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The South Australian dental labour force

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Abbreviations

ABS	Australian Bureau of Statistics
ADC	Australian Dental Council
AIHW	Australian Institute of Health and Welfare
ARCPOH	Australian Research Centre for Population Oral Health
ASGC	Australian Standard Geographical Classification
DSRU	Dental Statistics and Research Unit
ERP	Estimated resident population
SA	South Australia

Symbols

..	not available
%	percentage
–	zero or rounded to zero

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Editorial team

Several people have contributed to the editing of this publication. Lorna Lucas of ARCPOH and proofreaders Jo Mason and Jeanette Whelan have worked to improve the consistency, layout and readability of the text.

Summary

Introduction

1. In May 2003 The South Australian Dental Service contracted the Australian Research Centre for Population Oral Health (ARCPOH) to conduct a South Australian Dental Labour Force Project. ARCPOH's role was to inform discussion and decision making by developing and providing information on the supply and demand for dental services.
2. The specific objectives of the project were to prepare projections through to the year 2015 of the demand for dental services and supply of dental professionals across all disciplines in both the public and private sectors in South Australia.
3. ARCPOH pursued these objectives through analyses conducted at The University of Adelaide using labour force data of which it is the custodian, and data on the use of dental services which it has collected over time.

Supply of dental services

4. The supply of the dental labour force has been examined by regarding it as a dynamic system of stock and flows. The stock of providers was equivalent to the number of registered dentists, hygienists, therapists and prosthetists in 2002. Flows were associated with supplementation of the stock (recruitment through education and migration) and attrition (migration out, retirement, cessation of the pursuit of dentistry as a career and death). So that the stock and flows were accurately represented, dentists were divided into sex and 10 age categories; allied dental professionals were divided into age categories only.
5. The dental labour force was projected to 2015 using a Markov chain model, the key components of which were the recruitment vector, wastage vector and transitional matrix. Separate models were specified for dentists (male and female), and dental hygienists, therapists and prosthetists.
6. In 2002 the number of registered dentists in South Australia was 918 and the number of dentists practising was estimated at 838.
7. Across the period 1998 to 2002, between 43 and 87 dentists were recruited to the dental register each year, averaging 60.5 dentists per year. Graduates from Australian university dental schools made up 76.5% of recruits, with most (63.6%) coming from The University of Adelaide. Overseas-trained dentists, predominantly from Asia, the United Kingdom and New Zealand, made up the remainder of recruits.
8. Taking the 2002 number of registered dentists as a base and using a medium recruitment vector of 60 dentists per year, the number of registered dentists was projected to be 997 in 2010 and 1,027 in 2015. Using age- and sex-specific rates for registered practising dentists, these numbers translated to 902 and 927 practising dentists in 2010 and 2015 respectively.

9. The 2002 baseline rate of dentists per 100,000 population was 55.3. This was projected to increase to 59.6 per 100,000 in 2015 under the medium recruitment scenario (60 dentists per year).
10. Using a **static** matrix of age- and sex-specific annual productivity estimates for practising dentists, the capacity of dentists to supply visits under the medium recruitment scenario was estimated at the 2002 base to be 1.87 million visits, and projected to increase to 1.95 million visits in 2015.
11. Using a matrix of **declining** age- and sex-specific productivity rates, the capacity of dentists to supply visits under the medium recruitment scenario was estimated at the 2002 base to be 1.835 million visits and projected to decrease by 4.5%, to 1.752 million visits in 2015. (Productivity rates were decreased at 50% of the rate of decline previously observed 1983/84 to 1998/99.)
12. The projections of dentists and their capacity to supply under different recruitment scenarios and using the declining matrix of productivity rates are summarised below:

Year	Recruitment vector	Number registered	Number practising	Capacity to supply dental visits (millions)
2002	Base	918	838	1.84
2015	Low (52)	957	863	1.64
2015	Medium (60)	1027	927	1.75
2015	High (68)	1097	990	1.86

13. There were an estimated 145 registered and 123 practising dental therapists in South Australia in 2002. Using a recruitment vector of 6 per year, the number of practising dental therapists was projected to decrease to 90 in 2015.
14. The supply estimates and projections for dental therapists are summarised below:

Dental therapists	Recruitment vector	Number registered	Number practising	Capacity to supply dental visits (millions)
2002	Base	145	123	0.292
2015	6	103	90	0.214

15. There were an estimated 151 registered and 115 practising dental hygienists in South Australia in 2002. Using a recruitment vector of 15 per year, the number of practising hygienists in 2015 was projected to be 111 practising hygienists.
16. The supply estimates and projections for dental hygienists are summarised below:

Dental hygienists	Recruitment vector	Number registered	Number practising	Capacity to supply dental visits (millions)
2002	Base	151	115	0.103
2015	15	151	111	0.100

17. There were an estimated 35 registered and 26 practising dental prosthetists in South Australia in 2002. Using a recruitment vector of 4 per year, the number of practicing prosthetists was projected to decrease to 24 in 2015.
18. The supply projections for dental prosthetists are summarised below:

Dental prosthetists	Recruitment vector	Number registered	Number practising	Capacity to supply dental visits (millions)
2002	Base	35	26	0.046
2015	4	32	24	0.043

19. The total capacity to supply dental visits in South Australia under varying recruitment scenarios for dentists and assuming medium projected productivity is summarised below:

	Dental visits (millions)				Total
	Dentists	Dental hygienists	Dental therapists	Dental prosthetists	
2002	1.84	0.103	0.292	0.046	2.28
2015:					
Low	1.64	0.100	0.214	0.043	2.00
Medium	1.75	0.100	0.214	0.043	2.11
High	1.86	0.100	0.214	0.043	2.23

Demand for dental services

20. The demand for dental services has been estimated and projected on the basis of 10 age-specific South Australian population estimates and projections divided into dentate and edentulous subgroups. These were multiplied by the same 10 age-specific per capita number of dental visits per year and rates of services provided per visit. These were based on past time trends extrapolated forward to 2015 under a range of assumptions varying from no continuation of the time trend (0%) to 100% of the past time trend continuing across the projection period. Most emphasis has been placed on an assumption of 50% of past time trends continuing through to 2015.
21. The South Australian population is projected to increase from 1.512 to 1.555 million between 2002 and 2015, a 2.9% increase.
22. The dentate proportion of the Australian population has been increasing since 1979, especially in middle-aged and older age groups. The proportion of dentate Australians has been projected from 1989 through to 2019, and estimates for the base year 2002 and for every year up to 2015 were interpolated from these Australian data and applied to the South Australian population. Between 2002 and 2015 the proportion of the dentate population increased; for instance, the proportion in the 65-74 and 75+ age groups who were dentate increased from 71.6% and 57.5% to 84.7% and 72.4% respectively.

23. Time trends in the per capita demand for each age group among Australian dentate and edentulous persons across the years 1979, 1988 and 1995 were established and used to estimate demand in 2002, and to project demand through to 2015 based on assumptions of continuation of the time trends.
24. The demand estimates and projections for dental visits are summarised below:

	Projection of demanded visits (millions) under varying assumptions for continuation of the time trend in per capita demand from 1995		
	0%	50%	100%
2002 base	2.034	2.181	2.328
2015	2.144	2.605	3.067
% change 2002 to 2015	5.4	19.4	31.7

Most of the growth in demand for dental visits was projected among the 35–44, 45–54, 55–64, 65–74 and 75+ age groups.

25. In a South Australian sample surveyed in 2002, of those who had made a dental visit in the previous 12 months, there was an estimated 29.0% who were eligible for public dental services.
26. Demand through to 2015 among eligible persons will increase by 32.4%, faster than the 13.9% increase among the 71.0% who are not eligible for public dental services.
27. There has been an underlying pattern of increasing numbers of services being provided at a dental visit between 1983 (1.72 services) and 1998 (2.09 services). Extrapolation of the time trend in the rate of services per visit in private general practices for each age group was used to project the number of services to be demanded in 2015. This was applied to total services and services in each of 10 main categories. Again, a number of assumptions were made about the continuation of the time trend through to 2015. These included 0%, 25%, 50%, 75% and 100% continuation of the time trend.
28. The demand estimates for 2002 and projections for demanded services in 2015 are summarised below:

	Demanded services (millions) (based on 50% time trend in visits and 50% time trend for services)	
	2002	2015
Diagnostic	1.457	1.863
Preventive	0.929	1.214
Periodontic	0.036	0.048
Oral surgery	0.175	0.180
Endodontic	0.286	0.424
Restorative	1.247	1.572
Crown and bridge	0.143	0.227
Prosthodontic	0.186	0.235
Orthodontic	0.070	0.081
General miscellaneous	0.087	0.115
Total	4.617	5.958
		(29.0% increase)

Discussion of supply and demand

29. Only a discontinuation of the linear time trends in per capita demand for dental visits after 1995 would see the capacity to supply visits exceed demand. This seems unlikely given that the 2002 supply estimates are close to the full continuation of growth in per capita demand projections. All other assumptions lead to an excess of demand over capacity to supply dental visits.

Capacity to supply dental visits		Demand for dental visits			
		2002	2015*		
2002	2.28	2.034–2.328	Low 0%	Medium 50%	High 100%*
2015					
Low	2.00		2.144		
Medium	2.11			2.605	
High	2.22				3.067

*Based on continuation in the time trend from 1995 to 2015.

An extra 190 providers on the 2002 numbers would be required to bridge the gap between potential demand and the capacity to supply dental visits under the medium assumptions.

Issues

30. Three broad directions might be considered to increase the capacity to supply dental services:
- increased recruitment of dentists
 - increased annual productivity
 - increased recruitment of dental hygienists, therapists and prosthetists.
31. A combination of time lags in expanding dentist education and uncertainty about choice of location for both locally trained and overseas-trained dentists reduces the certainty of a direct proportional increase in supply via dentists. However, some additional education of dentists is bound to increase South Australian supply. Annual productivity is unlikely to assist because trends are moving towards longer dental visits and therefore lower annual production of visits per dentist. This does not imply that dentists' productivity is declining; there is an increase in the number of services per visit, and the number of services produced per year is stable. However, those services are being provided across fewer patient visits. Recruitment of dental hygienists, therapists and prosthetists has advantages because of the shorter times necessary for their education. However, for those professional groups, there are similar uncertainties about retention in South Australia as those for dentists. For each of the allied dental professionals, there are also issues surrounding scope of practice and their role in substitution or complementary practice with a dentist.
32. The increasing demand for dental visits and services projected through to 2015 raises questions about allocative efficiency. Although increasing demand for diagnostic and preventive services may result in early diagnosis and prompt treatment for some, the frequency at which these services are demanded needs consideration. Management of the interval between courses of care might be preferable to price increases in the private sector or increased barriers to public dental services.

Further considerations

From this discussion of supply of and demand for oral health services, a number of matters are put forward for consideration.

33. There is a need for informed, coordinated policy on the dental labour force.

There have been numerous indications of the need for a sustained investment in information on the supply of and demand for dental visits and services so as to better understand the past, describe the present and project the future. Several areas where this is most apparent are:

- recruitment and wastage from the stock of dental hygienists, therapists and prosthetists
- annual productivity of dental hygienists and prosthetists
- the degree of substitution versus complementary activity between the allied dental labour force and the dentist labour force
- the macro economic influences on demand for dental visits and services.

It is also apparent that no state or territory is isolated from others in terms of the impact of policy decisions. In relation to policies that shape the capacity to supply services, South Australia operates in a national system for educating dental providers who, through mutual recognition and trans-Tasman agreements, are free to practise anywhere in Australia and New Zealand. This may reduce the efficacy of increasing course completion numbers to expand the capacity to supply dental services in any one state alone, and emphasises the need for national policy.

34. Given the projected excess of demand over supply, where possible, actions should be taken to increase recruitment and retention of qualified persons in the labour force. With the dominance of women in the stock of dental hygienists and therapists and increasing feminisation of the dentist labour force, increased retention would be aided by strong retraining programs and conditions that support re-entry at equivalent levels to those enjoyed before interruptions to work. Consideration should be given to encouraging the use of any additional capacity within the dental labour force to satisfy the needs and demands of segments of the population where equity of access to dental care is also a priority issue. Such actions would be easier to implement and adjust as necessary in a highly integrated educational and service environment, with articulation between educational programs and greater flexibility in career paths.
35. As a substantial proportion of recruitment of the dental labour force is from interstate or overseas, measures to increase such recruitment should be considered. Particular attention might be given to limited registration for overseas dentists to practice in 'shortage' areas.
36. Specific incentives for dentists, hygienists, therapists and prosthetists to be recruited to South Australia and to serve in the public dental services, especially in rural areas, might also be considered, built around financial and public sector career opportunities.
37. If demand sharply exceeds capacity to supply dental visits, then attention should be given to actively managing demand in an effective and non-regressive manner, e.g. through guidelines generated by the dental profession on longer recall intervals and incentives through private health insurance for dentists to adopt longer intervals between courses of care. Such active strategies are seen as more favourable than price increases which would further reduce the access of some patients potentially in greater need of dental services.

1 Introduction

In May 2003 the Australian Research Centre for Population Oral Health agreed to conduct the South Australian Dental Labour Force Study. The aims of the project were to inform policy decisions about the dental labour force by providing timely, authoritative and detailed estimations and projections on the supply of and demand for oral health services.

1.1 Background

The nature and size of the dental labour force have become increasingly vexed issues for dentistry in Australia. There is considerable opinion expressed about the relative roles of different occupational groups and, more recently, the adequacy of the total aggregate supply of dental professionals.

To many this will be somewhat surprising. Firstly, it was only 20 years ago that there was a perceived excess or over-supply of dentists, leading to cuts in intakes into university dental degrees. Secondly, many would imagine that the two major improvements in oral health over the last two decades, i.e. decreases in dental caries in children and decreases in tooth loss in adults, would have led to a reduction in need and demand for dental services. This has not been the outcome.

“Past improvements in oral health have not translated into reduced need for dental services. Improvements in oral health and ageing of the population both contribute to a greater need for dental services. Lower caries experience among children has been more than matched by increased awareness of the expectations for maintaining improved oral health. A lower rate of tooth loss in middle-aged and older Australians illustrates ‘the paradox of success’ when it leads to an increased burden of disease and need for treatment” (AHMAC 2001).

Collectively, two events – the reduction in dental undergraduate numbers in Australian universities and the paradoxical increase in need and demand for dental services – are causing the emerging shortage in the dental labour force. Such a shortage appears earliest in those sectors and situations that traditionally have been less attractive locations for dental practice. Hence, shortage emerges initially in rural/remote areas, public dental services and areas of lower socioeconomic status in capital cities. Reports on the dental labour force in Victoria and New South Wales indicate that this has indeed occurred. It is therefore timely to consider the dental labour force in South Australia.

The aims of this report are to:

- inform the South Australian dental community about the findings of national data collections maintained by the Australian Institute of Health and Welfare's Dental Statistics and Research Unit (AIHW DSRU) at The University of Adelaide
- inform the dental community about projects conducted by the Australian Research Centre for Population Oral Health (ARCPOH) at The University of Adelaide (ARCPOH use data to estimate and project the supply of and demand for dental services in Australia.)
- stimulate thinking and assist in identifying preferred solutions.

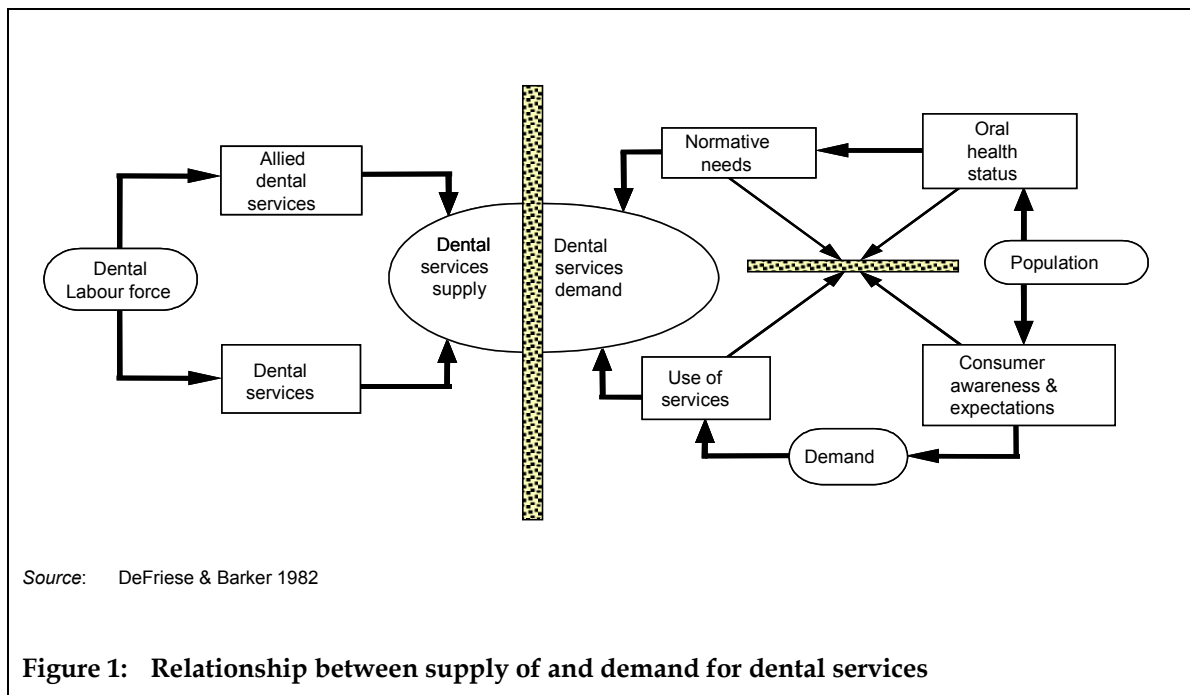
The proposed methodology is largely driven by:

- previous experience in oral health services labour force research, especially the 1986 Ministerial Review of Dental Services in Victoria, the 1999 Victorian Oral Health Services Labour Force Planning Project and the 2002 New South Wales Oral Health Workforce Planning Project
- access to South Australian data on the stock of dentists, dental hygienists, therapists, prosthetists, and chairside dental assistants over varying periods of time
- access to data on the use of oral health services by South Australian children and adults over time and on the social, demographic and oral health factors that influence the per capita demand for oral health services
- experience with research into dentist participation in the labour force and influences on career pathways
- the interface between supply and demand, where decisions on the appropriateness of the balance reflect social, economic and political interests and drive policy directions.

1.2 Outline

A useful basic plan for the relationship between supply of and demand for dental services and, subsequently, the dental labour force is a model adapted from that proposed by DeFriese & Barker (1982). The model, presented in Figure 1, begins at the periphery with head counts of the dental labour force and the population, but endeavours to work towards common units to quantify the capacity to supply dental services and the demand for dental services. The model illustrates:

- the complexity on the supply side introduced by multiple levels of qualification among personnel and the consequent matching within individual dental practices of personnel to services supplied
- the complexity on the demand side of reconciling the interaction between needs and demand for dental services
- the interface between supply and demand, where decisions on the appropriateness of the balance reflect social, economic and political interests and drive policy directions.



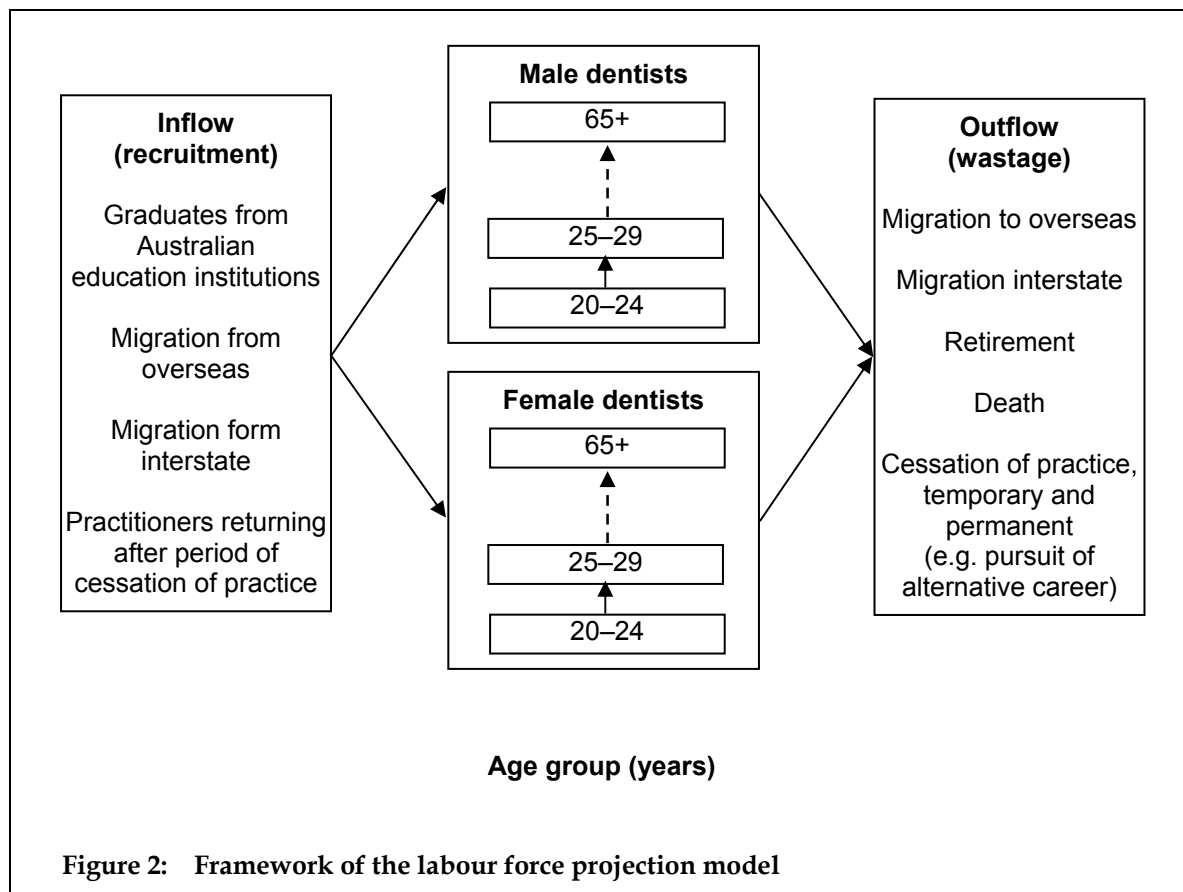
This report is organised around key components of the plan. Discussion focuses on:

- the estimation and projection of dental labour force numbers and the capacity to supply dental visits (sections 2, 3, 4 and 5)
- the estimation and projection of the demand for dental visits and services (section 6)
- a reconciliation of supply and demand (section 7).

2 The supply projection model

The framework underlying the projection of numbers of practising dental professionals in South Australia conceives the labour force as a dynamic system of stocks and flows. The stock of dental service providers is equivalent to the number of registered dentists, therapists, hygienists and prosthetists. Movement into the stock of dental practitioners (recruitment) consists of practitioners who were educated in Australian educational institutions, practitioners who have migrated into Australia or have moved from interstate, and practitioners who return to practice after a period of cessation from practice. Attrition (wastage) from the stock of practitioners is associated with migration out of Australia, movement interstate, retirement, death and cessation of practice. Cessation of practice may be permanent (e.g. to pursue another career) or short-term (e.g. prolonged parental leave, study leave).

To ensure accurate representation of the stock of practitioners in South Australia, dentists were categorised into sex and age groups, and allied dental professionals into age groups. Each element of the inflows and outflows were followed through each age and sex group, as shown in Figure 2.



The baseline stock of dentists was divided into male and female dentists and then grouped into 10 age categories, I ($I = 1, 2, \dots, 10$). The baseline stock of allied dental professionals was also divided into 10 age categories. There was no categorisation by sex as these groups are highly gendered, the prosthetists dominated by males and the therapists and hygienists by females.

A basic Markov chain model was adopted; the model assumes that dentists flow in and out of age categories independently and with identical probabilities that do not vary over time (Bartholomew & Forbes 1979). Each dentist with the passage of time has a given probability of staying in the same age group (P_{ii}) or of making a transition into an older age group ($P_{i,i+1}$). The transitional probabilities between each of the age groups are set out in an array as follows:

P_{11}	P_{12}	...	...	...	W_1
...	P_{22}	P_{23}	...	...	W_2
...	...	P_{33}	P_{34}	...	W_3
...	...	...	P_{II}	P_0	W_I

Each element P_{ii} is the probability that a member of the age category i at the start of the time interval remains in that age category at the end, and $P_{i,i+1}$ is the probability that a member of age category i at the start of the time interval is in age category $i+1$ at the end. W_i is the probability that a member of age category i at the start would no longer contribute to the stock of dentists at the end of the time interval. Because each dentist must either stay in the same age group, move to the next age group, or no longer contribute to the stock of dentists, each row sums to 1:

$$P_{ii} + P_{i,i+1} + W_i = 1$$

(Note: As there are only 10 age categories, dentists who are 65 years or older cannot move into the next age category – they can only stay in the current age category or be wasted out of the stock of dentists.)

The matrix P is the transition matrix, and the row vector W ($W_1, W_2 \dots W_I$) is the wastage vector. It is implicit in this model that time is discrete, typically one year. The elements of P and W are assigned numerical values by estimating the probabilities from past data.

The Markov chain model is completed by an estimation of the flow of new recruits. The number of recruits at year T and for age category i is denoted by $R_i(T)$, referred to as the recruitment vector. The recruitment vector is set out in an array as follows:

$R_1(2001)$	$R_1(2002)$	...$R_1(T)$
$R_2(2001)$	$R_2(2002)$	...$R_2(T)$
...
$R_I(2001)$	$R_I(2002)$	...$R_I(T)$

The following notation specifies the calculation for each age category, with the total number of practising dentists in an age category for year T denoted by $D_i(T)$:

$$D_i(T) = R_i(T) + D_i(T-1) \times P_{ii} + D_{i-1}(T-1) \times P_{i-1,i}$$

$$I = 12, T > 2000$$

For example, the notation for the calculation of the number of practising dentists in age category 2 ($i = 2, 25-29$ years) in 2003 would be:

$$D_2(2003) = R_2(2003) + D_2(2002) \times P_{22} + D_1(2002) \times P_{12}$$

3 Dentist labour force

3.1 Previous growth in the dentist labour force

Figure 3 and Table 1 present the South Australian dentist labour force for the years 1990 to 2002 by sex and age group. The 2002 numbers of registered dentists provide the baseline for labour force projections.

