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International profiles of dental hygiene 1987 to 2001: A 19-nation comparative study

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Aim: The purpose of this international longitudinal study is to examine patterns and monitor trends and changes in dental hygiene. **Method:** Information was collected from national dental hygienists' associations through surveys conducted in 1987, 1992, 1998 and 2001. Sample size increased from 13 countries in 1987 to 22 by 2001 – of which 19 were included in the analysis. **Results:** Overall, characteristics of the profession were remarkably similar; most noteworthy was the scope of dental hygiene clinical practice. Regarding historical development, educational programmes and professional organisation, the profession was more similar than dissimilar. Greater variation was evident regarding numbers, distribution, regulation, workforce behaviour, predominant work setting, and remuneration. Over the relatively short 14-year period, several observations were of particular interest: marked increase in the supply of dental hygienists, accompanied by a decline in their ratio to populations and to dentists and a high workforce participation rate; increase in baccalaureate dental hygiene programmes, with a gradual shift from the diploma as the entry-level qualification; and increase in scope of practice and professional autonomy, including for Europe and North America in particular, a decline in mandated level of work supervision and a slight but gradual increase in independent practice. **Conclusion:** By 2001, the profiles reflected the vast majority of the world's population of dental hygienists. Rate of change varied across the countries examined; however, the nature of the change overall was consistent, resulting in a continuing homogeneity in the profession worldwide. Observed trends, changes and persistent 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

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The supply and role of the dental hygienist are of increasing interest worldwide. This paper reports on a study undertaken to maintain an international longitudinal database on dental hygiene. Selected findings from the 2001 survey (n=19 countries) are presented, together with comparative information from the 1987, 1992 and 1998 surveys[1–4].

Background

As discussed previously[5,6] a variety of complex environmental trends and changes underlie the importance of maintaining a global database on dental hygiene. Economic pressures combined with population ageing, changes in oral health status and consumer expectations, and often-conflicting societal goals, have resulted in a paradigm shift from treatment to wellness and self-care, increased emphasis on access to and cost-effectiveness in the provision of services, and efforts to re-structure health care systems. There is growing acceptance that oral health is an essential component of total health, renewed emphasis on setting and attaining oral health goals, and increasing recognition that dental hygiene services are an important element in attaining those goals[7–9].

The dental hygienist is the only healthcare professional and member of the oral health team whose primary function continues to be

the prevention of oral disease and promotion of wellness[4]. Their contribution in terms of cost-containment and technical efficiency has been well documented for both traditional and non-traditional settings[10–17]. The dental hygiene profession continues to attain greater responsibility for its education, regulation and practise. Work roles and relationships have been evolving from the dentist-predominant, dental hygienist-as-auxiliary mode to a more collegial one that involves greater collaboration between dentists and dental hygienists regarding client care and provides latitude for the dental hygienist to work as a primary care provider in a variety of practice settings[18].

The rate of change from labour complement to labour substitute has varied and legislative restrictions regarding work supervision remain an issue for many countries. For example, the Pew Health Professions Commission in 1995 urged revision of the health professions regulations in the United States to remove barriers to the full use of competent health professionals, under the consumer's right to choose their own healthcare providers from a range of safe options[19]. In the United Kingdom, following publication of the Nuffield Report (September 1993), the General Dental Council's Dental Auxiliaries Review Group in 1998 recommended regulatory changes that included expanded functions for dental hygienists and therapists[8]. In Canada, health economist Manga recently concluded from his review of the literature that, based on technical competence, quality of care, safety of patients and other criteria, there was no rationale for dentists' supervision or direction of dental hygienists or for examining patients before they go to a dental hygienist[20].

New practice arrangements have been emerging, in particular in Europe and North America[8,21–26], which include broader community-based, multi-disciplinary configurations and independent dental hygiene practice. At the time of this study, independent practice was reported for Denmark, Finland, Germany, the Netherlands, Norway, Sweden, and selected provinces or states of Canada, Switzerland, and the United States.

As the entrepreneur dental hygienist assumes legal and fiscal responsibility for practice, there will be an increasing shift in decision-making responsibility involving, for example, dental hygiene treatment regimes and office protocols and procedures. 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.

Methods

The study was descriptive and exploratory in nature. The purpose was 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.

The sampling frame consisted of national dental hygienists' associations, the majority of which are 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 by mail 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[1–4], publications[5,6] and numerous invited presentations at national and international symposia and conferences.

Results

As indicated in *Table 1*, response rates were exceedingly high. By 2001, the database included information for Australia, Austria, Canada, Denmark, Finland, Germany, Israel, Italy, Japan, Korea, Latvia, the Netherlands, New Zealand, Nigeria, Norway, South Africa, Spain, Sweden, Switzerland, the United Kingdom, and the United States, plus Hong Kong.

The first objective involved the availability of data. Overall, findings were positive even given the variability of national dental hygienists' associations' access to basic planning information, coupled with problems inherent in the use of an English-language questionnaire for an international study. Regarding *completeness* of the data, for the 2001 survey all questions were answered, suggesting the survey instrument had face validity. Data apparently were becoming more available – by 1998 and 2001, there was a marked proportionate decrease for the *data not available* and *don't know* response categories. Regarding *timeliness* of the data, across the four surveys, two-thirds of the associations were able to report data for the year specified in the questionnaire – important when making comparisons across nations. Although Canada, Japan and the United States

Table 1 International profiles of dental hygiene: participating countries, by year of survey

Survey year	Sampling frame	Survey responses	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	20	See 1998, plus Austria and Latvia (and the jurisdiction of Hong Kong[2]) and except Nigeria and Switzerland

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 for 2001.
2. Information for Hong Kong was excluded from the analysis presented in this report; it will be maintained as part of the longitudinal database.

persistently were exceptions, by 2001, the time lag between 'year specified' and 'year of data provided' had been reduced for most items.

