


Rural and remote dental care: Patient characteristics and health care provision

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Abstract

Objective: To describe the characteristics of patients who used the Royal Flying Doctor Service dental clinics and determine Royal Flying Doctor Service and non-Royal Flying Doctor Service dental service provision in mainland Australia.

Design: A prospective cohort study.

Setting: All Royal Flying Doctor Service dental clinics located throughout rural and remote Australia.

Participants: All patients who accessed an Royal Flying Doctor Service dental clinic from April 2017 to September 2018.

Interventions: Royal Flying Doctor Service mobile dental clinics.

Main outcome measures: Patient demographics and dental procedures conducted (by age, sex and Indigenous status); and the dental service provision and coverage (Royal Flying Doctor Service and non-Royal Flying Doctor Service) within mainland rural and remote Australia.

Results: There were 8992 patient episodes comprising 3407 individual patients with 27 897 services completed. There were 920 (27%) Indigenous and 1465 (43%) non-Indigenous patients ($n = 1022$ missing ethnicity data). The mean (SD) age was 31.5 (24.8) years; the age groups 5-9 years and 10-14 years received 17.6% and 15.1% of the services, respectively. There were 1124 (33%) men and 1295 (38%) women ($n = 988$ with missing sex data). Women were more likely (all $P < .05$) to receive preventive services, diagnostic services, restorative services, general services, endodontics and periodontics. Men were more likely (both $P < .05$) to receive oral surgery and prosthodontics. There are many rural and remote people required to travel more than 60 minutes by vehicle to access dental care.

Conclusion: Without increasing dental provision and preventive services in rural areas, it seems likely that there are and will be unnecessary oral emergencies and hospitalisations.

KEY WORDS

Aboriginal health, access issues, dental health, remote health delivery, youth health

1 | INTRODUCTION

Australians living in rural and remote regions have significantly poorer access to health care compared to those living in major cities.^{1,2} Coupled with the higher prevalence of chronic disease and poor adherence to physical exercise and nutritional recommendations, this is believed to be a significant contributor to the lower life expectancies of rural and remote populations.³

Poor oral health is associated with increased risk of several chronic diseases, including heart disease, oral cancers, diabetes mellitus, stroke and lung disease,⁴ and poor pregnancy outcomes.⁵ There are more dentists and other types of dental practitioners per 100 000 population in major cities than in rural and remote areas.⁶ Kruger et al⁷ estimated an overall average (per 100 000 population) for Australia of 43 dental practitioners, with major cities having an average of 51.2, compared with 28.7 in rural and remote areas. This is consistent with the Australian Institute of Health and Welfare Dental workforce report,⁸ which indicated that there were (per 100 000 population) 56.9 dentists Australia-wide in 2012, with 72.3 in major cities but only 22.7 in rural and remote areas.⁸

Although the literature indicates lower service provision and longer patient wait lists in rural and remote Australia,⁹ there are limited contemporary demographic and clinical data on the users of dental services, with an absence of data on Royal Flying Doctor Service (RFDS) dental services provided in rural and remote regions. As such, this study has the following objectives:

- To determine the RFDS patient demographics and dental procedures conducted within rural and remote Australia; and
- To determine the dental service provision and coverage (RFDS and non-RFDS) within mainland rural and remote Australia.

2 | METHODS

2.1 | Setting

The RFDS provides extensive primary health care services throughout Australia including, but not limited to, primary care (general practice), nursing and oral (dental) health clinics. The types of services differ in response to configuration of other local health services in specific operating regions. RFDS also operates a 24-hour, 7-days-a-week (24/7) aeromedical retrieval service, supported by a 24/7 telehealth system, to people who live, work or travel in rural and remote regions of Australia.

Recognising the gap in provision of dental health services in rural and remote areas, the RFDS has established oral health services throughout Australia. These services are provided

What is already known on this subject:

- The literature indicates lower dental provision in rural and remote regions; however, there is an absence of demographic and clinical data on the users of Royal Flying Doctor Service dental services.