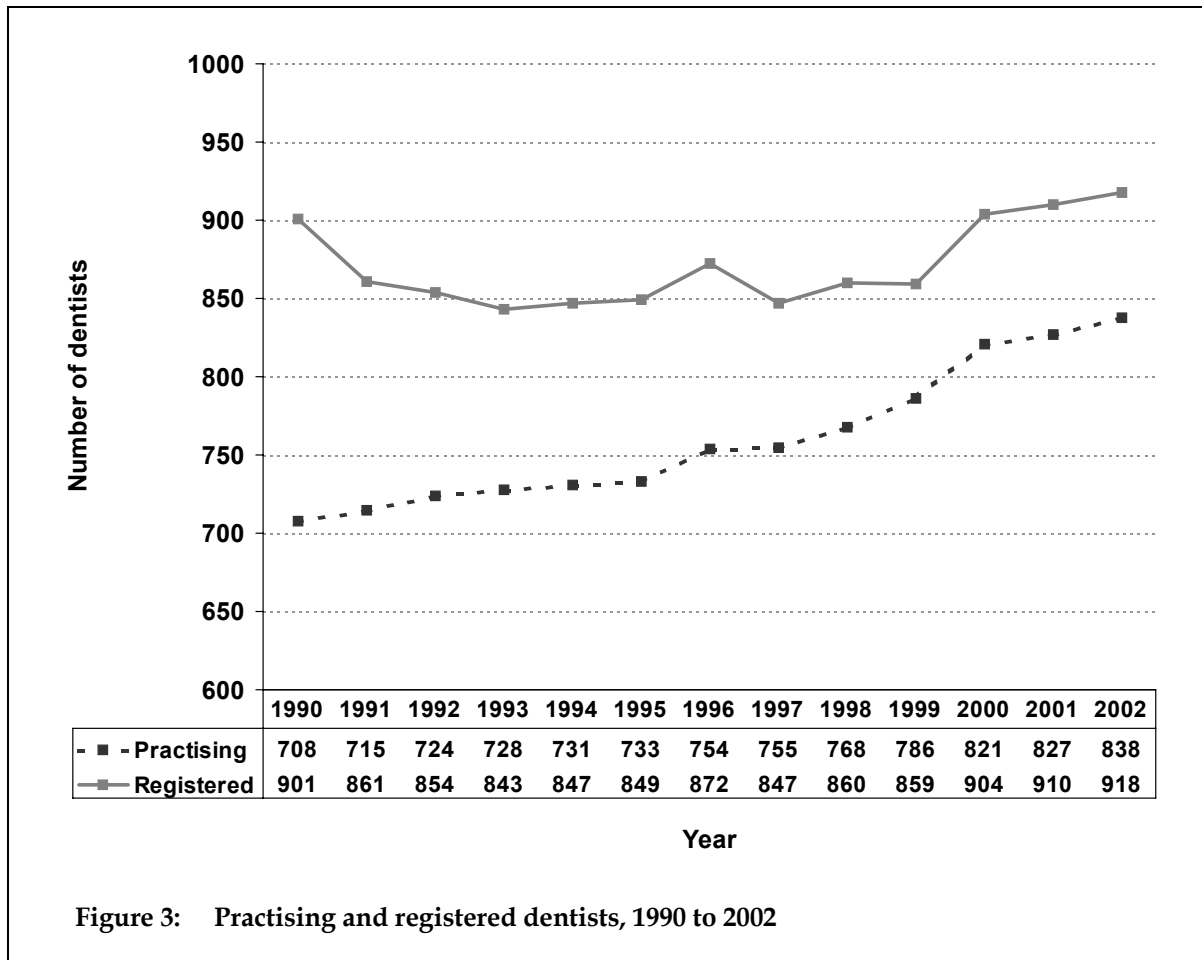


Table 1: Registered dentists by age group and sex, 2002

Age group (years)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Male dentists													
20–24	9	10	11	11	16	7	18	11	14	10	6	14	11
25–29	55	47	47	43	40	41	54	60	64	69	74	63	53
30–34	136	112	85	80	64	49	46	35	38	37	43	58	74
35–39	157	143	139	132	118	100	98	77	69	63	51	45	44
40–44	133	135	128	125	141	132	131	131	122	105	111	95	75
45–49	81	97	117	128	126	130	138	127	125	139	139	126	125
50–54	38	42	46	45	56	92	92	114	128	125	129	129	118
55–59	39	35	36	35	30	35	33	37	40	53	69	89	108
60–64	58	49	46	40	37	33	30	31	28	22	24	25	30
65–69	41	40	42	45	53	60	32	24	19	17	20	20	20
70–74	..	..	..	..	..	..	17	17	18	20	19	11	9
75+	..	..	..	..	..	..	2	3	4	6	9	10	12
Total	747	710	697	684	681	679	691	667	671	666	695	685	679
Female dentists													
20–24	13	9	15	14	12	5	17	17	12	4	8	8	9
25–29	39	43	35	38	36	28	25	28	39	39	45	50	48
30–34	33	28	32	27	28	40	42	36	33	35	29	33	39
35–39	29	36	37	35	36	29	28	26	25	27	33	37	41
40–44	23	17	19	18	23	34	34	37	35	37	34.3	29	31
45–49	7	8	8	15	17	18	19	20	19	23	27	34	37
50–54	4	3	3	5	6	7	7	8	14	16	20	21	23
55–59	1	1	2	2	3	4	4	2	5	6	6	8	7
60–64	2	2	2	1	1	1	1	2	2	3	4	3	2
65–69	3	4	4	4	4	4	1	1	1	—	—	—	1
70–74	..	..	..	..	..	..	3	3	3	—	—	—	—
75+	..	..	..	..	..	..	—	—	—	2	2	2	1
Total	154	151	157	159	166	170	181	180	189	193	209	225	239
All dentists													
20–24	22	19	26	25	28	12	35	28	26	14	14	22	20
25–29	94	90	82	81	76	69	79	88	103	108	119	113	101
30–34	169	140	117	107	92	89	88	71	72	72	72	91	113
35–39	186	179	176	167	154	129	126	103	94	90	84	82	85
40–44	156	152	147	143	164	166	165	168	157	142	145	124	106
45–49	88	105	125	143	143	148	157	147	144	161	166	160	162
50–54	42	45	49	50	62	99	99	122	142	141	149	150	141
55–59	40	36	38	37	33	39	37	39	45	59	75	97	115
60–64	60	51	48	41	38	34	31	33	30	25	28	28	32
65–69	44	44	46	49	57	64	33	25	20	17	20	20	21
70–74	..	..	..	..	..	..	20	20	21	20	19	11	9
75+	..	..	..	..	..	..	2	3	4	8	11	12	13
Total	901	861	854	843	847	849	872	847	860	859	904	910	918

Source: SA dental registers 1990 to 2002.

Table 2 presents estimates of the numbers of dentists practising by age group and sex. These estimates are derived by multiplying the number of registered practitioners (Table 1) by the observed labour force participation rate which is determined from the annual labour force data collection. In 2002 the practising rate was 55.1 dentists per 100,000 population, with female dentists comprising 25.4% of all practising dentists. Nearly two-thirds (63.8%) of the male practitioners were 45 years or older; in comparison, only a third of female practitioners were 45 years or older.

Table 2: Practising dentists by age group and sex, 2002

Age group (years)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Male dentists													
20–24	8	6	7	9	11	7	13	10	8	10	5	9	9
25–29	35	36	35	32	37	36	44	54	55	58	68	56	42
30–34	103	86	71	64	56	41	40	32	35	35	41	54	66
35–39	128	120	118	114	99	85	88	69	64	57	42	39	40
40–44	117	124	119	116	127	119	117	115	106	97	104	88	71
45–49	70	85	104	115	116	120	126	123	115	133	131	120	119
50–54	34	38	42	41	49	84	82	103	119	121	124	127	117
55–59	30	32	34	33	24	26	24	31	35	49	58	82	99
60–64	47	40	41	34	33	29	30	27	29	22	19	21	29
65–69	23	29	27	34	38	42	23	19	17	18	16	19	18
70–74	..	..	..	..	..	..	15	15	16	17	15	8	8
75+	..	..	..	..	..	..	1	2	1	4	5	8	9
Total	595	596	598	592	590	589	604	602	601	622	630	629	625
Female dentists													
20–24	12	8	11	12	10	5	13	10	9	3	7	5	3
25–29	26	34	29	31	30	22	20	24	34	35	39	44	46
30–34	24	20	25	23	23	35	34	30	30	26	27	26	33
35–39	23	28	28	30	30	24	22	23	22	23	28	32	34
40–44	15	14	16	16	20	28	31	33	30	32	33	27	25
45–49	6	7	8	13	16	16	16	18	19	22	28	34	39
50–54	3	3	3	5	6	7	7	7	13	14	18	20	22
55–59	—	1	2	2	3	4	3	2	5	5	7	8	7
60–64	1	—	—	—	—	—	—	1	1	2	2	2	1
65–69	3	4	4	4	3	3	—	—	—	—	—	—	1
70–74	..	..	..	..	..	..	3	3	3	—	—	—	—
75+	..	..	..	..	..	..	—	—	—	2	2	1	1
Total	113	119	126	136	141	144	150	153	167	164	191	198	213
All dentists													
20–24	20	14	18	21	21	12	27	20	16	13	12	14	12
25–29	61	70	64	63	67	58	64	78	89	93	106	99	88
30–34	127	106	96	87	79	76	73	63	65	61	68	81	99
35–39	151	148	146	144	129	109	110	92	86	80	70	71	74
40–44	132	138	135	132	147	147	148	149	137	129	137	115	96
45–49	76	92	112	128	132	136	143	142	135	155	159	153	158
50–54	37	41	45	46	55	91	89	110	132	135	142	147	139
55–59	30	33	36	35	27	30	28	33	40	54	65	89	106
60–64	48	40	41	34	33	29	30	28	30	24	22	23	30
65–69	26	33	31	38	41	45	23	19	17	18	16	19	19
70–74	..	..	..	..	..	..	18	18	20	17	15	8	8
75+	..	..	..	..	..	..	1	2	1	6	8	9	10
Total	708	715	724	728	731	733	754	755	768	786	821	827	838
Practising rate^(a)	49.4	49.4	49.7	49.8	49.9	49.9	51.1	51.0	51.6	52.5	54.6	54.7	55.1

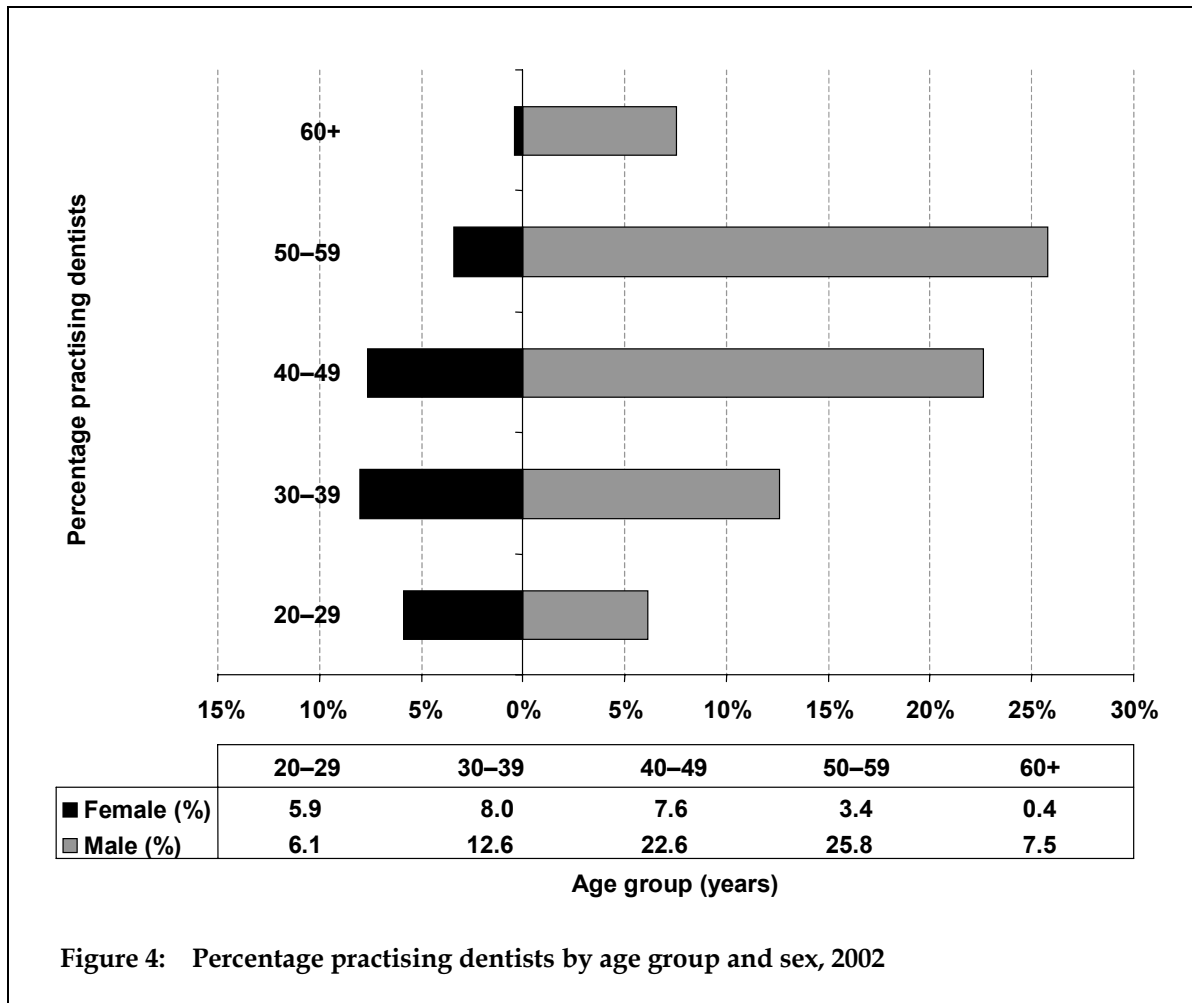
(a) Practising rate: number of dental practitioners per 100,000 ERP. See Appendix A for South Australian ERPs, 1990 to 2002.

Notes

1. Includes dentists practising solely or mainly in South Australia. Practitioners who were on leave for three or more months were excluded from tables of practising dentists.
2. Adjusted to take account of non-response. Non-respondents were assumed to have the same percentage practising status as respondents.
3. For the years 1990 to 1995, no age breakdown beyond 65 years of age was available.

Source: AIHW DSRU dental labour force data collections, 1990 to 2002.

Figure 4 presents the percentage of practising dentists by age group and sex and shows the differing age distribution of male and female dentists.



3.2 Geographic distribution

The rates of practising dentists per 100,000 by geographic location in 2001 are presented in Table 3. The highest rate was in major cities (66.1) and the lowest in very remote areas (7.7). Rates were more evenly distributed for inner regional, outer regional and remote areas at 24.8, 27.3 and 29.8 respectively.

Table 3: Practising dentists, practising rate per 100,000 population by geographic location (ASGC remoteness code) of main practice location, 2001

AGSC remoteness code	Practising dentists			Per cent practising dentists			Population 2001	Practising rate per 100,000 population
	Female	Male	Total	Female	Male	Total		
Major cities	179	538	717	90%	86%	87%	1,085,262	66.1
Inner regional	7	40	47	3%	6%	6%	187,204	24.8
Outer regional	11	37	48	6%	6%	6%	178,876	27.3
Remote	1	13	14	1%	2%	2%	45,608	29.8
Very remote	—	1	1	0%	0%	0%	14,778	7.7
Total	198	629	827	100%	100%	100%	1,511,728	54.7

Notes

1. Numbers practising adjusted to account for non-response. Integers rounded to whole numbers.
2. At the time of preparation the 2002 population estimates by statistical local area were not available.

The change in practising rates by region between 1990 and 2000 is presented in Table 4. Practising rates in the capital city region increased by 10.0% and a similar increase was observed in the rest of state (11.0%).

Table 4: Practising dentists, practising rate per 100,000 population by region, and percentage change over time, 1990, 1995 and 2000

Year	Practising dentists	Practising rate per 100,000 population ^(a)		
	SA	Capital city	Rest of state	Total
1990	708	58.4	25.3	49.4
1995	733	59.8	22.8	49.9
2000	821	64.2	28.1	54.6
Per cent change: 1990 to 2000	16.0%	10.0%	11.0%	10.3%

(a) Practising rate: number of dental practitioners per 100,000 ERP. See Appendix A for ERP at 30 June 1990, 1995 and 2000.

Source: AIHW DSRU dental labour force data collection, 2000. Includes dentists practising solely or mainly in South Australia. Adjusted to take account of non-response.

4 Projections of the South Australian dentist labour force

4.1 Dentist labour force recruitment

The first step in projecting the future dental labour force is the development of a 'likely' recruitment vector for the years 2002 to 2015. The numbers of new recruits to the South Australian register were examined for the most recent years (1998 to 2002) and annual average recruitment was calculated (Table 5).

Table 5: New recruits to South Australian dental register by age group, sex and average annual recruitment, 1998 to 2002

Age group (years)	1998	1999	2000	2001	2002	Average annual recruitment
Male dentists						
20–24	9.6	4.6	5.3	12.0	6.0	7.5
25–29	17.5	10.3	10.5	12.0	10.5	12.2
30–34	1.2	2.3	3.5	7.0	8.1	4.4
35–39	4.8	4.6	3.5	6.0	1.2	4.0
40–44	1.2	—	3.5	4.0	1.7	2.1
45–49	2.4	—	1.8	3.0	1.0	1.6
50–54	1.2	2.3	1.8	2.0	3.0	2.0
55–59	2.4	—	—	2.0	1.0	1.1
60–64	—	—	—	1.0	—	0.3
65+	—	1.1	—	—	—	0.3
Total	40.3	25.2	29.9	49.0	32.4	35.5
Female dentists						
20–24	5.4	—	8.2	8.0	7.0	5.7
25–29	9.0	5.5	3.5	13.0	11.5	8.5
30–34	2.1	4.1	3.5	6.0	6.9	4.5
35–39	1.1	2.7	—	5.0	4.8	2.7
40–44	—	5.5	—	2.0	3.3	2.2
45–49	1.1	—	—	1.0	1.0	0.6
50–54	—	—	—	2.0	—	0.4
55–59	1.1	—	—	1.0	—	0.4
60–64	—	—	—	—	—	—
65+	—	—	—	—	—	—
Total	19.7	17.8	15.1	38.0	34.6	25.0
All dentists						
20–24	14.9	4.6	13.4	20.0	13.0	12.8
25–29	26.5	15.8	14.0	25.0	22.0	19.2
30–34	3.3	6.4	7.0	13.0	15.0	10.4
35–39	5.9	7.3	3.5	11.0	6.0	7.0
40–44	1.2	5.5	3.5	6.0	5.0	5.0
45–49	3.5	—	1.8	4.0	2.0	1.9
50–54	1.2	2.3	1.8	4.0	3.0	2.8
55–59	3.5	—	—	3.0	1.0	1.0
60–64	—	—	—	1.0	—	0.3
65+	—	1.1	—	—	—	0.3
Total	60.0	43.0	45.0	87.0	67.0	60.5

Note: Numbers adjusted to account for missing sex and age data.

Sources: SA Dental Gazettes, 1997 to 1999; AIHW DSRU dental labour force data collections 2000 to 2002.

The sources of new recruits to the dental register can be understood by examining the qualifications of new recruits (Table 6).

Table 6: New recruits to South Australian dental register by place of initial qualification, 1998 to 2002

Place of initial qualification	1998	1999	2000	2001	2002	Total	Total %
Australia							
South Australia	45	21	30	55	41	192	63.6%
Victoria	3	4	—	3	2	12	4.0%
Queensland	3	2	—	2	3	10	3.3%
New South Wales	3	1	—	4	1	9	3.0%
Western Australia	—	—	5	1	2	8	2.6%
Total for Australia	54	28	35	65	49	231	76.5%
Overseas							
Asia	2	9	2	7	7	27	8.9%
United Kingdom	1	4	3	10	7	25	8.3%
New Zealand	3	2	1	2	—	8	2.6%
USA/Canada	—	—	1	1	—	2	0.7%
Europe	—	—	2	1	1	4	1.3%
ADC (country not stated)	—	—	1	1	3	5	1.7%
Total for overseas	6	15	10	22	18	71	23.5%
Total	60	43	45	87	67	302	100.0%

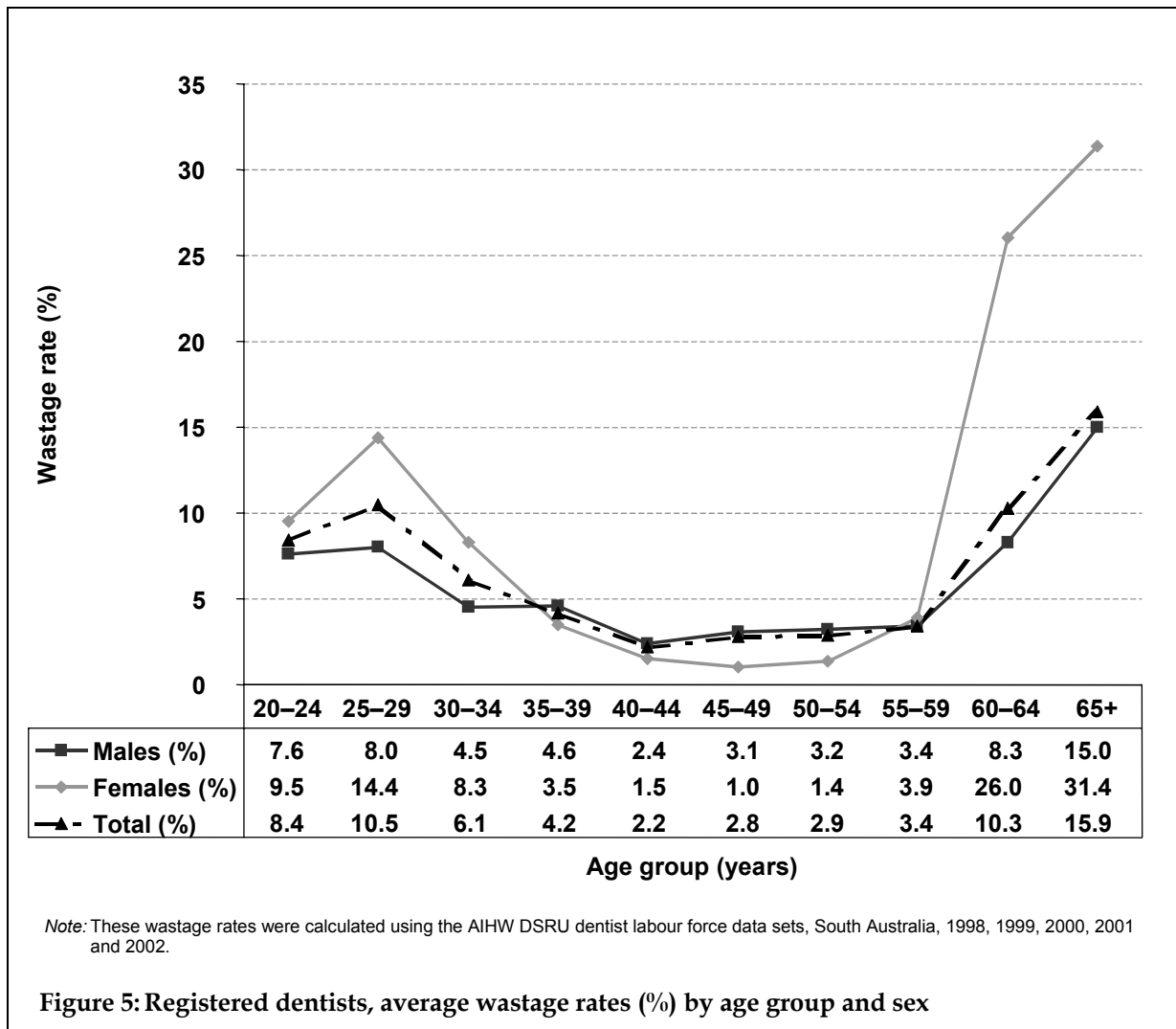
4.2 Dentist labour force attrition

Labour force attrition from the stock of practising dentists can be attributed to death, retirement, overseas migration and the temporary (12 months or more) or permanent cessation of the practice of dentistry. Attrition is represented in the projection model by the input of sex- and age-specific wastage rates.

Wastage rates for the purpose of the projection model were calculated by averaging the observed wastage in recent years from the South Australian dental register (Table 7 and Figure 5). The lowest wastage rates for male dentists occurred in the 40–59 age groups, and for female dentists in the 35–59 age groups. Consistent with the expectation that the majority of labour force attrition can be related to retirement, the highest observed wastage rates for female and male dentists were in the 65+ age group. Overall, the wastage rates were higher for female dentists than for male dentists.

Table 7: Registered dentists, wastage rates (%) by age group and sex, 1998 to 2001

Age group (years)	Average wastage rates		
	Males	Females	Total
20–24	7.6%	9.5%	8.4%
25–29	8.0%	14.4%	10.5%
30–34	4.5%	8.3%	6.1%
35–39	4.6%	3.5%	4.2%
40–44	2.4%	1.5%	2.2%
45–49	3.1%	1.0%	2.8%
50–54	3.2%	1.4%	2.9%
55–59	3.4%	3.9%	3.4%
60–64	8.3%	26.0%	10.3%
65+	15.0%	31.4%	15.9%
Total	4.8%	6.7%	5.2%



4.3 Projections of registered dentists

The matrices of transitional probabilities for female and male dentists were calculated using the observed movement between age groups and wastage rates from 1998 to 2002 (Table 8).

Table 8: Transitional probabilities matrix for projections of registered dentists

Age group (years)	Transitional probabilities male dentists			Transitional probabilities female dentists		
	Probability of staying in same age group (P_{ii})	Probability of moving to the next age group ($P_{i,i+1}$)	Wastage rates (W)	Probability of staying in same age group (P_{ii})	Probability of moving to the next age group ($P_{i,i+1}$)	Wastage rates (W)
20–24	0.3825	0.5413	0.0761	0.2284	0.6765	0.0950
25–29	0.7133	0.2069	0.0798	0.7175	0.1386	0.1439
30–34	0.7799	0.1756	0.0445	0.7017	0.2148	0.0834
35–39	0.6867	0.2673	0.0460	0.8095	0.1555	0.0350
40–44	0.7285	0.2475	0.0240	0.7633	0.2212	0.0154
45–49	0.7853	0.1833	0.0314	0.8638	0.1265	0.0097
50–54	0.7767	0.1918	0.0315	0.9159	0.0701	0.0140
55–59	0.8547	0.1114	0.0338	0.8428	0.1179	0.0393
60–64	0.7146	0.2021	0.0833	0.6583	0.0816	0.2601
65+	0.8503	—	0.1497	0.6862	—	0.3138

As discussed in section 4.1, a likely recruitment vector for the years 2000 to 2015 was estimated by averaging recruitment for the years 1998 to 2002 (numbers were rounded to whole integers). The medium recruitment vector totalled 35 for male dentists and 25 for female dentists (Table 9). To test the impact on supply of variations in the recruitment levels, low and high recruitment vectors were also developed. The low vector was calculated by applying a loading of -15% and the high vector by applying a loading of 15%.

Table 9: Low, medium and high recruitment vectors by age group and sex

Age group (years)	Low			Medium			High		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
20–24	7	5	12	8	6	14	9	7	16
25–29	10	7	17	12	8	20	14	9	23
30–34	3	4	7	4	5	9	5	6	11
35–39	3	3	6	4	3	7	5	3	8
40–44	2	2	4	2	2	4	2	2	4
45–49	2	1	3	2	1	3	2	1	3
50–54	2	—	2	2	—	2	2	—	2
55–59	1	—	1	1	—	1	1	—	1
Total	30	22	52	35	25	60	40	28	68

Note: All numbers rounded to whole integers prior to input in projection model.

The transitional probabilities and estimated recruitment vectors were used to calculate the projected stock of registered dentists to the year 2015, as presented in Tables 10 and 11. The number of registered male dentists is projected to decline from 679 in 2002 to 585 in 2015, a decrease of 13.8%.