The remaining objectives involved the development of descriptive profiles and monitoring of trends and changes in the profession. Overall, survey results indicated the profession globally was remarkably homogeneous. Changes noted for the period 1987 to 2001 involved, in particular, the supply and workforce participation patterns of dental hygienists; however, these and other apparent changes should be viewed with caution given the relatively short 14-year data span.

Title

The term *dental hygienist* was reported to be the official title for the profession for 17 of the 19 countries. Exceptions were *oral hygienist* for South Africa and *dental therapist* for Nigeria. Based on the characteristics examined below, little difference was apparent with the exception, in particular, of the inclusion of restorative functions as an integral part of the dental therapists' practice, together with a reduced emphasis on periodontal therapy.

Historical development

Historically, the profession originated in the early 1900s in the United States, followed by Norway in 1924. Near the end of the next quarter century, it had commenced in another three countries – the United Kingdom (1943), Japan (1948) and Canada (1949). The greatest expansion globally occurred during the third quarter (1950–1974) with the addition of another eight of the countries surveyed – listed in sequence, these were Nigeria, Denmark, Switzerland, Korea, the Netherlands, Sweden, Australia and South Africa. During the fourth quarter (1975–1999), dental hygiene commenced in a further seven countries – Austria, Finland, Israel, Italy, Spain, New Zealand, and, most recently, Latvia in 1995.

Legislation to regulate the practice of dental hygiene tended to be approved either in the year the profession reportedly was first established or shortly thereafter. For nine countries, the delay between establishment and legal recognition was two years or less whereas for another six countries it ranged from 10 years (for Italy) to 56 years (for Norway). Enactment of legislation for Australia, Canada, Switzerland, and the United States occurred on a regional basis for each country and considerable time elapsed before the process was complete. Legislation pertaining to dental hygiene did not exist for Austria and Germany at the time of the survey.

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

Supply and distribution

Using information provided by respondents regarding the numbers and distribution of dental hygienists, as well as the population and dentists for their respective countries, ratios and percent changes were calculated. Selected results are presented in *Table 2*. Two aspects of dental hygiene supply were investigated, the *total* number for a country and the number *legally authorised* to practice; the latter was defined as persons that currently held the necessary professional credential to practice as a dental hygienist (that is, through registration, certification and/or licensure).

Total

This varied widely, ranging from a high of approximately 169,636 for Japan to a low of 10 for Austria. The United States ranked second with 140,750, while next with markedly fewer numbers were Korea (17,102) and Canada (14,789), followed – again distantly – by Spain (5,000) and the United Kingdom (3,944). The largest group (n=8 countries) had from 500 to 2,000 dental hygienists. Fewer than 150 dental hygienists were reported for, in descending order, New Zealand, Latvia, Germany, and Austria.

Table 2 Supply of dental hygienists: total number, number authorised to practice, population and dentist ratios, and percent change

Country	Year to which data apply	Dental hygienists total (N)	Dental hygienists authorised to practice[1](n)	Dental hygienist: population ratio[2]	Dental hygienist: dentist ratio[3]	Percent change Survey 1 to Survey 4[4]
Australia	2000	500	420	1:47,143	1:33[5]	+145.6
Austria	2001	10	[6]	1:800,000	1:360[4,5]	
Canada	2001	14,789	14,057	1:2134	1:1	+137.6
Denmark	2001	1900	1000	1:5300	1:5	+53.8
Finland	2000	1350	1200	1:4333[5]	1:4	
Germany	2000	110	[6]	1:736,354	1:500[4]	
Israel	2000	missing	750	1:8000	1:11	
Italy	2001	1500	1500	1:40,000	1:17	+976.9
Japan	1998	169,636	61,331	1:2066	1:1[5]	+87.8
Korea	2000	17,102	8500	1:5562	1:2	+77.9
Latvia	2001	129	105	1:22,857	1:16	
Netherlands	2000	2000	2000	1:8,000	1:4	+98.0
New Zealand	2001	140	140	1:25,000	1:11	
Norway	2001	1050	missing	1:4476[5]	1:4	+183.8[7]
South Africa	2000	1125	889	1:44,994[5]	1:5	
Spain	2000	5000	4000[5]	1:9000	1:3	
Sweden	2000	3100	3100	1:2903	1:3	+72.2
United Kingdom	1999	3944	3944	1:14,199	1:8	+79.9
United States	1998	140,750	85.0%[5]	1:1920[5]	1:1[5]	+49.7

[1] Authorised refers to persons working or legally available for work in dental hygiene – that is, those registered to practise and who hold a current certificate or licence if required.
[2] Ratios are based on the number of dental hygienists authorised to practise.
[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 based on numbers of dental hygienists authorised to practise.
[5] Estimate. The figure either is based on data for different years or unknown.
[6] Legislation to regulate the practise of dental hygiene, including issuance of a professional credential, did not exist for Austria and Germany at the time of the survey.
[7] Percent change was calculated based on the total number of dental hygienists.

Authorised

When supply was defined in terms of dental hygienists *authorised* to practise, the picture changed for nine of the countries reported. (The item was not relevant for Austria and Germany since legal provision for the registration of dental hygienists did not exist at the time of the survey).As noted in *Table 2* the greatest variation was evident for Japan and Korea where only approximately 36.0 per cent and 50.0 per cent respectively were currently authorised to practise; this phenomenon reflected both public health policies and family values that encouraged married women not to work outside the home.