What this study adds:

- Children were more likely to receive dental interventions consistent with improving dental health.
- Women were more likely to receive prevention services, whereas men were more likely to receive oral surgeries and prosthodontics. We found that there are many rural and remote areas without dental provision.
- Without increasing dental provision and preventative services, it seems likely that many of these people will have future oral emergencies and hospitalisations.

using fly-in fly-out, mobile and outreach delivery models, funded by the Commonwealth of Australia. The RFDS dental service includes dentists, oral health therapists and dental therapists. The RFDS dental service was established Australia-wide on 1 April 2017 and was designed to provide support to communities without any other dental provision.

The RFDS services from which these data have been drawn were provided in rural and remote areas, with the term 'rural and remote' including all areas outside Australia's major cities. This includes areas that are classified as inner and outer regional (RA2 and RA3, respectively) and remote or very remote (RA4 and RA5, respectively) under the Australian Statistical Geography Standard.¹⁰

2.2 | Design and participants

Here, we report the results of a cohort study based on administratively collected patient data from the RFDS Commonwealth-funded dental clinics (Australia-wide) from 1 April 2017 to 30 September 2018.

2.3 | Data sources

We used RFDS clinical databases to provide data on patient demographic information, medical history, diagnosis, location, service provider and type, and extensive information concerning patient treatment.