Table 10: Projected number of registered male dentists by age group, 2002 to 2015

Age group (years)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	11	10	10	10	10	10	10	10	10	10	10	10	10	10
25–29	53	51	50	49	48	48	47	47	47	47	47	46	46	46
30–34	74	74	73	72	72	71	70	70	69	68	68	68	67	67
35–39	44	46	47	48	49	49	49	49	49	49	48	48	48	48
40–44	75	69	64	61	60	59	58	57	57	57	56	56	56	55
45–49	125	118	111	104	98	92	88	85	82	79	77	76	74	73
50–54	118	115	111	106	101	97	92	88	84	80	77	74	71	69
55–59	108	115	120	124	126	127	127	127	125	123	120	118	115	112
60–64	30	33	37	40	42	44	46	47	48	48	48	48	47	46
65+	41	41	42	43	44	46	48	50	52	54	56	57	58	59
Total	679	672	665	658	651	643	636	629	621	614	607	599	592	585
Per cent change^(a)	-1.0%	-1.0%	-1.1%	-1.1%	-1.1%	-1.1%	-1.1%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%

(a) Per cent decrease from previous year.

Note: Projections based on medium recruitment vector.

The number of registered female dentists is projected to grow from 239 in 2002 to 442 in 2015, an increase of 84.9%.

Table 11: Projected number of registered female dentists by age group, 2002 to 2015

Age group (years)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	9	10	10	10	10	10	10	10	10	10	10	10	10	10
25–29	48	53	57	60	62	63	64	65	66	66	67	67	67	67
30–34	39	38	38	38	39	40	41	42	42	43	43	44	44	44
35–39	41	46	49	52	54	56	58	60	62	63	64	65	66	67
40–44	31	32	33	35	37	39	40	42	43	45	46	47	48	49
45–49	37	41	44	48	51	54	57	60	63	66	69	72	74	77
50–54	23	28	33	37	42	47	52	57	62	67	71	76	81	85
55–59	7	9	10	12	14	15	17	19	21	23	25	27	29	31
60–64	2	2	2	3	3	4	4	5	5	6	7	7	8	9
65+	2	2	1	1	1	1	1	1	1	1	1	1	2	2
Total	239	259	278	296	314	330	346	362	376	390	404	417	429	442
Per cent change^(a)	1.4%	1.3%	1.2%	1.1%	1.1%	1.0%	0.9%	0.8%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%

(a) Per cent increase over previous year.

Note: Projections based on medium recruitment vector.

4.4 Projections of practising dentists

Following the projection of registered dentists, the number of practising dentists was imputed by multiplying the projected number of registered dentists by the average labour force participation rates for each age and sex group (Table 12). Overall, the labour force participation rates for male and female dentists were very similar.

Table 12: Average labour force participation rates (%) by age group and sex, 1999 to 2002

Age group (years)	Average labour force participation rates (%)		
	Males	Females	Total
20–24	100.0	94.7	98.0
25–29	96.7	95.5	96.2
30–34	94.2	86.0	91.0
35–39	89.6	86.2	88.3
40–44	89.5	93.3	90.4
45–49	91.8	95.8	92.6
50–54	95.1	86.0	93.8
55–59	86.0	89.1	86.3
60–64	88.4	78.1	87.5
65+	81.9	87.7	82.2
Total	91.2	90.8	91.1

Source: AIHW DSRU dental labour force data collections, 1999 to 2002.

The resulting imputed projections of practising dentists are presented in Tables 13 and 14. The number of practising male dentists is projected to decline from 618 in 2002 to 528 in 2015, a decrease of 14.6%.

Table 13: Projected number of practising male dentists, 2002 to 2015

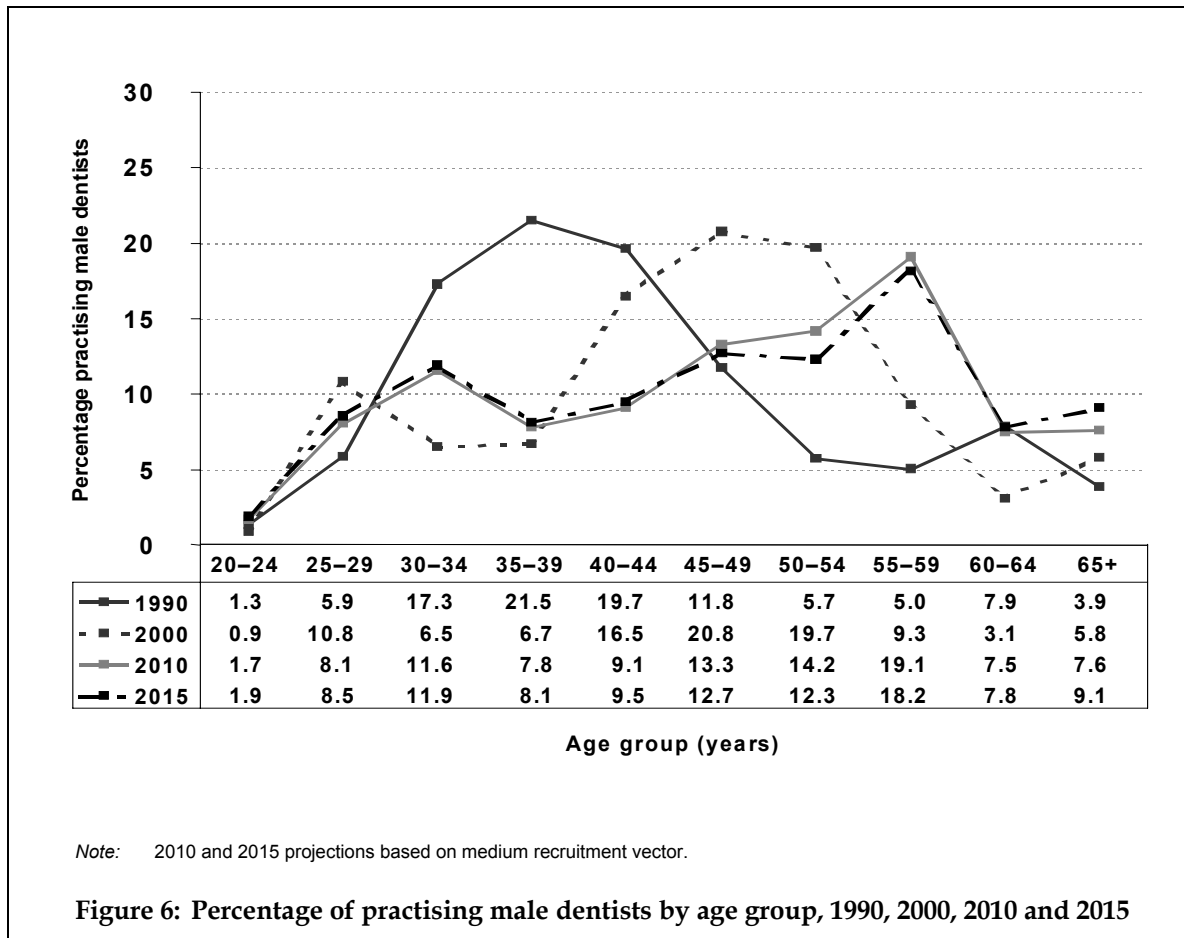
Age group (years)	2002 ^(a)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	11	10	10	10	10	10	10	10	10	10	10	10	10	10
25–29	51	50	49	48	47	46	46	45	45	45	45	45	45	45
30–34	70	70	69	68	68	67	66	66	65	65	64	64	64	63
35–39	39	41	43	43	44	44	44	44	44	44	43	43	43	43
40–44	67	61	57	55	53	52	52	51	51	51	50	50	50	50
45–49	115	108	101	95	90	85	81	78	75	73	71	69	68	67
50–54	112	109	105	101	97	92	88	83	79	76	73	70	68	65
55–59	93	99	103	107	109	110	110	109	108	106	104	101	99	96
60–64	27	30	32	35	37	39	40	41	42	42	42	42	42	41
65+	34	34	34	35	36	38	40	41	43	44	46	47	48	48
Total	618	611	604	597	590	583	576	569	562	555	548	541	534	528
Per cent change^(b)		-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%	-1.2%

(a) Baseline estimates of practising dentists differ from numbers cited in Table 2. For Table 2, the numbers of practising dentists for 2002 were calculated by multiplying the number of registered dentists by the participation rates for 2002. For Table 13 and Table 14, baseline numbers and projected numbers of registered dentists were multiplied by participation rates averaged over the years 1999 to 2002.

(b) Per cent decrease from previous year.

Note: Projections based on medium recruitment vector.

The age distribution of male dentists is projected to shift to an older distribution, with the proportion of dentists aged 50 years and over increasing from 37.9% in 2000 to 47.4% in 2015 (Figure 6).



The number of practising female dentists is projected to grow from 217 in 2002 to 399 in 2015, an increase of 83.8%. The annual rate of increase is expected to decline as the female labour force grows.

Table 14: Projected number of practising female dentists, 2002 to 2015

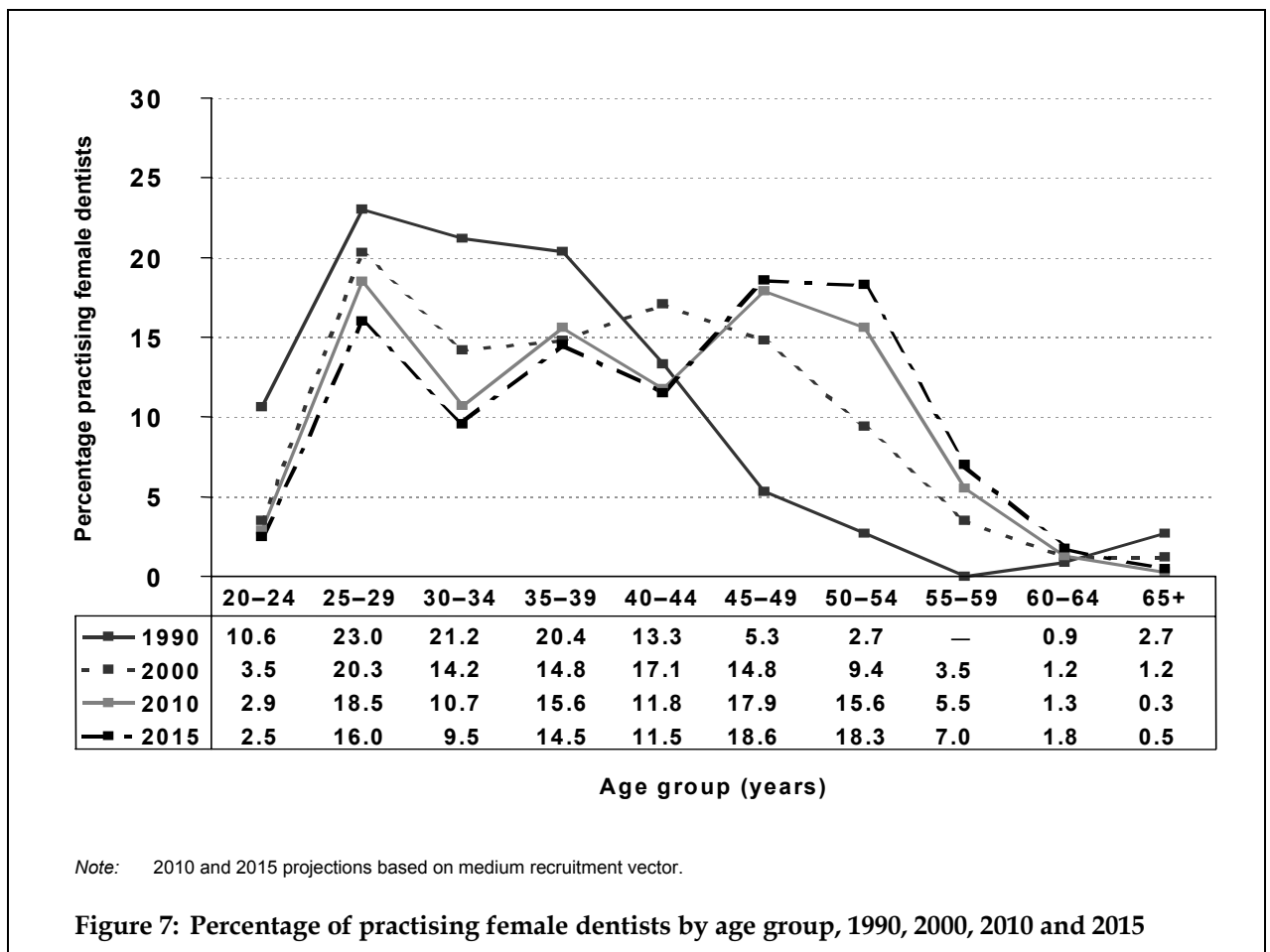
Age group (years)	2002^(a)	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	9	10	10	10	10	10	10	10	10	10	10	10	10	10
25–29	46	51	54	57	59	61	62	62	63	63	64	64	64	64
30–34	33	33	33	33	34	34	35	36	36	37	37	37	38	38
35–39	36	40	42	45	47	49	50	52	53	54	55	56	57	58
40–44	29	30	31	33	34	36	38	39	40	42	43	44	45	46
45–49	35	39	42	46	49	52	55	58	61	64	66	69	71	74
50–54	20	24	28	32	36	41	45	49	53	57	61	65	69	73
55–59	6	8	9	11	12	14	15	17	19	21	22	24	26	28
60–64	2	2	2	2	3	3	3	4	4	5	5	6	6	7
65–69	2	1	1	1	1	1	1	1	1	1	1	1	1	2
Total	217	235	253	269	284	299	314	327	340	353	365	377	388	399
Per cent increase^(b)		1.3%	1.2%	1.1%	1.0%	0.9%	0.8%	0.7%	0.7%	0.6%	0.6%	0.5%	0.5%	0.5%

(a) Baseline estimates of practising dentists differ from numbers cited in Table 2. For Table 2, the numbers of practising dentists for 2002 were calculated by multiplying the number of registered dentists by the participation rates for 2002. For Table 13 and Table 14, baseline numbers and projected numbers of registered dentists are multiplied by participation rates averaged over the years 1999 to 2002.

(b) Per cent increase over previous year.

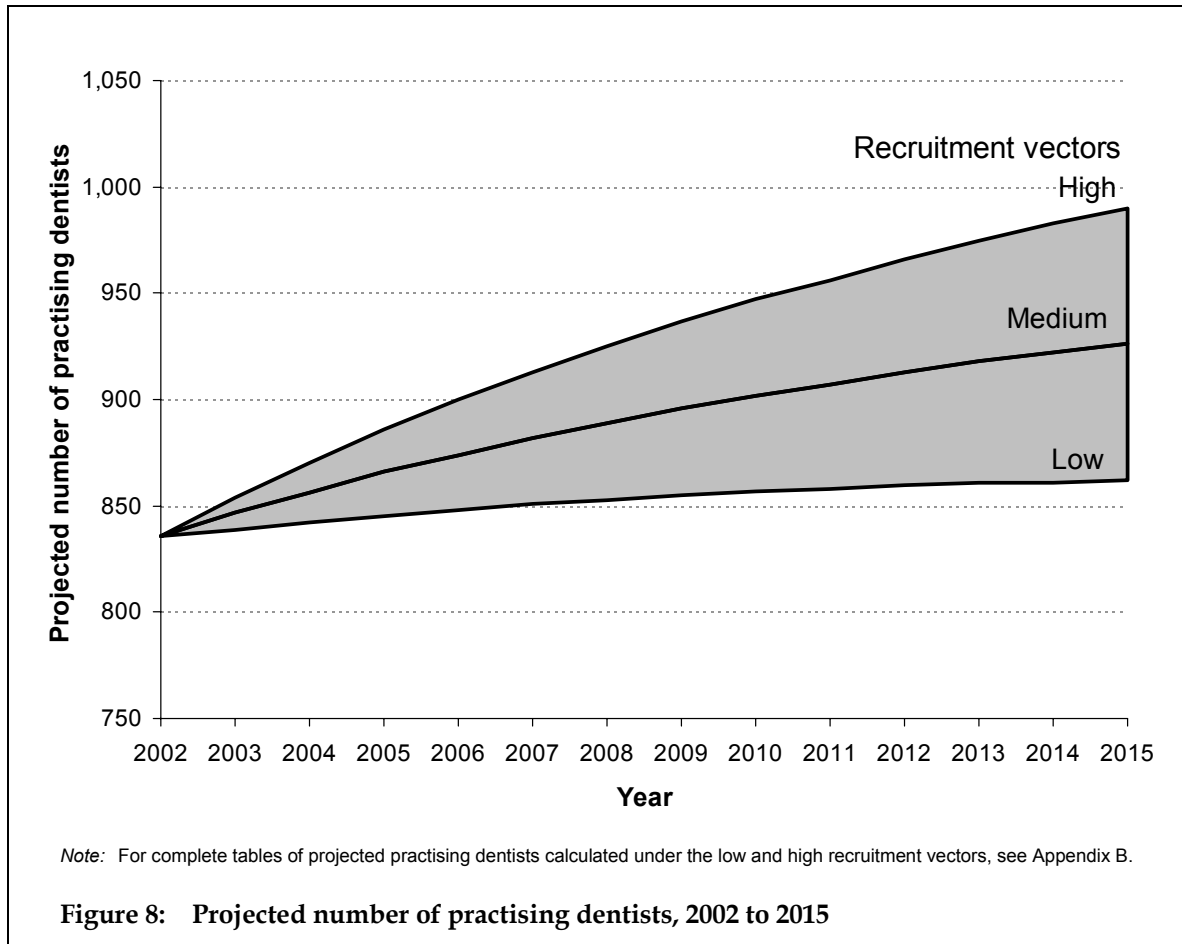
Note: Projections based on medium recruitment vector.

The age distribution of female practising dentists is also projected to shift to an older distribution, with the proportion of dentists aged 50 years and over increasing from 15.3% in 2000 to 27.6% in 2015 (Figure 7).

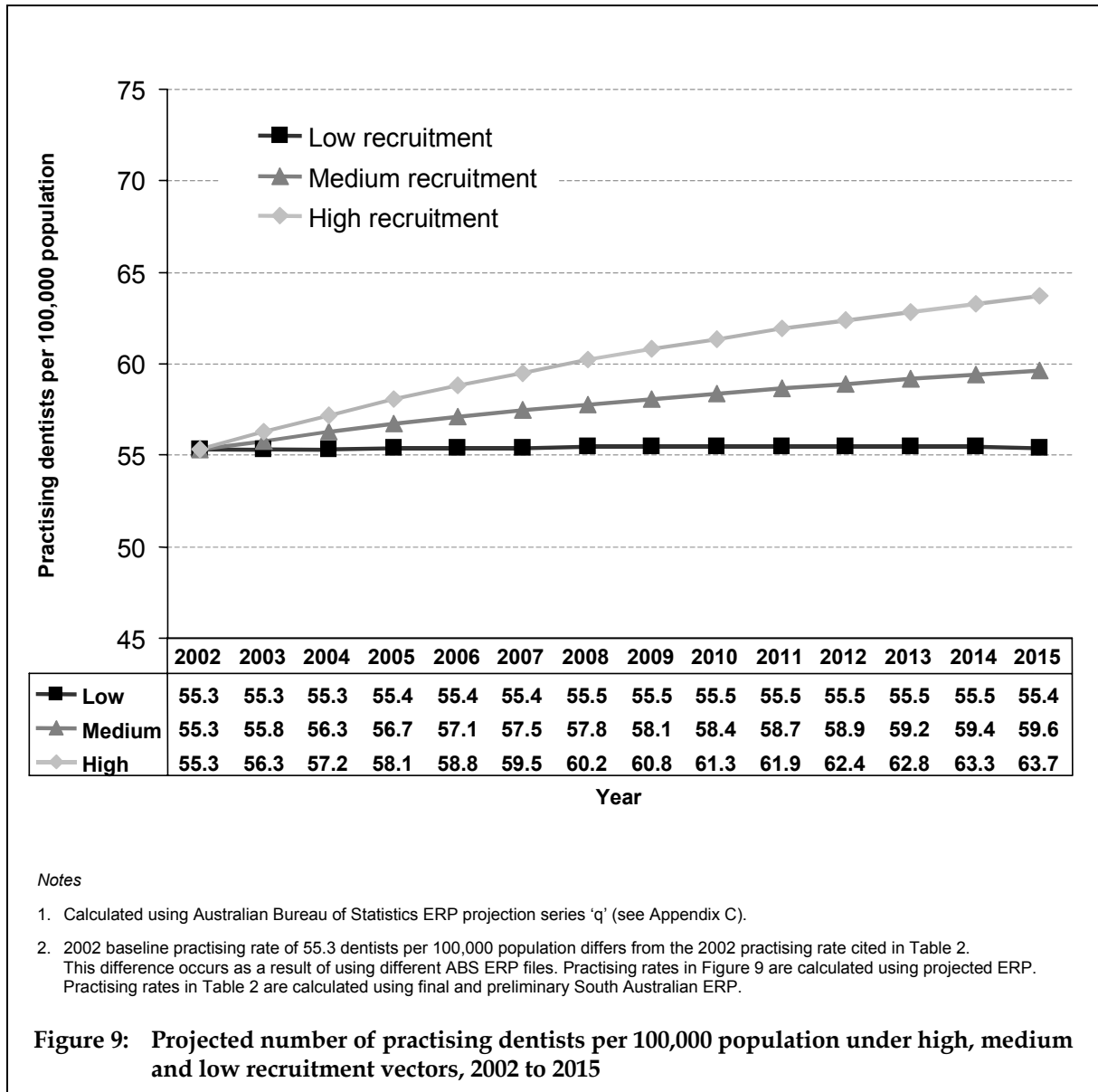


Overall, under the medium wastage vector, it is projected that in 2015 the number of practising dentists will be 927, an increase of 10.9% (Figure 8).

The percentage of practising female dentists in the dental labour force is projected to grow substantially, increasing from 26% in 2002 to 43% in 2015.



Growth in the South Australian dentist labour force to the year 2015 is projected to slightly outpace population growth, with the practising rate per 100,000 population increasing from 55.3 to 59.6 under the medium wastage vector (Figure 9). The projection under the low recruitment vector results in an essentially no-growth situation, and under the high recruitment vector the practising rate per 100,000 population is projected to increase from 55.3 to 63.7.



4.5 Sensitivity analysis of dentist projections

To explore the impact of different recruitment levels on the dentist labour force, a series of projections were developed. The projected practising rates per 100,000 population attained as a result of a series of hypothetical recruitment vectors are presented in Table 15. It can be seen that to maintain the 2002 practising rate (55.3), a recruitment vector totalling approximately 50 dentists per year would need to be maintained. Very similar rates are achieved if the recruitment is not constant and the average recruitment over the projection period 2002 to 2015 is equivalent to the annual total of the recruitment vector. (This applies only because of the short time frame of the projections and probably would not hold true for projections after 2015.)

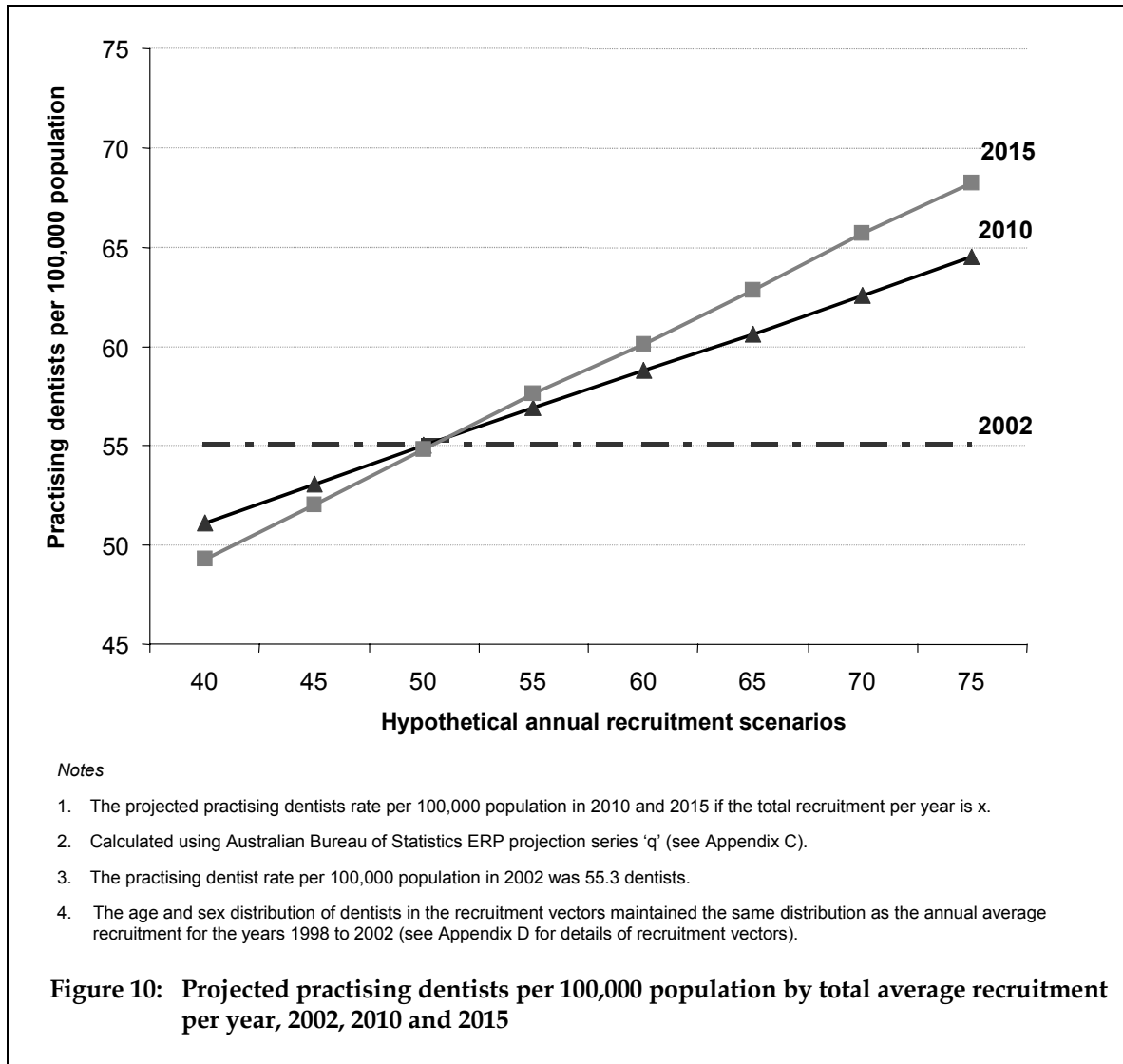
Table 15: Projected practising dentists per 100,000 population by total average recruitment per year, 2010 and 2015

	Average recruitment per year							
	40	45	50	55	60	65	70	75
Practising rate per 100,000 population in 2010	51.1	53.1	55.0	56.9	58.8	60.6	62.6	64.5
Practising rate per 100,000 population in 2015	49.3	52.0	54.8	57.6	60.1	62.8	65.7	68.2

Notes

1. Calculated using Australian Bureau of Statistics ERP projection series 'q' (see Appendix C).
2. The age and sex distribution of dentists in the recruitment vectors maintained the same distribution as the annual average recruitment for the years 1998 to 2002 (see Appendix D for details of recruitment vectors).

Analysis of the sensitivity of the projections to variations in the recruitment vector is shown in Figure 10. The total recruitment per year is represented on the x axis. The 2010 and 2015 lines show, respectively, the projected practising rates per 100,000 population attained if the level of recruitment indicated by the x axis is maintained for the 10 or 15 years of projection. The 2002 line shows the practising rate per 100,000 at baseline, 55.3 dentists.



4.6 Capacity to supply dental visits

Annual productivity is the product of total hours worked per year multiplied by the rate of visits per hour. Annual productivity measured in number of visits supplied each year is an alternative expression of full-time equivalence, the amount of work characteristically performed by different age and sex groups.

