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International profiles of dental hygiene 1987 to 2006: a 21-nation comparative study

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This international longitudinal study examines trends and changes in dental hygiene. Information was collected from national dental hygienists' associations through a series of five surveys conducted between 1987 and 2006; sample sizes increased from thirteen to twenty-five countries. As dental hygiene has evolved, it has remained remarkably consistent globally, in particular its scope of clinical practice. Regarding historical development, predominant work setting, and professional organisation, the profession was more similar than dissimilar. Greater variation existed regarding the supply, education, regulation, workforce behaviour and remuneration of dental hygienists. Over the 19-year period, there was a marked increase in supply accompanied by improved dental hygienist-to-population and to-dentist ratios, continuing high workforce participation rates, shift to and increase in the number of baccalaureate-level education programmes, and increase in scope of practice and professional autonomy including, for many countries, a decline in mandatory work supervision and slight increase in independent practice. By 2006, the profiles reflected the vast majority of the world's population of dental hygienists. While the rate of change varied, its nature was consistent overall, resulting in a continuing homogeneity in the profession worldwide. Observed trends and persisting issues have implications for service accessibility and technical efficiency and should continue to be monitored.

Key words: Dental hygienists, international, supply and distribution, education, practice, trends

The supply and role of the dental hygienist are of interest worldwide. This paper reports on a study undertaken to maintain an international longitudinal database on dental hygiene. Selected findings from the 2006 survey are presented, together with comparative information from the 1987, 1992, 1998 and 2001 surveys[1-5].

Background

As discussed previously[1-4,6,7] complex environmental factors comprising economic and societal pressures and population-based trends and changes underlie the importance of maintaining a global database on dental hygiene. Consistent with the paradigm shift from treatment to prevention, wellness and self-care, renewed emphasis on improved access to cost-effective services, and growing acceptance that oral health is an essential component of total health, is the increasing role of the dental hygienist in the delivery of essential oral health services. The profession's value in terms of cost-containment and improved technical efficiency in the use of scarce resources has been well documented. With re-structuring of health care systems, dental hygienists are achieving greater control over their education, regulation and practice. Work roles and relationships are evolving from the dentist-predominant, dental hygienist-as-auxiliary mode to a more collegial one that involves greater collaboration regarding client care and provides latitude for the dental hygienist to work as a primary care provider in a variety of practice settings. Rate of change has varied. To assist health care systems to plan for the appropriate number, type and mix of oral health personnel to meet current and future service requirements, reliable information about the rapidly increasing supply of dental hygienists and their changing practice patterns is required.

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Methods

The Dental Hygiene Profiles Study is longitudinal, descriptive and exploratory in design. The purpose is to provide a broad picture of dental hygiene rather than comprehensive information on any one dimension and to update the picture periodically. Initial objectives were to:

- Investigate the availability of basic information on dental hygiene and assess the feasibility of collecting it through national dental hygienists' associations
- Develop and maintain a series of descriptive profiles
- Examine patterns and monitor trends and changes in the profession.

There have been five surveys to date, commencing in 1987. For all surveys, the sampling frame consisted of national dental hygienists' associations, the majority of which were members of the International Federation of Dental Hygienists. This group accounted for the vast majority of the world's supply of dental hygienists. Information was collected using a self-administered, English language, primarily closed-ended questionnaire developed for the purpose. Refinements made over the successive surveys improved the instrument's validity and reliability for the varied national, cultural and language groups involved. Clarification of responses was obtained as needed and preliminary tabulations were circulated for verification. Results are, of course, subject to risks inherent in the use of secondary source data. Findings have been released through a series of reports[1-5], publications [6-8] and numerous presentations to national and international audiences.

As indicated in *Table 1*, response rates were exceedingly high. By 2006, the database included Australia, Austria, Canada, Denmark, Finland, Germany, Ireland, Israel, Italy, Japan, Korea, Latvia, the Netherlands, New Zealand, Nigeria, Norway, Slovakia, South Africa, Spain, Sweden, Switzerland, the United Kingdom (UK), and the United States (US), plus Hong Kong and Fiji. This paper reports findings for all countries except Nigeria, Spain, Hong Kong and Fiji.

Results

Availability of data

The first objective involved the availability of data. Findings overall were positive even given apparent variability in access to basic planning information experienced by national dental hygienists' associations, coupled with problems inherent in the use of an English-language questionnaire for an international study. Regarding *completeness* of the data, over the period 1987 to 1998, there was a marked decrease for the '*data not available'* and '*don't know'* response categories, a trend that continued albeit more gradually to 2006. *Missing* responses were relatively few by 2001 and declined even further for 2006. Regarding *timeliness* of the data, across the five surveys, approximately two-thirds of the national associations were able to report data for the year specified - important when making comparisons between nations and across time. Among the remaining one-third, which included Canada and the US, by 2006 the time lag *between 'year specified'* and '*year of data provided'* had been further reduced for most items. It would appear both that face validity of the survey instrument had improved and data were becoming more available.

Historical development

Historically, the profession originated in the early 1900s in the US, followed by Norway in 1924. Near the end of

Table 1 International Profiles of Dental Hygiene: Participating Countries, By Year of Survey

Survey Year	Sampling Frame	Number of Participants	Participating Countries
1987	13	13	Australia, Canada, Denmark, Italy, Japan, Korea, The Netherlands, Nigeria, Norway, Sweden, Switzerland, United Kingdom, United States
1992[1]	17	15	See 1987, plus Finland, Germany, South Africa and except Korea
1998	20	19	See 1992, plus Israel, Korea, New Zealand and Spain
2001	22	19[2]	See 1998, plus Austria and Latvia and except Nigeria and Switzerland
2006	25	21[2]	See 2001, plus Ireland, Slovakia and Switzerland and except Lithuania, Nigeria, Portugal and Spain

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Notes:
1. For the 1992 survey, there were two non-respondents – namely, Columbia (South America) and Korea. Columbia again was a non-respondent for 1998 and was dropped from the sampling frame in 2001.
2. The sampling frame included several associations that were not yet members of the International Federation of Dental Hygienists. Responses for Hong Kong and Fiji, while excluded from the analyses for this study, are maintained as part of the longitudinal database.

the next quarter century, it had commenced in another three countries, the UK (1943), Canada (1947) and Japan (1948). During the third quarter (1950-1974), dental hygiene was established in a further eight countries, namely listed chronologically, these were Nigeria, Denmark, Switzerland, Korea, the Netherlands, Sweden, Australia and South Africa. The greatest expansion globally occurred during the fourth quarter, with the addition of ten more countries, Austria, Finland, Israel, Italy, Spain, Germany, New Zealand, Ireland, Slovakia and, most recently, Latvia in 1995.