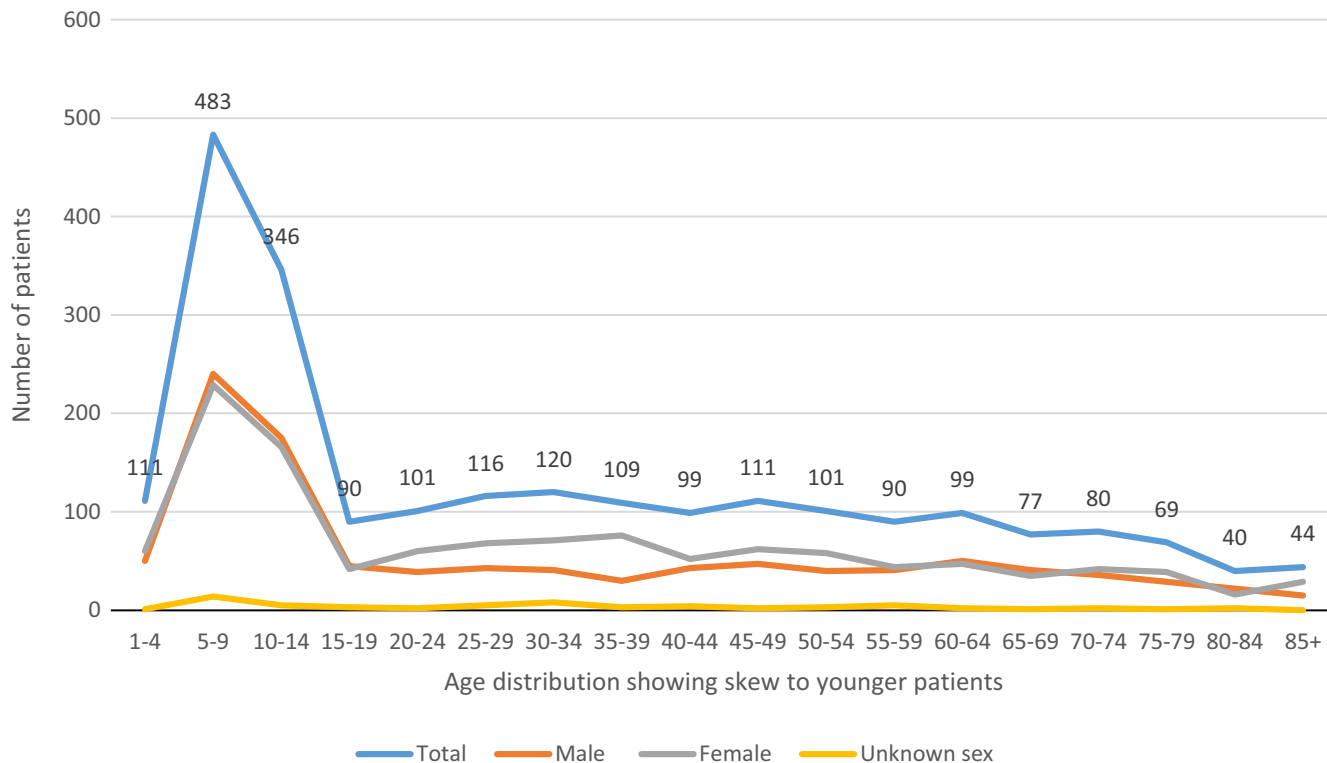


FIGURE 1 Age and sex distribution of patients receiving dental therapy from Royal Flying Doctor Service services showing skew to younger patients. Note that age was missing in 1121 patients

We used the RFDS clinical databases to provide data on non-Medicare Benefits Schedule (MBS; the MBS is a listing of the Medicare services subsidised by the Australian Government)¹¹ dental service provision (such as the location of RFDS dental clinics provided throughout Australia). This information was then used in conjunction with Health Direct data,¹² which detail the locations of health services throughout Australia (such as the locations of non-RFDS dental clinics). The combination of these data sources detailing clinic locations was mapped (detailed below) against data from the Australian Bureau of Statistics (ABS) to provide population distribution (using residential addresses) throughout Australia, and dental clinic coverage per head of population.

2.4 | Data analysis

We used descriptive statistics to analyse the characteristics of patients using RFDS dental services. We used chi-square analysis and two-sample tests of proportions to test the association between patient characteristics and services delivered. A *P*-value of <.05 was considered statistically significant. All analyses were performed using Microsoft Excel and the statistical software package R version 3.5.1.

To determine the adequacy of dental service provision in rural and remote regions, we used the Service Planning and Operational Tool (SPOT). SPOT is designed to explore health

care coverage in rural and remote Australia. Working from a geographic distribution of 'demand' (defined below) and a set of health care facilities that provide cover for a range of services, SPOT calculates the proportion of demand covered by those facilities within a user-specified drive time (ie 60 minutes). Reasonable access to dental services was determined as those who could access dental services (public and private) within a 60-minute drive time, using Google Maps time metrics. This figure does not account for a patient's ability to access motor vehicle transportation, nor does it measure the direct and indirect costs of doing so. Demand is represented by population levels in different categories by Statistical Area 3 (SA3; eg age and sex) as well as the specific RFDS demand types (dental).

2.5 | Ethics approval

This project was deemed a low-risk quality assurance project by the RFDS Clinical and Health Services Research Committee, on 18 March 2019. As this project involved routinely collected data, specific patient consent forms were not required.

3 | RESULTS

During the study period, the RFDS conducted dental clinics in 88 separate rural and remote communities, often