Trend

Percent change in the number of authorised dental hygienists was calculated using previously reported survey information. No percentage decreases were observed, with the exception of Spain, and percentage increases tended to be substantial. For Canada, Denmark, Italy, and Norway, increases over the 14-year period ranged from a high of 976.9 per cent for Italy to a low of 49.7 per cent for the United States. For another four countries, data were available for a 13-year period; among this group, variability tended to be less and the greatest increase was observed for the Netherlands (98.0 per cent). Increases for another two countries were noteworthy – 145.8 per cent for Australia and 118.3 per cent for Nigeria over 12-year and 10-year periods respectively.

Ratios

Ratios are useful when planning, for example, the appropriate mix and number of service providers. The dental hygienist-to-population ratio indicates service accessibility and the dental hygienist-to-dentist ratio indicates technical efficiency. Ratios involving dental hygienists were based on the number authorised to practice, with the exception of Austria and Germany. Data typically were reported for 2000 or 2001. For Canada, Japan, and the Netherlands, a discrepancy of one year existed in the data reported for dental hygienists, total population, and/or dentists; for Israel, the discrepancy was slightly greater (*Table 2*).

As noted in *Table 2*, the dental hygienist-to-population ratio was highest for the United States, Japan, Canada, and Sweden and lowest for Austria and Germany. The lowest recorded ratio in the longitudinal database was 1:20,000,000 for Nigeria, observed in 1998.

Regarding the dental hygienist-to-dentist ratio, it was approximately 1:1 for Canada, Japan and

Table 3 Employment status of dental hygienists: percent working in dental hygiene, definition of and percent working full-time, by country, 2001

Country	Year to which data apply	Percent working in dental hygiene	Percent that work full-time	Number of hours/week considered full-time
Australia	2000	95.0	60.0	35+
Austria	2001	90.0	10.0	40
Canada	2001	93.0	57.0	37.5
Denmark	2001	95.0	60.0	37
Finland	2000	70.0	majority	38
Germany	2000	D/K	D/K	38.5
Israel	2000	80.0[1]	50.0[1]	40
Italy	2001	80.0	80.0	40
Japan	1998	36.0	D/K	40[2000]
Korea	2000	50.0	95.0	44
Latvia	2001	91.0	70.0	40
The Netherlands	2000	80.0	D/K	36
New Zealand	2000	95.0	20.0	35
Norway	1999	60.0	70.0	37.5
South Africa	2000	70.0	D/K	40
Spain	2000	95.0[1]	70.0–80.0	40
Sweden	2000	95.0	70.0	40
United Kingdom	2000	D/K	D/K	35
United States	1998	D/K	D/K	32

1. Estimate

the United States, with no change since 1998. For another nine countries, the ratio of dental hygienists to dentists ranged from 1:2 to 1:5. The lowest ratio of 1:500 was observed for Germany, followed by 1:360 for Austria.

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 somewhat more available since the database was first established. Participation data were provided for 13 of 19 countries in 2001, with estimates for another three countries, an increase from one-half in 1993; exceptions were Germany, the United Kingdom, and the United States. Time worked data were reported for 10 countries and estimated for Israel and Spain; exceptions were Finland, Germany, Japan, the Netherlands, South Africa, the United Kingdom, and the United States.

Participation

Overall, workforce participation was high, that is, for 12 of the 16 countries reported, at least 7 out of 10 dental hygienists worked in dental hygiene. Workforce participation increased over the varying periods for which data were available, consistent with the trend among women in general. Since 1998, notable increases were observed among dental hygienists in Italy, Korea, and New Zealand; the exception was Denmark for which a decline was reported.

Time worked

'Full-time' was defined nationally as the number of hours worked per week that reportedly constituted full-time employment. Results indicated that the definition ranged from a high of 44 hours per week for Korea to a low of 32 hours per week for the United States (see *Table 3*), and among the majority of countries did not change over time. Given the importance of using 'full-time equivalents' to estimate labour supply for a predominately female occupation subject to the dual demands of child rearing and paid work, it was surprising to find that information regarding full-time employment apparently was not available for seven of the 19 countries reported. For 10 of the 12 remaining countries, dental hygienists worked full-time more than part-time. Proportions for the 'full time' group ranged from a high of 95.0 per cent for Korea to a low of 10.0 per cent for Austria.

Dental hygiene education

Characteristics of dental hygiene education examined for the study included number, type and length of programmes and number of graduates in the past year. Selected findings are presented in *Table 4*.

Entry-level programmes

Certificate or diploma types of entry-level dental hygiene programmes were reported for 16 countries. Exceptions were Austria and Germany where no programme existed and Finland where they were offered at the baccalaureate level only. In addition to diploma programmes, at least one baccalaureate entry-level

Table 4 Entry-level certificate/diploma programs in dental hygiene: number, length of program and school year, and total number of recent graduates, by country, 2001

Country	Number	Length of programme (years)	Length of school year (months)	Number of graduates in 2000
Australia	2	2	8	36
Austria	0	–	–	–
Canada	27	2–3	7–9[1]	798
Denmark	2	2.5	12	90
Finland	Entry level programs are offered at the baccalaureate level only			
Germany	0	–	–	m
Israel	3	2	9	60[2]
Italy	19	3	11	140
Japan	135	2	8.5	7000
Korea	25	3	7.5	2300
Latvia	2	2+1 (DN+DH)	10	24
The Netherlands	4	3	10.5	156
New Zealand	1	2	10	16
Norway	3	2	10	54
South Africa	3	2	12	46
Spain	20	2	10	±300
Sweden	9	2–3	10	170
United Kingdom	16	2	10	160[1999]
United States	197[3]	2	7–12	4074[1998]

[1] Total months per year vary – typically 9 for community college-based programs compared to 9 months for university-based programmes.
[2] With the opening of a third program in 2000, the total number of graduates will increase to 90.
[3] Of the 197 programmes, 9 granted a certificate in dental hygiene and the remaining 188 granted an associate degree.