Legislation to regulate the practice of dental hygiene tended to be enacted either during the year the profession reportedly was first established or shortly thereafter. For eleven countries, the delay between date of establishment and legal recognition was three years or less. In contrast, for another six countries an interval of at least ten years was reported. Enactment of legislation for multi-jurisdictional, Australia, Canada, Switzerland and the US occurred on a regional basis and considerable time elapsed before the process was complete. Legislation pertaining to dental hygiene did not exist for Austria, Germany or Slovakia at the time of the 2006 survey.

The profession remains predominately female. Across all countries surveyed, women comprised at least 97.0% of the dental hygiene population.

Supply

Information provided by respondents was used to investigate the supply of dental hygienists and to calculate ratios and percent change over time. Two aspects of supply were investigated, the *total* number of dental hygienists for a country and the number *legally authorised* to practice. The 'authorised' group was defined as persons that held a currently valid credential required to practice as a dental hygienist (for example, an annually renewable certificate of registration or a license). This category did not pertain to Austria, Germany or Slovakia where legal provision for the regulation of dental hygienists did not exist at the time of the survey. Selected findings are presented in *Table 2*.

Comparability of the data

Comparability of the data used to investigate dental hygiene supply has improved over time. Among the 21 countries examined most recently, the data provided pertained to 2006 (the year specified) for 11 countries and to 2005 for another five countries. Regarding the calculation of ratios, for over one-half of the countries investigated data were provided for 2006, the year specified. One exception was the UK where a one-year differential was observed; that is, data for dental hygienists and for dentists pertained to 2005 and for the population to 2006. The differential increased to two years for Finland, Norway and the US, and to three years for Slovakia. Of greater concern was the six-year differential noted for Canada and Korea and the undated population data provided for Australia, Finland and the Netherlands.

Total

The *total* number of dental hygienists varied widely. For two-thirds of the countries, fewer than 2,500 dental hygienists each were reported (*Table 2*). By far the greatest numbers were cited for Japan and the US with approximately 200,000 dental hygienists each. Korea ranked third with 30,782, followed by Canada with 18,350. Fewer than 300 dental hygienists each were reported for Ireland, Slovakia, New Zealand, Latvia, Germany, and Austria (listed in descending order).

Authorised

The picture changes only slightly when 'supply' is defined in terms of dental hygienists *currently authorised* to practice. As noted in *Table 2*, with the exception of Japan, the total number of dental hygienists for a country did not differ markedly from the number currently authorised to work; no differentiation was observed for Canada or Korea. The US accounted for one out of two 'currently authorized' dental hygienists (53.0%). In contrast, another seven countries collectively accounted for less than 1%.

Trends

Percent change in the number of authorised dental hygienists was calculated using information from all five Profile surveys, as provided and subsequently verified by the respective countries. No percent decreases in dental hygiene supply were observed (with the exception of Spain in 2001) and percent increases tended to be substantial (*Table 2*). By far the greatest increase was observed for Italy, a remarkable 2207.7% over the 18-year period 1987-2005. Next was Australia with a 319.3% increase over a 15-year period, followed by New Zealand at 150.0% over a considerably shorter 9-year period.

Ratios

Ratios are useful when planning, for example, the appropriate mix and number of service providers. The dental hygienist-to-population ratio is an indicator of service accessibility and the dental hygienist-to-dentist ratio an indicator of technical efficiency. Ratios were based, for the most part, on the number of dental hygienists authorised to practice; exceptions included Austria, Germany and Slovakia.

As indicated in *Table 2*, the dental hygienist-to-population ratio was highest for Korea at 1:1494, followed

Table 2 Supply of Dental Hygienists: Total Number, Number Authorized to Practice, Population and Dentist Ratios, and Percent Change

Country	Year to Which Data Apply	Total Dental Hygienists (N)	Hygienists Authorized to Practice[1] (n)	Dental Hygienist: Population Ratio[2]	Dental Hygienist to Dentist Ratio[3]	Percent Change in Supply: Survey 1 to Survey 5[4]
Australia	2003	850	717	1:27,713	1:14	+319.3
Austria	2006	10	[6]	1:1,000,000	1:350	
Canada	2006	18,350	18,350	1:1775[5]	1:1	+200.0
Denmark	2006	1800	1500	1:3618	1:3	+130.8
Finland	2006	1500	1400	1:3571	1:4	
Germany	2006	120	[6]	1:683,333	1:333	
Ireland	2005	292	292	1:13,699	1:8	
Israel	2005	1000	1000	1:6800	1:9	
Italy	2005	3000	3000	1:19,333	1:12	+2207.7
Japan	2006	202,603	79,695[7]	1:1597[5]	1:1	+143.9
Korea	2006	30,782	30,782	1:1494[5]	1:1	
Latvia	2006	172	165	1:13,939	1:9	
Netherlands	2006	2400	2400	1:8500[5]	1:3	+137.6
New Zealand	2006	260	260	1:16,140	1:9	
Norway	2004	1143	1143	1:4060[5]	1:5	+208.9
Slovakia	2006	270	[6]	1:19,924[5]	1:11	
South Africa	2000	2000	1200	missing	1:5	
Sweden	2004	3512	3512	1:2563	1:2	+95.1
Switzerland	2005	1600	1600	1:3889	1:3	
United Kingdom	2005	4843	4843	1:12,432[5]	1:7	+121.0
United States	2004	D/K	173,566	1:1719[5]	1:1	+84.6

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1 Authorized refers to persons currently registered or otherwise qualified to practice legally as a dental hygienist.
2 Ratios are based on the number of dental hygienists authorized to practice.
3 Figures are rounded to the nearest whole number. For all countries, the number of dentists exceeded the number of dental hygienists; for some, the difference was slight.
4 Calculation was based on numbers of dental hygienists authorized to practice.
5 Estimate. Calculation was based on data for different years or year of data was not stated.
6 The practice of dental hygiene was not regulated in Austria, Germany or Slovakia at the time of the survey.
7 Data pertain to the year 2004.

closely by Japan, the US and Canada. Ratios ranged from 1:2563 to 1:8500 for another seven countries and from 1:12,432 to 1:27,713 for a further seven countries. Not surprisingly, the lowest ratios were observed for the two countries with the fewest dental hygienists, 1:1,000,000 and 1:683,333 for Austria and Germany respectively. The lowest ratio recorded in the longitudinal database was 1:20million for Nigeria, observed in 1998.

