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Dental hygienists in Europe: trends towards harmonization of education and practice since 2003

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Abstract: *Aim:* The aim of this study was to investigate the trends in dental hygienists' education and regulation in the European Union (EU) and European Economic Area (EEA) to examine whether, since 2003, there has been harmonization in dental hygiene education. *Methods:* Information and data were obtained via piloted questionnaires and structured interviews with delegates from the International and European Dental Hygienists' Federations and representatives of the Council of European Chief Dental Officers and by literature review. *Results:* In the EU/EEA, dental hygienists are legally recognized in 22 countries. Since 2003, there has been an increase in the number of Bachelor degree programmes and in autonomous practice. Entry to the profession is now exclusively via a Bachelor degree in five EU/EEA Member States and pending in two more. Ten Member States have adapted their degree programmes to the European Credit Transfer System. Two Member States combine education for dental hygienists and dental therapists. However, dental hygienists are not recognized by EU law and in five Members States, the introduction of the profession has been opposed by dental associations. *Conclusions:* For the reasons of wide variations in the standards of preventive care and periodontal therapies, the formal recognition of the dental hygiene profession by EU legislation and agreement on a pan-European curriculum for dental hygiene education leading to defined professional competencies and learning outcomes is required. To achieve this, there is a need for a better collaboration between competent authorities including governments, universities and dental and dental hygienists' associations.

Key words: bologna declaration; dental hygiene education; dental hygiene research, professional practice; dental hygienist; dental therapy; dental workforce; European credit transfer system; European union; evidence-based practice; harmonization of curricula; oral health

Introduction

Historically, the profession of dental hygiene was developed to address the populations oral health needs. Dental hygienists are therefore trained to acquire core skills in prevention and oral health promotion including periodontal therapies. In 2003, three comparative international studies were published (1–3). They described and compared educational attainment and practice. It was concluded that, in Europe, there was a movement towards increased academic attainment, independent delivery of care and extended scope of practice. At the same time, it was found that the profession was not harmonized and that an equitable quality of care could not be assured in all the member states of the European Union and European Economic Area (EU/EEA). This study investigates whether or not trends in education and practice, which were observed in 2003, are continuing and whether or not equitable access to dental hygiene care has improved in the EU/EEA Member States.

Since 2003, the enlargement of the EU, changes in the European Commission (EC) Directive on professional training and in reimbursement of care and the Bologna Process, which impacts on undergraduate academic studies (4), are all having an effect on dental hygiene education and competencies. The underlying principles of the EU include freedom of mobility of the workforce and access to equitable health care. These principles are best served by portability of licenses and by the harmonization of the educational process. Accordingly, several EU/EEA member states offer dental hygienists education at university level and have adapted their curricula to the European Credit Transfer System (ECTS), introduced in 1999, with the objective of making academic studies more attractive, transparent and transferable and thus promoting free movement for the dental hygienists workforce. Today, an estimated 50% of European school leavers go to university, allowing the conclusion that, if dental hygiene education does not result in the award of a degree, it may be increasingly difficult to recruit school leavers with adequate intellectual abilities to follow the scientific principles of evidence-based (EB) practice and autonomous provision of care.

Core skills for dental hygienists correlate with the majority of the current objectives of the World Health Organization (WHO) in relation to oral health (5, 6). These core skills are population-based and guided by the principles of disease prevention, health promotion and EB practice. WHO promotes a stronger public health orientation, with a focus on modifiable oral risk behaviours and on the reduction of periodontal diseases (5). The implications of the WHO approach connect oral health with general health and require that links between medicine and dentistry (7) and between practice and science be established and/or strengthened (8, 9). Projected demographic changes in Europe will lead to the need for more care for a growing elderly population whose members will often have complex health issues. Furthermore, many will take a number of medications. Clinicians will therefore increasingly need a strong background in EB clinical decision-making (10, 11). The application of critical thinking skills and the transfer of research knowledge to dental hygiene students and practitioners are fundamental for meeting these challenges (8). These developments necessitate a solid educational process in dental hygiene, with an academic orientation that integrates science and practice.

By 2003, dental hygiene education was offered in the Czech Republic, Denmark, Finland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, the Republic of Ireland, Romania, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland and the UK (1, 2). Since then, schools of dental hygiene are expected to open or re-open in Croatia, Germany, Hungary, Iceland and Malta (Table 1).