programme was reported for Australia, Canada, the Netherlands, Norway, South Africa, Sweden, the United Kingdom, and the United States; the number of programmes and of countries appeared to have increased since 1998. The vast majority of entry-level programmes were offered at the post-secondary or equivalent level and were approximately two years in length. Programmes based in community or technical colleges were more predominant than those in universities. Numbers of programmes varied widely, with the largest group (n=9 countries) reporting fewer than five programmes each. The greatest number of programmes was reported for the United States (n=197), followed by Japan (n=135). As expected, the total numbers of graduates also varied widely. By far the largest numbers reported for 2000 – specifically, 7,000 and 2,300 – were for Japan and Korea respectively; as noted previously, the highest workforce attrition rates were reported for these two countries. (Although the United States presumably ranked second with 4,074 graduates, the data provided pertained to 1998, not 2000).

Graduate-level programmes in dental hygiene

Masters programmes in dental hygiene were reported for Norway, Sweden and the United States. One doctoral programme was reported for Sweden.

Trends

Dental hygiene education continues to evolve. Major changes were anticipated for all countries except Denmark. Cited most frequently was increased entry programme length, followed by expansion of the curriculum typically to the baccalaureate level, and increases in both number of programmes and number of graduates.

Dental hygiene regulation

Professional regulation exists under public statute to register persons authorised to practise, regulate supply, and ensure safety and quality of services. Three characteristics pertaining to dental hygiene were examined – namely, method of regulation, registration requirements, and decision making responsibilities. Findings are summarised in *Table 5*. At the time of the survey, legislation did not exist to legally recognise and regulate the practise of dental hygiene in Austria.

Method

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 method was reported for Israel, Japan, Korea, and South Africa, plus another six in Europe. For six of the countries, namely Finland, Israel, Italy, Korea, the Netherlands, and South Africa, dental hygienist representatives served on the government boards, an increase over past findings.

Second most prevalent was

Table 5 Professional regulation of dental hygienists, by country, 2001

Country	Type of professional regulation			Requirements for immigrants			
	#1 Self regulation	#2 Dental Board	#3 Government agency	Proof of graduation	Written exam	Clinical exam	Case review
Australia		X		X	X	X	
Austria		No legislation[1]		to employer			
Canada	X[2]	X	X	X[3]	X	X	X
Denmark			X				X
Finland			X	X	X	X	X
Germany		No legislation[1]		to employer			
Israel			X	X	X	X	
Italy			X			[4]	
Japan			X	X	X		
Korea			X	X	X	X	
Latvia		X		X	X	X	
The Netherlands	X			X			X[5]
New Zealand		X		X			X
Norway			X	X			
South Africa			X	X	X	X	X
Spain			X	X		[6]	
Sweden			X	X			
United Kingdom		X			X	X	
United States		X		X	X	X	

[1] At the time of the survey, there was no legislation for dental hygiene.
[2] Method of regulation varies by province and territory. In 2001, 92.0% of dental hygienists were self-regulating; less than 1.0% were regulated through a government agency.
[3] Varies by province. French language proficiency certificate required for Quebec.
[4] Italian citizens must show proof of graduation from a dental hygiene programme equivalent to those in Italy. Residents of an EC member nation must obtain a work permit. All other persons must successfully complete a dental hygiene programme in Italy.
[5] Unsuccessful applicants are required to complete further schooling in dental hygiene.
[6] To work in public health, successful completion of an examination is required.

indirect regulation through a governing board consisting primarily or solely of dentists. This method was reported for seven countries (Australia, several jurisdictions in Canada, Germany, Latvia, New Zealand, the United Kingdom and the majority of jurisdictions in the United States). Of that group, dental hygienist representation on the dental governing boards was reported for all except Germany, Latvia, and New Zealand.

The third method involved self-regulation whereby the governing board consisted primarily of dental hygienists. By 2001, self-regulation existed for the Netherlands, nine out of ten dental hygienists in Canada, and several of the United States, an overall increase since 1998.

Registration

Three methods were evident. Most predominant was proof of graduation from a recognised dental hygiene educational programme with no further credential being required; this method was reported for Germany, Italy, Latvia, the Netherlands, New Zealand, Spain, and Sweden. A certificate, that by definition does not require periodic renewal, was required for six countries (Denmark, Finland, Israel, Japan, Korea, and Norway). A licence, that typically must be renewed annually, was required for Australia, Canada, collaborative practise in Latvia, South Africa, United Kingdom and United States, and was proposed for New Zealand.

Regarding registration requirements for immigrants, two groups were evident (*Table 5*). For nine countries, applicants had to successfully complete both written and clinical examinations and, with the exception of the United Kingdom, provide proof of graduation from an approved dental hygiene programme. For another seven countries, requirements consisted solely of proof of graduation and/or an individual case review. Requirements varied widely for the remaining countries. For Spain, a clinical examination in addition to the usual written examination was required to work in public health. For Italy, immigration from abroad was not encouraged: while residents of a member nation of the European Community were required to obtain a work permit, all other immigrants had to acquire a dental hygiene diploma through an educational programme in Italy. For Japan, proof of graduation plus a written examination only was required. No authorisation other than proof of graduation to the employer was required for Austria.