Regarding the dental hygienist-to-dentist ratio, it was approximately 1:1 for Canada, Japan, Korea and the US, with essentially no change since 1998. For two of the four countries, Korea and the US, by 2006 dental hygienists slightly exceeded dentists in number. For another seven countries, the ratio of dental hygienists to dentists ranged from 1:2 to 1:5. The lowest ratios - 1:333 and 1:350, were observed for Germany and Austria respectively.

Workforce behaviour

Workforce behaviour refers to the rate of participation in the dental hygiene workforce and, for those that participate, the amount of time they work. Results are presented in *Table 3*.

It would appear that dental hygiene workforce information has become considerably more available in recent years. Participation data were provided for 20 of 21 countries examined in 2006, the exception being the Netherlands. This constituted an increase from one-half of the countries investigated in 1993 and two-thirds in 2001. Time worked data were reported for 14 countries; exceptions were Finland, Ireland, Italy, Korea, the Netherlands, New Zealand and Norway.

Participation

Overall, workforce participation was high. For 15 of the 20 countries for which information was provided, at least four out of five dental hygienists worked in dental hygiene. Participation ranged from a high of 100% for Austria, Ireland, New Zealand and Switzerland and 99% for Italy to a low of 40% for Japan, followed by 50% for Slovakia and 51% for the US. Overall, workforce participation among dental hygienists increased over the periods for which data were available, consistent with the trend among women in general. Increases observed since 1998 for Italy, Korea, and New Zealand were particularly noteworthy.

Time worked

'Full-time' was defined by the respondent for each country based on the number of hours considered to be 'full-time' employment among dental hygienists (*Table 3*). Definitions ranged from a high of 50 hours for Korea to a low of 30 hours for Australia and Canada and 26-37 hours for Denmark. For the majority of countries, the definition remained relatively constant over time.

It is deemed advisable to use 'full-time equivalents' when estimating labour supply for a predominately female occupation subject to the dual demands of child rearing and paid work. Thus, it was surprising to find that information regarding full-time employment apparently was not available for seven of the 21 countries examined and was outdated for Canada.

Among the 14 countries for which 'time worked' data were provided, full-time was predominant for seven countries and part-time for the remainder. The proportion of dental hygienists that worked full-time ranged from a high of 90% for Latvia, followed by 80% each for Japan and Sweden, to a low of zero percent for Austria, followed by 20% for Switzerland.

Dental hygiene education

Regarding dental hygiene education, characteristics examined included program type, number, length overall, tuition and, for 2005, the number of graduates.

Table 3 Employment Status of Dental Hygienists: Percent Working in Dental Hygiene, Working Full-Time and Definition of Full-Time, by Country, 2006

Country	Year to Which Data Apply	Percent Working in Dental Hygiene	Percent That Work Full-time	Number of Hours/Week Considered Full-time
Australia	2003	80.0	56.0	30
Austria	2006	100.0	0.0	40
Canada	2006	95.0	57.0[2001]	30
Denmark	2006	75.0	50.0	26-37
Finland	2006	90.0	don't know	38
Germany	2006	80.0	35.0	40
Ireland	2005	100.0	don't know	40
Israel	2005	80.0	35.0	35-40
Italy	2005	99.0	don't know	40
Japan	2004	40.0	80.0	missing
Korea	2006	59.0	don't know	50
Latvia	2006	92.0	90.0	40
Netherlands	2006	missing	don't know	38
New Zealand	2006	100.0	don't know	35
Norway	2004	88.0	missing	37.5
Slovakia	2006	50.0	60.0	40
South Africa	2005	85.0	70.0	40
Sweden	2004	86.0	80.0	40
Switzerland	2005	100.0	20.0	40
United Kingdom	2005	95.0	40.0[2004]	37.5[2006]
United States	2004	51.0	50.0	32

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Table 4 Entry-Level Educational Programs in Dental Hygiene: Number, Length of Program and School Year, and Total Number of Recent Graduates, by Country, 2006

Country	Type	Number	Length of Program (Years)	Length of School Year (weeks)	Number of Graduates in 2005
Australia	Diploma	2	2	36	20-24[2006]
	Degree[1]	7	3	33	100[2006]
Austria		0	--	--	--
Canada	Diploma	41	2-3	32	1179[2006]
	Degree	2	3	26-28	
Denmark	Diploma	1	2.5	52	103[2006]
	Degree	1	1	52	[2010]
Finland	Degree	4	3.5	missing	missing
Germany		0			
Ireland	Diploma	2	2	36	20
Israel	Diploma	4	2	44	80
Italy	Degree	missing	3+2	48	missing
Japan	Diploma	149	3	30	7040[2007]
	Degree	3	4	30	0
Korea	Diploma	47	3	32	3450[2006]
	Degree	6	4	32	80[2006]
Latvia	Diploma	1	2+1 (DN+DH)	40	24
Netherlands	Degree	4	4	40	missing
New Zealand	Diploma	1	2	28	13
	Degree	2	3	missing	46
Norway	Diploma	1	2	missing	13
	Degree	2	3	missing	40[2006]
Slovakia	Degree	3	3	24	7[2007]
South Africa	Diploma	5	2	35	24
	Degree	1	3	35	5
Sweden	Diploma	8	2-3	40	200
	Degree	7	3	40	60
Switzerland	Diploma	4	3	40-42	75
United Kingdom	Diploma	18	3	46	310
	Degree	3	3	38	48
United States	Diploma	253	2	30	5058
	Degree	33	4	30	1709

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Entry-level programmes

There has been a steady increase since 1998 in the number of entry-level dental hygiene education programmes, together with a shift to the baccalaureate as the predominant type. By 2006, at least one entry-level dental hygiene programme was reported for 19 of the 21 countries examined (*Table 4*); exceptions were Austria and Germany. As expected, the total number of programmes per country varied widely. Regarding programme type, by 2006 both diploma and baccalaureate level dental hygiene programmes were reported for 11 countries and, for seven of those, the degree programme equalled or exceeded the diploma programme in number. In addition, baccalaureate programmes exclusively were reported as the entry-level requirement for another four countries, an increase from two countries in 2001. During the same period, the number of countries for which only the diploma level programme existed declined to four, Ireland, Israel, Latvia and Switzerland.