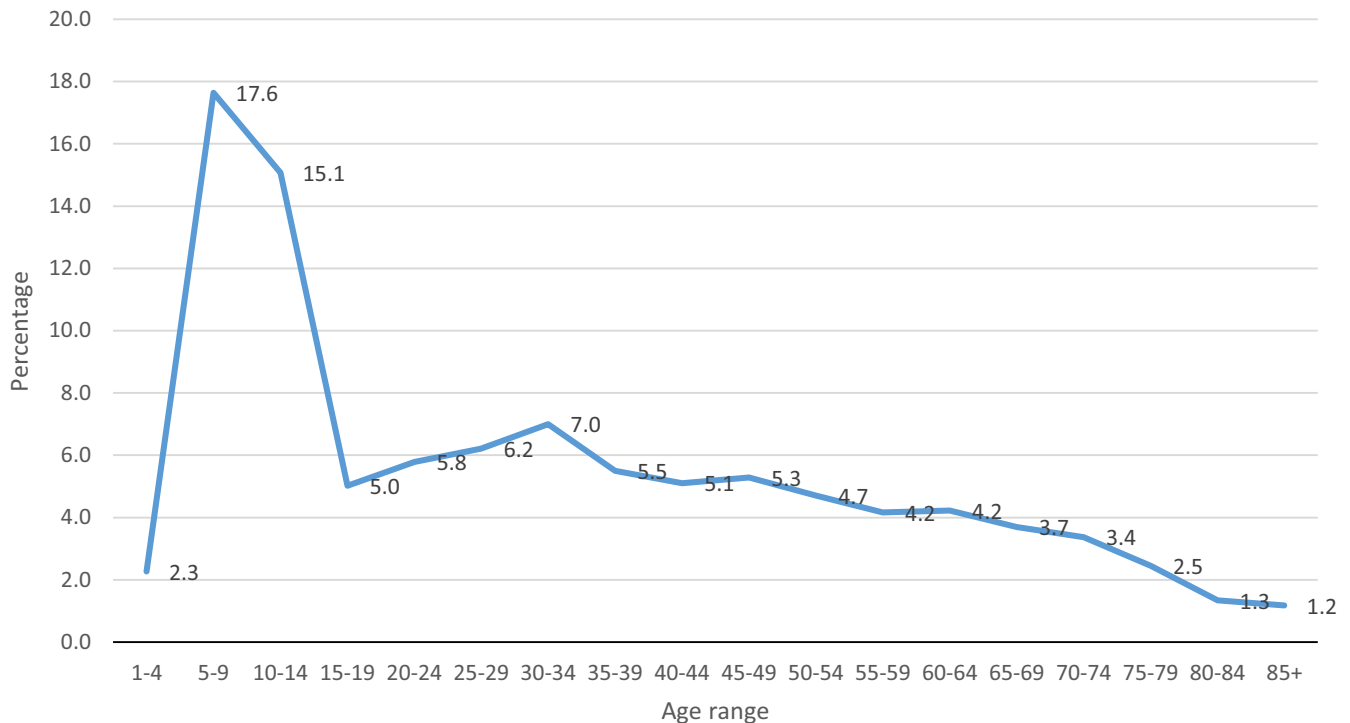


FIGURE 2 Proportion of all services conducted according to age group in Royal Flying Doctor Service dental patients during 2017-2018. Note that the total number of services with corresponding patient age equalled 20 425 (73.4%), with 6564 patient episodes not having a corresponding age

staying in the community multiple days per visit as required (mean = 3 days).

There were 8992 patient episodes throughout the study period, comprising 3407 individual patients with 27 897 services completed. The majority (70.7%) of patients had 1-9 services, with each patient having an average of 3.3 (SD = 1.2) appointments.

Of the individual patients, 920 (27%) were Indigenous and 1465 (43%) were non-Indigenous; 1022 (30%) patients had missing data for ethnicity. Age was collected for two-thirds of patients ($n = 2286$, 67.1%), with the mean age of 31.5 and the median age of 28.0 (SD = 24.8) years. The patient group was comprised of 1124 (33%) men, 1295 (38%) women and 988 (29%) of unknown sex. Figure 1 details the distribution of age and sex. The age distribution was similar for men and women and markedly skewed towards younger age groups. Children aged 5-9 years and 10-14 years received 17.6% and 15.1% of the services, respectively (Figure 2).

The leading service categories included preventive services ($n = 9764$), diagnostic services ($n = 7902$), restorative services ($n = 6018$), general services ($n = 2239$) and oral surgery ($n = 1563$). The leading interventions included the following: first exposure only radiological examination and interpretation ($n = 2522$); comprehensive oral examination ($n = 2449$); fissure and/or tooth surface sealing ($n = 1920$); oral hygiene instruction ($n = 1910$); removal of calculus—first visit ($n = 1715$); and adhesive restoration—one

surface—posterior tooth ($n = 1073$), with the remainder detailed in Table 1.

Men and women showed a significantly different distribution across the nine service categories ($X^2 = 3238.3$, $df = 8$, $P < .05$). Women made up a greater proportion of those receiving preventive services, diagnostic services, restorative services, general services, endodontics and periodontics. Men made up a greater proportion of those receiving oral surgery and prosthodontics. Note also that between 20% and 70% of the sex data in each category are missing, which means that these results should be interpreted with caution, and a call is made for more complete data collection at the time of patient treatment.