Decision making responsibility

Professional accountability and

Table 6 Decision-making responsibility and work supervision for dental hygienist clinicians, by type of practice setting and country, 2001

Country	Most typical work situation: Person that decides dental hygiene services to provide and level of work supervision							
	Dentist dentist decides all procedures and remains on-site when dental hygienist works intra-orally		Dentist dentist decides all procedures: may be off-site when dental hygienist works intra-orally		Collaborative dental hygienist and dentist together decide services required: dentist may be off-site		Independent dental hygienist decides in collaboration with client: refers as needed	
	Dental office	Public sector	Dental office	Public sector	Dental office	Public sector	Dental office	Public sector
Australia	X	X						
Austria	X	X						
Canada					X	X		
Denmark							X	X
Finland					X	X	X	X
Germany			X	N/A	X		X	
Israel	X	X			X			
Italy		X	X		X			
Japan	X	X						
Korea					X	X		
Latvia					X			Clients < 18 years of age
Netherlands					X[1]	X	X	X
New Zealand	X	N/A						
Norway					X	X	X	X
South Africa			X	X				
Spain			X	X				
Sweden							X	X
United Kingdom			X	X				
United States	X		X	X	X	X	X[2]	X[2]

[1] Level of work supervision varies by type of procedure - for example, anesthesia.
[2] In California and Oregon, specially qualified dental hygienists may work independent of a dentist to provide services to selected groups including residents of long term care facilities and in under-serviced areas.

autonomy for dental hygienists have been evolving for many countries, as evidenced by reported changes in legislation and practise. Under the traditional models of direct and indirect supervision, legally the dentist decides 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*).

There has been a gradual but increasing shift since 1987 to *collaborative* practice whereby the dentist and dental hygienist together decide the services required. The prevalence of independent practice continues to grow, in which the dental hygienist makes decisions regarding dental hygiene care in consultation with the client, referring as required to a dentist or other healthcare professional (*Table 6*). Indicative of the gradual evolvement, more than one method of decision-making was reported for a number of countries. With few exceptions, supervision requirements tended to be consistent regardless of whether the workplace was in the public or the private sector. Findings tended to vary by province or state for countries with multiple jurisdictions such as Canada and the United States.

The dentist as decision maker was the sole method reported for seven countries, namely Australia, Japan, New Zealand, South Africa, Spain, the United Kingdom, and Austria (where it was not yet legally mandated). It was one of two or more methods for Israel, Italy, and some jurisdictions of the United States. The collaborative method was reported for a total of ten countries. It existed for dental hygienists working in private and public sector workplaces in Canada, Finland, Korea, the Netherlands, Norway and the United States, and for the private sector only in Germany, Israel, Italy, and Latvia.

Independent practice was reported for a total of eight countries, a slight increase over findings for 1998. It was the sole method reported for Denmark and Sweden and co-existed, together with collaborative practice, for Finland, Norway and the Netherlands. For Latvia and two states in the USA, independent practice was limited to specific types of workplaces and/or specially qualified practitioners.

Trends

Over the survey period an overall growth in professional autonomy for dental hygienists was observed in that decision-making responsibilities increased while requirements for work supervision declined. Change was observed for nine of the 11 countries for which data were available for both 1987 and 2001; exceptions were Australia and Japan where the traditional method tended to prevail.

Changes in the regulation of dental hygiene practice were anticipated for 10 countries. Introduction of legislation to regulate dental hygiene practice was expected for Austria and Germany. Amendments that would provide for the registration and annual licensing of dental hygienists were to be proposed for New Zealand, while requirements for Australia were expected to change. Other anticipated changes included the introduction of self-regulation for the remainder of Canada and parts of the USA and direct billing of health insurance plans for dental hygienists' services for Canada and Finland. Independent practice without referral from a dentist was reported for the Netherlands and an increase in independent practice but limited to specific population groups for the United States.

Employment

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

Work role

Clinical practice remains by far the most predominant work role among dental hygienists. For fourteen countries, at least eight out of 10 dental hygienists reportedly worked in clinical practice; for 11 of those countries, the proportion increased to at least nine out of 10. A notable exception was South Africa where the proportion for clinical declined to 40.0 per cent.

Workplace

Regarding type of workplace or practice setting, respondents were asked to rank eight types according to prevalence for their country. Information for Israel and the United States was reported for the private dental office only. Based on feedback from respondents for Canada, Finland and the Netherlands, another category is required for surveys of this type, that of the private dental hygiene office. Findings tended to vary depending on whether a country's oral healthcare system was based primarily in the private or the public sector. There was little change in distribution over the study period.

In 2001, the private dental office was by far the most predominant. Cited for all 19 countries, it ranked first for sixteen and second for Finland, Norway and Sweden. Second most predominant was the public or community health workplace. Cited for 14 of the 17 countries for which data were available, it ranked first for the above three Scandinavian countries and second for Canada, Denmark, Italy, Korea, South Africa, and Spain. Although the dental hygiene educational programme was cited as a workplace for a total of 16 countries, it typically ranked third or lower in terms of prevalence.

Anticipated changes in workplace distribution were reported for eight countries. Cited most frequently was an expected increase in community health positions. They included positions in nursing homes for Australia, school clinics for Denmark and Korea, hospital clinics for New Zealand, and public health for the United States. For Canada and Finland, positions in both the public and private sectors, including independent dental hygiene offices, were expected to increase once changes to dental insurance coverage and, for Canada, to legislation regarding work supervision were implemented. Establishment of a dental hygiene education programme for Austria was expected to produce teaching positions.

Employment opportunities

In 2001, employment in dental hygiene was reported to be very available for eleven countries – a marked improvement over the two countries reported for 1998. Employment was rated as somewhat available for New Zealand and Sweden. In contrast, it reportedly was very scarce for Italy, somewhat scarce for Israel, and neither scarce nor available – that is, 'neutral' - for Canada, Germany, Japan, and Spain. The greatest increase since 1998 in availability of jobs was noted for Sweden (from *very scarce* to *somewhat available*), followed by Denmark, South Africa, and the United States (from *neutral* to *very available*). No change was observed for Australia, Israel, Korea, New Zealand, and Spain.