Regarding the diploma programme (*Table 4*), namely the greatest number was reported for the US (n=253), followed by Japan (n=149) and, more distantly, by Korea (n=47) and Canada (n=41). The majority of countries reported fewer than five programmes each. Diploma

programmes varied widely in terms of overall length (calculated as the number of weeks per year by total years). The shortest programme was observed for Latvia (a 40 week, post-dental-nurse programme), followed by New Zealand (56 weeks) and the US (60 weeks) and the longest for Denmark (130 weeks), followed by Switzerland (120 to 126 weeks). As expected, tuition varied widely and ranged from being state-funded in Sweden and the UK to being highest for Korea and the US. Not surprisingly, the total numbers of graduates was consistent with the number of programmes offered.

Regarding the baccalaureate programme in dental hygiene (*Table 4*), it was the sole entry-to-practice academic requirement for Finland, Italy, the Netherlands and Slovakia. Four programmes each were reported for Finland and the Netherlands and three for Slovakia; information was missing for Italy. Programmes typically ranged from three to four years in length. Those in Finland and Slovakia were state-funded. In Slovakia, a total of seven graduates were anticipated for 2007; information was incomplete for the other three countries. As noted previously, one or more baccalaureate programmes in dental hygiene, in addition to diploma-level programmes, were reported for another 11 countries. For Canada, Denmark, Japan, Korea, Norway, South Africa, Sweden, the UK and the US, programmes were exclusive to dental hygiene with the majority being direct-entry although a few were offered as post-diploma, degree-completion programmes. In contrast, the baccalaureate programmes cited for Australia (n=7) and New Zealand (n=2) offered a combined dental hygiene/dental therapy degree. The greatest number of dental hygiene baccalaureate programmes was reported for the US (n=33).

Graduate-level programs in dental hygiene

Masters programmes in dental hygiene were reported for Finland, Italy, the Netherlands and the US, and are pending for Australia and Norway. A doctoral programme reportedly was under development for Norway.

Future directions

Dental hygiene education continues to evolve. Major changes were anticipated for 17 of the 21 countries. Cited most frequently were increased length for the entry-level programme and expansion of its curriculum typically to the baccalaureate level, followed by an increase in the number of both programmes and graduates.

Dental hygiene regulation

Professional regulation exists under public statute to ensure safety and quality of services and to protect the public from harm. Through the regulatory process, qualified persons become registered and thereby authorised to practice. At the time of the survey, the practice of dental hygiene was not regulated in Austria, Germany and Slovakia. Four aspects of dental hygiene regulation were examined for this study, namely method, registration requirements, mandatory professional liability insurance, and decision-making responsibilities. Selected findings for 18 countries are presented in *Tables 5* and *6*.

Method of regulation

Three methods of regulation were evident. Distribution tended to vary by continent and by a country's historical ties. The predominant method was direct regulation through a government agency such as a Department of Health. This was the sole method reported for 11 countries, namely Denmark, Finland, Israel, Italy, Japan, Korea, the Netherlands, Norway, Sweden, Switzerland and the UK, as well as for the three northern territories of Canada. For five of the 11 countries, dental hygienist representatives served on the government boards and, for Denmark and the UK, had voting rights.

Second most prevalent was indirect regulation through a governing board consisting primarily or solely of dentists. This method was reported for Australia, Ireland, New Zealand and the US, as well as for several provinces in Canada. Dental hygienist representation on the dental governing boards, with voting rights, was reported for Australia, New Zealand and the US.

The third method is self-regulation whereby regulatory authority is delegated to the dental hygiene profession and the governing board consists of dental hygienists and one or more public representatives. Self-regulation was the sole method reported for Latvia and South Africa and was by far the most predominant method for Canada (94% of dental hygienists).

Registration

To practice the regulated profession of dental hygiene, an individual typically must register with the appropriate authority and attain the necessary credential. Requirements for registration vary and may include proof of graduation from an approved dental hygiene programme and successful completion of written and/or clinical examinations. To remain registered, the dental hygienist may be required to provide proof of continued competence among other criteria. With the exception of Canada and the US, the required credential was valid nationally. Reciprocity of regulatory credentials existed between Australia and New Zealand and among member countries of the European Community. For many countries, registration and credentialing requirements as a dental hygienist, for both citizens and immigrants, have become more rigorous.

Regarding citizens/residents, of the three registration methods examined, two were almost equally pre-

Table 5 Professional Regulation of Dental Hygienists, by Country, 2006

Country	Type of Professional Regulation			Requirements for Immigrants[1]			
	#1 Self Regulation	#2 Dental Board	#3 Government Agency	Proof of Graduation	Written Exam	Clinical Exam	Case Review
Australia		X		X	X	X	
Austria		Not regulated			To employer		
Canada[2]	X	X	X	X	X	X	X
Denmark			X	X			X
Finland			X	X			
Germany		Not regulated					
Ireland		X		X	X	X	X
Israel			X	X	X	X	
Italy[3]			X				
Japan			X		Not specified		
Korea			X		X	X	X
Latvia	X			X	X	X	X
Netherlands			X	X			X[4]
New Zealand		X		X	X	X	X
Norway			X	X			X
Slovakia		Not regulated			To employer		
South Africa	X			X			X
Sweden			X	X			X
Switzerland			X	X			X
United Kingdom			X	X[3]	X	X	X
United States		X		X	X	X	