In 1998–99 Australian male dentists aged 30–39, 40–49 and 50–59 years supplied the highest numbers of dental visits per year. Australian female dentists aged 20–29 and 50–59 years were the next most productive in terms of visits supplied. Female dentists aged 30–49 years and 60 years or older provided the fewest numbers of visits per year (Table 16).

Table 16: Annual productivity (number of visits supplied per year per dentist) of practising dentists by sex and age group, Australia, 1998–99

Age group (years)	Male dentists 1998–99	Female dentists 1998–99
20–29	2,248	2,393
30–39	2,883	2,163
40–49	3,396	2,085
50–59	3,083	2,367
60+	2,339	2,200 ^(a)

(a) No available data, 'guess' estimate for purpose of calculating productivity projections.

Source: 1998–1999 Longitudinal Study of Dentists' Practice Activity (DS Brennan & AJ Spencer, unpublished data).

On average hours worked per week have varied little over the period 1990 to 2000. South Australian dentists have reported fewer hours usually worked per week than the Australian mean in previous labour force collections (Table 17).

Table 17: Hours usually worked per week

Hours group	South Australia			Australia
	1990	1995	2000	2000
<20	6.8%	4.7%	9.4%	7.3%
20–29	7.7%	8.5%	7.2%	7.0%
30–39	51.3%	39.4%	34.7%	28.4%
40+	34.2%	47.4%	48.7%	57.2%
Total	100.0%	100.0%	100.0%	100.0%
Mean hours usually worked per week	..	38.3	37.4	39.3

Source: AIHW DSRU dental labour force data collections, 1999 to 2000.

Furthermore, the Longitudinal Study of Dentists' Practice Activity shows that the average number of visits supplied per year by South Australian dentists (2,428.1) is substantially lower than the average for Australia, (2,813.4). Because of the small number (55) of South Australian dentists in the study, the determination of sex and age specific productivity rates from that data set is problematic in some age and sex groups. Hence, South Australian productivity rates were imputed by scaling down Australian sex and age rates by the same percentage. South Australian dentists provide on average only 86.3% of the mean number of visits per year by all Australian dentists (Table 18).

Table 18: Imputed annual productivity (number of visits supplied per year per dentist) of practising dentists by sex and age group, 1998–99

Age group (years)	Male	Female
20–29	1,940.2	2,065.3
30–39	2,488.2	1,866.8
40–49	2,931.0	1,799.5
50–59	2,660.8	2,042.9
60+	2,018.7	1,898.7

Source: 1998–1999 Longitudinal Study of Dentists' Practice Activity, (DS Brennan & AJ Spencer, unpublished data).

The capacity of practising dentists to supply dental visits is generated by multiplying the number of projected practising dentists (Table 13 and Table 14) by the percentage of practising dentists working in clinical practice (93.1%) by the imputed South Australian 1998–99 annual productivity rates for each age and sex group (Table 18).

The capacity to supply dental visits in 2002 (baseline supply) and the projected capacity to supply dental visits to 2015 are shown in Table 19. It is projected that the total number of visits supplied by dentists will increase by 4.0% from 1.871 million visits in 2002 to 1.946 million visits in 2015.

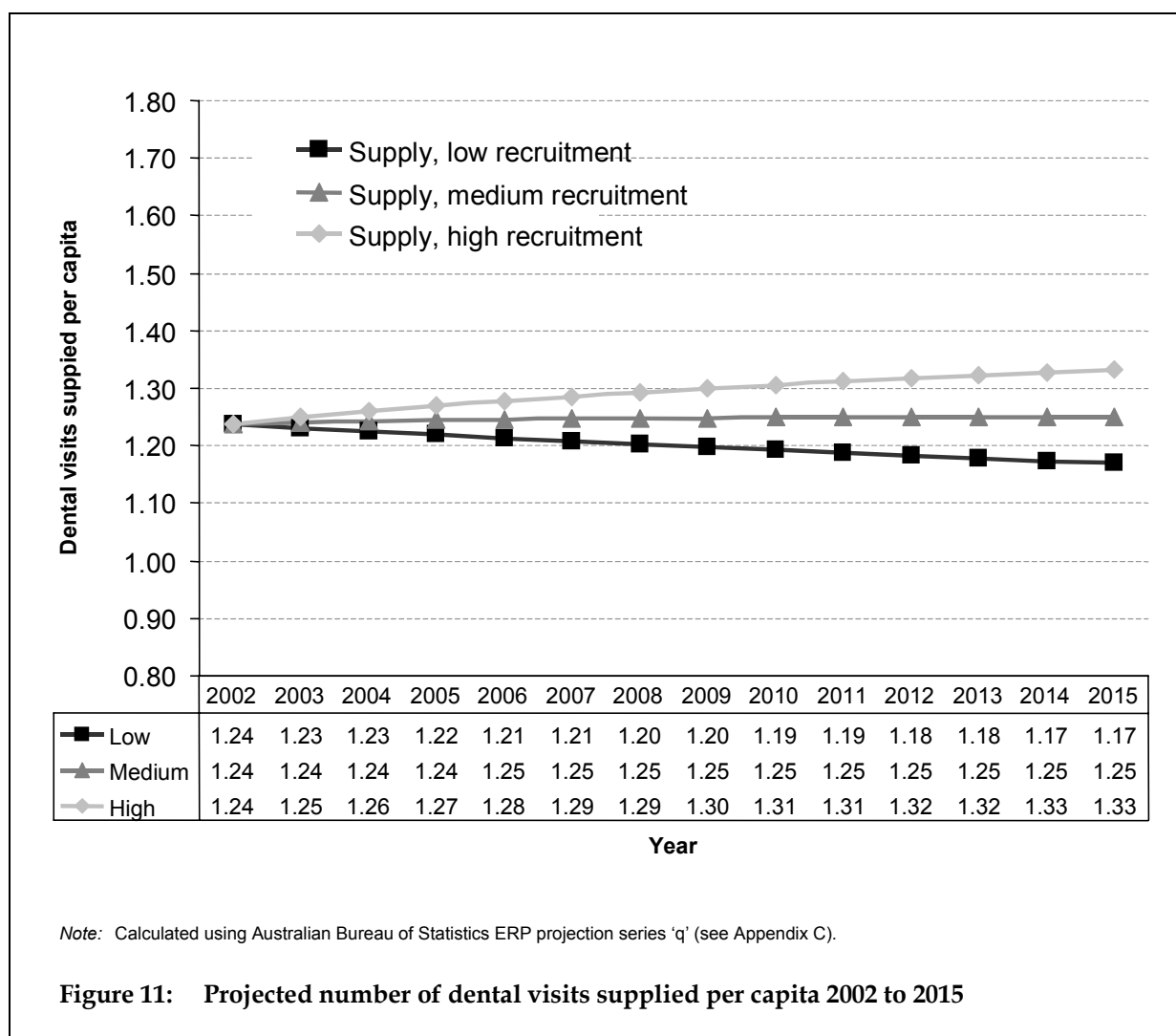
Table 19: Projected number of dental visits supplied (millions) by sex and age, 2002 to 2015

Age group (years)	Projected number of dental visits supplied (millions)													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.112	0.108	0.106	0.104	0.102	0.101	0.100	0.100	0.099	0.099	0.099	0.099	0.099	0.099
30–39	0.253	0.257	0.258	0.259	0.258	0.257	0.256	0.254	0.252	0.251	0.249	0.248	0.247	0.246
40–49	0.497	0.463	0.434	0.410	0.391	0.375	0.362	0.352	0.343	0.336	0.331	0.326	0.322	0.318
50–59	0.508	0.515	0.517	0.514	0.508	0.499	0.489	0.476	0.463	0.450	0.437	0.424	0.411	0.400
60+	0.113	0.119	0.125	0.132	0.138	0.145	0.150	0.155	0.160	0.163	0.165	0.167	0.168	0.168
Total	1.483	1.461	1.440	1.418	1.398	1.377	1.357	1.337	1.318	1.299	1.281	1.263	1.246	1.230
Female dentists														
20–29	0.105	0.115	0.123	0.128	0.132	0.135	0.137	0.139	0.140	0.141	0.141	0.142	0.142	0.142
30–39	0.120	0.125	0.130	0.135	0.140	0.145	0.149	0.152	0.155	0.158	0.161	0.163	0.165	0.166
40–49	0.107	0.115	0.123	0.131	0.139	0.147	0.155	0.162	0.169	0.176	0.183	0.189	0.195	0.200
50–59	0.049	0.060	0.070	0.081	0.092	0.103	0.114	0.126	0.137	0.148	0.159	0.171	0.182	0.193
60+	0.006	0.005	0.005	0.005	0.006	0.007	0.007	0.008	0.009	0.010	0.011	0.012	0.014	0.015
Total	0.388	0.421	0.452	0.482	0.510	0.537	0.563	0.587	0.611	0.633	0.655	0.676	0.696	0.716
All dentists														
20–29	0.217	0.224	0.229	0.232	0.235	0.236	0.238	0.238	0.239	0.240	0.240	0.240	0.240	0.241
30–39	0.373	0.382	0.389	0.394	0.398	0.402	0.404	0.406	0.408	0.409	0.410	0.411	0.411	0.412
40–49	0.605	0.578	0.557	0.541	0.530	0.522	0.517	0.514	0.513	0.513	0.513	0.515	0.516	0.518
50–59	0.558	0.575	0.587	0.595	0.600	0.603	0.603	0.602	0.600	0.598	0.596	0.595	0.593	0.592
60+	0.119	0.124	0.130	0.137	0.144	0.151	0.158	0.164	0.169	0.173	0.177	0.180	0.182	0.183
Total	1.871	1.882	1.892	1.900	1.908	1.914	1.919	1.924	1.929	1.932	1.936	1.939	1.943	1.946

Note: Projections of dentist visits supplied per annum calculated using the medium recruitment vector. For tables of visits supplied under the low and high recruitment scenarios, see Appendix E.

The projected increase in supply of dental visits (4.0%) is less than the projected increase in numbers of practising dentists (10.9%, medium recruitment). The projected growth in dental visits does not parallel the projected growth in practitioners because of demographic changes within the dentist labour force. It is projected that the percentage of female dentists will increase from 26.0% in 2002 to 43.0% by 2015 (Table 13 and Table 14), and that the percentage of dentists over 60 years of age will increase from 7.6% to 10.6%. As these subgroups, on average, provide substantially fewer dental visits per annum, these demographic changes have a combined effect of limiting the growth in visits supplied.

The projected number of dental visits supplied per capita is presented in Figure 11. The number of visits per capita under the medium recruitment vector appears to keep pace with population growth for the period of the projection. The number of visits per capita marginally increases from 1.24 in 2002 to 1.25 in 2015. However, if recruitment is closer to the levels specified by the low recruitment vector, then supply per capita is expected to decline from 1.24 visits in 2002 to 1.17 in 2015.



Impact of declining annual productivity

Dentist practice activity studies have shown that although the total hours worked by dentists has altered little, the number of visits per hour has been declining for 35 years (Spencer & Lewis 1986). There has been an increase both in the duration of a visit and in the number of services provided per visit. Although the total number of services provided annually per year per dentist has remained relatively stable, those services are delivered across fewer visits. The decline in number of visits supplied per year is shown in Table 20, which summarises the average number of visits supplied per annum from the study of dentists' practice activity conducted between 1983 and 1999.

Table 20: Annual productivity (number of visits supplied per year per dentist) of Australian practising dentists by sex, age group and year of study

Age group (years)	Male dentists				Female dentists			
	1983–84	1988–89	1993–94	1998–99	1983–84	1988–89	1993–94	1998–99
20–29	3,195	2,828	2,959	2,248	2,611	2,638	2,724	2,393
30–39	3,964	3,707	3,081	2,883	2,530	2,303	2,413	2,163
40–49	3,897	3,753	3,723	3,396	2,876	2,444	2,691	2,085
50–59	3,614	3,972	3,083	3,083	2,704	2,036	3,091	2,367
60+	3,003	2,744	2,413	2,339	1,936	2,427	2,160	2,200 ^(a)

(a) No available data, 'guess' estimate for purpose of calculating productivity projections.

Source: 1998–1999 Longitudinal Study of Dentists' Practice Activity (DS Brennan & AJ Spencer, unpublished data).

Taking into account the observed trends, it appears unlikely that the number of visits provided per annum is going to suddenly stabilise and remain static. Hence, the impact of declining productivity on visits supplied projections should be explored.

Although it is unlikely that 1998–99 productivity rates will remain the same over the next 10 to 15 years, it is equally unlikely that productivity rates will continue to decline at the same rate that has been observed. Hence for the purposes of calculating projections of dentist visits supplied, a moderate approach was adopted. It was assumed that the rate of decline in annual productivity from the years 2002 to 2015 would be half the rate that was observed between 1983 and 1998.

Capacity to supply visits was calculated by multiplying a matrix of declining sex- and age-specific annual productivity rates by the projected number of practising dentists under the low, medium and high recruitment vector and by the estimated percentage of dentists working in clinical practice (93.1%).

The percentage rate of decline applied to the imputed South Australian productivity rates was determined from the Australian annual rate of decline in productivity observed between the years 1983–84 to 1998–99, multiplied by 50%.

The projected number of visits supplied, based on the medium recruitment vector, is expected to decrease by 4.5%, from 1.835 to 1.752 million visits (Table 21).

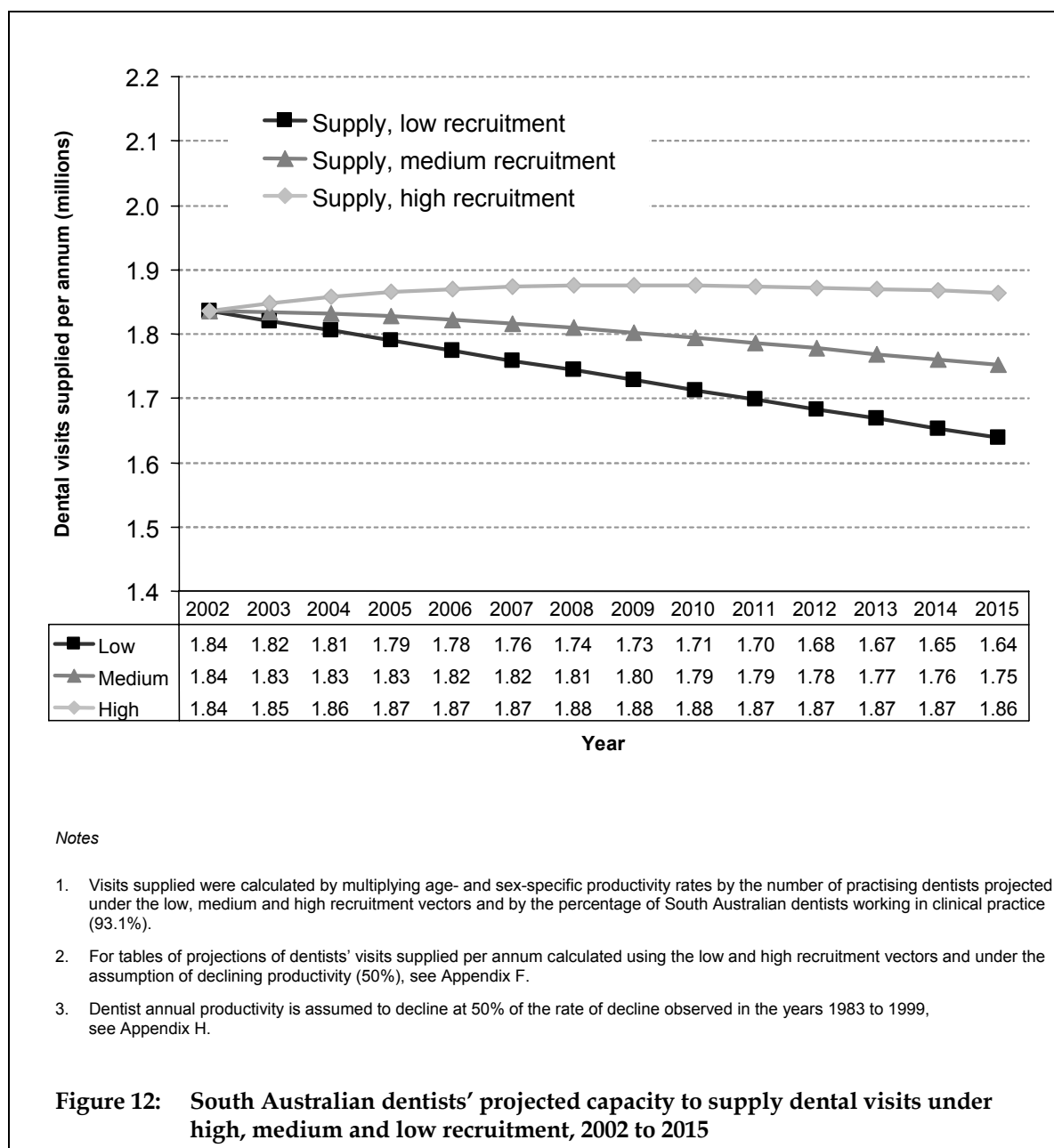
Table 21: Projected number of dental visits supplied (millions) by sex and age, 2002 to 2015, under the assumption of declining annual productivity

Age group (years)	Projected number of dental visits supplied (millions)													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.108	0.103	0.100	0.097	0.094	0.092	0.090	0.089	0.087	0.086	0.085	0.084	0.083	0.082
30–39	0.245	0.246	0.245	0.243	0.240	0.236	0.232	0.228	0.225	0.221	0.217	0.214	0.211	0.208
40–49	0.491	0.454	0.424	0.399	0.378	0.361	0.348	0.336	0.327	0.318	0.312	0.306	0.300	0.296
50–59	0.500	0.504	0.503	0.498	0.490	0.479	0.466	0.452	0.437	0.422	0.408	0.394	0.380	0.367
60+	0.110	0.115	0.120	0.125	0.131	0.135	0.140	0.143	0.146	0.147	0.148	0.149	0.148	0.147
Total	1.454	1.422	1.392	1.362	1.333	1.304	1.276	1.248	1.221	1.195	1.170	1.146	1.122	1.099
Female dentists														
20–29	0.105	0.114	0.121	0.126	0.130	0.132	0.134	0.135	0.135	0.136	0.136	0.136	0.136	0.136
30–39	0.118	0.123	0.127	0.131	0.135	0.139	0.142	0.144	0.147	0.149	0.150	0.151	0.152	0.153
40–49	0.104	0.110	0.117	0.123	0.129	0.135	0.141	0.146	0.151	0.155	0.159	0.163	0.166	0.169
50–59	0.049	0.059	0.069	0.079	0.089	0.100	0.110	0.120	0.130	0.140	0.151	0.160	0.170	0.180
60+	0.006	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.011	0.012	0.013	0.015	0.016
Total	0.381	0.411	0.439	0.465	0.490	0.512	0.534	0.554	0.573	0.591	0.607	0.623	0.638	0.652
All dentists														
20–29	0.212	0.217	0.221	0.223	0.224	0.224	0.224	0.224	0.223	0.222	0.221	0.220	0.219	0.217
30–39	0.363	0.369	0.372	0.374	0.375	0.375	0.374	0.373	0.371	0.369	0.367	0.365	0.363	0.360
40–49	0.594	0.565	0.541	0.522	0.508	0.497	0.488	0.482	0.477	0.473	0.471	0.468	0.466	0.464
50–59	0.549	0.563	0.572	0.577	0.579	0.578	0.576	0.572	0.568	0.563	0.558	0.554	0.550	0.547
60+	0.116	0.120	0.125	0.131	0.137	0.142	0.147	0.152	0.155	0.158	0.160	0.162	0.163	0.163
Total	1.835	1.834	1.831	1.827	1.822	1.816	1.809	1.802	1.794	1.786	1.778	1.769	1.760	1.752

Notes

1. Projections of dental visits supplied per annum were calculated using the medium recruitment vector and under the assumption of declining productivity at 50% the rate of decline previously observed.
2. For projections of dental visits supplied per annum calculated using the low and high recruitment vectors and under the assumption of declining productivity (50%), See Appendix F.
3. For projections of dental visits supplied per annum calculated using the low and high recruitment vectors and under the assumption of declining productivity (100%), see Appendix G
4. For declining age- and sex-specific productivity rates, see Appendix H.

Projections of visits supplied were calculated using the projections of practising dentists based on the low, medium and high recruitment vectors (Figure 12). The assumption of declining visits supplied per annum produces a significant impact on the projections of visits supplied. Projections presented in Table 19, using a static age and sex productivity matrix, calculated under the medium recruitment vector, projected a 4.0% increase in visits supplied by 2015. In contrast, the alternative medium supply projection, which assumes declining productivity, results in a 4.5% decrease. The high supply projection resulted in a 1.6% increase in visits supplied, and the low supply projection calculated a 10.7% decrease.



5 Projections of the allied dental practitioner labour force

5.1 Recruitment and attrition of allied dental practitioners

Projection of the allied dental practitioner labour force is a more uncertain process than for dentists. The numbers of practising dental therapists, hygienists and prosthetists are relatively small, increasing the potential for error.

In the case of hygienists and therapists, future practice activity is particularly difficult to anticipate because of the recent emergence of a hybrid course, the Bachelor of Oral Health. Graduates of this course can practise as either a hygienist or a therapist. The degree to which graduates move between the professions remains to be seen.

The impact of migration varies between the professions, mainly because of a lack of training courses before 1998–99 in Australia. Nearly one-fifth (18.8%) of the practising hygienist labour force was trained overseas. In contrast, the vast majority (89.8%) of practising dental therapists gained their initial therapy qualification in the state where they currently practised and only 2.9% were trained overseas. Similarly, only a small percentage (5.4%) of prosthetists were trained overseas.

Because of the difficulties of developing a likely recruitment vector, a series of constant recruitment vectors for each professional group was developed, and a range of projections was calculated. The age distribution of the recruitment vectors approximated the age distribution of recent graduates, as reported in the 2000 dental labour force data collection.

Estimating wastage of allied dental practitioners was limited by lack of consecutive data collections. Consecutive annual data collections for allied dental practitioners only commenced in 2000, and at the time of this study only 1997 and 2000 data were available. Hence, for the purposes of producing labour force projections, the observed dentist wastage rates were applied as a proxy. Female dentist wastage rates were applied to dental hygienists and dental therapists, as the percentage of male practitioners in these professions was negligible. However, as has been shown in other studies (Newton, Buck & Gibbons 2000), the wastage rates for therapists and hygienists are typically higher than those for female dentists. Hence, the wastage rates applied in the projections of dental therapists and dental hygienists were increased by 50%.

5.2 Dental therapist labour force

As shown in Table 22, the estimated number of practising dental therapists in 2000 was 128, and the overall practising rate per 100,000 population was 8.5 therapists. This estimate provides the baseline for projections to the year 2015.

Table 22: Dental therapists by practice status, 2000

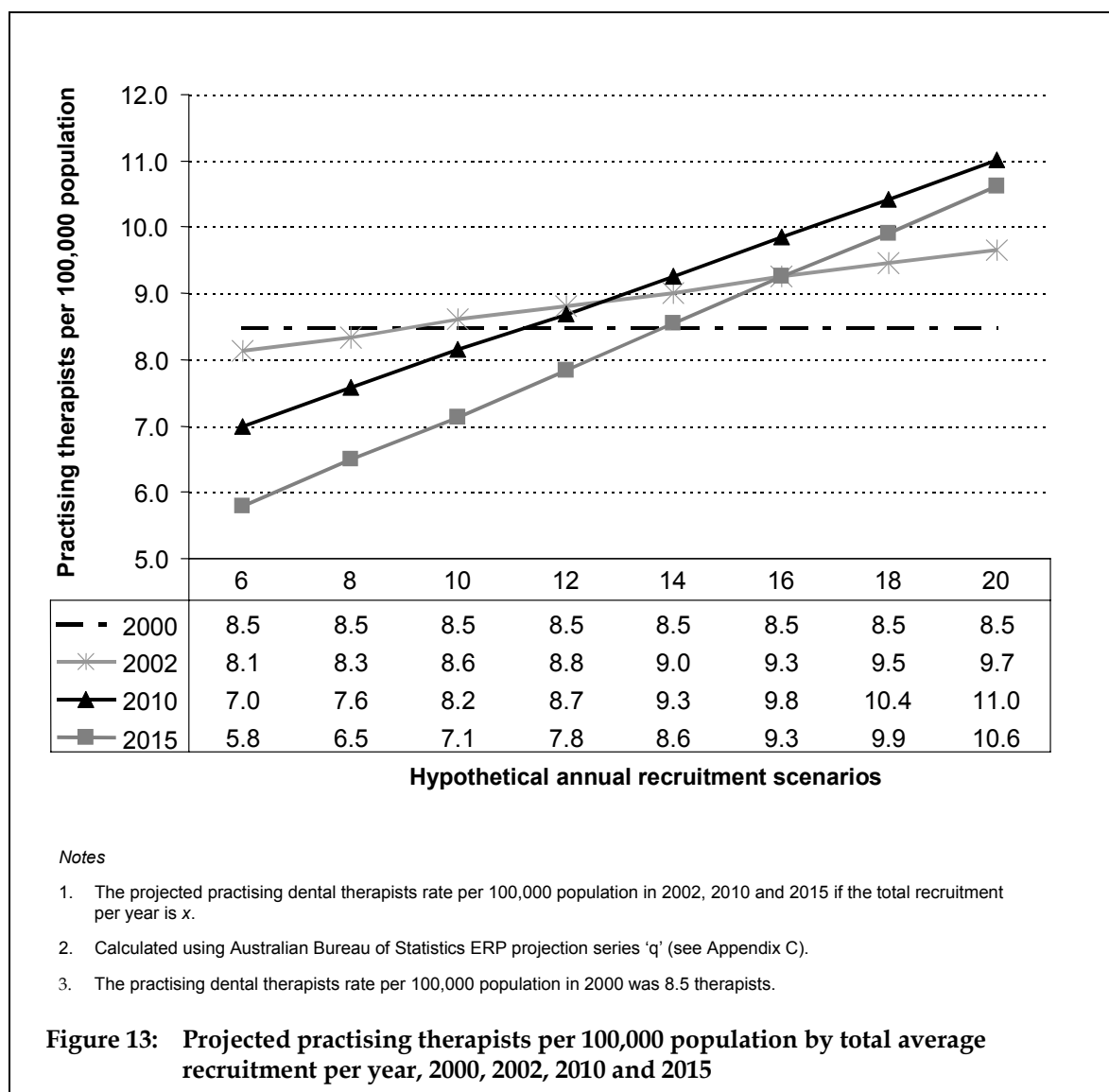
Practice status	South Australia
Working as dental therapist	128
Working, on 3+ months' leave	7
Overseas	—
Working, but not in dental therapy	12
Working, but not in dentistry	4
Not working	—
Total	151
Practising rate per 100,000 ERP	8.5

Source: Teusner & Spencer 2003.

Projections of practising dental therapists

The projected practising rate per 100,000 population is attained as a result of a series of hypothetical recruitment vectors which total between 6 and 13 dental therapists per year (Figure 13). The total average recruitment per year is represented on the *x* axis. The 2002, 2010 and 2015 lines show, respectively, the projected practising rates per 100,000 population attained if the level of recruitment per year indicated by the *x* axis is maintained for the 2, 10 or 15 years of projection. The 2000 line shows the practising rate per 100,000 at baseline, 8.5 dental therapists. Very similar results are achieved if the recruitment is not constant and the average recruitment over the projection period 2000 to 2015 is equivalent to the *x*-axis value. (This applies only because of the short time frame of the projections and probably would not hold true for projections after 2015.)

Figure 13 shows an average recruitment of 14 dental therapists per year is required to maintain the 2000 practising rate of 8.5 therapists per 100,000 population in 2015.