Career opportunities

Greater variation was apparent regarding the availability of career opportunities for appropriately qualified dental hygienists, i.e. those with advanced academic qualifications and/or specialised experience. Career opportunities were reported to be somewhat scarce for Australia, Canada, Germany, Japan,

New Zealand, and Norway, and very scarce for Sweden. On the other hand, they were perceived to be very available for Austria, the Netherlands, South Africa, and the United States, and somewhat available for Denmark, Finland, and Korea. Respondents for Italy, Latvia, Spain, and the United Kingdom tended to be ambivalent.

Remuneration

Remuneration consists of wages and benefits. For this study, the wage component was defined as the annual salary (reported in US$) earned on average by dental hygienists that work full-time. It is recognised that the wage rate may be comparatively low for countries where the population is relatively more reliant on self-produced agricultural, clothing, and other items required for daily living.

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 Germany and the United Kingdom, and was incomplete for Austria and the United States.

Remuneration varied widely by country and type of workplace. Overall, it appeared to be greatest for Australia, Austria, and Denmark, and least for Latvia and Korea, with the highest annual rate $40–50,000 reported for Austria and the USA. For Canada, Denmark, and Norway, the average annual wage rate ranged from $30–39,999, declining to $20–29,999 for Australia, Italy, Japan, and Sweden. For the largest group of countries (Finland, Israel, Korea, the Netherlands, New Zealand, South Africa, and Spain) the reported annual wage rate ranged from $10–19,999. Wages were lowest for Latvia, at less than $5,000 annually, followed by South Africa.

Wages varied by type of workplace. For eight countries, they tended to be higher among those working in educational programmes. Included in this group were Australia, Canada, Japan, Korea, New Zealand, Norway, Spain, and Sweden; for Sweden, wages in the dental industry were similar to education whereas for Japan, educational programmes and public health wages were similar. For another six countries (Denmark, Finland, Israel, Italy, Latvia, and the Netherlands) wages were higher for those who worked in dental offices; for the Netherlands, the dental industry was also cited. For South Africa, wages were reported to be highest in the dental industry.

From a list of twelve employment benefits, respondents indicated those that were usually available to dental hygienists working full-time. Information was available for 18 countries, the exception being the UK. Four benefits were predominant: vacation leave and legal holidays (n=17 countries each) and sick leave and maternity leave (n=16). Next most frequently cited were continuing education courses and health insurance premiums (n=13), followed by contributions to a pension fund (n=12). Convention fees and merit pay or bonuses were reported for just over one-half of the countries (n=11 and n=10 respectively), and disability insurance premiums for one-half. Least frequently reported were overtime pay and cost of living increases (n=7 countries each).

From 10 to 12 benefits were reported for one-half of the countries, although the actual distribution varied by country. Denmark and Sweden ranked first with all twelve benefits cited. For the largest group of countries (n=7), 10 benefits each were reported; included in this group were Finland, Germany, Italy, the Netherlands, Norway, South Africa, and Spain. Nine benefits each were reported for Australia, Austria, and Korea, and seven benefits for the United Kingdom. Less than one-half of the benefits were reported for the remaining five countries; Canada, Japan, and New Zealand (5 benefits each), Latvia (n=4), and Israel (n=3).

Overall, employment benefits changed little in terms of availability over the study period. (It should be noted that fluctuations in information for a country from survey to survey may reflect availability of data and /or reporting inconsistencies more than employment reality). A change in remuneration was anticipated for seven of the 19 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 (Austria and Denmark), increased self-employment (Finland), increased earnings (Latvia), and a retirement fund (the Netherlands); factors were not specified for Italy and New Zealand.

Clinical practice

Two aspects of dental hygiene practice were investigated, its legally defined scope and alternate providers for those intra-oral services. Seventeen countries were included in the analysis, the exceptions being Austria and Germany for which a legal scope of practice did not exist at the time of the survey. Findings are summarised in *Table 7*.

Scope of practice

The four dimensions of clinical practice examined were client assessment, planning dental hygiene care, and preventive and therapeutic services. Findings were remarkably similar worldwide. Overall, clinical practice was characterised by a common set of activities. Of the 28 procedures specified, 18 were within the legal scope of dental hygiene practice for 16 or more countries; actual distribution varied by procedure and country. Variance was greatest among the assessment and therapeutic procedures. A comparison of findings for the four 'profile' surveys

Table 7 Scope of dental hygiene clinical practice, by dimension, number of procedures examined and country

Country	Dimension of practice and number of procedures (N) Assessment (N=8)	Planning (N=6)	Preventive (N=6)	Therapeutic (N=8)
Australia	6	6	6	4
Canada	8	6	6	7[1]
Denmark	7	6	6	7[2]
Finland	7	6	6	6
Israel	7	5	6	4
Italy	6	5	5	4
Japan	5	5	5	6
Korea	7	6	6	7
Latvia	6	6	6	4
The Netherlands	8	6	6	8[2,3]
New Zealand	7	3	6	4
Norway	8	6	6	5
South Africa	8	6	5	7
Spain	8	5	6	5
Sweden	6	6	6	5
United Kingdom	2	4	6	5
United States	8	6	6	5

[1] Varies by province.
[2] Dental hygienists may finish restorations but not place them.
[3] Dental hygienists in an experimental children's program may do cavity preparation.

disclosed that a change in scope had occurred across all dimensions of practice and for the majority of countries for which longitudinal data were available. Responses for 2001 indicated that more changes were expected.