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1 In addition, a work permit reportedly was required for Austria, Germany and Ireland.
2 Method of regulation in Canada varies by province and territory. In 2006, 94.0% of dental hygienists were self-regulated whereas less than 1.0% were regulated through a government agency.
3 In addition, applicant must successfully complete a dental hygiene program in Italy and a prescribed course of study in the United Kingdom.
4 Unsuccessful applicants are required to complete further schooling in dental hygiene.

dominant. Annual registration, sometimes known as licensure, typically requires applicants to meet a more rigorous set of criteria than the other two methods and must be renewed once a year to remain valid. This method was cited for eight countries, namely Australia, Canada, Ireland, Japan, New Zealand, South Africa, UK and US. In contrast, certification involves some predefined criteria but typically does not require renewal to remain valid. This method was cited for Denmark, Finland, Israel, Korea, Latvia, Norway and Sweden and for independent practice in Switzerland. In the case of Latvia, the certificate required renewal every five years. The third method reported required only proof of graduation from a recognised dental hygiene programme. Once the most prevalent method, by 2006 it was cited for three countries only, Italy, the Netherlands and Switzerland (other than independent practice).

Regarding requirements for immigrants (*Table 5*), by 2006 the number of countries for which applicants had to successfully complete both written and clinical examinations as well as provide proof of graduation from an approved dental hygiene programme (Korea excepted) had increased to nine. Additionally for the UK, an applicant was required to complete a prescribed course of study. For another eight countries, immigrants wishing to become registered as a dental hygienist were required to provide proof of graduation from an approved programme and, with the exception of Finland, undergo an individual case review. Among this group, Italy was unique in that immigrants from other than European Community countries were not eligible to apply unless they also had completed an Italian dental hygiene programme, regardless of prior schooling. Unsuccessful applicants to the Netherlands were required to complete further training prior to re-applying. No authorisation other than proof of graduation to the employer was

Table 6 Decision-Making Responsibility for Dental Hygienist Clinicians, by Country, 2006

Country	Typical Work Situation for Dental Hygienist Clinician: Decision-Maker And Level of Work Supervision				
	Dentist *dentist decides all DH procedures to be provided; when the dental hygienist performs them, dentist is:*		*Collaborative* *dental hygienist and dentist together decide DH services; when the dental hygienist provides them, dentist is:*		*Independent* *dental hygienist decides all DH services in collaboration with the client and refers as necessary; dentist's presence:*
	On-Site	Off-Site	On-Site	Off-Site	Not Required
Australia	X	X			
Austria			X	X	X
Canada				X	X
Denmark					X
Finland				X	
Germany	X	X	X	X	X
Ireland		X			
Israel		X	X[1]	X[2]	
Italy					X
Japan	X				
Korea	X[2]			X[1]	
Latvia	X		X	X	
Netherlands				X	X
New Zealand				X	
Norway					X
Slovakia				X	X
South Africa				X	
Sweden					X
Switzerland		X[1]	X[1]	X	X
United Kingdom				X	
United States		X[2]	X	X[1]	

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1 Public health settings
2 Private practice settings

required for Austria and Germany. Information was not provided for Japan.

Decision-making responsibility

Professional accountability and autonomy for dental hygienists have been evolving for many countries. Patterns and trends in legally mandated requirements for work supervision and, more recently, decision-making responsibilities were investigated as part of the Dental Hygiene Profiles Study. Findings for 2006 are presented in *Table 6*.

Under the traditional models of direct and indirect supervision, legally the dentist is responsible for deciding the services to be provided by the dental hygienist and, for some jurisdictions, must remain on-site while intra-oral procedures are performed (i.e., direct supervision). There has been a gradual but increasing shift since 1987 to collaborative practice whereby the dentist and dental hygienist together decide the services to provide and direct supervision is not required. More recently, an increase in independent dental hygiene practice has been observed; that is, dental hygienists are making their own decisions regarding dental hygiene care in consultation with the client and referring as needed to a dentist or other healthcare professional. Hence by 2001, to better capture the realities of practice, the focus of relevant Profile items shifted from legally mandated supervision requirements to include decision-making responsibilities in the typical work situation. Indicative of the gradual evolvement, more than one method of decision-making was reported for a number of countries. With few excep-

tions, supervision requirements tended to be the same for both public and private sector workplaces. They did vary somewhat by province or state for countries with multiple jurisdictions such as Canada and the US.

By 2006, the collaborative method was predominant, being reported for 14 of the 21 countries examined, an increase from nine countries observed in 2001. The group consisted of Austria, Canada, Finland, Germany, Israel, Korea, Latvia, the Netherlands, New Zealand, Slovakia, South Africa, Switzerland, the UK and the US. Independent practice ranked second, being reported for ten countries, an increase from eight in 2001. It was the sole method reported for Denmark, Italy, Norway, and Sweden and co-existed, together with collaborative practice, for Austria, Canada, the Netherlands and Slovakia. Ranked third was 'the dentist as decision-maker'. It was the sole method reported for Australia, Ireland and Japan – a decline from the seven countries observed in 2001. This method was reported also for Germany, Israel, Korea, Latvia, Switzerland and the US, in conjunction with at least one other method. Based on regulatory changes reportedly anticipated for Australia, Canada, Denmark, Finland, South Africa and the UK, the trend toward increased decision-making responsibility for the dental hygienist is expected to continue.

Professional liability insurance

Consistent with the increasing responsibility, accountability and self-governance observed for the profession, a new survey item pertaining to professional liability insurance (indemnity or malpractice insurance) was added for the 2006 survey. Findings indicated that, for the majority of countries examined, a dental hygienist is legally required to have individual insurance coverage in order to practice clinically.

Liability insurance was required under all circumstances for nine countries (Australia, Canada, Israel, Norway, Slovakia, South Africa, Sweden, Switzerland and the UK) and to practice independently as a dental hygienist for another three (Denmark, Finland and Germany). Requirements varied by state for the US. Although not a legal requirement for Ireland and New Zealand, it was reported to be 'highly recommended'. There was no apparent relationship between requirement for liability insurance and method of regulation (that is, whether the profession was regulated directly by the state or through a dental or a dental hygiene board).