Using SPOT mapping in conjunction with ABS population data, and service data from Health Direct and the RFDS, we found that many communities (which show up as grey dots on a grey background in Figure 3) in rural and remote areas do not have dental coverage, as detailed in Figure 3. The community areas with the largest rural and remote populations without dental provision within a 60-minute drive time from their residence (neither RFDS nor non-RFDS) included Newman, Nyngan, Karratha, Katherine and Gillen, as detailed in Table 2. While these communities can have dental provision, it is generally centrally located in the towns named, thus requiring people outside of the towns to travel. Due to the population concentrations within Victoria, we have provided a separate dental coverage map, as shown in

TABLE 1 Detailed description of the services per category

	Number (%) ^a	Men	Women	Unknown
Preventive services	9764 (35.0)	3530 (36.2)	4211(43.1)	2023 (20.7)
Fissure and/or tooth surface sealing—per tooth	1920 (19.7) ^b	748 (39.0)	822 (42.8)	350 (18.2)
Oral hygiene instruction	1910 (19.6)	711 (37.2)	819 (42.9)	380 (19.9)
Topical application of remineralising and/or cariostatic agents, one treatment	1787 (18.3)	706 (39.5)	843 (47.2)	238 (13.3)
Removal of calculus—first visit	1715 (17.6)	493 (28.7)	601 (35.0)	621 (36.2)
Other	2432 (65.0)	1553 (63.9)	445(18.3)	434 (17.8)
Diagnostic services	7902 (28.3)	2273 (28.8)	2679 (33.9)	2950 (37.3)
First exposure only (radiological examination and interpretation)	2522 (31.9)	790 (31.3)	975 (38.7)	757 (30.0)
Comprehensive oral examination	2449 (31.0)	752 (30.7)	824 (33.6)	873 (35.6)
Oral examination—limited	1497 (18.9)	231 (15.4)	316 (21.1)	950 (63.5)
Other	1434 (18.15)	906 (63.2)	158 (11.0)	370 (25.8)
Restorative services	6018 (21.6)	1978 (32.9)	2285 (38.0)	1755 (29.2)
Adhesive restoration—one surface—posterior tooth	1664 (27.6)	579 (34.8)	694 (41.7)	391 (23.5)
Adhesive restoration—two surfaces—posterior tooth	1073 (17.8)	334 (31.1)	435 (40.5)	304 (28.3)
Adhesive restoration—one surface—anterior tooth	641 (10.6)	204 (31.8)	179 (27.9)	258 (40.2)
Other	2640 (43.9)	1168 (44.2)	670 (25.4)	802 (30.4)
General services	2239 (8.0)	783 (35.0)	999 (44.6)	457 (20.4)
Travel to provide services	2032 (90.7)	758 (37.3)	954 (46.9)	320 (15.7)
Other	207 (9.25)	25 (12.1)	45 (21.7)	137 (66.2)
Oral surgery	1563 (5.6)	496 (31.7)	379 (24.2)	688 (44.0)
Removal of a tooth or part(s) thereof—1st tooth extracted from each quadrant	1361(87.1)	416 (30.6)	324 (23.8)	621 (45.6)
Other	202 (12.9)	80 (39.6)	45 (27.2)	67 (33.2)
Endodontics	195 (0.7)	18 (9.2)	44 (22.6)	133 (68.2)
Extirpation of pulp or debridement of root canal(s)—emergency or palliative	71 (36.4)	10 (14.1)	17 (23.9)	44 (62.0)
Complete chemomechanical preparation of root canal—one canal	35 (17.9)	1 (2.9)	5 (14.3)	29 (82.9)
Complete chemomechanical preparation of root canal—each additional canal	28 (14.4)	0 (0.0)	3 (10.7)	25 (89.3)
Additional visit for irrigation and/or dressing of the root canal system—per tooth	26 (13.3)	4 (15.4)	3 (11.5)	19 (73.1)
Root canal obturation—one canal	13 (6.7)	1 (5.5)	5 (11.4)	7 (5.3)
Root canal obturation—each additional canal	4 (2.0)	0 (0.0)	3 (6.8)	1 (0.07)
Other	18 (9.2)	2 (1.1)	8 (44.4)	8 (44.4)
Periodontics	126 (0.5)	20 (15.9)	40 (31.7)	66 (52.4)
Root planing and subgingival curettage—per tooth	103 (81.7)	15 (14.6)	35 (34.0)	53 (51.5)
Treatment of acute periodontal infection—per visit	14 (11.1)	0 (0.0)	1 (7.1)	13 (92.9)
Other	9 (7.1)	5 (55.6)	4 (44.4)	0 (0.0)
Prosthodontics	80 (0.3)	39 (48.8)	20 (25.0)	21 (26.3)
Immediate tooth replacement— per tooth	31 (38.7)	31 (100.0)	0 (0.0)	0 (0.0)
Adjustment of a denture	26 (32.5)	3 (11.5)	11 (42.3)	12 (46.2)
Cleaning and polishing of pre-existing denture	22 (27.5)	5 (22.7)	9 (40.9)	8 (36.4)
Other	1 (1.25)	0 (0.0)	0 (0.0)	1 (100.0)