Client assessment

Of the eight procedures examined, only one reportedly was common to all 17 countries, that of performing a soft tissue examination. Second most frequent was taking/reviewing medical history, cited for 16 countries, followed by performing a hard tissue examination and exposure and use of radiographs (n=15 each). Cited for 14 countries were taking vital signs, performing diagnostic tests, and making dental impressions. Least frequently cited was the extra-oral examination (n=11). In terms of distribution, all eight procedures were reported for Canada, the Netherlands, Norway, South Africa, Spain, and the United States. Seven procedures each were reported for Denmark, Finland, Korea, Israel, and New Zealand. Six procedures each were cited for Australia, Italy, Latvia, and Sweden. Only two procedures were cited for the United Kingdom, a marked decrease from findings for the previous surveys.

Dental hygiene care plan

A total of six activities and decisions were examined. Across all 17 countries, the scope of dental hygiene practice included identifying dental hygiene care needs and informing the client of assessment findings. Informing the client of dental hygiene treatment options was cited for all countries except the United Kingdom. Similarly, decisions regarding both the sequence in which dental hygiene services should be provided and the appointment schedule itself were within the scope of practice for all 17 countries. However, the decision regarding selection of actual dental hygiene services to provide for a client was excluded for Israel, Italy (unless made jointly with the dentist), Japan, Spain, and the United Kingdom.

Preventive services

Six procedures were investigated. Findings were remarkably similar across all 17 countries. Reported for all countries were oral hygiene and diet counselling and application of topical fluorides and fissure sealants. The decision regarding self-care products to recommend was reported for all countries with the exception of Japan. Counselling for smoking cessation was excluded for Italy and South Africa.

Therapeutic services

Of the eight procedures examined, supra- and sub-gingival calculus removal and stain removal were common to all 17 countries. Subgingival irrigation was cited for all countries except Finland. The remaining four procedures were cited for relatively few countries and their distribution varied. Administration of local anaesthesia was reported for Canada (selected provinces), Denmark, Finland, Korea, the Netherlands, South Africa, Sweden, the United Kingdom and the United States. Placement and fitting of orthodontic bands was reported for Canada (selected provinces), Denmark, Finland, Japan, the Netherlands, Norway, South Africa, and Spain. Placement and finishing of dental restorations was reported for Canada (selected provinces), Denmark, Finland, Japan, Korea, the Netherlands, and South Africa. In addition, dental hygienists in Denmark may finish restorations previously inserted by a dentist and those in Spain may place and finish temporary restorations and finish permanent ones. Cavity preparation or 'drilling' was reported only for the Netherlands.

Anticipated changes

For one-half of the countries (n=9), no change in scope of practice was anticipated. Among the remainder, changes reported for the Netherlands were particularly notable; clinical practice is to include detection, diagnosis and treatment of

small carious lesions. For South Africa, local analgesia, temporary cementing of inlays, crowns and bridges, orthodontic procedures, and placement of temporary filings, denture linings, and desensitising agents will be added to the scope of practice. Administration of local anaesthesia is to be included for more jurisdictions in Canada and for New Zealand, Norway, and the United Kingdom. For the United States, inclusion of oral cancer screening using brush biopsy was anticipated. An unspecified increase in scope of practice was noted for Finland.

Alternates

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 directly associated 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, five broad categories of personnel were identified. They included the intra oral or prophylaxis dental assistant (n=9 countries), chair side dental assistant (n=8), dental therapist (n=5), denturist or dental mechanic (n=3), and dental technician (n=2). In addition, an aid nurse and a receptionist were reported for Korea. At least one alternate to the dental hygienist was reported for all countries, with the exception of Israel. For approximately one out of two countries (n=9), only one type of alternate was reported, most frequently the dental assistant. The greatest variety was reported for Australia, Canada, and South Africa, with three types each.

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. There was one exception in that all 28 procedures were cited for the intra oral dental assistant in Austria. Over all countries for which they were reported, the intra oral dental assistant, followed closely by the dental therapist, tended to perform the greatest number of procedures in common with the dental hygienist; however, on a country-by-country basis, the range of procedures was limited. For example, the dental assistant typically did not perform hard and soft tissue and extra oral examinations, decision-making associated with planning care, and the majority of therapeutic procedures examined. Similarly, the dental therapist appeared to focus on caries detection and diagnosis (for example, hard tissue examination and radiographs) and subsequent treatment, more so than on periodontal assessment, therapy and maintenance – the latter remaining largely exclusive to the dental hygienist and the dentist.

Professional organisation

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

Structure

Dental hygiene is organised globally through the International Federation of Dental Hygienists (IFDH). By 2001, IFDH members included national dental hygienists' associations for 23 countries. Respondents for 12 of the 19 member associations included in this analysis reported that, geographically, the organisational structure was multi level. That is, it included regional associations (for example, state or provincial) and, for Canada, Italy, and the United States, local associations (for example, municipal) also.

Membership

A membership rate, an indicator of an organisation's perceived legitimacy and influence, was calculated based on the proportion of authorised dental hygienists that were members of their respective national dental hygienists' association. Over the period since 1987 or 1992 (depending on when a country was first included in the survey) and among the 13 associations for which data were available, membership rates tended to increase; the greatest proportionate growth was observed for Canada and Denmark.

By 2001, membership overall tended to be relatively high but varied widely. It ranged from 100 per cent for Denmark, Germany, and Korea, followed by 88 per cent for Sweden, to a low of 16 per cent for Spain and 18 per cent for South Africa. For almost one-half of the associations (n=9), the rate was 70 per cent or greater. This group included, in addition to the countries cited above and in descending order, Australia, Austria, Finland, Canada, and Latvia. A rate of at least 50 per cent was observed for the Netherlands, the United Kingdom, and New Zealand. Relatively low membership rates observed for Japan and the United States were offset in part by the large numbers of members.