Trends

Further changes in regulation were anticipated for 12 countries. They include the introduction of new legislation to regulate dental hygiene practice in Austria and Slovakia, self-regulation for the remaining jurisdictions of Canada and for some US states, an 'advanced dental hygiene practitioner' for the US, and additional unspecified decision-making responsibilities for several countries.

Dental hygiene employment

Dental hygienists work primarily as employees, as opposed to being self-employed. Four aspects of employment were investigated.

Work role

By far the most predominant work role for the dental hygienist continues to be that of clinician. In 2006, across all 21 countries examined, at least 70% of dental hygienists reportedly worked in clinical practice. For 17 of those countries (an increase from the 11 observed in 2001), the proportion had increased to a minimum of 90%.

Workplace

Regarding type of workplace or practice setting, respondents were asked to rank nine types (plus an 'other' category) according to prevalence. Based on previous findings, a new category was added for 2006; the *private dental hygiene office (i.e. independent practice)*.

The private dental office was consistently ranked first followed by the public or community health setting. There were three exceptions; for the Scandinavian countries, the ordering reversed and community health was predominant. Rankings were remarkably consistent over the period 1987-2006. While changes in workplace distribution were reportedly anticipated for eight countries, with an increase in community health positions being cited most frequently, the private dental office is expected to remain predominant for the foreseeable future.

Employment opportunities

Similar to findings for the year 2001, employment in dental hygiene for 2006 was reported to be *very available* for eleven countries. It was rated as *somewhat available* for another six countries, an increase from the two observed in 2001. Exceptions were Finland and Israel where employment opportunities reportedly were *very scarce* and *somewhat scarce* respectively, and Slovakia where they ranked three on the five-point scale. In the US, employment opportunities for the dental hygienist were reported to vary based on types of work setting and work role.

Career opportunities

While greater variation was apparent regarding career opportunities for qualified dental hygienists, findings overall were positive. Opportunities were perceived to

be *very available* for Canada, Italy, Korea and Latvia and *somewhat available* for Australia, Austria, Germany, Japan, New Zealand and South Africa. In contrast, career opportunities were reported to be *somewhat scarce* for Slovakia, Sweden and Switzerland and *very scarce* for Ireland. Respondents for Denmark, Finland, the Netherlands, Norway and the UK tended to be ambivalent. That is, they indicated 'three' on the five-point scale. In the US, career opportunities for the dental hygienist reportedly varied by work setting and work role.

Remuneration

The two aspects of remuneration examined were employment wages and benefits. For this study, the wage component was defined as the annual salary (reported in US dollars) earned on average by dental hygienists that work full-time. (It is recognised that wage rates vary considerably worldwide, regardless of occupation.) Employment benefits were defined as those usually paid by the employer for dental hygienists that work full-time. Wage information was provided for all countries except Austria and Korea. Benefits information was provided for all 21 countries.

Dental hygiene remuneration tended to vary widely by country and by type of workplace. Among the 17 countries for which information was complete, remuneration on average for the dental hygienist employed in a dental office was greatest for Germany, followed by Ireland, the UK, Denmark and Switzerland.

Regarding dental hygiene wages, the highest annual rate, $US60,000-120,000, was reported for Germany, followed by $61-70,000 for Denmark, Ireland, and the UK and $51-60,000 for Norway and Switzerland. Wages reportedly were lowest for Latvia and Slovakia at less than $7,000 annually.

Regarding employment benefits, from a list of 12, respondents indicated those that usually were available to the dental hygienist employed full-time. Three benefits reported for all 21 countries were maternity leave, legal holidays and sick leave. Next most frequently cited was vacation leave (n=20), followed by continuing education course fees (n=15), contributions to a pension fund and overtime pay (n=13 each), convention fees, cost of living increases, and health insurance (n=12 each), disability insurance (n=11), and lastly, merit pay or bonuses (n=10).

In terms of distribution, Denmark ranked first with all 12 benefits cited, followed by Austria, Japan, Korea, Norway, Switzerland and the UK with 11 each. Ten benefits each were reported for Ireland and the US. The fewest number of benefits were reported for Canada (n=4), followed closely by Australia (n=5).

Overall, employment benefits changed little in terms of availability over the period 1987 to 2006. A change in remuneration was anticipated for 10 of the 21 countries; the direction of the change was not always indicated. Factors cited included extension of dental 'insurance' or third-party payment plans to include direct billing for dental hygiene services, increased self-employment, and increased earnings.

Dental hygiene clinical practice

Two aspects of dental hygiene practice were investigated namely the legally defined scope of clinical practice and alternate service providers. Eighteen countries were included in the analysis, the exceptions being Austria, Germany and Slovakia where a legally defined scope of practice did not exist at the time of the survey.

Scope of practice

Four categories of clinical dental hygiene services were investigated namely client assessment, planning dental hygiene care, preventive services, and therapeutic services. Findings, summarised in *Table 7*, were remarkably similar worldwide.

Overall, dental hygiene clinical practice was characterised by a common set of activities. Of the 28 procedures examined, 23 were within the legal scope of dental hygiene practice for at least 15 of the 18 countries included in the analysis; actual distribution varied by procedure and country. Variance was greatest among procedures that comprised the assessment and the therapeutic categories.

Regarding *client assessment*, three of the eight procedures investigated were common to all 18 countries; taking/reviewing a client's medical history and performing both an extra-oral examination and a soft tissue examination. Second most prevalent were performing a hard tissue examination and making dental impressions (n=17 each), followed by taking vital signs and exposure and use of radiographs (n=15 each). Least frequently cited was the performance of diagnostic tests (n=13). In terms of distribution all eight procedures were reported for 11 countries and seven procedures each for another three countries. The fewest number was reported for Ireland; excluded were vital signs, diagnostic tests and dental impressions.

Regarding the *dental hygiene care plan*, all six activities and decisions investigated were cited for 16 of the 18 countries, a significant increase since the 2001 survey. The two exceptions were Japan and Korea. Thus, for the vast majority of countries, scope of practice included the identification of dental hygiene care needs, informing the client of both assessment findings and dental hygiene treatment options, and deciding the dental hygiene services to provide, the sequence in which to perform them, and the overall appointment schedule.