For the purposes of projecting the future number of practising dental therapists, a 'best guess' recruitment vector was determined by consultation with Jenny Miller, coordinator of the Bachelor of Oral Health office, Dental School, The University of Adelaide. Application of a recruitment vector totalling 6 dental therapists projected that there would be 90 practising therapists in 2015, representing a 29.7% decrease from 2000 and a 26.8% decrease from 2002 (Table 23). The annual rate of decline in practising numbers is projected to increase year to year as the number of dental therapists in the older age groups increases.

Table 23: Projected number of practising dental therapists by age group, 2000 to 2015

Age group (years)	Projected number of practising dental therapists															
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
25–29	12	13	12	12	12	12	12	12	12	12	12	12	12	12	12	12
30–34	18	15	12	11	10	9	8	8	8	7	7	7	7	7	7	7
35–39	15	15	14	13	12	10	10	9	8	7	7	7	6	6	6	6
40–44	50	42	36	31	27	23	20	18	16	14	12	11	10	9	8	8
45–49	25	29	32	32	30	29	27	25	23	21	19	17	16	14	13	12
50–54	2	7	11	16	19	22	23	24	25	24	24	23	22	20	19	18
55–59	0	0	1	3	5	8	10	12	14	15	16	17	17	17	17	16
60–64	0	0	0	0	1	1	2	3	4	4	5	6	6	6	6	6
65+	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	2
Total	128	125	123	121	120	119	117	115	113	111	108	104	101	97	94	90
Per cent change^(a)	-2.1%	-2.0%	-1.2%	-1.1%	-1.1%	-1.3%	-1.6%	-1.9%	-2.3%	-2.7%	-3.0%	-3.3%	-3.6%	-3.8%	-4.0%	

(a) Per cent change over previous year.

Note: Based on a constant recruitment vector of 6 dental therapists per year.

5.3 Dental hygienist labour force

As shown in Table 24, the estimated number of practising dental hygienists in 2000 was 110, and the overall practising rate per 100,000 population was 7.3 dental hygienists. This estimate provides the baseline for projections to the year 2015.

Table 24: Dental hygienists by practice status, 2000

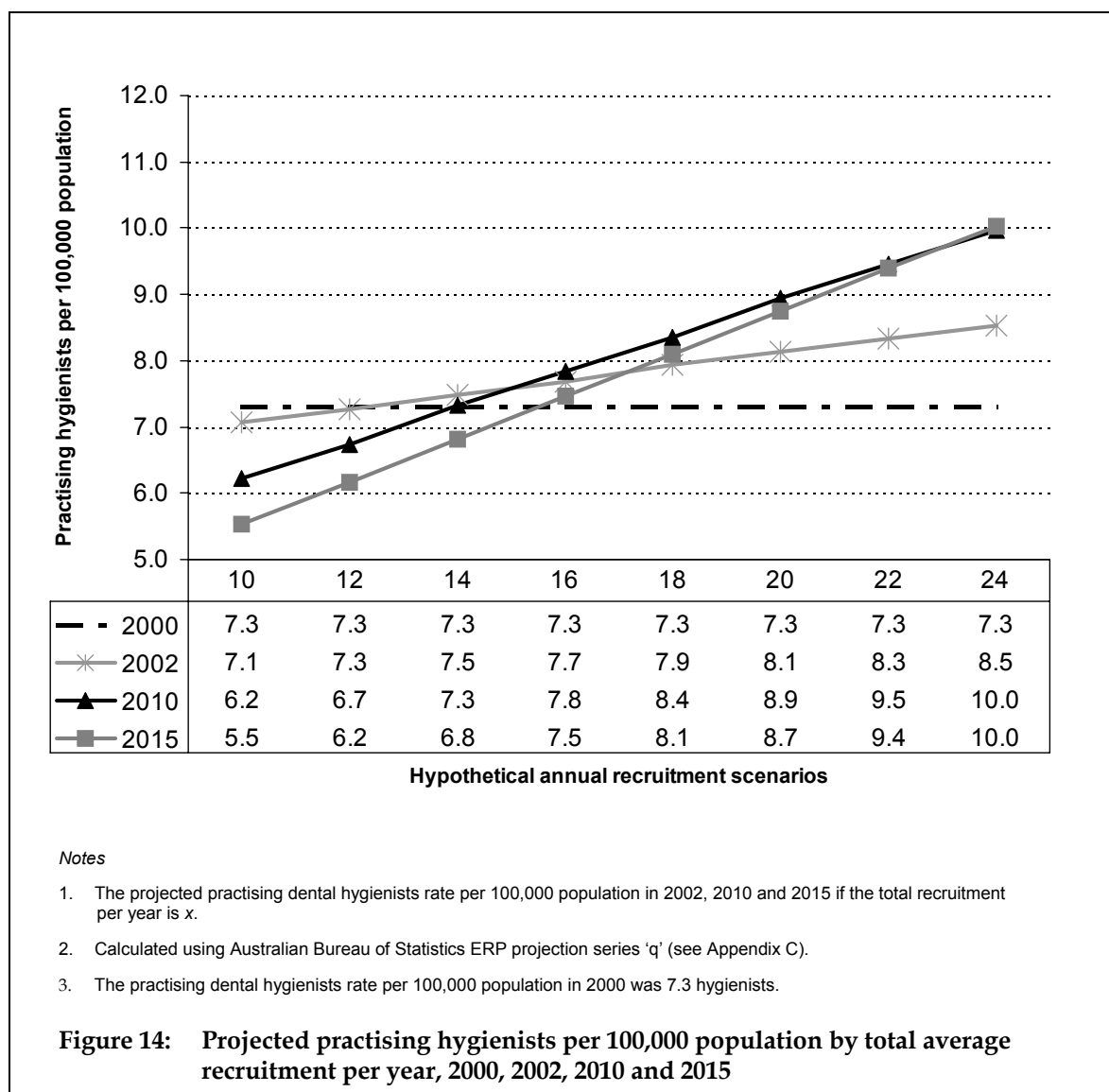
Practice status	South Australia
Working as dental hygienist	110
Working, on 3+ months' leave	5
Working, but not in dental hygiene	9
Not working	8
Overseas	5
Total	137
Practising rate per 100,000 ERP	7.3

Source: Teusner & Spencer 2003.

Projections of practising dental hygienists

The projected practising rate per 100,000 population is attained as a result of a series of hypothetical recruitment vectors totalling between 10 and 24 dental hygienists per year (Figure 14). The total average recruitment per year is presented on the *x* axis. The 2002, 2010 and 2015 lines show, respectively, the projected practising rates per 100,000 population attained if the level of recruitment per year indicated by the *x* axis is maintained for the 2, 10 or 15 years of projection. The 2000 line shows the practising rate per 100,000 population at baseline, 7.3 dental hygienists. Very similar results are achieved if the recruitment is not constant and the average recruitment over the projection period 2000 to 2015 is equivalent to the *x*-axis value. (This applies only because of the short time frame of the projections and probably would not hold true for projections after 2015.)

Figure 14 shows an average recruitment of 16 hygienists per year is required to maintain the 2000 practising rate of 7.3 dental hygienists per 100,000 population in 2015.



For the purposes of projecting the future number of practising dental hygienists, a 'best guess' recruitment vector was determined by consultation with Jenny Miller, coordinator of the Bachelor of Oral Health office, Dental School, The University of Adelaide, and is presented in Table 25. Application of a recruitment vector totalling 15 dental hygienists projected that there would be 111 practising dental hygienists in 2015, representing a 1.8% increase from 2000 and a 3.5% decrease from 2002. The annual rate of increase in practising numbers is projected to decline year to year as the number of dental hygienists in the older age groups increases.

Table 25: Projected number of practising dental hygienists by age group, 2000 to 2015

Age group (years)	Projected number of practising dental hygienists															
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	1	8	10	11	11	11	11	11	11	11	11	11	11	11	11	11
25–29	15	15	18	20	23	24	25	26	26	26	26	26	26	26	27	27
30–34	28	23	19	17	16	16	15	15	16	16	16	16	16	16	16	16
35–39	21	20	19	18	16	15	14	13	12	12	12	11	11	11	11	11
40–44	24	23	22	22	21	19	18	17	16	15	14	14	13	13	12	12
45–49	11	13	14	15	16	16	16	16	15	15	14	14	13	13	12	12
50–54	8	9	10	11	13	14	15	16	16	17	17	17	17	17	16	16
55–59	1	1	2	2	2	3	3	3	4	4	4	4	5	5	5	5
60–64	—	—	—	—	1	1	1	1	1	1	1	1	2	2	2	2
65+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	109	113	115	117	118	119	119	119	118	118	117	116	115	114	112	111
Per cent increase^(a)	3.3%	1.9%	1.7%	1.0%	0.6%	0.2%	-0.1%	-0.4%	-0.6%	-0.7%	-0.8%	-0.9%	-1.0%	-1.0%	-1.0%	

(a) Per cent change over previous year.

Note: Based on a constant recruitment vector of 15 dental hygienists per year.

5.4 Dental prosthetist labour force

As shown in Table 26, the estimated number of practising dental prosthetists in 2000 was 27, and the overall practising rate per 100,000 population was 1.8 dental prosthetists. This estimate provides the baseline for projections to the year 2015.

Table 26: Dental prosthetists by practice status, 2000

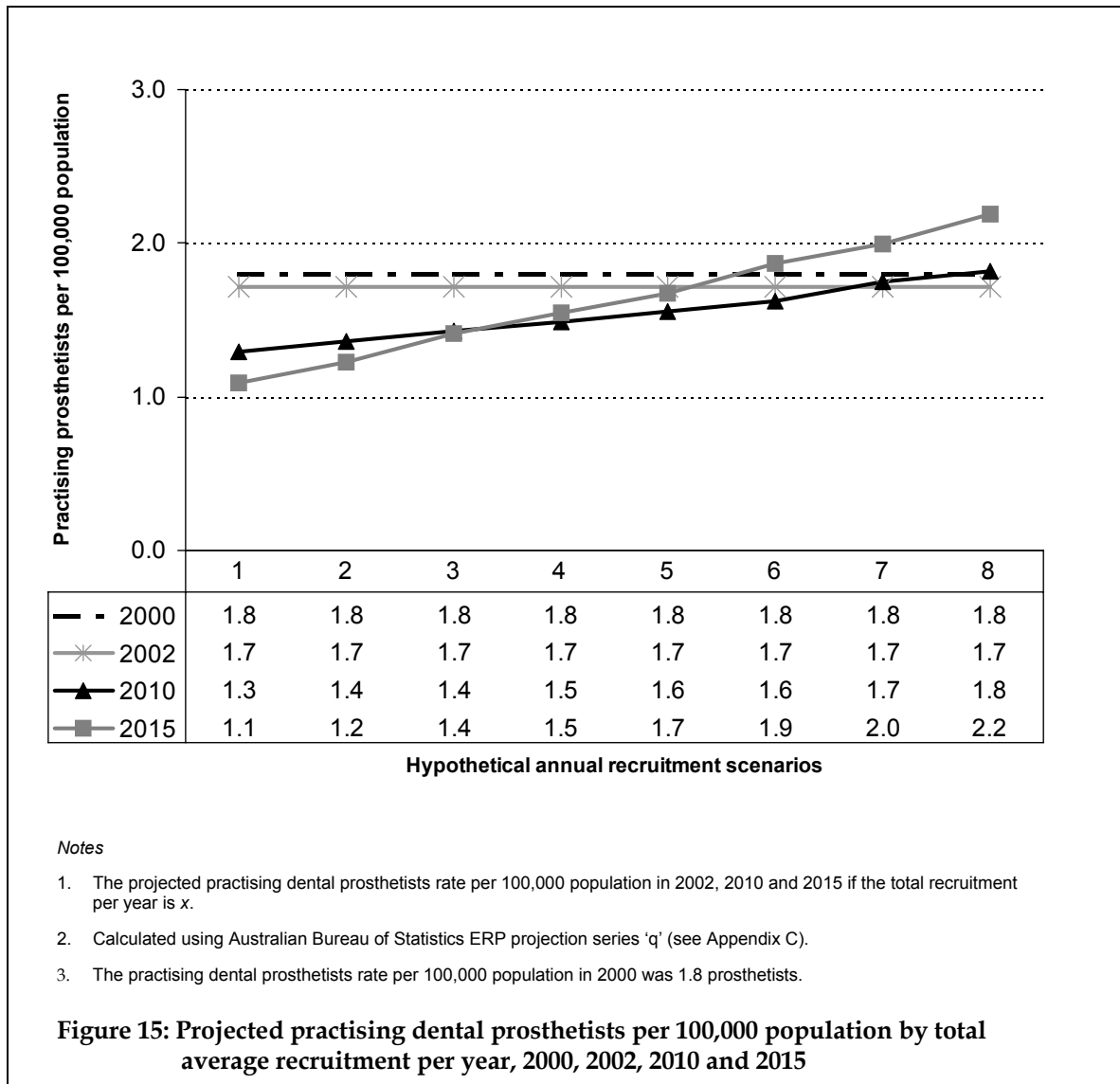
Practice status	South Australia
Working solely in this state/territory or mainly in this state/territory	27
Working only in another state/territory	3
On extended leave (3+ months)	—
Working overseas	2
Not working	2
Working in dentistry but not in prosthetics	—
Working but not in dentistry or prosthetics	2
Total registered	36
Practising rate per 100,000 population	1.8

Source: Teusner & Spencer 2003.

Projections of practising dental prosthetists

The projected practising rate per 100,000 population is attained as a result of a series of hypothetical recruitment vectors totalling between 1 and 8 dental prosthetists per year (Figure 15). The total average recruitment per year is represented on the x axis. The 2002, 2010 and 2015 lines show, respectively, the projected practising rates per 100,000 population attained if the level of recruitment per year indicated by the x axis is maintained for the 2, 10 or 15 years of projection. The 2000 line shows the practising rate per 100,000 at baseline, 1.8 dental prosthetists. Very similar results are achieved if the recruitment is not constant and the average recruitment over the projection period 2000 to 2015 is equivalent to the x -axis value. (This applies only because of the short time frame of the projections and most likely would not hold true for projections after 2015.)

Figure 15 shows that an average recruitment of 6 dental prosthetists per year is required to maintain the 2000 practising rate of 1.8 dental prosthetists per 100,000 population in 2015.



For the purposes of projecting the future number of practising dental prosthetists, a 'best guess' projection was calculated and is presented in Table 27. Application of a recruitment vector totalling 4 dental prosthetists projected that there would be 24 practising dental prosthetists in 2015, representing an 11.1% decrease from 2000 and a 7.7% decrease from 2002. The annual rate of decline in practising numbers is projected to increase year to year as the number of dental prosthetists in the older age groups increases.

Table 27: Projected number of practising dental prosthetists by age group, 2000 to 2015

Age group (years)	Projected number of practising dental prosthetists															
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25–29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30–34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35–39	2	1	1	1	1	1	1	1	2	2	2	3	3	3	4	4
40–44	8	6	5	4	3	3	2	2	2	2	2	2	2	3	3	3
45–49	7	8	8	8	7	6	6	5	4	4	4	3	3	3	3	3
50–54	10	9	8	8	7	7	6	6	5	5	5	4	4	3	3	3
55–59	0	2	4	5	5	6	6	7	7	7	7	7	7	6	6	6
60–64	0	0	0	0	1	1	2	2	2	2	2	2	3	3	3	2
65+	0	0	0	0	0	0	0	1	1	1	1	2	2	2	2	3
Total	27	26	26	25	25	24	24	23	23	23	23	23	23	24	24	24
Per cent change^(a)	-2.7%	-1.6%	-2.7%	-2.4%	-2.0%	-1.5%	-1.1%	-0.7%	-0.3%	0.0%	0.3%	0.5%	0.7%	0.8%	0.9%	

(a) Per cent change over previous year.

Note: Based on a constant recruitment vector of 4 dental prosthetists per year.

5.5 Capacity to supply dental visits

The allied dental labour force provides a relatively small proportion of the total dental visits supplied. The services provided by dental therapists, dental hygienists and dental prosthetists tend to be concentrated, both in the range of services delivered and/or the age groups treated. Consequently, the services provided are more significant in relation to specific target groups in the population. The services provided by dental hygienists can be viewed as largely complementary to those provided by dentists, and in the case of dental therapists and prosthetists, largely substitution.

Productivity information for dental therapists, dental hygienists and dental prosthetists is presented in Table 28. The mean number of hours worked per week is highest for prosthetists at 44.6 hours, followed by therapists at 27.6 hours and then hygienists at 25.8 hours per week. Patient visits per year were calculated for each group based on the information available. (Dentist data were substituted where no profession-specific data were available). These figures show that full-time practising therapists provided 2,607 visits per year, dental hygienists 1,853 visits and dental prosthetists 3,421 visits.

Table 28: Estimated annual productivity (estimated number of dental visits): dental hygienists, dental therapists and dental prosthetists

	Dental therapists	Dental hygienists	Dental prosthetists
Hours per week	27.60 ^(a)	25.80 ^(a)	44.60 ^(a)
Weeks per year	n.a.	43.26 ^(b)	44.60 ^(c)
Hours per year	1,650.00 ^(d)	1,116.11 ^(e)	1,989.16 ^(e)
Dental visits per hour	1.58 ^(b)	1.66 ^(a)	1.72 ^(c)
Dental visits per year	2,607.00 ^(f)	1,852.74 ^(f)	3,421.36 ^(f)

(a) The dental therapist, dental hygienist and dental prosthetist 2000 South Australian labour force data collection.

(b) 1998/99 Longitudinal Study of Dentists' Practice Activity, practising female dental practitioners.

(c) 1998/99 Longitudinal Study of Dentists' Practice Activity, practising male dental practitioners.

(d) Personal communication, Andrew Chartier, South Australian Dental Service.

(e) [Hours per year] = [Hours per week] x [Weeks per year]

(f) [Dental visit per year] = [Hours per year] x [Dental visits per hour]

Because of the limited availability of appropriate annual productivity data, additional caution needs to be exercised when interpreting the projections of the allied dental labour force to provide dental visits. Patient visits per year supplied by dental hygienists equalled 1,853. However, data from the evaluation of the Colgate Periodontal Education Program run by the Dental Practice Education Unit showed that only 44.5% of those visits were to the hygienist alone. Some 55.5% of visits to a hygienist also involved visiting the dentist. As patients report such a visit as a single encounter, there is a need to introduce a deflator for unique visits supplied by a dental hygienist; a 50% deflator has been used in this report. The same situation exists to a lesser extent among dental therapists. Although most visits to a school dental clinic lead to an encounter with only a dental therapist, a small percentage also involve dentist consultations or provision of dental services. No specific data have been accessed; however a modest deflator of 5% has been used.

Additionally, it should be noted that not all practising allied dental professionals are principally involved in delivering clinical services. This is particularly relevant for dental prosthetists, the majority of whom do not work in clinical practice but in laboratory settings. Hence, the calculation of visits supplied by allied dental professionals was multiplied by an estimate of the percentage practising whose principal practice location was clinical. The projected capacity of the allied dental labour force to supply visits is presented in Table 29. It was projected that the overall number of visits supplied by the allied dental labour force will decline by approximately 19.2%, from a total of 0.442 million dental visits in 2002 to 0.357 million visits in 2015.

Table 29: Capacity of allied dental labour force to supply dental visits, 2002 and 2015

	2000			2002 (baseline supply)		2015 (projected supply)	
	Patient visits per year ^(a)	Unique visits deflated ^(b)	% Clinical practice ^(c)	Number practising	Capacity to supply visits ('000) ^(d)	Projected number practising ^(e)	Capacity to supply visits ('000) ^(f)
Dental therapists	2,607.00	2,476.65	96.1%	123	292.12	90	214.01
Dental hygienists	1,852.74	926.37	97.3%	115	103.47	111	100.36
Dental prosthetists	3,421.36	3,421.36	51.9%	26	46.12	24	42.58
Total capacity to supply dental visits					441.71		356.94

(a) Patient visits per year, Table 28.

(b) [Patient visits per year, Table 28] x [deflator: 95% (therapists); 50% (hygienists)].

(c) Percentage of practising dental auxiliaries that reported their type of main practice was clinical or mainly clinical, dental labour force data collection, 2000

(d) [Unique patient visits per year, Table 29] x [% clinical practice] x [number practising in 2002].

(e) Projected number practising based on constant recruitment vectors totalling 15 hygienists, 6 therapists and 4 prosthetists per year.

(f) [Unique patient visits per year, Table 29] x [% clinical practice] x [projected number practising in 2015].

6 Demand for dental services

6.1 Outline

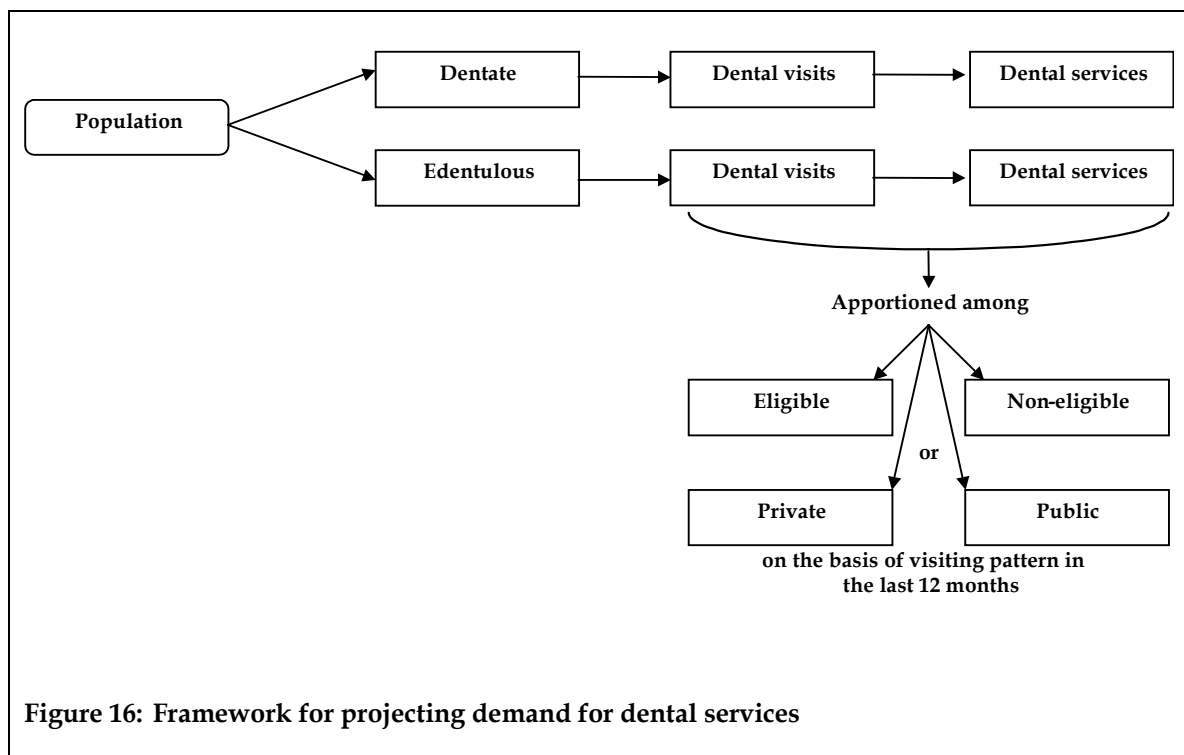
The requirement for oral health services has been approached from a demand-based perspective. Per capita demand data have been analysed for South Australian children and adults based on the ABS Special Supplementary Survey 1979, the National Oral Health Survey of Australia 1987–88, and the 1994, 1995 and 1996 National Dental Telephone Interview Surveys. Projections of per capita demand have been separately modelled for dentate and edentulous persons, and changing percentages of edentulism in specific age groups accommodated in terms of edentulism. Per capita demand has then been multiplied by South Australian population projections.

6.2 Framework for projecting the demand for dental services

Demand for dental visits in 1996 through to 2015 was projected using the following age groups: 0–4, 5–11, 12–17, 18–24, 25–34, 35–44, 45–54, 55–64, 65–74 and 75+ years; and on the basis of:

- the estimated resident population (ERP) and population projections for South Australia
- the estimated resident population who are or are projected to be dentate and edentulous
- the per capita demand from dentate persons for dental visits and trends in demand from 1979, 1987–88 and 1995 data extrapolated forward at either 0%, 25%, 50%, 75% or 100% of the linear trend continuing across 1996 to 2015; and
- the per capita demand from edentulous persons for dental visits and trends in demand from 1987–88 and 1995 data extrapolated forward at either 0%, 25%, 50%, 75% or 100% of the linear trend continuing across 1996 to 2015.

The framework for projecting demand for dental services used in this study is depicted in Figure 16. This figure shows that the population can be divided into the proportions of any age group who are dentate and edentulous. Previous linear time trends in per capita demand can then be used to estimate demand for visits for dentate and edentulous persons of an age group at each time. Multiplying these three elements (i.e. population, proportions of dentate/edentulous, and dentate-specific per capita demand) gives the demand for dental visits or services for each age group. These estimates then take various factors into account in determining the demand for dental visits by specific subpopulations. The last division is between those eligible to use public dental services and those who are not, and the proportions visiting private or public dental clinics based on visiting patterns in the last 12 months.



6.3 Demand for dental visits

The resident population of South Australia for 2002 and the projected population in 2010 and 2015 are presented in Table 30, using Australian Bureau of Statistics (ABS) figures (series 'q'). The estimated increase in the South Australian population from 2002 to 2015 is 2.9%, from 1.51 million people to 1.56 million.

Table 30: South Australian population by age group in 1998, 2010 and 2015

Age group (years)	Population by year ('000)		
	2002	2010	2015
0-4	89.2	78.5	76.0
5-11	137.1	122.5	113.5
12-17	120.8	116.5	108.1
18-24	140.0	140.6	138.3
25-34	209.4	196.3	196.4
35-44	224.7	210.5	202.3
45-54	211.1	221.4	213.4
55-64	156.4	201.6	211.1
65-74	115.0	132.9	164.8
75+	108.0	123.0	131.3
Total	1,511.6	1,543.8	1,555.2
Per cent change: 2002 to 2015			2.9

Source: Australian Bureau of Statistics 2000b.

Population projections are periodically updated in Australia. Such projections are sensitive at the national level to fertility rates, and to net migration numbers and its age distribution. At a state/territory level, further complications are introduced through the attraction of migrants to locate in specific states/territories and the migration flows between states/territories.

Proportions of the population who are dentate/edentulous are given in Table 31, based on ABS Special Supplementary Survey data for 1979, National Health Survey data for 1989 and National Dental Telephone Interview Survey data for 1994–96. The dramatic increase in the rates of retention of some natural teeth is demonstrated across the three years by the percentage of dentate people in each age group. The percentage of people with at least some natural teeth rose from 73.5% in 1979 to 90.1% in 1995 for the 45–54 age group, and from 21.4% to 47.1% for the oldest age group (75 and over). Corresponding to the increased retention of some natural teeth, edentulism rates fell steadily over this period. For the oldest age group, edentulism fell from 78.6% in 1979 to 52.9% in 1995.

