

# Service provision trends between 1983-84 and 1993-94 in Australian private general practice

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## Abstract

Patterns of service provision are expected to change over time, reflecting the dynamics of factors such as oral health status and trends in population demographics. The aim of this study was to identify trends in service provision over time. Data were collected from a random sample of Australian dentists in 1983-84, 1988-89, and 1993-94. Changes observed between 1983-84 and 1993-94 included a trend towards increased proportions of patients in older age groups, decreases in the percentage of persons receiving restorative care (from 40.2 per cent to 37.7 per cent) and prosthodontic care (9.3 per cent to 8.0 per cent), and increases in diagnostic (from 38.7 per cent to 46.0 per cent), preventive (20.9 per cent to 25.2 per cent), endodontic (5.3 per cent to 7.1 per cent), and crown and bridge services (3.1 per cent to 4.7 per cent) per visit. Other services such as orthodontic and general/miscellaneous services showed increases over the first half of the study period, but these did not continue between 1988-89 and 1993-94. The total number of services per visit increased over the study period for adult patients. These findings indicate changing patterns of practice over time, consistent with an increasing orientation towards prevention of disease and maintenance of a natural dentition.

**Key words:** Service provision, patient age, time trends, private general practice.

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## Introduction

Historical trends in Australia have indicated improved oral health for children, with more than half the child population having no experience of clinical caries in the permanent dentition at the age of 12 years.<sup>1</sup> Among adults, decreased levels of tooth

loss have occurred. The percentage of persons aged 65 years and over who had no natural teeth declined from 66 per cent in 1979 to 50 per cent in 1987-88 and 40 per cent in 1994.<sup>2-4</sup>

These shifts in oral health status need to be considered along with changes in population demographics for Australia. As the population grows, the numbers of children and young adults are only changing minimally, but there are substantial increases in the numbers of middle-aged and older adults. These changes will continue across the next several decades.<sup>5</sup> The pool of children and young adults at risk of oral diseases will be maintained, while the pool of middle-aged to older adults at risk of oral diseases, and hence in potential need of dental services, will increase.<sup>6</sup> Shifts in service provision can be expected to reflect these changes occurring in population demographics and oral health status.

Data from the United States have shown that most dental treatment consisted of a narrow range of procedures, primarily of a reparative nature,<sup>7</sup> while Australian service-mix has been dominated by restorative, diagnostic and preventive services, with service patterns related to patient age.<sup>8,9</sup>

In the United Kingdom, the changing pattern of treatment within the general dental service has included reductions in extractions and prosthodontics and increases in diagnostic, preventive and restorative care.<sup>10</sup> Australian data have indicated that while restorative services did not change in total between 1983-84 and 1988-89 there were changes in component services such as decreased provision of amalgams, but increases in glass ionomer restorations.<sup>11</sup>

The aim of this analysis was to identify trends in service provision in Australian private general practice over time. This involved an examination of the distribution of patients by age group, the mix of services provided by main service areas, and the

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number of services provided per visit at three points across a ten year period.

## Materials and methods

### Sample and response

A sample of 10 per cent of male dentists and 40 per cent of female dentists was randomly drawn from the dental registers for each Australian State or Territory in 1983, as the first wave of a longitudinal study. In both 1988-89 and 1993-94, a sample supplementation procedure was used to ensure representative cross-sectional samples at each of these follow-up waves of the study. This sample supplementation procedure consisted of sampling 10 per cent of male and 40 per cent of female dentists who were new to the dental registers since the previous wave of the study. This new component of the sample was added to the longitudinal component of the sample who were still present on the dental registers. In 1983-84, 1988-89, and 1993-94 this sample was surveyed by mailed questionnaire, providing response rates of 73 per cent, 75 per cent, and 74 per cent.

### Sample weighting

Weighted data are presented in this paper to provide measures which are representative of the age and sex distribution of Australian private practice dentists near each wave of the study. Data were weighted using the estimated number of practising private dental general practitioners at December 1983 and 1988,<sup>12,13</sup> with the age and sex distribution of dentists from the 1981 and 1986 population censuses of Australia to obtain age and sex distributions of dentists for the first and second waves of the study,<sup>14,15</sup> and dental board registration statistics from 1992 were used to obtain dentist age and sex distributions for the third wave.<sup>16</sup>

The data reported here are restricted to private general practitioners. In Australia, general practice comprised the predominant main area of practice (84.5 per cent), while the majority of dentists were from the private sector (77.4 per cent).<sup>16</sup> Tests of statistical significance were based on the weighted sample data, using a weighting factor which avoided inflating the sample size.<sup>17</sup> Services provided were recorded by dentists over one self-selected typical day of practice in 1983-84 and 1988-89, and over one to two days in 1993-94. The classification of services into main areas of service followed the Australian Dental Association's *Schedule of Dental Services*.<sup>18</sup>