At the opposite end of the spectrum, a few EU Member States still oppose the introduction of the dental hygiene profession. This is possible because the above-mentioned European Directive does not recognize dental hygiene as a health profession. As a consequence, regulatory aspects are left to the discretion of individual EU Member States. These differences within the EU/EEA create the potential for heterogeneity in the education of dental hygienists and their practice and interfere with convergence of education as well as with an equitable standard of oral health care throughout the EU/EEA.

Dental hygiene workforce planning

Workforce planning and corresponding educational opportunities in a health profession ought to respond to demographics and to evolving challenges in the provision of care. In wealthier EU/EEA countries, there exists a demand for prevention, aesthetics and wellness, and recognition that oral health is an integral part of general health and of quality of life (12). The majority of Europe's estimated 30 000 dental hygienists are found in these countries and there is also evidence of a decline in dental decay in children (13) and a decline in numbers of edentulous older adults and a general improvement of oral health (14, 15).

The majority of European dental hygienists provide care on an individual basis in dental or dental hygiene clinics/offices/practices and, aside from their preventive orientation, they increasingly serve the high maintenance 'heavy metal generation', the growing number of persons who have maintained a

Table 1. **Educational attainment in Dental Hygiene in Europe (2007–2008)**

Country	Number of programmes	Study duration in years	Diploma	BA Degree	Expected changes
Czech Rep.	3	3	3	BA*	
Croatia	–	–	–	–	BA* programme pending
Denmark	2	2.5 and 3.5	1	1*	BA entry discussed
Finland	5	3.5	–	All*	
Germany	0†	?‡	–	–	1 BA pending 2009/10
Hungary	3	2 and 3‡	3	–	BA* pending 2009/10
Iceland§	–	–	–	–	1 BA* 2009
Ireland	2	2	2	–	1 BA* pending
Italy	20	3	15	5*	MA in DH pending
Latvia	1	1 + 2 and 2 + 2¶	1	–	BA programme planned
Lithuania	2	3 and 4	1	1	Change BA to ECTS
Malta**	–	–	–	–	2- to 3-year programme pending
The Netherlands	4	4††	–	All*	
Norway	3	3	–	All*	MA and PhD pending
Poland	2	3	2	0‡‡	BA planned
Portugal	2	3	–	All*	
Romania	Missing	3‡	All	–	
Spain	Missing	3	Missing	Missing	Missing
Slovenia	1	2	–	–	Diploma pending
Slovakia	1	3	–	All*	
Sweden	8	2§§ and 3	8	7*	BA* entry pending MA in DH
Switzerland	4	3	4	–	Expanded curriculum
UK	20	2.5 and 3	16 dual††	4*	More BA* programmes pend.

BA, Bachelor degree; MA, Master degree.
*BA degree programmes adapted to European Credit Transfer System (ECTS).
†One 3-year Swiss style Diploma programme was closed in 2006.
‡CE model for dental assistants.
§Foreign educated DHs are legally registered to work in Iceland.
¶For medical nurses or prophylaxis assistants who had 1 or 2 years of previous training.
**DH education was discontinued when needed workforce numbers were reached.
††Dual education as dental hygienists and dental therapists.
‡‡Applicable for postgraduate degree in public health.
§§Third year voluntary for BA degree after Diploma.
Comment of authors: Startups of Bachelor programmes in Hungary, Ireland and Iceland have currently been delayed due to the economic crisis

functional but heavily restored dentition as a consequence of complex restorative dentistry including crown- and bridgework and dental implants (14). Life expectancy is increasing and teeth are more likely to be retained. The ageing of the population poses new scientific challenges in the management of complex health issues. Increasingly, dental hygienists are also serving in institutions for the elderly and the mentally and physically disabled, in hospitals and in public health clinics, where they reach a larger segment of the population regardless of their socio-economic background.

An additional challenge for the European dental workforce is the polarization of dental caries in many EU/EEA Member States to the socio-economically deprived and immigrants from lesser developed nations (16, 17). Furthermore, in parts of post-communist eastern Europe, oral health has improved little overall and appears to have deteriorated in socio-economically deprived groups (18).