(Continues)

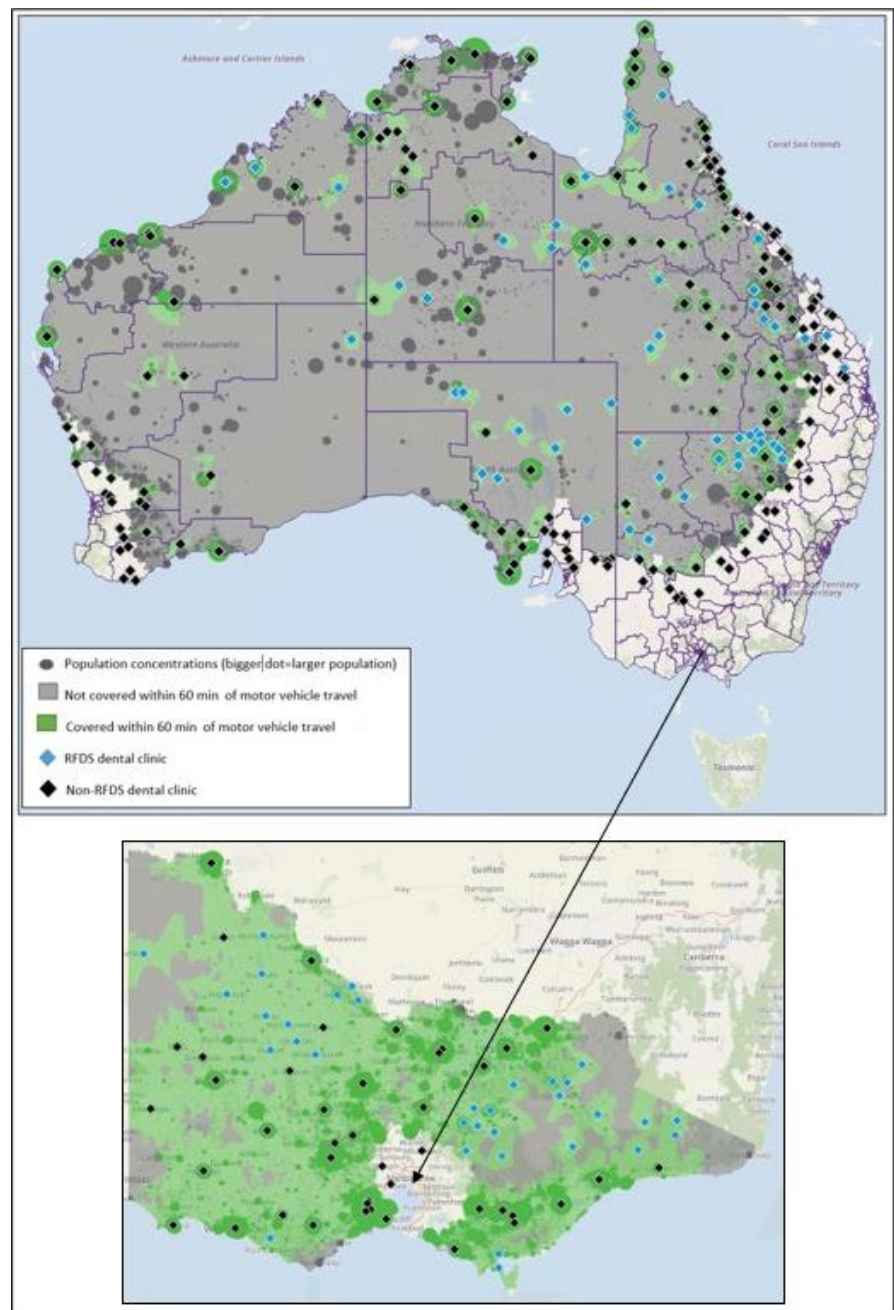
TABLE 1 (Continued)