## Results

### Dentist age by sex distribution

The data presented relate to the subset of responding dentists who were private general

**Table 1. Age and sex distribution of responding private dental general practitioners who provided service provision data**

Dentist age (years)	Sex of dentist				All	
	Male		Female			
1983-84	n	%	n	%	n	%
20-29	35	(14.1)	26	(36.6)	61	(19.1)
30-39	79	(31.9)	25	(35.2)	104	(32.6)
40-49	56	(22.6)	11	(15.5)	67	(21.0)
50-59	54	(21.8)	6	(8.5)	60	(18.8)
60+	24	(9.7)	3	(4.2)	27	(8.5)
Total	248		71		319	
1988-89	n	%	n	%	n	%
20-29	35	(12.7)	60	(38.5)	95	(22.0)
30-39	97	(35.1)	60	(38.5)	157	(36.3)
40-49	70	(25.4)	17	(10.9)	87	(20.1)
50-59	37	(13.4)	14	(9.0)	51	(11.8)
60+	37	(13.4)	5	(3.2)	42	(9.7)
Total	276		156		432	
1993-94	n	%	n	%	n	%
20-29	35	(13.4)	43	(27.9)	78	(18.8)
30-39	81	(31.0)	68	(44.2)	149	(35.9)
40-49	74	(28.4)	30	(19.5)	104	(25.1)
50-59	38	(14.6)	9	(5.8)	47	(11.3)
60+	33	(12.6)	4	(2.6)	37	(8.9)
Total	261		154		415	

practitioners and provided data from a log of services performed on a self-selected typical day. The age and sex distribution of responding private general practitioners, prior to weighting, is presented in Table 1. In total, there were 319 dentists from 1983-84, 432 from 1988-89, and 415 from 1993-94. The highest percentage of dentists occurred in the 30-39 year age group. For female dentists the highest percentages were in the two youngest age groups while the highest percentages of male dentists were in the 30-39 and 40-49 years age groups.

### Patient age by sex distribution

The age and sex distribution of patients treated by private general practitioners, prior to weighting, is presented in Table 2. For all three waves of the study there were only small percentages of patients aged less than five years old. Patients aged 65+ years also constituted a small percentage of total patients but this age group increased across successive waves of the study. The largest percentage of total patients was made up by the 25-44 year old age group, which comprised 36.3 per cent (1983-84), 40.9 per cent (1988-89), and 37.2 per cent (1993-94) of patients between the three waves of the study. Greater numbers of female patients than males were seen in all three waves. Higher total numbers of patients in 1993-94 are due to the collection of two sample days of treatment as opposed to one sample day in 1983-84 and 1988-89.

Examination of changes in the percentage of patients treated by age group over the period of the study showed that a decrease occurred in the

**Table 2. Age and sex distribution of patients treated by responding private dental general practitioners**

Patient age (years)	Sex of patient				All	
	Male		Female			
1983-84	n	%	n	%	n	%
<5	43	(2.0)	47	(1.8)	90	(1.9)
5-11	212	(10.0)	194	(7.3)	406	(8.5)
12-17	242	(11.7)	260	(9.8)	502	(10.5)
18-24	311	(14.7)	475	(17.9)	786	(16.5)
25-44	717	(33.9)	1016	(38.3)	1733	(36.3)
45-64	459	(21.7)	527	(19.8)	986	(20.7)
65+	130	(6.1)	136	(5.1)	266	(5.6)
Known	2114		2655		4769	
Unknown	-		-		86	
Total	2114		2655		4855	
1988-89	n	%	n	%	n	%
<5	43	(1.6)	43	(1.4)	86	(1.5)
5-11	191	(6.9)	227	(7.2)	418	(7.1)
12-17	232	(8.4)	277	(8.7)	509	(8.6)
18-24	328	(11.9)	440	(13.9)	768	(13.0)
25-44	1081	(39.3)	1342	(42.4)	2423	(40.9)
45-64	664	(24.1)	628	(19.8)	1292	(21.8)
65+	213	(7.7)	211	(6.7)	424	(7.2)
Known	2752		3168		5920	
Unknown	-		-		11	
Total	2752		3168		5931	
1993-94	n	%	n	%	n	%
<5	63	(1.6)	46	(1.0)	109	(1.3)
5-11	300	(7.8)	328	(6.9)	628	(7.3)
12-17	333	(8.6)	343	(7.2)	676	(7.9)
18-24	293	(7.6)	461	(9.7)	754	(8.8)
25-44	1343	(34.8)	1862	(39.2)	3205	(37.2)
45-64	1084	(28.1)	1242	(26.2)	2326	(27.0)
65+	445	(11.5)	465	(9.8)	910	(10.6)
Known	3861		4747		8608	
Unknown	-		-		150	
Total	3861		4747		8758	