Table 31: Percentage of dentate and edentulous persons by age group, Australia, 1979, 1989 and 1995

Age group (years)	Dentate			Edentulous		
	1979 (%)	1989 (%)	1995 (%)	1979 (%)	1989 (%)	1995 (%)
0–4	100.0	100.0	100.0	—	—	—
5–11	100.0	100.0	100.0	—	—	—
12–17	100.0	100.0	100.0	—	—	—
18–24	98.7	99.4	99.6	1.3	0.6	0.4
25–34	94.6	98.6	99.0	5.4	1.4	1.0
35–44	86.0	94.3	96.7	14.0	5.7	3.3
45–54	73.5	85.1	90.1	26.5	14.9	9.9
55–64	59.8	71.1	78.1	40.2	28.9	21.9
65–74	39.3	56.8	63.6	60.7	43.2	36.4
75+	21.4	36.6	47.1	78.6	63.4	52.9

Marked differences exist in per capita demand between edentulous and dentate adults of the same age. The current projections of demand have also included trends in edentulism.

The data on dentate and edentulous status in 1979 and 1989 were used to project dentate status forward to 1999, 2009 and 2019 (AIHW DSRU 1998). Using this existing information, the percentage dentate or edentulous in 2002, 2010 and 2015 was interpolated from the linear trends for each age group. These projections are presented in Table 32.

The percentage of dentate people is expected to continue to increase, with an estimated 72.4% of people retaining at least some of their natural teeth, even in the oldest age group, by the year 2015.

Table 32: Percentage of dentate and edentulous persons by age group, 2002, 2010 and 2015

Age group (years)	Dentate			Edentulous		
	2002 (%)	2010 (%)	2015 (%)	2002 (%)	2010 (%)	2015 (%)
0–4	100.0	100.0	100.0	—	—	—
5–11	100.0	100.0	100.0	—	—	—
12–17	100.0	100.0	100.0	—	—	—
18–24	99.8	99.9	100.0	0.2	0.1	—
25–34	99.4	99.6	99.7	0.6	0.4	0.3
35–44	98.5	99.0	99.2	1.5	1.0	0.8
45–54	94.6	97.5	97.8	5.4	2.5	2.2
55–64	85.2	91.4	93.4	14.8	8.6	6.6
65–74	71.6	80.5	84.7	28.4	19.5	15.3
75+	57.5	66.6	72.4	42.5	33.4	27.6

The demand for dental visits in Australia in each of 1979, 1988 and 1995 is shown in Table 33. Demand for dental visits from both the dentate and the edentulous increased over this period. For dentate persons, the demand increased from 0.99 visits per capita per year in 1979 to 1.50 in 1995; for the edentulous, there was an increase in demand from 0.30 visits per capita per year in 1979 to 0.48 in 1995. Because of the dramatic decline in edentulism, the number of persons on which the per capita demand estimate was based for many of the age groups was very low (fewer than 20 people). This led to very unstable estimates for most age groups in 1988 and 1995 for edentulous persons. Therefore, a constant per capita demand was used across age groups for these years to provide greater stability for the model. Table 33 also shows the much greater demand of dentate persons for visits, compared with the edentulous. Annual demand from the dentate was more than three times the rate of those without any natural teeth.

Table 33: Per capita demand for dental visits per year, 1979, 1988 and 1995

Age group (years)	Dentate			Edentulous		
	1979	1988	1995	1979	1988	1995
0–4	0.20	0.20	0.20	—	—	—
5–11	1.18	1.65	1.85	—	—	—
12–17	1.49	1.90	2.17	—	—	—
18–24	1.15	1.13	1.34	0.67	0.35	0.48
25–34	1.06	1.06	1.11	0.46	0.35	0.48
35–44	0.97	1.23	1.41	0.30	0.35	0.48
45–54	0.82	1.13	1.52	0.32	0.35	0.48
55–64	0.91	1.26	1.54	0.29	0.35	0.48
65–74	0.75	1.26	1.49	0.30	0.35	0.48
75+	0.69	1.13	1.40	0.22	0.35	0.48
Total	0.99	1.32	1.50	0.30	0.35	0.48

The different levels of demand for dental visits across age groups in different years can be more easily seen in Figure 17. There was growth in demand for dental visits from 1979 to 1988 in the younger age groups, particularly the 5-11 and 12-17 age groups. Demand also increased substantially for all adults aged 35 years and over.

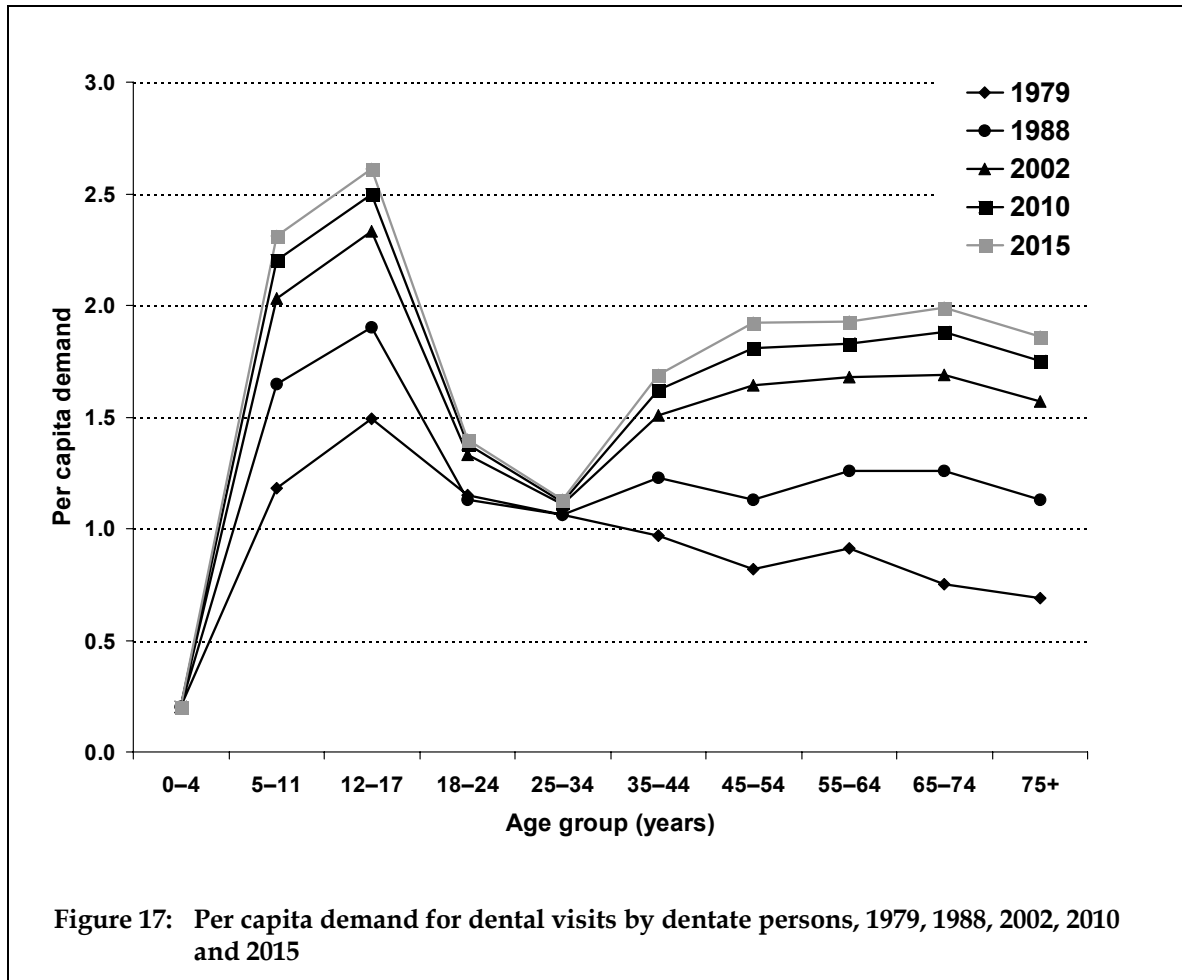


Table 34 provides estimates of per capita demand for dental visits per year up to 2015. These figures are based on previous data for Australia and an assumption that Australian time trends from 1988 to 1995 will continue up to 2015. Three rates at which those trends may continue have been applied: 0%, 50% and 100% continuation in time trends demand for dental visits.

Table 34: Per capita demand for dental visits per year, Australia, 2002 and 2015

Age group (years)	Dentate						Edentulous					
	2002			2015			2002			2015		
	Growth rate 1995+ ^(a)			Growth rate 1995+			Growth rate 1995+			Growth rate 1995+		
	0%	50%	100%	0%	50%	100%	0%	50%	100%	0%	50%	100%
0-4	0	0.20	0.20	0.20	0.20	0.20	—	—	—	—	—	—
5-11	1	2.03	2.18	1.88	2.31	2.73	—	—	—	—	—	—
12-17	2	2.33	2.48	2.18	2.61	3.03	—	—	—	—	—	—
18-24	1	1.33	1.37	1.29	1.40	1.52	0.48	0.55	0.61	0	0	0.85
25-34	1	1.11	1.12	1.10	1.13	1.16	0.48	0.55	0.61	0	0	0.85
35-44	1	1.51	1.61	1.41	1.69	1.97	0.48	0.55	0.61	0	0	0.85
45-54	1	1.64	1.79	1.49	1.92	2.36	0.48	0.55	0.61	0	0	0.85
55-64	1	1.68	1.81	1.54	1.93	2.33	0.48	0.55	0.61	0	0	0.85
65-74	1	1.69	1.85	1.52	1.99	2.46	0.48	0.55	0.61	0	0	0.85
75+	1	1.57	1.73	1.42	1.86	2.31	0.48	0.55	0.61	0	0	0.85

(a) Percentage of previous Australian time trends across 1988 to 1995 assumed to continue after 1995.

The previous analysis indicated that increasing per capita demand was being driven by not only a move towards reduced edentulism but also within the dentate and edentulous groups. In both groups, per capita demand increased by approximately 50% between 1979 and 1995 (Table 33). The factors behind such increasing demand are complex. They include a range of macroeconomic factors such as growth in gross domestic product; broad social factors such as increasing educational attainment and occupational prestige and the impact of these on consumer expectations about oral health and dental services; and the impact of science and technology within dentistry, which is broadening the range of diagnostic tests, interventions for common dental conditions and materials used. There is an expanding range of dental services and improved efficacy of those services in improving oral wellbeing, which influences the population's desire for the services.

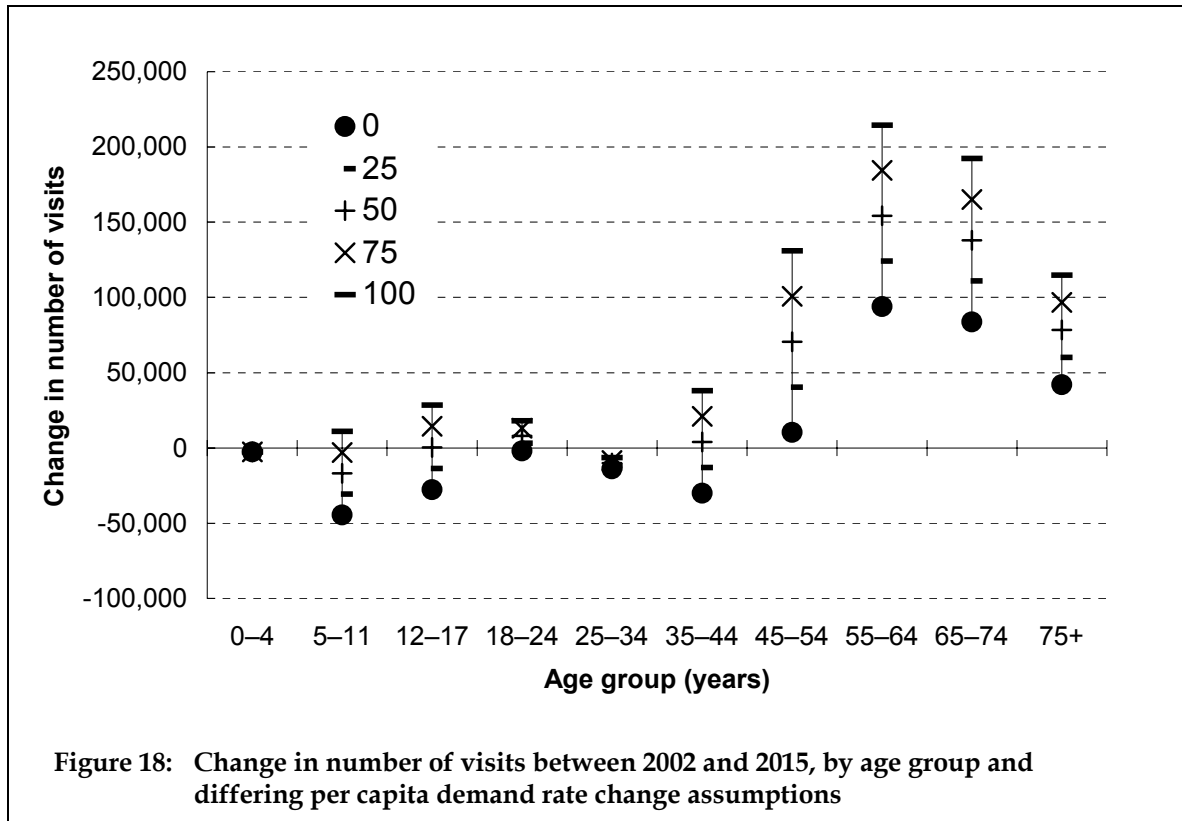
Given the increase in per capita demand between 1988 and 1995, a key issue for the projections was the extent to which the trend of the recent past would continue into the future. A number of scenarios were examined, ranging from 0% of the previous linear trend projected through to 2015, to a continuation of growth at the same rate as that between 1988 and 1995, i.e. 100% of the previous linear time trend projected through to 2015. Variations of 25%, 50% and 75% were also examined. Although continuation of 100% growth in per capita demand is certainly possible, most emphasis in this study has been placed on the 50% rate of growth across 1988 to 1995 continuing through to 2015. This is a reasonably cautious approach, yet it produced a very substantial increase in demand (19.4%) projected for the period 2002 to 2015 (Table 35).

Table 35 shows the demand for dental visits in South Australia in 2002 and 2015, based on the population projections, rates of edentulism and per capita demand for dental visits given in previous tables. The zero growth rate option from the linear trend in demand for dental visits from 2002 to 2015 leads to a 5.4% increase in demand for dental visits, the 50% growth option to a 19.4% increase, and the 100% growth option to a 31.7% increase.

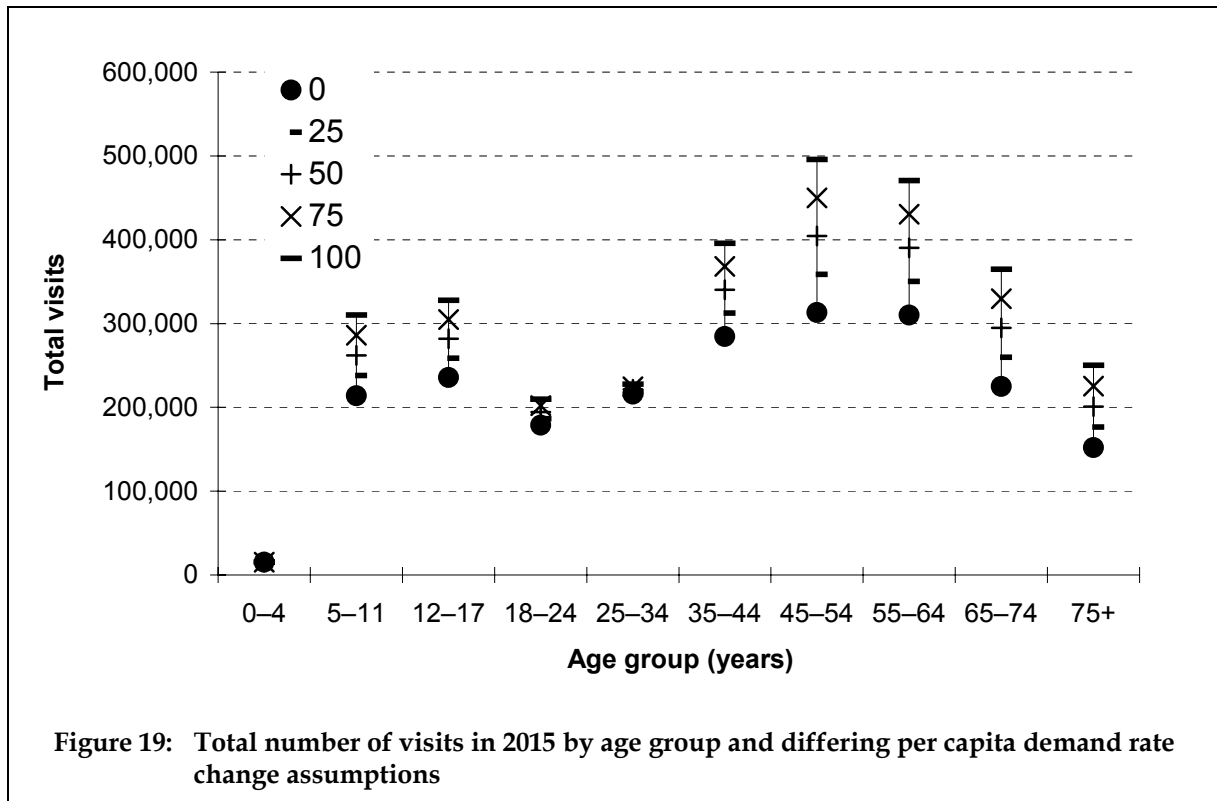
Table 35: Demand for dental visits ('000s), 2002 and 2015

Age group (years)	2002			2015		
	Growth rate 1995+			Growth rate 1995+		
	0%	50%	100%	0%	50%	100%
0-4	17.8	17.8	17.8	15.2	15.2	15.2
5-11	258.4	278.7	299.0	213.8	261.9	309.9
12-17	263.3	281.4	299.4	235.6	281.7	327.8
18-24	180.7	186.2	191.7	178.8	194.3	209.8
25-34	229.5	231.7	234.0	215.7	221.6	227.5
35-44	314.7	336.3	357.9	284.6	340.2	395.8
45-54	302.8	333.8	364.8	313.0	404.3	495.6
55-64	216.1	235.9	255.8	310.0	390.2	470.4
65-74	141.2	156.8	172.4	224.9	294.8	364.7
75+	108.9	122.5	135.2	151.8	200.9	250.0
Total	2,034.3	2,181.1	2,328.0	2,143.5	2,605.2	3,066.9
Per cent change: 2002 to 2015				5.4	19.4	31.7

The change in the number of visits under the three growth rate scenarios of 0%, 50% and 100%, as well as two additional scenarios of 25% and 75% growth rates, are shown in Figure 18. The main growth occurs in the 5-11 and 12-17 age groups, as well as for those aged 35 years and over. The 0%, 25% and 50% growth options lead to a reduction in demand for dental visits for the 5-11 age group. A reduction in the demand for visits is projected for the 0-4 and 25-34 age groups under all the different demand growth rates.



The projected total number of visits required in 2015, using the same five different scenarios, is presented in Figure 19. This chart clearly highlights the widely varying numbers of visits required by different age groups. It also indicates the volatility of the estimates associated with different growth rates of demand for some of the age ranges. Those groups that have particularly large ranges are the 45-54, 55-64 and 65-74 age groups; however, the 5-11, 12-17, 35-44 and over 75+ age groups also vary widely in relation to different scenarios.



6.4 Demand for dental visits within the private and public sectors

The demand for dental visits in the year 2015 for different age groups of the South Australian population as a whole has been presented in the preceding pages. This section deals with the demand for dental visits within the private and public sectors using two different approaches.

Data that recorded the age-specific eligibility status for public dental services among South Australians who had visited in the previous 12 months, taken from the National Dental Telephone Interview Survey 2002, were used to indicate the likely demand among eligible and non-eligible persons. Estimation of age-specific eligibility among users, rather than in the population at large avoids, the assumption that per capita demand is the same in both subgroups of the population. This is important given the depression of demand among eligible persons caused by rationing strategies in the public dental services.

Table 36 shows the age-specific percentages of the South Australian population in relation to their eligibility to use public dental services, and the place of their last dental visit. An estimated 29% of persons in South Australia who used dental services in the previous 12 months were eligible for public dental services in 2002. Eligibility initially decreased across adolescent and young adult age groups, then increased across adult age groups. The most common place of last dental visit was private practice, with 73.8% of persons in South Australia reporting that they last visited this type of practice. Small proportions last visited either a public dental clinic (11.5%) or a school dental service (14.7%).

Table 36: Age-specific percentage of the population eligible for use of public dental services, and place of last dental visit among persons who had made a dental visit in the previous 12 months^(a)

Age group (years)	Eligibility		Place of last visit		
	Eligible	Non-eligible	Public dental clinic	School Dental Service	Private practice
5–11	33.4	66.6	3.8	67.5	28.7
12–17	17.6	82.4	4.8	36.9	58.3
18–24	14.8	85.2	12.2	4.0	83.8
25–34	28.9	71.1	17.2	0.0	82.8
35–44	24.5	75.5	19.6	0.0	80.4
45–54	13.7	86.3	3.6	0.5	95.9
55–64	34.3	65.7	13.6	0.0	86.4
65–74	76.3	23.7	18.3	0.0	81.7
75+	63.6	36.4	25.4	0.0	74.6
Total (weighted)	29.0	71.0	11.5	14.7	73.8

(a) Derived from the AIHW DSRU National Dental Telephone Interview Survey 2002.

The projected demand for dental visits for 2015, divided into eligibility and non-eligibility for public dental services, is given in Table 37. This projection is based on a growth rate of 50% of the linear trend in per capita demand for visits, which results in a 32.4% increase in demand for dental visits by persons eligible to receive public dental services and a more modest 13.9% increase for those who are not eligible.

Table 37: Demand for dental visits by persons eligible and non-eligible for public dental services (growth rate 1995+ 50%), 2002 and 2015

Age group (years)	Eligible		Non-eligible	
	2002	2015	2002	2015
0–4	5,955	5,076	11,875	10,121
5–11	93,086	87,471	185,615	174,419
12–17	49,518	49,585	231,833	232,146
18–24	27,559	28,756	158,652	165,541
25–34	66,968	64,041	164,755	157,553
35–44	82,393	83,352	253,905	256,860
45–54	45,727	55,393	288,047	348,938
55–64	80,928	133,840	155,013	256,364
65–74	119,635	224,932	37,160	69,868
75+	77,925	127,792	44,599	73,139
Total	649,694	860,237	1,531,454	1,744,947
Per cent change: 2002 to 2015		32.4		13.9

However a high proportion of eligible users do not seek their dental visits in the public sector; many seek their visits privately. An alternative split into populations using private and public sector services can be derived by information on the place of last dental visit. Hence, to project the demand for public sector dental visits, the percentage of persons who had visited in the last 12 months and whose last visit was to a public dental service was determined. This percentage was applied to projections of demand from public dental services. Of course, this projection is highly sensitive to policy on provision of public dental services. For instance, an increase in public dental clinic resources would most likely see a greater percentage of eligible adults visiting public dental clinics. Alternatively, more public funds might be used for subsidising eligible adults to visit private dental practitioners. This is, therefore, only an indication of what might prevail in 2015.

Table 38 shows the division between private and public dental services according to the place of last visit for 2002, and projected for 2015 based on a growth rate in per capita demand of 50% of the previous linear trend in demand. The demand for dental visits rises by 22.9% for those last attending a private practice and 9.8% for those last attending a public practice. The greater increase in the demand for dental visits in the private sector reflects the fact that many people who are eligible for public dental services attend private practices because they cannot wait for treatment on lengthy public clinic waiting lists, or for other reasons such as continuity of care with a dental provider.

Table 38: Demand for dental visits by persons whose last visit was to a private practice or public dental service (growth rate 1995+ 50%), 2002 and 2015

Age group (years)	Private practices		Public dental services	
	2002	2015	2002	2015
0-4	5,117	4,362	12,713	10,836
5-11	79,987	75,162	198,714	186,728
12-17	164,028	164,249	117,323	117,482
18-24	156,045	162,821	30,166	31,476
25-34	191,867	183,480	39,856	38,114
35-44	270,383	273,530	65,914	66,681
45-54	320,089	387,753	13,685	16,578
55-64	203,853	337,136	32,088	53,068
65-74	128,101	240,851	28,693	53,948
75+	91,403	149,894	31,121	51,036
Total	1,610,873	1,979,238	570,275	625,946
Per cent change: 2002 to 2015		22.9		9.8

6.5 Rates and types of services per visit

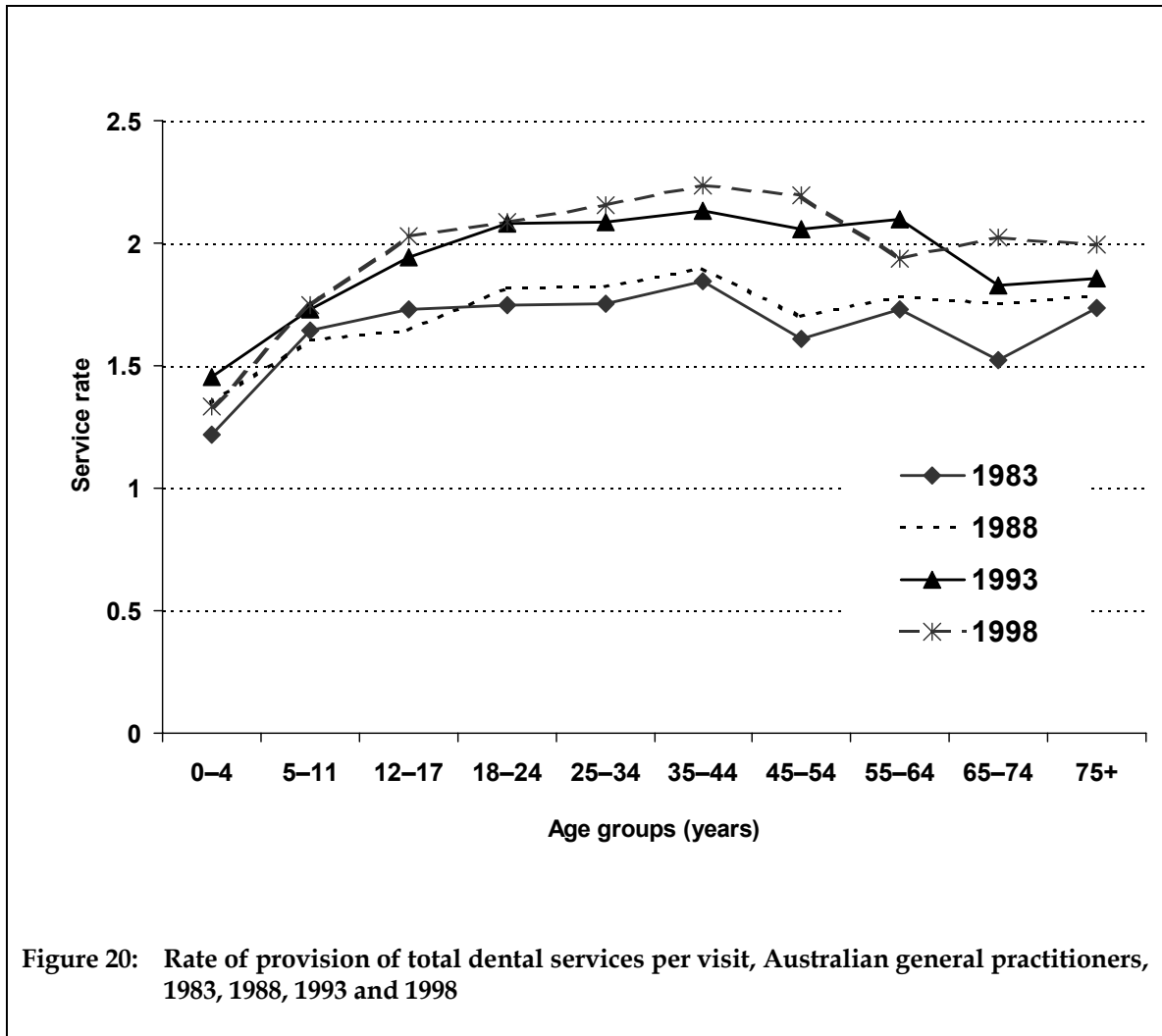
One method of further examining demand for supply of dental visits is to look at the rate and type of dental services provided per visit rather than the number of visits required. Data are available on trends in the rate of provision of dental services per visit among private general practice dentists in Australia. As few data are available on either the public dental services for adults or the rate of provision of dental services per visit among dental hygienists, therapists and prosthetists, the rates among private dentists were applied to all projected dental visits.