	Number (%) ^a	Men	Women	Unknown
Crown and bridge	10 (<0.1)	3 (30.0)	1 (10.0)	6 (60.0)
Recementing crown or veneer	6 (60.0)	2 (33.3)	0 (0.0)	4 (66.7)
Removal of bridge or splint	3 (30.0)	0 (0.0)	1 (33.3)	2 (66.7)
Recementing bridge or splint—per abutment	1 (10.0)	1 (100.0)	0 (0.0)	0 (0.0)
Other	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Services total	27 897	10 658 (38.2)	9140 (32.8)	8099 (29.0)

^aProportion (%) of the services total.

^bProportion (%) of each dental service category.

FIGURE 3 Non-Royal Flying Doctor Service (RFDS) and RFDS dental clinic rural and remote coverage in 2017-2018. This figure estimates the rural and remote provision of dental services and excludes metropolitan areas, using Health Direct, RFDS and Australian Bureau of Statistics data sources. The dots indicate population concentrations, with larger dots equalling more people. Green dots or shading indicates population concentrations that are able to access services within a 60-min drive time; grey dots or shading indicates population concentrations that are not able to access services within a 60-min drive time. Service Planning and Operational Tool uses Google Maps to determine drive time, generally taking road quality and geography into consideration. White areas are non-rural and remote, such as inner-regional and major city areas. Does not include metropolitan areas or rural and remote areas of Tasmania. Tasmania mapping is currently in development, and will be published in a subsequent article as the maps mature



State or territory	Region/health service	Total rural and remote population 2016 ^a	Population without coverage within 60 min (%) ^b
Vic	Goulburn Valley Health	65 497	2753 (4.2)
	Albury Wodonga Health	56 002	2768 (4.9)
	Colac Area Health	23 015	3543 (15.4)
	South West Healthcare (Hamilton)	19 951	757 (3.8)
	Orbost Regional Health	6066	1570 (25.9)
NSW	Nyngan	7298	4759 (65.2)
	Walgett	5151	2424 (47.1)
NT	Katherine	14 499	3515 (24.2)
	Gillen	13 398	3324 (24.8)
	Alice Springs	10 898	2830 (26.0)
WA	Karratha	19 160	4082 (21.3)
	Newman	11 913	8820 (74.0)
	Merredin	4051	2740 (67.6)
	Kalgoorlie	3498	2307 (66.0)
	Ravensthorpe	2934	2248 (76.6)

^aThe population and service provision include only those within rural and remote areas, and all others are excluded. Note also that this includes only non-Tasmanian areas.

^bThis percentage includes residents covered with a 60-min drive time from their place of residence. It does not consider clinic wait times or whether the clinic has patient workload capacity. For example, the health service might not have capacity to see additional patients. It should also be resaid that while these communities might have dentists, they did have the highest levels of rural and remote patients required to travel more than 60 min to access.

Figure 3. The Victorian regions with a lack of dental services (neither RFDS nor non-RFDS) were the Colac area, Albury-Wodonga, the Goulburn Valley, the Orbost area, and the Hamilton area, as detailed in Table 2.