Regarding *preventive services*, six procedures were investigated. For the first time since the initial Profile survey in 1987, all six activities were reported for all countries examined. The common set of procedures consisted

Table 7 Scope of Dental Hygiene Clinical Practice, by Dimension, Number of Procedures and Country, 2006

	Dimension of Practice and Number of Procedures (N)			
Country	Assessment (N=8)	Planning (N=6)	Preventive (N=6)	Therapeutic (N=8)
Australia	8	6	6	6
Canada	8	6	6	7
Denmark	8	6	6	7
Finland	8	6	6	7
Ireland	5	6	6	5
Israel	6	6	6	4
Italy	6	6	6	4
Japan	7	3	6	7
Korea	6	3	6	5
Latvia	8	6	6	5
Netherlands	8	6	6	8
New Zealand	8	6	6	5
Norway	7	6	6	5
South Africa	8	6	6	6
Sweden	8	6	6	6
Switzerland	8	6	6	5
United Kingdom	7	6	6	5
United States [1]	8	6	6	5

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1 Varies by state

of oral hygiene, diet and smoking cessation counselling, application of topical fluorides and fissure sealants, and deciding the self-care products to recommend. In the past, counselling for smoking cessation was typically cited less frequently.

Greater variation was evident regarding *therapeutic services*. Of the eight procedures investigated, four were common to all 18 countries, namely supra- and sub-gingival calculus and extrinsic stain removal (i.e., debridement), and most recently, sub-gingival irrigation. Administration of local anaesthesia was reported for 14 countries, an increase from nine in 2001, followed by placement and fitting of orthodontic bands (n=8) and placement and finishing of dental restorations (n=6). Cavity preparation was reported only for the Netherlands. In terms of geographic distribution, all eight procedures were reported only for the Netherlands, seven procedures each were cited for Denmark, Finland, Japan and selected jurisdictions in Canada, and six procedures each for Australia, South Africa and Sweden. The actual mix of services varied by country. For the largest group consisting of seven countries, an identical set of five procedures each was cited. A slightly different set of five procedures was reported for Korea. Four procedures that comprise the core of dental hygiene traditional practice were reported for Israel and Italy; the set, which was identical for both countries.

Trends and changes

Dental hygiene practice continues to evolve. A comparison of findings across the past five 'profile' surveys disclosed changes in scope for all categories of practice and for the vast majority of countries examined. Responses for 2006 indicated that more changes in dental hygiene practice can be expected. Among the nine countries for which no change was anticipated, a large number already had experienced considerable expansion in scope. Among the group for which change was anticipated, new responsibilities cited included the authority to issue prescriptions (Canada, Finland), administration of local anaesthesia (Australia, Ireland), tooth bleaching (South Africa), and placement of temporary dressings and crowns (Ireland). In addition, aspects of independent practice were cited for Canada, Norway and the UK. Unspecified expansion of the role and responsibilities of the dental hygienist was reported for Denmark, Ko-

rea, the Netherlands and the US. The introduction of an Advanced Dental Hygiene Practitioner was anticipated for the US.

Alternates

Regarding *alternate service providers*, respondents indicated personnel, other than a dentist, that were legally qualified to provide those services previously identified to be within the scope of dental hygiene practice. Personnel types not associated primarily with oral health (e.g., registered nurse) were excluded from the analysis.

While titles for the occupations varied, based on the 28 'dental hygiene' services examined, nine categories of personnel were identified. They included the dental assistant (n=7 countries), intra oral dental assistant (n=5), chair side dental assistant (Latvia), dental therapist (n=4), dental nurse (Ireland), denturist or dental prosthetist (Australia, New Zealand), orthodontic therapist (Ireland, UK), aid nurse (Korea), and dental hygiene auxiliary (New Zealand). At least one alternate to the dental hygienist was reported for 14 of the 21 countries; exceptions were Austria, Finland, Italy, Japan, Norway, Slovakia and South Africa. For six countries, only one type of alternate was reported, typically a type of dental assistant.

It would appear that the dental hygienist continues to play a unique role on the oral health team. A comparison of scopes of practice suggested that, while alternate providers existed for selected services, a substitute provider (i.e., a complete replacement) other than the dentist did not. The greatest number of procedures in common with the dental hygienist was cited for the intra oral dental assistant in the Netherlands and for both the dental therapist and the dental hygiene auxiliary in New Zealand

Professional organisation

Three aspects of professional organisation were examined, namely structure, membership and practice guidelines.

Structure

Dental hygiene is organised globally through the International Federation of Dental Hygienists (IFDH) (www.ifdh.org). Its membership consists of national dental hygienists organisations, individuals and corporations. Over the period 1987 to 2006, membership increased across all categories, with an almost doubling in the number of association members from 13 to 25. Of the 21 national associations examined for this study, 14 reported having a multi-level organisational structure in which each association comprised regional and, in the case of Canada, Italy, and the US, local (e.g., municipal) associations as well.

Membership

Membership provides an indicator of an organisation's perceived legitimacy and potential influence. For each IFDH-member association, a membership rate was calculated based on the proportion of authorised dental hygienists that were members. Over the period since 1987 (or 1992, depending on when a country was first included in the Profile Study) and among the 13 associations for which longitudinal data were available, membership rates typically increased. Proportionately, growth was greatest for Canada and Denmark. By 2006, 10 countries reported a minimum of seven out of 10 dental hygienists were members of their national association. The highest rates were observed for Latvia and Switzerland (100%), followed by Ireland, Finland, Sweden and New Zealand (90% or greater), the Netherlands (87%) and Denmark (80%). On the other hand, for seven countries, the national associations each represented less than one-half of eligible dental hygienists; this group consisted of (in ascending order) the US, Japan, South Africa, Korea, Italy, Israel and Slovakia. The relatively low membership rates observed for Japan, Korea and the US were offset, in part, by large numbers of members.