proportion of younger patients (aged 12-17 and 18-24 years) and that an increase occurred in the proportion of older patients (aged 45-64 and 65+ years). For example, the 18-24 year age group declined from 16.5 per cent in 1983-84 to 8.8 per cent in 1993-94, while the 65+ year age group increased from 5.6 per cent to 10.6 per cent over the same period. The following sections on service provision are based on weighted data, as outlined in the materials and methods.

### Main areas of service

#### Receipt of services by patient age

Table 3 shows the percentage of persons receiving services at a visit by age of patient for all three points of time combined. Significant differences between age groups occurred for all 10 areas of service. The differences in service provision by age follow the expected patterns. For example, diagnostic and preventive services were provided at higher percentages in younger compared with older age groups, restorative services were provided at higher percentages in middle age groups, and orthodontic services were highest among adolescents. The association of service provision with age of patient

**Table 3. Percentage of persons receiving services per visit by patient age**

Service area	Age of patient						
	<5	5-11	12-17	18-24	25-44	45-64	65+
Restorative	18.2	22.1	28.8	41.7	45.3	40.2	30.2*
Diagnostic	79.3	61.1	52.4	45.4	41.6	36.2	33.5*
Preventive	17.0	28.5	28.0	25.1	24.0	22.1	19.1*
Prosthetic	0.0	0.3	0.3	1.4	4.5	14.4	33.0*
Oral surgery	1.3	8.2	7.2	8.4	6.3	6.3	6.1*
Endodontic	1.7	2.3	2.2	6.6	8.0	7.3	4.7*
Crown/bridge	0.4	0.1	0.3	1.9	4.8	7.3	4.0*
General/misc.	4.1	2.6	2.7	5.0	4.6	3.5	2.4*
Periodontic	0.0	0.1	0.1	1.0	1.9	1.8	1.0*
Orthodontic	0.0	6.8	12.0	1.0	0.3	0.1	0.0*

\*Significant (chi-square;  $p < 0.05$ ).

indicated that comparisons over time need to be controlled for any differences in age distribution.

#### Receipt of services by sex of patient

Table 4 shows the percentage of persons receiving services at a visit by sex of patient for all three points of time combined. Differences in the percentage of service received per visit by sex of patient were not as pronounced as observed for age of patient, but were statistically significant in four of the 10 areas of service. Higher percentages of female patients received diagnostic and general/miscellaneous services per visit compared with male patients. However, higher percentages of male patients received oral surgery and endodontic services.