4 | DISCUSSION

In this study, we used routinely collected RFDS data to document the dental procedures and dental clinical provision in rural and remote Australia. This study showed that the main procedures that the RFDS dental clinics provided were related to oral hygiene (preventive services), adhesive restoration (restorative services) and tooth removal (oral services). Furthermore, this study found that there are thousands of people living in rural and remote regions of Australia who do not have access to dental care within a 60-minute drive time. This poor dental coverage is believed to be a significant contributor to the higher rates of hospitalisations for oral diseases that rural and remote communities are experiencing.^{13,14}

TABLE 2 Rural and remote regions with corresponding population size and dental service coverage (RFDS and non-RFDS) within a 60-min drive time

It has been identified that rural and remote children are at high risk of incidence of dental caries, often related to poor dental hygiene (such as limited brush frequency) combined with consumption of soft drinks and high-sugar snacking,^{13,15} and a lack of fluoridation of community water.¹⁶ This study showed that the most common age range at RFDS dental clinics was 0-20 years, indicating that parents are valuing their children's dental health when the service is made available within their communities, and specifically accessing the RFDS oral health therapists.

Women were more likely to have preventive dental procedures, whereas men were more likely to have restorative services and oral surgery. This indicates that women access dental services in the management of their dental health, whereas men appear to be accessing more for acute trouble. Our findings are consistent with Roberts-Thomson and Stewart,¹⁷ who found that women were more likely to attend the dentist and that women were more likely to focus on prevention with men accessing clinics when pain is apparent. Findings suggesting that women are more likely to use health services for prevention have been reported in many studies¹⁷

with education level reflecting knowledge, attitudes and value placed on dental health.¹⁸

The dental coverage in rural and remote Australia has been identified as being significantly lower than major cities.^{7,19-21} This is consistent with our findings that showed many people within rural and remote Australia do not have dental access within 60 minutes of travel, with the majority of the provision located in major cities. Many of our patients, within this study period, presented with acute conditions requiring treatment. This likely reflects a historical lack of dental services and management within their geographic area, thus leading to people forgoing treatment until at crisis point or until services visit their community. Policy leverages might be needed to promote dental workforce redistribution in rural and remote areas, as has been seen in the general practitioner workforce.²² Without increasing the dental provision in these areas and improving socio-economic detriments of health, it seems likely that many of these people will continue to have poor oral health.

This study was limited in that we were unable to collect 30% and 29% of the patients' ethnicity and sex data, respectively. This limitation has subsequently been addressed, via employee education and training. While this study included RFDS Tasmania dental data, we were unable to determine RFDS and non-RFDS dental service provision within Tasmania due to immature RFDS SPOT mapping capacity. However, this limitation is being addressed and Tasmania service provision data will be presented in future publications. A further limitation was that the 60-minute drive time to access services did not account for the patient's ability to access motor vehicle transportation, nor did it measure the direct and indirect costs of accessing services.

5 | CONCLUSION

The RFDS provided 3407 patients with dental care during the study period. These patients were all from areas without prior provision of dental services. We found that children were more likely to receive dental interventions consistent with improving dental health, while encouraging ongoing adherence to oral guideline recommendations. Furthermore, we found that women were more likely to focus on prevention, whereas men were more likely to receive oral surgeries. We found that there are many rural and remote areas without dental provision, which we suspect is contributing to increased oral emergencies and hospitalisations. As such, the RFDS hopes to expand its dental services to areas identified as having a low service provision. Furthermore, it is hoped that these findings will encourage new developments in policy to improve the availability and adequacy of dental services.

AUTHORS' CONTRIBUTION

Fergus W Gardiner: Formulated the research design and conducted data collection, analysis, and manuscript drafting. Alice Richardson: Conducted statistical analysis. Lauren Gale: Drafting of the manuscript. Lara Bishop: Conducted data analysis and manuscript drafting. Abby Harwood: Conducted data analysis and manuscript drafting. Robyn M Lucas: Drafting of the manuscript. Lorika Strickland: Data collection and analysis. Sandra Taylor: Data collection and analysis. Martin Laverty: Research design and drafting of the manuscript.

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