The rate of provision of dental services per visit for Australian general dental practitioners based on data from the Longitudinal Study of Dentists' Practice Activity (1983, 1988, 1993 and 1998) is presented in Table 39. It shows a steady increase in the number of services provided per visit from 1983 to 1988 and to 1993 and then a very slight decrease to 1998. These changes are not uniform across age groups of patients, with the largest increases occurring for patients in the 45–54 and older age groups.

Table 39: Rate of provision of total dental services per visit: Australian general dental practitioners, 1983, 1988, 1993 and 1998

Age group (years)	Year			
	1983	1988	1993	1998
0–4	1.22	1.35	1.45	1.33
5–11	1.64	1.60	1.73	1.75
12–17	1.73	1.65	1.94	2.03
18–24	1.75	1.81	2.08	2.08
25–34	1.76	1.82	2.09	2.16
35–44	1.85	1.90	2.13	2.23
45–54	1.61	1.70	2.06	2.19
55–64	1.73	1.78	2.10	1.94
65–74	1.53	1.75	1.83	2.02
75+	1.74	1.78	1.86	2.00
Total (weighted)	1.72	1.78	2.02	2.09

These changes in rate of provision of services per visit are more clearly demonstrated in Figure 20, which shows an increase in intensity of servicing across the 15-year period. Increases in the rate of provision occurred for all age groups up to 1993. In the last 5-year period to 1998, however, this rate fell for the 0-4 and 55-64 age groups and remained static for the 18-24 age groups. Where provision continued to rise to 1998, the gains in the last 5-year period were small, indicating that this trend had flattened out.



The provision of different types of dental services per visit is shown in Table 40. The major growth across this 15-year period was in diagnostic, preventive, endodontic and crown and bridge services. The provision of other types of services remained fairly stable.

Table 40: Rate of provision of types of dental services per visit, Australian general dental practitioners, 1983, 1988, 1993 and 1998

Area	Year			
	1983	1988	1993	1998
Diagnostic	0.49	0.49	0.60	0.62
Preventive	0.27	0.30	0.34	0.37
Periodontic	0.01	0.02	0.02	0.02
Oral surgery	0.09	0.09	0.09	0.08
Endodontic	0.06	0.06	0.11	0.14
Restorative	0.61	0.60	0.63	0.62
Crown and bridge	0.03	0.06	0.07	0.07
Prosthodontic	0.11	0.09	0.10	0.11
Orthodontic	0.01	0.02	0.02	0.01
General miscellaneous	0.04	0.05	0.05	0.04
Total services	1.72	1.78	2.02	2.09

The demand for dental services by service type for South Australia in 2002 and projections of demand for 2015 are presented in Table 41, indicating that the demand for all types of services will rise in terms of total services. Under the assumptions used in these projections, the demand for dental services is expected to increase by 29.0% from 2002 to 2015. The largest proportional increases are expected to be for endodontic and crown and bridge services. The smallest proportional increase is expected for oral surgery services as more people retain at least some of their natural teeth.

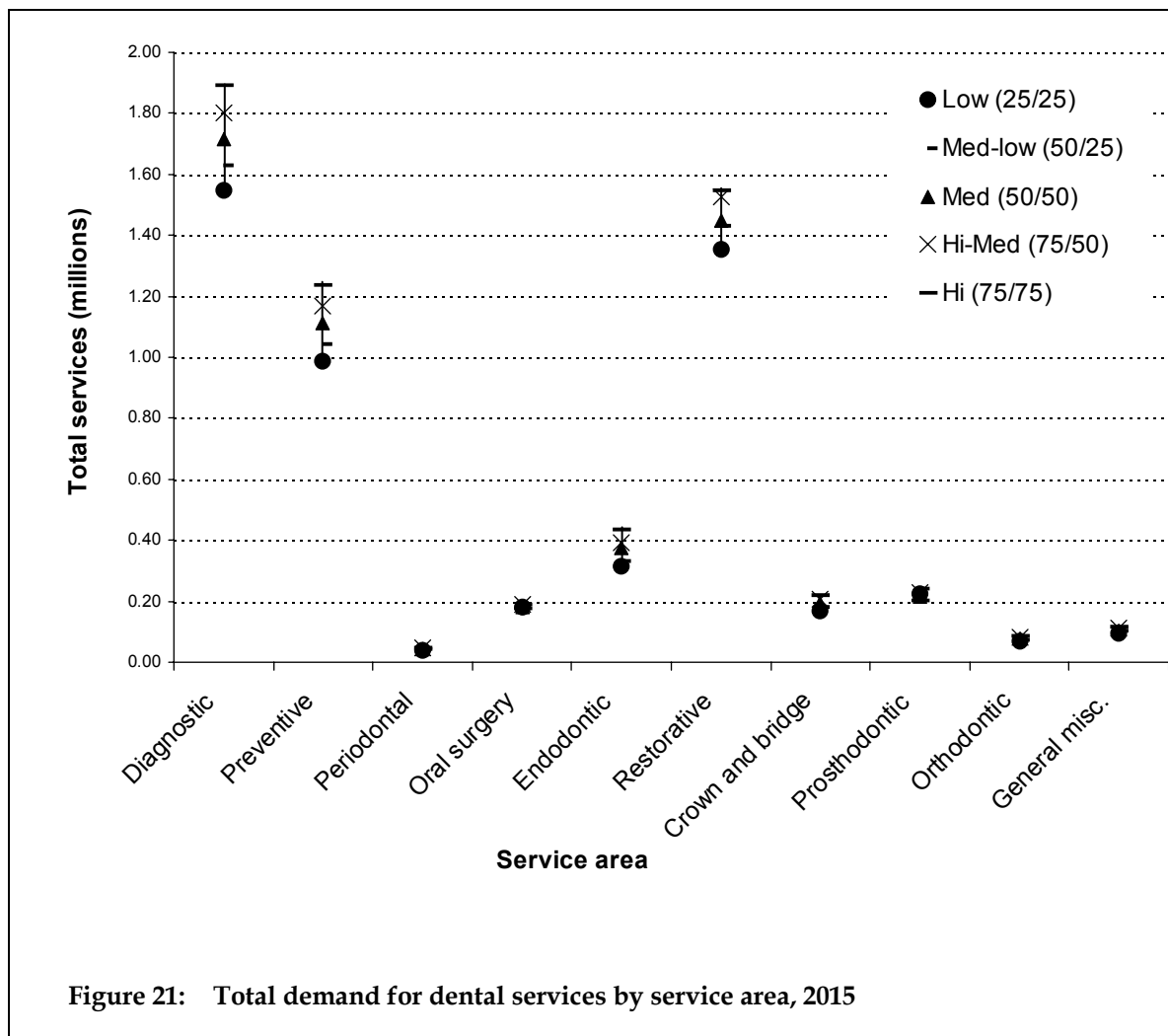
Table 41: Demand for dental services, 2002 and 2015^(a)

Age	Service areas							
	Diagnostic		Preventive		Periodontic		Oral surgery	
	2002	2015	2002	2015	2002	2015	2002	2015
0–4	16,856	15,371	4,719	4,576	0	0	0	0
5–11	230,207	239,833	155,686	160,664	333	301	17,666	5,060
12–17	199,615	215,311	204,880	247,687	45	0	25,465	24,691
18–24	150,065	179,183	74,724	87,097	3,664	4,492	24,467	28,246
25–34	171,764	185,182	89,670	95,477	3,463	3,563	27,916	30,707
35–44	218,953	248,197	118,004	132,771	9,560	8,739	24,055	24,864
45–54	209,509	292,120	114,318	161,166	9,208	11,929	16,677	13,479
55–64	125,475	234,371	79,269	145,107	4,665	7,662	21,301	33,554
65–74	74,595	151,065	53,553	117,782	2,880	6,217	8,086	10,572
75+	59,548	102,347	34,214	61,243	2,287	4,619	9,091	8,930
Total	1,456,586	1,862,980	929,037	1,213,569	36,105	47,522	174,724	180,104
Age	Endodontic		Restorative		Crown and bridge		Prosthodontic	
	2002	2015	2002	2015	2002	2015	2002	2015
	2002	2015	2002	2015	2002	2015	2002	2015
0–4	310	242	3,105	2,261	0	0	0	0
5–11	7,780	7,947	63,183	50,259	0	0	748	910
12–17	15,786	20,034	79,371	55,262	806	509	1,816	2,113
18–24	25,927	32,749	113,602	114,232	2,149	1,197	0	0
25–34	42,429	50,135	156,360	149,815	13,890	15,008	426	0
35–44	75,674	99,956	261,891	266,285	32,073	35,263	9,455	1,597
45–54	67,820	106,865	257,975	343,260	36,970	51,556	31,899	25,449
55–64	31,693	66,213	145,960	247,960	32,070	65,268	32,487	26,770
65–74	11,803	25,279	98,220	207,790	16,434	38,094	56,465	107,751
75+	7,054	14,473	67,420	134,538	8,988	20,118	52,850	70,761
Total	286,277	423,892	1,247,088	1,571,661	143,381	227,013	186,146	235,261
Age	Orthodontic		General miscellaneous		All			
	2002	2015	2002	2015	2002	2015		
	2002	2015	2002	2015	2002	2015		
0–4	0	0	436	256	25,427	22,705		
5–11	11,907	9,726	4,781	3,266	492,291	477,966		
12–17	50,695	61,083	2,136	0	580,614	626,691		
18–24	4,133	5,631	7,689	6,592	406,420	459,417		
25–34	2,018	2,334	9,943	9,156	517,881	541,377		
35–44	569	703	20,421	22,755	770,655	841,130		
45–54	563	1,006	19,384	29,284	764,324	1,036,113		
55–64	212	152	14,090	26,684	487,223	853,740		
65–74	0	0	4,333	9,258	326,369	673,809		
75+	0	0	4,230	8,171	245,682	425,109		
Total	70,098	80,634	87,445	115,422	4,616,886	5,958,058		

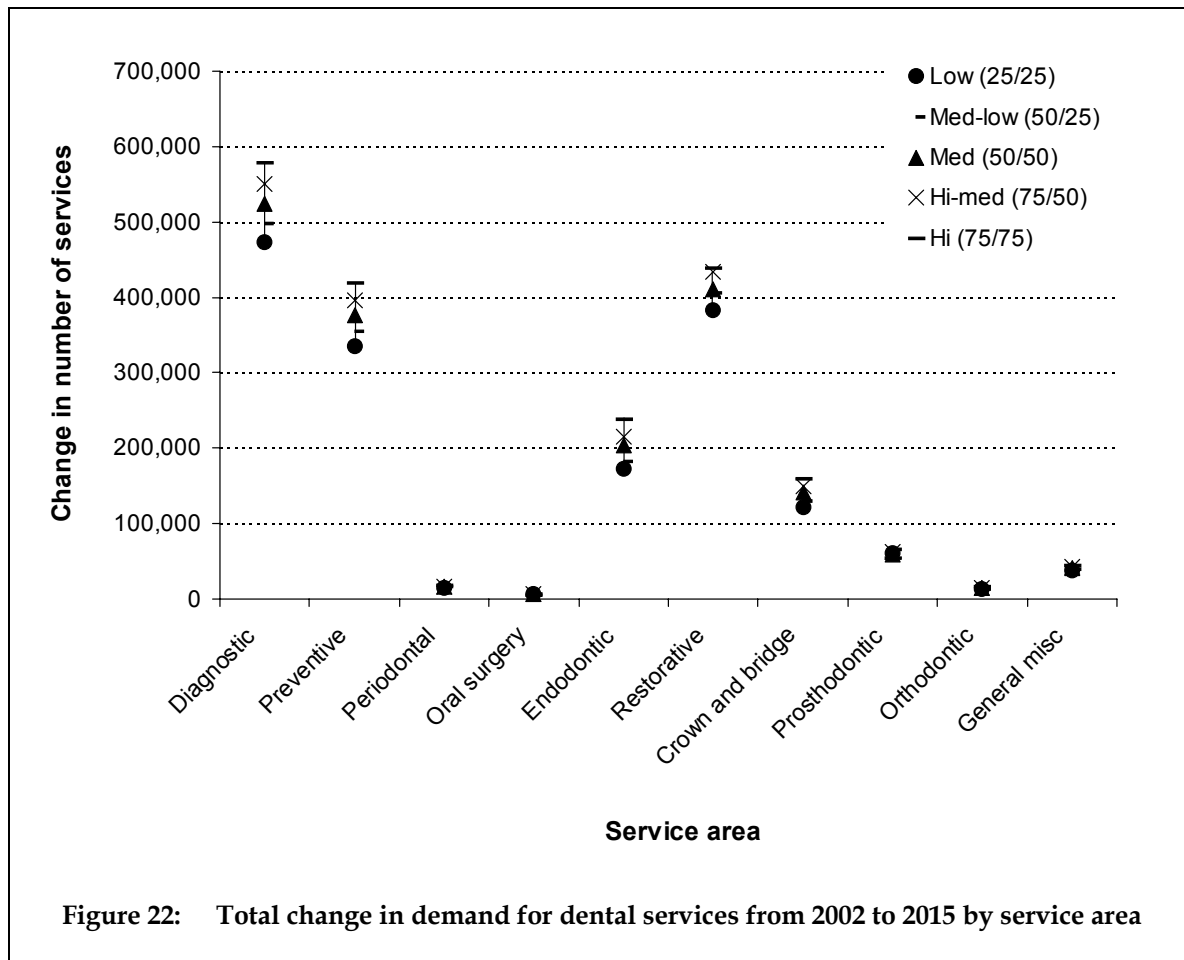
(a) Under the assumption of 50% of the previous time trend in per capita demand 1979 to 1995 and 50% of the previous time trend in rate of provision of services per visit 1983 to 1998 continuing through to 2015.

The trends in demand for total services and for dental services by service type are regarded as illustrative. The projections have been based on the age-specific trends in rates of dental services across the period 1983 to 1998. Similar to per capita demand among dentate and edentulous persons, a key issue was the extent to which trends in the recent past would continue through to 2015. A number of scenarios were examined, ranging from an abrupt halt in any change (zero growth) to a continuation of the linear trend in the rates of provision of dental services in the period 1983 to 1998 (100% increase of the previous linear trend projected through to 2015).

The sensitivity of the projections of demand for services in 2015 is shown in Figure 21, which contains projections under five different sets of growth rate assumptions. The lowest estimate assumes a 25% increase in the previous time trend in per capita demand from 1979 to 1995, and a 25% increase in the previous time trend for rate of provision of services per visit from 1983 to 1998, continuing to 2015. The highest estimate assumes a 75% growth rate for both per capita demand and rate of provision of services per visit, through to 2015. Although Table 41 indicated that the largest proportional growth in demand will occur for endodontic and crown and bridge services, current demand is by far highest for diagnostic, preventive and restorative services. It follows that future demand for these services, in terms of the total number of services provided in each area, is highest for these three areas, and so projections for these service areas vary the most.



Total change in demand for different service areas from 2002 to 2015 is given in Figure 22. Again, scenarios based on five different sets of assumptions are presented. The greatest changes in demand in terms of total numbers of services are projected to be in the largest service areas of diagnostic, preventive and restorative services. These are followed by endodontic and crown and bridge services, where current demand is substantially smaller but is expected to grow far more rapidly in the future.



These projections reveal a level of detail on the type of dental services demanded. However, they need to be approached with some caution as they actually mix population data on dental visits with data from a majority segment of providers on rates of provision of dental services. They have been included to illustrate service areas where demand is likely to grow so as to stimulate discussion about appropriate occupational distribution among providers.

7 Overview

7.1 Supply

Projections of the dentist and allied dental practitioner labour forces are summarised in Table 42. Calculated using a total annual recruitment of 60 dentists per year and the medium age- and sex-specific wastage rates, the dentist labour force was projected to increase by 10.9% from 2002 to 2015. Projections of the therapist, hygienist and prosthetist labour force resulted in decreases in the number of practitioners (26.8%, 3.5% and 7.7% respectively).

Growth in the dentist labour force up to the year 2010 is projected to slightly outpace population growth; however, by 2013 the practising rate per 100,000 population starts to decline, indicating that projected growth in the labour force will not keep pace with population growth in the longer term.

Table 42: Projections of the dental labour force, 2002, 2005, 2010 and 2015

Year	Professional group			
	Dentists	Therapists	Hygienists	Prosthetists
	Number of practitioners			
Baseline - 2002	835	123	115	26
2005	866	119	119	24
2010	902	108	117	23
2015	927	90	111	24
Per cent change, 2002 to 2015	10.9%	-26.8%	-3.5%	-7.7%
	Practising rate per 100,000 population			
Baseline – 2002	55.1	8.1	7.6	1.7
2005	56.7	7.8	7.8	1.6
2010	58.4	7.0	7.6	1.5
2015	59.6	5.8	7.1	1.5
Per cent change, 2002 to 2015	8.2%	-28.4%	-6.6%	-11.8%

Note: Projected number of practitioners calculated by applying constant recruitment vectors totalling 60 dentists, 6 therapists, 15 hygienists and 4 prosthetists per year.

Dentist projections calculated using a range of recruitment scenarios illustrated that projected practising rates were not particularly sensitive to alterations in the total average annual recruitment. An increase in annual average recruitment from 60 to 68 dentists per year (a 13.3% increase) only resulted in a small increase in the projected practising rate in 2015. An average recruitment level of 60 resulted in 59.6 dentists per 100,000 population, compared to 63.7 if recruitment totalled 68 (an increase of 6.9%).

In calculating the projections of dentists' capacity to supply visits, the long-term trend of declining dentist productivity (visits supplied per annum) was taken into consideration. Although historically some of the decrease was a result of reduced hours worked per year, most was due to an increase in the length of time per visit. One possible reason for the increased length of time per visit is the impact of science and technology on dental practice. In more recent times, factors such as infection control may have contributed to the lengthening of visits and the consequent reduction in visits supplied per annum.

Capacity to supply was calculated using a declining matrix of age- and sex-specific productivity rates. The results highlighted the significant impact on capacity to supply if historical trends were to continue in the future. If productivity remained static, capacity to supply in 2015 was projected to be 1.95 million visits, whereas under the assumption of declining productivity, supply in 2015 was projected to be 1.75 million visits.

The projected capacity of dentists (under the assumption of declining productivity and under low, medium and high recruitment scenarios) and allied dental practitioners to supply dental visits to the year 2015 is summarised in Table 43.

In 2002 it was estimated that the combined capacity of the allied dental practitioner labour force to supply dental visits was 19.4% of all visits supplied (0.44 million allied visits). By 2015 this percentage is projected to decline slightly, with the allied dental practitioner labour force providing 16.9% of all dental visits (0.36 million allied visits).

The low projection of dental supply based on low recruitment of dentists results in a decrease of 12.3% in visits supplied between 2002 and 2015, and a decline in visits per capita by 14.8%. The medium dental supply, based on medium recruitment of dentists indicates a decrease in capacity to supply visits of 7.4%, and a decline in visits per capita by 10.0%. The high dental supply, based on high recruitment of dentists also results in a decrease in capacity to supply visits (2.4%), and a decline in visits per capita by 5.2% (Table 43).

Table 43: Capacity of the total dental labour force to supply dental visits, high, medium and low dentist recruitment scenarios, 2002, 2005, 2010 and 2015

Year	Capacity to supply dental visits by total dental labour force					
	Supply projection (Low dentist recruitment)		Supply projection (Medium dentist recruitment)		Supply projection (High dentist recruitment)	
	Visits ('000)	Visits per capita	Visits ('000)	Visits per capita	Visits ('000)	Visits per capita
Baseline 2002	2.276	1.51	2.276	1.51	2.276	1.51
2005	2.222	1.46	2.259	1.48	2.296	1.50
2010	2.115	1.37	2.196	1.42	2.277	1.47
2015	1.996	1.28	2.109	1.36	2.221	1.43
Per cent change, 2002 to 2015	-12.3%	-14.8%	-7.4%	-10.0%	-2.4%	-5.2%

Note: Dentist supply projections based on the assumption that dentist productivity rates (visits supplied per annum) will continue to decline at 50% the rate that was observed in Australian dentist data 1983–1998.

Population growth is a major driver of the burden of disease, and the demand for and use of dental services. Hence, it appears that projections of the dental labour force and capacity to supply visits may potentially be at odds with trends in demand for dental services.

7.2 Demand

Demand for dental visits from both the dentate and edentulous have increased over the period 1979 to 1995. During the same period there has been a dramatic decline in edentulism. Projections of demand for dental visits were determined by considering these trends and the projected increase in the South Australian population.

Given the increase in per capita demand, the projections explored the outcomes if this trend continued into the future. A number of scenarios were examined, ranging from 0% of the previous trend projected through to 2015, to a full continuation of growth at the same rate as that observed between 1988 and 1995.

The demand for dental visits in South Australia in 2002 and 2015 is presented in Table 44. The zero growth rate option from the linear trend in demand for dental visits from 2002 to 2015 leads to a 5.4% increase in demand for dental visits. The 50% growth option leads to a 19.4% increase, and the 100% growth option leads to a 31.7%.

Table 44: Demand for dental visits ('000s), 2002 and 2015

Age group (years)	Growth rate 1995+		
	0%	50%	100%
2002	2,034.3	2,181.1	2,328.0
2015	2,143.5	2,605.2	3,066.9
Per cent change, 2002 to 2015	5.4%	19.4%	31.7%

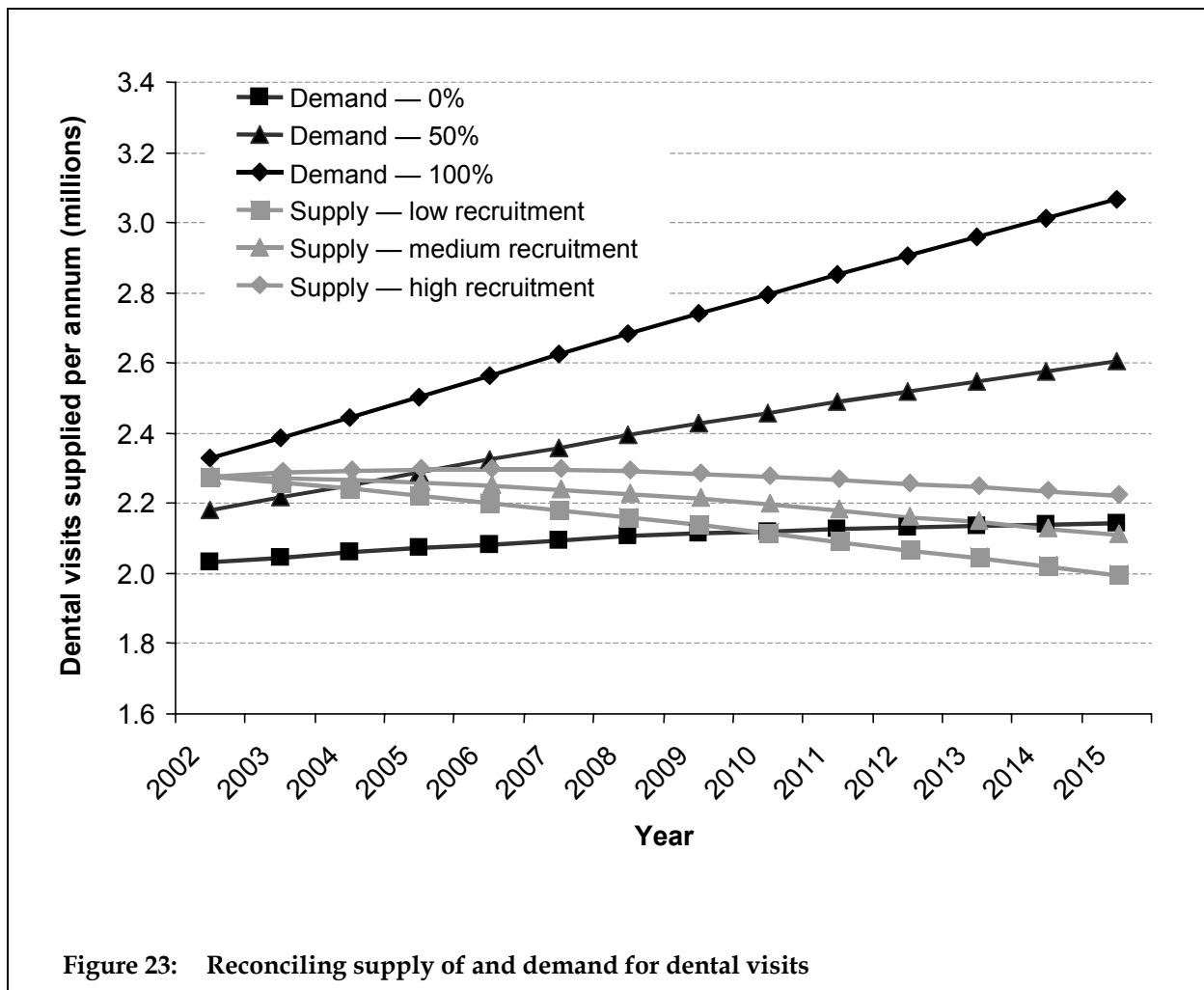
7.3 Reconciling supply of and demand for dental visits

One interpretation of the demand and supply estimates and projections presented is that, despite their different origins, these projections are in reasonable agreement. In 2002 the supply estimate of the total number of dental visits was approximately 2.3 million (Table 43). This sits very comfortably with the range of demand projections, being similar to the year 2002 demand projections under the assumption of continued full growth (Table 35). This provides some support for the full growth in demand assumption, i.e. the continuation of past trends in per capita demand. However, there are a number of issues that indicate a need for caution in that interpretation.

Firstly, more recent data on demand from the same time series from which the projections were made were not available. Such data was collected from the 2002 National Dental Telephone Interview Survey but was not available to incorporate into the underlying demand models. Secondly, there are variations in demand estimates derived from different sources and with different reference periods for reported use of dental services. This variation needs further investigation. Thirdly, there was limited allied labour force data available against which to assess the baseline estimates and assumptions used in the supply projections.

As well as the data limitations that urge caution in a literal interpretation, there are other reasons to expect disagreement between the supply and demand estimates and projections. For example, historically, demand estimates tend to be less than supply estimates. This may be due to double counting of visits from teams of dentist and hygienist, or dentist and therapist, but the reporting of only a single dental visit by service users. It should be noted that this study has attempted to adjust for the issue of double counting. However, for these reasons a good deal of emphasis is more appropriately placed on trends.

It is clear from Figure 23 (and data already presented) that the demand for dental visits is expected to increase under all three projections (0%, 50%, 100%), based on past trends in per capita demand. In contrast, the supply of dental visits is projected to decrease under all three projections (low, medium and high recruitment).



As an indication of the gap that could exist between demand and supply, it is useful to compare the half-growth (50%) model in per capita demand and the medium scenario in supply. This reconciliation is put forward as a cautious, maybe conservative, interpretation.