Practice guidelines

Respondents were asked to indicate whether three types of formalised quality assurance guidelines had been either developed by the national dental hygienists' association or adopted from organisations and agencies such as IFDH or the World Health Organisation. A professional code of ethics reportedly existed for 18 of the 21 national associations examined and was in the process of being developed for Korea and Slovakia; the exception was Germany. Standards for clinical dental hygiene practice were cited for 11 associations and were under development for another four. An infection control protocol was reported for nine associations and was 'in progress' for another five.

All three types of guidelines reportedly existed or were under development for the dental hygienist associations in Australia, Canada, Finland, Israel, Italy, Latvia, the Netherlands, New Zealand, Slovakia, Switzerland, the UK and the US. Two guidelines each were cited for Austria, Denmark, and Ireland. Progress on a second guideline was reported for Japan and Korea. Only one guideline each was cited for Norway and Sweden. None of the three guidelines was reported for Germany. Information was incomplete for South Africa.

Issues and initiatives

The final profile addressed future directions for dental hygiene. Using a set of open-ended questions, respondents identified, for their respective countries and dental hygiene associations, major issues of concern to dental

hygiene, anticipated changes, and organisational plans and initiatives. Across all three categories investigated, topics cited most frequently involved dental hygiene education, regulation and practice; these themes varied in predominance over the years.

In 2006, issues cited most frequently involved a perceived need to expand the legal scope of dental hygiene practice, establish baccalaureate and graduate-level educational programmes in dental hygiene, improve employment and career opportunities for dental hygienists, ensure an adequate supply of dental hygienists, and improve access to their services.

Among anticipated changes, those pertaining to dental hygiene education, in particular entry-level baccalaureate programmes, were predominant. Next most frequently cited were pending or expected amendments to the regulation of dental hygienists, with a particular focus on scope of practice and professional autonomy.

It was not surprising to find that organisational plans and initiatives were linked to national issues and expectations. Two topics were predominant. The first involved the expansion of existing entry-level dental hygiene educational programmes, typically to the baccalaureate level, coupled with an increase in the overall number of programmes. The second topic involved the attainment of greater independence and professional autonomy for the dental hygienist, together with increased career opportunities in the public sector in particular.

Globally, the profession evolved over the period 1987-2006 in terms of issues and initiatives. Across a majority of the countries examined, the emphasis tended to shift from establishing curriculum standards for typically diploma-level programmes toward establishing the baccalaureate degree in dental hygiene as the entry-to-practice academic requirement. It also shifted to a greater emphasis on the development of a master's degree programme in dental hygiene, as well as increased opportunities for professional development and continuing competence for graduate dental hygienists. A change in the nature of issues and initiatives related to the regulation of dental hygiene also was observed. The focus shifted from method of regulation (in particular, representation on dental governing boards and self-regulation) toward increased professional autonomy in practice (in particular, a legally mandated reduction in supervision requirements for the dental hygienist and provision for independent dental hygiene practice). Recent trends coupled with the increasingly proactive nature of reported organisational initiatives suggest that professional autonomy for the dental hygienist will continue to increase.

Discussion

The purpose of the International Profiles of Dental Hygiene project is to examine patterns and monitor trends and changes globally in the dental hygiene profession. The most recent findings continue to endorse the feasibility of using secondary source data collected through national dental hygienists' associations to maintain an international database. Systems for the regular collection, maintenance and dissemination of basic information on dental hygienists exist for most countries surveyed and have improved over time. Little relationship was evident between the size of a dental hygiene association and/or national population and the evolution of the corresponding information system, including, for example, the frequency with which data were updated. The gradual reduction in missing responses over the period 1987 to 2006 suggests that, for many countries, data had become more available. Problems persist in the collection of information with which to calculate supply and population ratios. For example, data pertaining to the same year for dental hygienists, dentists and the population apparently remain elusive for some respondents; on the other hand, the proportion overall has declined. The continuing challenge is to capture the full range of situations revealed both as the profession evolves and as countries continue to be added to the study, while at the same time maintaining the longitudinal integrity of the database.

Regarding the investigation of patterns and trends in the profession, by 2006 the profile had become more global in scope and reflected the vast majority of the world's population of dental hygienists. Over the 19-year period, it maintained a remarkable consistency worldwide, in particular regarding the scope of dental hygiene clinical practice. The profession remained more similar than dissimilar in terms of historical development, predominant work setting, and professional organisation. Variation persisted regarding labour force participation, hours worked, and remuneration for clinical practitioners and increased with respect to supply, educational preparation, and regulation of the profession.

Apparent changes over the period 1987-2006 should be viewed with caution due to the data's relatively short 19-year time span and the possibility of reporting inconsistencies for some countries from survey to survey. Given these caveats, a number of observed trends are noteworthy. The most dramatic and perhaps most reliably reported changes involve the supply of dental hygienists. There have been often dramatic increases in the numbers of dental hygienists and in hygienist-to-population and –to-dentist ratios. Also noteworthy is the growing shift toward the baccalaureate degree as the entry-level requirement for practice and the slow but steady increase in graduate level programmes. Workforce participation rates remain remarkably high for a predominately female occupation. Of particular interest is the increased scope of dental hygiene clinical practice and types of practice settings, together with greater professional autonomy for the dental hygienist as evidenced by a steady reduction in requirements for

work supervision, increasing prevalence of independent dental hygiene practice, and direct billing to 'third party payers'. Based on the major issues, expected changes and initiatives reported in 2006, these trends are expected to continue. Further, while the rate of change will continue to vary for the profession globally, the nature of the change will likely remain consistent, with the result that the profession will maintain its remarkable homogeneity.

Conclusions

Observed trends and changes indicate that dental hygiene continues to evolve both as a profession and an important part of the health care delivery system. Viewed within the context of broader population-based social and epidemiological trends and changes, politico-economic pressures, and healthcare re-structuring initiatives, this evolution presents both positive aspects and challenges. On the one hand, there is improved access to and greater technical efficiency in the provision of essential oral health services. On the other hand, the emergence of the dental-hygienist-as-primary-care-provider and as-entrepreneur necessitates new practice configurations, increased collaboration in the workplace, and more effective linkages between dental hygiene and other health groups. The evolution of the profession and its impact in terms of health outcomes and other effects merit further investigation.

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