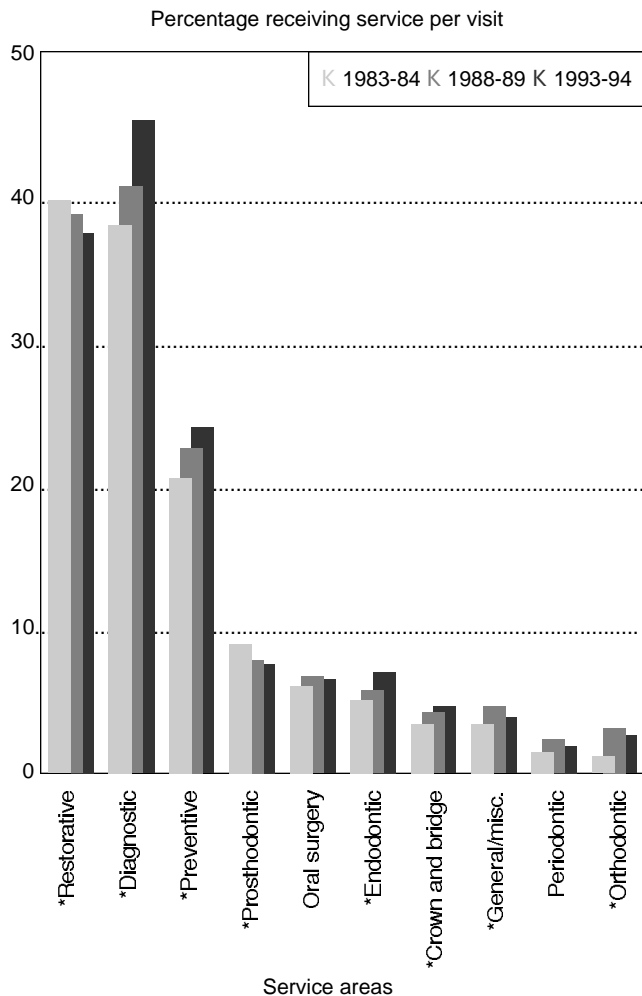
#### Receipt of services by year

Services provided are presented in Fig. 1 as the percentage of patients receiving services per visit by main areas of service and year. At all three points of the study period the distribution was dominated by restorative, diagnostic and preventive services. The percentage of patients receiving restorative services declined significantly over the study period from 40.2 per cent to 37.7 per cent. Prosthetic services also decreased significantly, mainly in the first half of the study period, from 9.3 per cent in

**Table 4. Percentage of persons receiving services per visit by patient sex**

Service area	Sex of patient	
	Male	Female
Restorative	39.0	38.6
Diagnostic	41.9	43.4*
Preventive	23.2	24.2
Prosthetic	8.3	8.5
Oral surgery	7.7	5.8*
Endodontic	6.9	5.9*
Crown/bridge	4.2	4.2
General/misc.	3.2	4.3*
Periodontic	1.6	1.3
Orthodontic	1.7	1.9

\*Significant (chi-square;  $p < 0.05$ ).



\*Significant (chi-square;  $p < 0.05$ ).

Fig. 1. – Percentage of persons receiving services per visit by year.

1983-84 to 8.2 per cent in 1988-89 and 8.0 per cent in 1993-94. Diagnostic and endodontic services increased significantly, mainly in the second half of the study period, while preventive and crown and bridge services increased mainly in the first half of

**Table 5. Number of services per visit by patient age and year**

Patient age	Year		
	1983-84	1988-89	1993-94
	Mean (SE)	Mean (SE)	Mean (SE)
<5	1.30 (0.08)	1.40 (0.09)	1.43 (0.10)
5-11	1.62 (0.06)	1.73 (0.07)	1.72 (0.06)
12-17	1.80 (0.06)	1.76 (0.06)	1.98 (0.07)
18-24	1.82 (0.05)	1.94 (0.05)	2.16 (0.07)*
25-44	1.83 (0.04)	1.94 (0.03)	2.13 (0.04)*
45-64	1.63 (0.05)	1.85 (0.05)	2.07 (0.05)*
65+	1.53 (0.08)	1.76 (0.08)	1.86 (0.05)*
Total	1.75 (0.03)	1.88 (0.03)	2.07 (0.03)*

\*Significant (Kruskal-Wallis test;  $p < 0.05$ ).

the period. General/miscellaneous and orthodontic services showed increases in the first half of the study period but declined slightly over the second half of the period.

#### *Number of services per visit by patient age and year*

The results from the percentage of patients receiving services per visit indicated that from the 10 main areas of service there were six areas which showed increases from baseline, suggesting an increase in the total numbers of services provided per visit over the study period. Table 5 shows the number of services provided per visit by patient age and year. For all age groups combined there was an increase in number of services provided to patients per visit across the three points of the study period. When broken down by age groups of patients there was a trend towards increased services per visit among all adult age groups. Statistically significant increases were observed for patients aged 18-24, 25-44, 45-64 and 65+ years. The shape of the association with age also altered. In 1983-84 the number of services per visit increased across age

**Table 6. Odds ratios from logistic regressions of restorative, diagnostic, preventive, prosthodontic, endodontic, and crown and bridge services by patient sex and age, and year**

	Service area					
	Restorative	Diagnostic	Preventive	Prosthodontic	Endodontic	Crown/bridge
Patient sex						
Male	1.05	0.93*	0.95	0.90	1.23*	0.98
Female†	1.00	1.00	1.00	1.00	1.00	1.00
Patient age						
<5	0.51*	8.44*	0.91	0.00*	0.37*	0.09*
5-11	0.65*	3.37*	1.75*	0.00*	0.51*	0.02*
12-17	0.92	2.36*	1.72*	0.01*	0.49*	0.07*
18-24	1.64*	1.83*	1.50*	0.02*	1.58*	0.49*
25-44	1.91*	1.49*	1.37*	0.09*	1.86*	1.25
45-64	1.56*	1.15*	1.21*	0.32*	1.62*	1.93*
65+†	1.00	1.00	1.00	1.00	1.00	1.00
Year						
1983-84†	1.00	1.00	1.00	1.00	1.00	1.00
1988-89	0.93	1.16*	1.18*	0.71*	1.11	1.37*
1993-94	0.89*	1.53*	1.32*	0.51*	1.37*	1.29*

\*Significant ( $p < 0.05$ ).