In 2015 the gap between the half-growth demand estimate of 2.61 million visits and the medium supply estimate of 2.11 million visits is 0.5 million visits. Under the current distribution of the dental labour force and its respective productivity rates, approximately 190 to 200 additional dental providers could supply a shortfall of 0.5 million dental visits.

Any program that improves access to dental care among disadvantaged groups is likely to stimulate demand from those eligible for such programs, widening the gap between potential demand and supply. Because supply will create a ceiling for visits supplied, estimates of demand derived from surveys such as the National Dental Telephone Interview Survey 2004-05 are likely to be similar to the supply projections, but below potential demand.

8 References

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Appendix A: Estimated resident population, South Australia

Year	SA estimated resident population	Capital city	Rest of state
1990	1,432,056		
1991	1,446,299		
1992	1,456,512		
1993	1,460,674		
1994	1,466,138		
1995	1,469,429		
1996	1,474,253		
1997	1,481,357		
1998	1,489,552		
1999	1,497,819		
2000	1,505,038	1,102,445	402,593
2001	1,511,728		
2002	1,520,242		

Source: Australian Bureau of Statistics 2000a.

Appendix B: Projected number of practising dentists, low and high recruitment vectors by age group and sex, 2002 to 2015

Projected number of practising male dentists under low recruitment by age group, 2002 to 2015

Age group (years)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	11	9	9	8	8	8	8	8	8	8	8	8	8	8
25–29	51	49	46	44	43	41	41	40	40	39	39	39	39	39
30–34	70	69	67	65	64	62	61	59	58	57	56	55	55	54
35–39	39	41	42	43	43	43	43	42	41	41	40	40	39	39
40–44	67	61	57	55	53	52	51	50	50	49	48	48	47	47
45–49	115	108	101	95	90	85	81	77	75	72	70	68	67	65
50–54	112	109	105	101	97	92	88	83	79	76	73	70	67	65
55–59	93	99	103	107	109	110	110	109	108	106	103	101	98	96
60–64	27	30	32	35	37	39	40	41	42	42	42	42	42	41
65+	34	34	34	35	36	38	40	41	43	44	46	47	48	48
Total	618	608	599	589	580	570	561	552	543	535	526	518	509	502

Projected number of practising female dentists under low recruitment by age group, 2002 to 2015

Age group (years)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	9	9	9	9	9	9	9	9	9	9	9	9	9	9
25–29	46	49	50	51	52	53	53	54	54	54	54	54	54	54
30–34	33	32	31	31	30	30	31	31	31	31	31	31	31	31
35–39	36	39	41	42	43	44	45	46	46	47	47	47	48	48
40–44	29	30	31	32	34	35	36	37	38	38	39	40	40	40
45–49	35	39	42	46	49	52	54	57	60	62	64	66	68	70
50–54	20	24	28	32	36	41	45	49	53	57	61	65	69	72
55–59	6	8	9	11	12	14	15	17	19	21	22	24	26	28
60–64	2	2	2	2	3	3	3	4	4	5	5	6	6	7
65+	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Total	217	231	244	256	269	281	292	303	314	324	334	343	352	361

(continued)

Appendix B (cont.): Projected number of practising dentists, low and high recruitment, by age group and sex, 2002 to 2015

Projected number of practising male dentists under high recruitment by age group, 2002 to 2015

Age group (years)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	11	11	11	11	11	11	11	11	11	11	11	11	11	11
25–29	51	51	51	51	51	51	51	51	51	51	51	51	51	51
30–34	70	71	71	71	71	72	72	72	72	72	72	72	72	72
35–39	39	41	43	44	45	45	46	46	46	47	47	47	47	47
40–44	67	61	57	55	54	53	52	52	52	52	52	52	52	52
45–49	115	108	101	95	90	85	81	78	75	73	72	70	70	69
50–54	112	109	105	101	97	92	88	83	80	76	73	70	68	66
55–59	92	99	103	107	109	110	110	109	108	106	104	101	99	96
60–64	27	30	32	35	37	39	40	41	42	42	42	42	42	41
65+	34	34	34	35	36	38	40	41	43	44	46	47	48	48
Total	618	614	610	605	600	595	590	585	580	575	570	564	559	554

Projected number of practising female dentists under high recruitment by age group, 2002 to 2015

Age group (years)	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
20–24	9	10	11	11	11	11	11	11	11	11	11	11	11	11
25–29	46	52	58	63	66	68	70	71	72	72	73	73	73	74
30–34	33	33	34	36	37	39	40	41	42	43	43	44	44	44
35–39	36	40	44	48	50	53	56	58	60	62	64	65	66	68
40–44	29	30	31	33	35	37	39	41	43	45	46	48	49	51
45–49	35	39	42	46	49	52	55	59	62	65	68	72	75	78
50–54	20	24	28	32	36	41	45	49	53	58	62	66	70	75
55–59	6	8	9	11	12	14	15	17	19	21	23	24	26	28
60–64	2	2	2	2	3	3	3	4	4	5	5	6	6	7
65+	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Total	217	240	261	281	300	318	335	351	367	382	396	410	424	436

Appendix C: Australian Bureau of Statistics projected estimated resident population, series 'q', 2002 to 2015, South Australia

Year	Estimated resident population
2002	1,511,562
2003	1,516,777
2004	1,521,916
2005	1,526,589
2006	1,530,804
2007	1,534,564
2008	1,537,928
2009	1,540,981
2010	1,543,811
2011	1,546,438
2012	1,548,879
2013	1,551,141
2014	1,553,233
2015	1,555,162

Source: Australian Bureau of Statistics 2000b.

Appendix D: Recruitment vectors for sensitivity analysis of dentist labour force projections (see Figure 10)

Age group (years)	Average number of recruits per year															
	40		45		50		55		60		65		70		75	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
20–24	5	4	6	4	6	5	7	5	7	6	8	6	9	7	9	7
25–29	8	6	9	7	10	7	11	8	12	9	14	10	15	10	15	11
30–34	3	3	3	3	4	4	4	4	4	5	5	5	5	5	5	6
35–39	3	2	3	2	3	2	4	3	4	3	4	3	5	3	5	3
40–44	1	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3
45–49	1	—	1	—	1	1	1	1	2	1	2	1	2	1	2	1
50–54	1	—	2	—	2	—	2	—	2	—	2	—	2	—	3	—
55–59	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1	1
Total	23	17	27	18	29	21	32	23	34	26	38	27	41	29	43	32

Note: Age and sex distribution of the recruitment total was determined by maintaining the average distribution of new recruits observed for the years 1998 to 2002. Integers were rounded to whole numbers prior to input in the projection model.

Appendix E: Projected number of dentist visits supplied per annum, low and high recruitment vectors, by age group and sex

Age group (years)	Projected number of dental visits supplied (millions), low recruitment													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.112	0.105	0.099	0.095	0.092	0.090	0.088	0.087	0.086	0.085	0.085	0.085	0.084	0.084
30–39	0.253	0.254	0.254	0.251	0.248	0.243	0.239	0.235	0.230	0.227	0.223	0.220	0.218	0.216
40–49	0.497	0.463	0.434	0.410	0.390	0.374	0.360	0.349	0.339	0.331	0.323	0.317	0.311	0.305
50–59	0.508	0.515	0.517	0.514	0.508	0.499	0.488	0.476	0.463	0.450	0.436	0.423	0.410	0.398
60+	0.113	0.119	0.125	0.132	0.138	0.145	0.150	0.155	0.160	0.163	0.165	0.167	0.168	0.168
Total	1.483	1.455	1.428	1.402	1.376	1.351	1.326	1.302	1.278	1.255	1.233	1.212	1.191	1.171
Female dentists														
20–29	0.105	0.110	0.113	0.116	0.117	0.118	0.119	0.120	0.120	0.121	0.121	0.121	0.121	0.121
30–39	0.120	0.122	0.124	0.126	0.128	0.130	0.131	0.132	0.134	0.135	0.135	0.136	0.137	0.137
40–49	0.107	0.115	0.123	0.131	0.138	0.145	0.151	0.157	0.163	0.168	0.173	0.177	0.181	0.185
50–59	0.049	0.060	0.070	0.081	0.092	0.103	0.114	0.125	0.137	0.148	0.158	0.169	0.180	0.190
60+	0.006	0.005	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.011	0.012	0.013	0.015
Total	0.388	0.412	0.436	0.459	0.481	0.503	0.523	0.543	0.562	0.581	0.599	0.616	0.632	0.648
All dentists														
20–29	0.217	0.215	0.212	0.210	0.209	0.208	0.207	0.207	0.206	0.206	0.206	0.206	0.206	0.206
30–39	0.373	0.377	0.378	0.378	0.376	0.373	0.370	0.367	0.364	0.361	0.359	0.356	0.355	0.353
40–49	0.605	0.578	0.557	0.540	0.528	0.519	0.512	0.506	0.502	0.499	0.496	0.494	0.492	0.490
50–59	0.558	0.575	0.587	0.595	0.600	0.603	0.603	0.602	0.600	0.597	0.595	0.592	0.590	0.588
60+	0.119	0.124	0.130	0.137	0.144	0.151	0.158	0.163	0.169	0.173	0.177	0.179	0.181	0.183
Total	1.871	1.868	1.865	1.861	1.858	1.854	1.850	1.845	1.841	1.836	1.832	1.827	1.823	1.819

Age group (years)	Projected number of dental visits supplied (millions), high recruitment													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.113	0.113	0.113	0.113	0.113	0.113	0.113
30–39	0.253	0.259	0.263	0.266	0.269	0.271	0.272	0.273	0.274	0.275	0.275	0.276	0.276	0.276
40–49	0.497	0.463	0.434	0.410	0.391	0.376	0.364	0.355	0.348	0.342	0.338	0.335	0.333	0.331
50–59	0.508	0.515	0.517	0.514	0.508	0.499	0.489	0.476	0.464	0.450	0.437	0.425	0.413	0.402
60+	0.113	0.119	0.125	0.132	0.138	0.145	0.150	0.155	0.160	0.163	0.165	0.167	0.168	0.168
Total	1.483	1.467	1.451	1.435	1.419	1.403	1.388	1.372	1.357	1.343	1.329	1.315	1.302	1.289
Female dentists														
20–29	0.105	0.121	0.133	0.141	0.148	0.152	0.155	0.158	0.159	0.161	0.161	0.162	0.162	0.163
30–39	0.120	0.128	0.136	0.144	0.152	0.159	0.166	0.172	0.177	0.182	0.186	0.189	0.192	0.195
40–49	0.107	0.115	0.123	0.132	0.141	0.150	0.159	0.167	0.176	0.184	0.193	0.200	0.208	0.215
50–59	0.049	0.060	0.070	0.081	0.092	0.103	0.114	0.126	0.137	0.149	0.160	0.172	0.184	0.195
60+	0.006	0.005	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.011	0.012	0.014	0.015
Total	0.388	0.429	0.468	0.504	0.539	0.571	0.601	0.631	0.659	0.685	0.711	0.736	0.760	0.783
All dentists														
20–29	0.217	0.233	0.245	0.254	0.260	0.265	0.268	0.270	0.272	0.273	0.274	0.275	0.275	0.275
30–39	0.373	0.387	0.400	0.411	0.421	0.430	0.438	0.445	0.451	0.457	0.461	0.465	0.468	0.471
40–49	0.605	0.578	0.557	0.542	0.532	0.526	0.522	0.522	0.523	0.526	0.530	0.535	0.541	0.546
50–59	0.558	0.575	0.587	0.595	0.600	0.603	0.603	0.602	0.601	0.599	0.598	0.597	0.597	0.597
60+	0.119	0.124	0.130	0.137	0.144	0.151	0.158	0.163	0.169	0.173	0.177	0.179	0.181	0.183
Total	1.871	1.896	1.919	1.939	1.957	1.974	1.989	2.003	2.016	2.028	2.040	2.051	2.062	2.072

Note: Projections of visits supplied calculated under the assumption of no decline in productivity, projected numbers of practising dentists multiplied by a constant age and sex matrix of South Australian dental visits supplied.

Appendix F: Projected number of dentist visits supplied per annum, low and high recruitment vectors, by age group and sex, under the assumption of declining productivity (50% continuation of historical trend)

Age group (years)	Projected number of dental visits supplied (millions), low recruitment													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.108	0.100	0.094	0.089	0.085	0.082	0.079	0.077	0.076	0.074	0.073	0.072	0.071	0.070
30–39	0.245	0.244	0.241	0.236	0.230	0.224	0.217	0.211	0.205	0.200	0.195	0.190	0.186	0.182
40–49	0.491	0.454	0.424	0.399	0.378	0.360	0.346	0.333	0.323	0.313	0.305	0.297	0.290	0.284
50–59	0.500	0.504	0.503	0.498	0.490	0.479	0.466	0.452	0.437	0.422	0.407	0.393	0.379	0.365
60+	0.110	0.115	0.120	0.125	0.131	0.135	0.140	0.143	0.146	0.147	0.148	0.149	0.148	0.147
Total	1.454	1.417	1.381	1.347	1.313	1.280	1.248	1.216	1.186	1.157	1.128	1.100	1.074	1.048
Female dentists														
20–29	0.105	0.109	0.112	0.114	0.115	0.116	0.116	0.116	0.117	0.117	0.116	0.116	0.116	0.116
30–39	0.118	0.120	0.121	0.123	0.124	0.124	0.125	0.126	0.126	0.126	0.127	0.127	0.127	0.126
40–49	0.104	0.110	0.117	0.122	0.128	0.133	0.137	0.141	0.145	0.148	0.150	0.153	0.154	0.156
50–59	0.049	0.059	0.069	0.079	0.089	0.100	0.110	0.120	0.130	0.140	0.150	0.159	0.168	0.177
60+	0.006	0.005	0.005	0.005	0.006	0.007	0.007	0.008	0.010	0.011	0.012	0.013	0.014	0.016
Total	0.381	0.403	0.423	0.443	0.462	0.479	0.496	0.512	0.527	0.541	0.555	0.568	0.579	0.591
All dentists														
20–29	0.212	0.209	0.205	0.202	0.199	0.197	0.195	0.194	0.192	0.191	0.189	0.188	0.187	0.186
30–39	0.363	0.364	0.362	0.358	0.354	0.348	0.342	0.337	0.331	0.326	0.321	0.317	0.312	0.308
40–49	0.594	0.565	0.541	0.521	0.506	0.493	0.483	0.475	0.467	0.461	0.455	0.450	0.444	0.439
50–59	0.549	0.563	0.572	0.577	0.579	0.578	0.576	0.572	0.567	0.562	0.557	0.552	0.547	0.543
60+	0.116	0.120	0.125	0.131	0.137	0.142	0.147	0.151	0.155	0.158	0.160	0.162	0.163	0.163
Total	1.835	1.820	1.805	1.790	1.775	1.759	1.744	1.729	1.713	1.698	1.683	1.668	1.653	1.639

Age group (years)	Projected number of dental visits supplied (millions), high recruitment													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.108	0.107	0.106	0.105	0.104	0.102	0.101	0.100	0.099	0.098	0.097	0.096	0.095	0.094
30–39	0.245	0.248	0.250	0.250	0.250	0.249	0.248	0.246	0.244	0.242	0.240	0.238	0.236	0.233
40–49	0.491	0.454	0.424	0.399	0.379	0.362	0.349	0.339	0.330	0.324	0.318	0.314	0.310	0.307
50–59	0.500	0.504	0.503	0.498	0.490	0.479	0.466	0.452	0.437	0.423	0.408	0.395	0.381	0.369
60+	0.110	0.115	0.120	0.125	0.131	0.135	0.140	0.143	0.146	0.147	0.149	0.149	0.148	0.147
Total	1.454	1.428	1.402	1.377	1.352	1.328	1.303	1.280	1.257	1.234	1.212	1.191	1.170	1.151
Female dentists														
20–29	0.105	0.120	0.131	0.139	0.145	0.149	0.151	0.153	0.154	0.155	0.155	0.156	0.156	0.155
30–39	0.118	0.126	0.133	0.140	0.147	0.153	0.158	0.163	0.167	0.171	0.174	0.176	0.178	0.179
40–49	0.104	0.110	0.117	0.124	0.131	0.137	0.144	0.150	0.156	0.162	0.168	0.173	0.177	0.182
50–59	0.049	0.059	0.069	0.079	0.089	0.100	0.110	0.120	0.131	0.141	0.151	0.162	0.172	0.182
60+	0.006	0.005	0.005	0.005	0.006	0.007	0.007	0.008	0.010	0.011	0.012	0.013	0.014	0.016
Total	0.381	0.420	0.455	0.487	0.517	0.545	0.571	0.595	0.618	0.640	0.660	0.679	0.697	0.714
All dentists														
20–29	0.212	0.226	0.237	0.244	0.248	0.251	0.253	0.253	0.253	0.253	0.252	0.251	0.250	0.249
30–39	0.363	0.374	0.383	0.390	0.396	0.402	0.406	0.409	0.411	0.413	0.414	0.414	0.413	0.412
40–49	0.594	0.565	0.541	0.523	0.509	0.500	0.493	0.489	0.487	0.486	0.486	0.487	0.488	0.489
50–59	0.549	0.563	0.572	0.577	0.579	0.578	0.576	0.572	0.568	0.564	0.560	0.556	0.553	0.551
60+	0.116	0.120	0.125	0.131	0.137	0.142	0.147	0.151	0.155	0.158	0.160	0.162	0.163	0.163
Total	1.835	1.847	1.857	1.865	1.870	1.873	1.875	1.875	1.875	1.874	1.872	1.870	1.867	1.864

Appendix G: Projected number of dentist visits supplied per annum, low, medium and high recruitment vectors, by age group and sex, under the assumption of declining productivity (100% continuation of historical trend)

Age group (years)	Projected number of dental visits supplied (millions), low recruitment													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.104	0.095	0.088	0.082	0.078	0.074	0.071	0.069	0.066	0.064	0.063	0.061	0.059	0.058
30–39	0.237	0.234	0.228	0.221	0.213	0.205	0.197	0.190	0.182	0.176	0.169	0.164	0.158	0.153
40–49	0.484	0.446	0.414	0.388	0.366	0.347	0.332	0.318	0.307	0.296	0.287	0.279	0.271	0.264
50–59	0.492	0.494	0.490	0.483	0.472	0.459	0.444	0.428	0.412	0.396	0.380	0.365	0.350	0.336
60+	0.107	0.111	0.115	0.119	0.123	0.127	0.129	0.132	0.133	0.133	0.133	0.132	0.131	0.129
Total	1.425	1.380	1.336	1.293	1.252	1.213	1.174	1.137	1.101	1.066	1.032	1.000	0.969	0.939
Female dentists														
20–29	0.104	0.107	0.110	0.112	0.113	0.113	0.113	0.113	0.113	0.113	0.112	0.112	0.111	0.110
30–39	0.116	0.117	0.118	0.119	0.119	0.119	0.119	0.119	0.119	0.119	0.118	0.118	0.117	0.116
40–49	0.100	0.106	0.110	0.115	0.119	0.122	0.125	0.127	0.129	0.130	0.131	0.131	0.131	0.131
50–59	0.048	0.058	0.067	0.077	0.087	0.096	0.106	0.115	0.124	0.133	0.141	0.149	0.157	0.165
60+	0.006	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.011	0.013	0.014	0.015	0.017
Total	0.375	0.393	0.411	0.428	0.443	0.457	0.471	0.483	0.494	0.505	0.515	0.524	0.532	0.540
All dentists														
20–29	0.208	0.203	0.198	0.194	0.190	0.187	0.184	0.182	0.179	0.177	0.175	0.173	0.170	0.168
30–39	0.353	0.351	0.346	0.340	0.333	0.325	0.317	0.309	0.302	0.294	0.288	0.281	0.275	0.270
40–49	0.584	0.552	0.525	0.503	0.485	0.469	0.457	0.445	0.435	0.426	0.418	0.410	0.402	0.395
50–59	0.541	0.551	0.557	0.560	0.558	0.555	0.550	0.543	0.536	0.529	0.521	0.514	0.507	0.501
60+	0.113	0.116	0.120	0.125	0.129	0.133	0.137	0.140	0.143	0.145	0.146	0.146	0.146	0.145
Total	1.799	1.773	1.747	1.721	1.695	1.670	1.645	1.620	1.595	1.571	1.547	1.524	1.501	1.479

Age group (years)	Projected number of dental visits supplied (millions), medium recruitment													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.104	0.099	0.094	0.090	0.087	0.084	0.081	0.079	0.077	0.075	0.073	0.071	0.069	0.068
30–39	0.237	0.236	0.232	0.228	0.223	0.217	0.211	0.205	0.200	0.194	0.189	0.184	0.180	0.175
40–49	0.484	0.446	0.414	0.388	0.366	0.348	0.333	0.321	0.310	0.301	0.293	0.286	0.280	0.275
50–59	0.492	0.494	0.490	0.483	0.472	0.459	0.444	0.428	0.412	0.396	0.381	0.365	0.351	0.337
60+	0.107	0.111	0.115	0.119	0.123	0.127	0.129	0.132	0.133	0.133	0.133	0.132	0.131	0.129
Total	1.425	1.385	1.346	1.308	1.271	1.234	1.199	1.165	1.132	1.100	1.069	1.040	1.011	0.984
Female dentists														
20–29	0.104	0.113	0.119	0.124	0.127	0.129	0.130	0.131	0.131	0.131	0.131	0.130	0.130	0.129
30–39	0.116	0.120	0.124	0.127	0.130	0.133	0.135	0.137	0.138	0.140	0.140	0.141	0.141	0.140
40–49	0.100	0.106	0.111	0.115	0.120	0.124	0.128	0.131	0.134	0.136	0.138	0.140	0.141	0.142
50–59	0.048	0.058	0.067	0.077	0.087	0.096	0.106	0.115	0.124	0.133	0.142	0.151	0.159	0.167
60+	0.006	0.006	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.011	0.013	0.014	0.016	0.017
Total	0.375	0.402	0.427	0.449	0.470	0.489	0.507	0.523	0.538	0.551	0.564	0.576	0.586	0.596
All dentists														
20–29	0.208	0.211	0.213	0.214	0.214	0.213	0.212	0.210	0.208	0.206	0.204	0.202	0.199	0.197
30–39	0.353	0.356	0.356	0.355	0.353	0.350	0.346	0.342	0.338	0.334	0.329	0.325	0.320	0.316
40–49	0.584	0.552	0.525	0.503	0.486	0.472	0.461	0.452	0.444	0.438	0.432	0.426	0.421	0.417
50–59	0.541	0.551	0.557	0.560	0.558	0.555	0.550	0.543	0.537	0.530	0.523	0.516	0.510	0.505
60+	0.113	0.117	0.120	0.125	0.129	0.134	0.137	0.140	0.143	0.145	0.146	0.146	0.146	0.146
Total	1.799	1.787	1.773	1.757	1.741	1.724	1.706	1.688	1.670	1.652	1.633	1.615	1.597	1.580

(continued)

Appendix G (cont.): Projected number of dentist visits supplied per annum, low, medium and high recruitment vectors, by age group and sex, under the assumption of declining productivity (100% continuation of historical trend)

Age group (years)	Projected number of dental visits supplied (millions), high recruitment													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Male dentists														
20–29	0.104	0.102	0.100	0.097	0.095	0.093	0.091	0.089	0.087	0.085	0.083	0.081	0.079	0.077
30–39	0.237	0.238	0.237	0.235	0.232	0.228	0.225	0.221	0.217	0.213	0.209	0.205	0.201	0.197
40–49	0.484	0.446	0.414	0.388	0.367	0.349	0.335	0.324	0.314	0.306	0.300	0.294	0.290	0.286
50–59	0.492	0.494	0.490	0.483	0.472	0.459	0.444	0.428	0.413	0.397	0.381	0.366	0.352	0.339
60+	0.107	0.111	0.115	0.119	0.123	0.127	0.129	0.132	0.133	0.133	0.133	0.132	0.131	0.129
Total	1.425	1.390	1.356	1.322	1.289	1.256	1.225	1.194	1.164	1.134	1.106	1.079	1.053	1.028
Female dentists														
20–29	0.104	0.118	0.129	0.137	0.142	0.145	0.147	0.149	0.149	0.150	0.150	0.149	0.149	0.148
30–39	0.116	0.123	0.130	0.136	0.141	0.147	0.151	0.155	0.158	0.160	0.162	0.163	0.164	0.165
40–49	0.100	0.106	0.111	0.116	0.121	0.126	0.131	0.135	0.139	0.143	0.146	0.148	0.151	0.153
50–59	0.048	0.058	0.067	0.077	0.087	0.096	0.106	0.115	0.124	0.134	0.143	0.152	0.161	0.170
60+	0.006	0.005	0.005	0.006	0.006	0.007	0.008	0.009	0.010	0.011	0.013	0.014	0.015	0.017
Total	0.375	0.410	0.442	0.471	0.497	0.521	0.543	0.562	0.581	0.598	0.613	0.627	0.640	0.652
All dentists														
20–29	0.208	0.220	0.229	0.234	0.237	0.238	0.239	0.238	0.236	0.235	0.233	0.230	0.228	0.226
30–39	0.353	0.361	0.366	0.370	0.373	0.375	0.376	0.376	0.375	0.373	0.371	0.368	0.365	0.361
40–49	0.584	0.552	0.525	0.504	0.488	0.475	0.466	0.459	0.453	0.449	0.446	0.443	0.441	0.438
50–59	0.541	0.551	0.557	0.560	0.559	0.555	0.550	0.544	0.537	0.530	0.524	0.518	0.513	0.509
60+	0.113	0.116	0.120	0.125	0.129	0.133	0.137	0.140	0.143	0.145	0.146	0.146	0.146	0.146
Total	1.799	1.800	1.798	1.793	1.786	1.777	1.767	1.756	1.744	1.732	1.719	1.706	1.693	1.680

Appendix H: Declining annual productivity rates by age, sex and year

Age group (years)	Projected dentist productivity													
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Male dentists													
20–29	1,874	1,852	1,830	1,809	1,788	1,768	1,747	1,727	1,707	1,687	1,668	1,648	1,629	1,610
30–39	2,411	2,385	2,360	2,335	2,311	2,287	2,263	2,239	2,215	2,192	2,169	2,146	2,124	2,101
40–49	2,891	2,878	2,865	2,852	2,839	2,826	2,813	2,800	2,787	2,774	2,762	2,749	2,737	2,724
50–59	2,619	2,605	2,591	2,578	2,564	2,551	2,537	2,524	2,511	2,497	2,484	2,471	2,458	2,445
60+	1,969	1,953	1,937	1,921	1,905	1,889	1,873	1,858	1,843	1,827	1,812	1,797	1,783	1,768
	Female dentists													
20–29	2,047	2,041	2,036	2,030	2,024	2,018	2,012	2,006	2,000	1,995	1,989	1,983	1,977	1,972
30–39	1,838	1,828	1,819	1,809	1,800	1,791	1,781	1,772	1,763	1,754	1,745	1,735	1,726	1,717
40–49	1,743	1,724	1,706	1,688	1,670	1,652	1,635	1,617	1,600	1,583	1,567	1,550	1,533	1,517
50–59	2,016	2,007	1,998	1,989	1,981	1,972	1,963	1,954	1,946	1,937	1,929	1,920	1,912	1,903
60+	1,923	1,931	1,940	1,948	1,956	1,965	1,973	1,982	1,990	1,999	2,007	2,016	2,024	2,033

Notes

1. South Australian annual productivity rates were decreased at 50% of the rate of decline observed from Australian annual productivity data 1983 to 1998.
2. The productivity rates for female dentists aged 60 years or older increased over time. This inconsistency with the general trends may be related to the small numbers of practitioners in this age and sex group.