Practice guidelines

Respondents were asked to indicate whether three types of formalised (that is, documented) quality assurance guidelines had been developed/ adopted by the national dental hygienists' association. (In several instances, associations had endorsed guidelines developed externally, for example, by IFDH or the World Health Organization).

A professional code of ethics either existed or was in the process of being developed for 15 associations; exceptions were Germany, Japan, Spain, and the United Kingdom. Standards for clinical dental hygiene practice were cited for eight member associations and under development for another four; they were reported as 'inac-

tive' for the American association. An infection control protocol was reported for eight associations and was 'in progress' for South Africa.

All three types of guidelines reportedly existed or were under development for the associations in Finland, Italy, Latvia, the Netherlands, South Africa, and the United States. Only one guideline each was cited for Israel, Japan, Norway, and Sweden, with no progress apparently made on the remainder. None of the three guidelines was reported for Germany, New Zealand, and the United Kingdom; however, a code of ethics and clinical standards were cited as 'in progress' for New Zealand and dental hygienists in the United Kingdom reportedly comply with guidelines issued by dental organisations.

Issues and initiatives

The final profile addressed future directions for dental hygiene – namely, perceived issues, anticipated changes, and organisational plans and initiatives. The topics cited remained remarkably constant over the years with only slight shifts in terms of predominance.

National issues were similar worldwide. The predominant issue, which was noted for 11 of 19 countries, involved dental hygiene practice. Within this category, two topics were cited most frequently. One involved a reportedly negative relationship between dental hygiene and dentistry, attributed for example to 'turf wars' and 'division of labour' problems. The other topic involved a need to improve access to dental hygiene services; related comments addressed scope of practice, direct billing of dental service plans, and independent practice. The second most predominant issue was dental hygiene education (9 countries). Cited most frequently were plans to extend the entry-level programme to a 3- or 4-year 'baccalaureate' programme.

Issues involving the regulation of dental hygienists ranked third overall, being cited for eight countries; scope of practice was the predominant topic.

At least one major change was expected for 17 of the 19 countries; exceptions were Denmark and Spain. Cited most frequently were changes involving dental hygiene education (n=11) and regulation (n=8); topics for the latter category varied widely.

Major plans and initiatives were reported by national associations for 14 countries; exceptions were Germany, Japan, the Netherlands, the United Kingdom, and the United States. Cited most frequently were initiatives to enhance the professional profile of dental hygiene, foster relationships with other non-governmental groups, and extend the entry-level programme for dental hygiene.

For the majority of countries surveyed, a relationship was observed between reported issues, expected changes, and organisational initiatives. It would appear that dental hygienists expected their concerns to be resolved and were working proactively through their professional associations to that end.

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. Results to date support 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 would appear to exist for most countries surveyed and have improved over time. Little relationship was evident between the size of a dental hygiene association and/or population and the evolution of the corresponding information system including, for example, frequency with which data were updated. The continuing high response rate suggests that associations approve of and support the project. The gradual reduction in missing responses over the period 1987 to 2001 suggests that, for many countries, data were becoming more available.

Problems persisted in the collection of information with which to calculate supply and population ratios; apparently data for the same year for dental hygienists, dentists and the population were not readily available to many respondents. Associations that had increased efforts to maintain a more complete, accurate and up-to-date database reported its usefulness at the national level. Efforts to capture the full range of situations revealed as additional countries are included in this project while at the same time maintaining the longitudinal integrity of the database continue.

Regarding the investigation of patterns and trends in the profession, by 2001 with the inclusion of 19 countries, the profile had become more global in scope and reflected the vast majority of the world's population of dental hygienists. Findings indicated a remarkable similarity, in particular in the scope of dental hygiene practice. The profession remained more similar than dissimilar in terms of historical development, educational preparation and professional organisation. Variation was increasing in terms of supply and distribution, regulation, labour force participation, hours worked, predominant work setting, and remuneration for clinical practitioners.

While apparent change over the period 1987 to 2001 should be viewed with caution due to the relatively short time span and the possibility of reporting inconsistencies between surveys, several observations are noteworthy. First was the dramatic increase in the overall supply of dental hygienists and in hygienist-to-population and –to-dentist ratios. Workforce

participation rates remain remarkably high for a predominately female occupation. Second, and with few exceptions, was the gradual decrease in requirements for work supervision, coupled with an increased prevalence in independent dental hygiene practice. Thirdly, the scope of practice and range of practice settings have continued to expand.

It was interesting to note that while the rate of change varied across the countries, the nature of the change tended to be consistent, with the result that the profession maintains a remarkable homogeneity worldwide. Based on the issues and initiatives reported for the 2001 survey, these trends are likely to continue. A more extensive sector-wide study would be required to determine whether the changes in supply and practice were subsequently reflected in improved access to and technical efficiency in the provision of oral health services. The results suggest that changes and trends in the profession should continue to be monitored; a fifth survey is scheduled for 2004.

Conclusions

Findings of this study, to date, have proven the feasibility and usefulness of the longitudinal database for monitoring and planning purposes. Trends and changes in supply and in professional education, regulation and autonomy indicate that dental hygiene continues to evolve as a profession. However, a number of issues remain, involving for example dental hygiene education, 'supervision' requirements, and financing of dental hygiene services. Several have contributed to inter-professional conflicts. Persistence of those issues has implications in terms of technical efficiency, cost containment, access to, and quality of, services, professional autonomy, and future work roles and opportunities for dental hygienists. With their growing responsibilities as primary care providers and entrepreneurs and increasingly more collaborative relationships in the workplace, coupled with population-based trends and changes, politico-economic pressures, and healthcare re-structuring initiatives, there is a need for renewed emphasis to resolve outstanding issues and provide future direction for the oral health professions.

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