†Reference category.

groups until it peaked in the 18-24 and 25-44 years age groups, then it declined across older age groups. The trend for 1988-89 and 1993-94 was for increases in services per visit among all patients aged over 18 years. The number of services per visit still peaked in the 18-24 and 25-44 year age groups but declined less across older adult patients.

### ***Logistic regression analysis of service provision***

Logistic regression was used to assess the effects of changes over time during the study period controlling for the effects of age and sex of patients. Separate regression models were constructed for six of the ten main areas of service, the results of which are presented in Table 6. Regression models were not performed for the areas of oral surgery and periodontics as these showed no significant difference over time in the cross-tabulation by year presented in Fig. 1. The general/miscellaneous and orthodontic service areas were not included in the regression analysis as they showed no clear trends over time and only account for a small percentage of service per visit.

The odds ratios for patient age and sex confirm the associations presented as cross-tabulations in Tables 3 and 4. Male patients received less diagnostic service, 0.93 times the odds, but more endodontic service, 1.23 times the odds, compared with females. Associations by age of patient indicated that, compared with the reference category of 65 years or more, adult patients generally had higher odds ratios, while children tended to have lower odds ratios for services such as restorative, endodontic, and crown and bridge. For services such as diagnostic and preventive there was a trend for most age groups to have higher odds ratios compared with the 65 years or older category, with the odds ratios becoming smaller across successively older age groups. For prosthodontic services the odds ratios were smaller for all age groups compared with the 65 years or more category, with a trend towards increased odds ratios across successively older age groups.

Associations by year indicated that restorative services were 0.89 times and prosthodontic services 0.51 times the odds in 1993-94 compared with 1983-84. In 1993-94 diagnostic services were 1.53 times, preventive 1.32 times, endodontic 1.37 times and crown and bridge services 1.29 times the odds compared with 1983-84.

### **Discussion**

In Australia there have been improvements in the oral health status of the population, such as a decrease in caries experience of children and adolescents and tooth loss in adults.<sup>6</sup> However, the

decrease in tooth loss increases the pool of teeth at risk of oral disease. Parallel to these changes in oral health is an increased number of middle-aged to older adults. The extent and magnitude of impact of such oral health and demographic changes on service provision is uncertain. For example, in the USA, caries prevalence has declined, but use of services has increased, particularly among young children and the elderly.<sup>19,20</sup>

Reductions in the levels of tooth loss have been linked with increased treatment needs, especially in the elderly.<sup>21,22</sup> The results of this study have shown increases in the number of services per visit provided to adults, and have also shown increases in the proportion of patients in the age groups 45-64 and 65 years or more. Such findings support the view that treatment emphasis is shifting towards older adults.

Predicted international trends for developed countries include an increased preventive orientation, decreased requirement for dentures, and shifts in restorative procedures such as more complex restorations in older teeth.<sup>22-24</sup> The findings presented here have shown reductions in the percentage of patients receiving restorative and prosthodontic services per visit. These findings parallel suggestions from the UK that decreased simple restorations may be compensated for by increased crowns, bridges and endodontic services,<sup>10</sup> while in the USA the pattern between 1979 and 1990 was one of declining numbers of dental amalgams and increased numbers of crowns.<sup>25</sup>

Service provision may also be influenced by factors other than oral health status and population demographic trends. Economic factors such as standard of living and financing of health care as well as supply factors relating to practice management and productivity may need to be considered when modelling future dental health care scenarios.<sup>26</sup>

The observed increase in total numbers of services per visit could reflect increased demand for services or a change in the pattern of practice activity among dentists. Trends in productivity over the same study period have indicated declining numbers of annual patient visits which may be offset by the increased numbers of services per visit.<sup>27</sup> A shift towards older patients with more complex treatment needs may result in more services being required per visit.

Changes in the pattern of service provision were observed between 1983-84 and 1993-94, with shifts in percentages of patients receiving services per visit by main service areas involving decreased percentages of restorative and prosthodontic services, but increased percentages of diagnostic, preventive, endodontic, and crown and bridge services. Total numbers of services per visit increased. Trends in

the percentage of patients receiving services were consistent with declining edentulism, involving reductions in prosthodontic care, but increases in areas such as diagnostic and preventive services.

Against the background of trends toward improved oral health among the general population, the findings of this study have indicated sustained capacity to supply services in private general practice, but gradual shifts in the level of supply between specific service areas. This changing pattern of service provision over time was consistent with an increasing orientation towards preventive care, and increased provision of services associated with the maintenance of a natural dentition, to a patient group with a growing percentage of middle-aged and older adults.

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