PM, CW, JE, LOM, AVE. Data curation – BS, JE, LOM, AVE, AC, TF. Formal analysis – TF. Funding acquisition – PM, CW, BS, JE, LOM, AVE, HSC, TF. Investigation – TF, CW, BS, JE, LOM, AVE, HSC, TF. Methodology – PM, CW, BS, JE, LOM, AVE, HSC, TF. Project administration – TF. Resources – TF. Software – TF. Supervision – TF. Writing – original draft – PM, CW, TF. Writing – revising and editing - PM, CW, BS, JE, LOM, AVE, HSC, AC, TF.

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Data availability
Reasonable requests to access de-identified data can be made in writing to the corresponding author and is subject to further ethics and organizational approvals.

Declarations

Ethics approval and consent to participate
Ethics approval and a waiver of consent to utilize participant data was granted by the Darling Downs Health Human Research Ethics Committee (Ref: EX/2022/QTDD/81938; dated 27/01/2022) and was ratified by the University of Queensland (Ref:2022/HE000313) and University of Southern Queensland (Ref: H22REA044) Human Research Ethics Committees. The study adhered to the Declaration of Helinski and complied with all relevant guidelines and regulations.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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