Studies from Sweden and from the UK concluded that dental hygienists were as effective in the diagnosis of caries (19) and periodontal diseases (20) as general dentists. Already, in Norway and in Finland, a growing number of patients (especially children and youth) receive primary oral health care from dental hygienists at public institutions (21). A Swedish study to assess the economic efficiency of an alternative division of labour based on an extensive use of dental hygienists combined with a reduced input of dentists showed a statistically significant, lower incidence of caries in the test group. A cost/benefit analysis showed a benefit/cost ratio of 1.48. Thus, the increased utilization of dental hygienists is cost-effective without a loss of quality of care for the patients (22). A more recent study in Sweden showed that patients had fewer negative attitudes towards dental hygienists than towards dentists (23) suggesting that many people might actually be more comfortable with dental hygienists as primary oral healthcare providers.

Dual education in dental hygiene and dental therapy

To facilitate cost-effective oral health equity for underserved and disadvantaged populations, and to respond to the future demographic changes, there is a need for a large multi-skilled dental hygienist and dental therapist workforce to promote oral health and to educate the public about fluorides, oral hygiene, smoking cessation and nutrition, as well as to provide care in residential institutions such as in nursing homes. Dual education models in dental hygiene and in dental therapy are emerging, leading to a combination of skills and competences, which enable dental hygienists/therapists to provide minimally invasive restorative care in addition to preventive and periodontal care (24, 25). If they are available in sufficient numbers, multi-skilled dually educated dental hygienists/dental therapists might impact on the reduction of disparities in oral health care (26). For example, a recent study suggested that a considerable proportion of work can be carried out by dental therapists (35.3% time on the treatment of primary caries) and dental hygienists (43% clinical time for the provision of periodontal care) (27).

Aims

Against this background, the aims of this study were to investigate whether or not:

- Dental hygienist education in Europe is responding to the new challenges and to the requirement for EB practice.
- New regulations increasingly promote autonomous delivery of care.
- Further steps towards harmonization of the profession have been taken in the EU/EEA.

Methods

Two papers published in 2003 (1, 2) provided baseline information for this study. They described access to care by dental hygienists in EU/EEA member States, the length of dental hygiene educational programmes, the curricula within such programmes, the nature of primary qualifications (Diploma or Bachelor degree) and legal regulations governing the delivery of dental hygiene care in the majority of European countries. In the present study, the approach taken was descriptive and exploratory. Information on comparative analysis of trends in the education and practice of dental hygienists was gathered using the English language, primarily closed-ended questionnaires, structured interviews and three fill in tables. The following questions were asked:

- When was the dental hygienist profession introduced and legally recognized in your country?
- How and by which agency is it regulated?
- Are dental hygienists permitted to provide care independently or only under supervision of a dentist (if yes, what kind of supervision)?
- Numbers pertaining to the dental hygienist and dental therapist workforce?
- Are changes expected and, if so, which changes?
- Number of dental hygienist education programmes?
- Number of Diploma or Bachelor degree programmes?
- Have Bachelor degree programmes been converted to ECTS?
- Are changes pertaining to educational attainment such as academic degrees or dual dental hygienist/therapist education expected and, if so, what changes?
- Are there opportunities for postgraduate degrees in dental hygiene or related fields?
- Expected trends and developments in scope of practice, output of graduates and work opportunities?

These questions were put to delegates of the International Federation of Dental Hygienists (IFDH) (28), of the European Dental Hygienists' Federation (EDHF) (29) and to representatives of the Council of European Chief Dental Officers (CECDO)* (30). Austria, Denmark, Finland, Germany, Great Britain, Italy, Latvia, Lithuania, the Netherlands, Norway, Portugal, the Slovak Republic, Sweden, Switzerland and Spain are members of the IFDH. Austria, the Czech Republic, Germany, Italy, Portugal, the Slovak Republic, the Netherlands, Spain and Switzerland are members of EDHF. For these countries, information was obtained from delegates and, in some cases verified by CECDO representatives, especially to clarify questions about workforce planning, the implementation of new scopes of practice, expected changes in academic attainment, or the process of creating new educational facilities. Information for countries which were neither members of IFDH nor EDHF, such as Croatia, Hungary, Iceland, Malta, Poland, Romania and Slovenia was gathered by consulting CECDO representatives who, in several cases, facilitated contact with organizing representatives of the dental hygienist

*The focus of the EDHF is on the recognition and harmonization of the dental hygiene profession within the EU/EEA Member States, in light of directives from the EU pertaining to free movement of workers throughout the EU and of the right of EU citizens to equitable access to health care, education and work opportunities. CECDO promotes dental public health and ethics and exchanges views on dental matters between EU and EEA Member States, with a goal to harmonize dental professions and access to care within Europe.

profession in their respective countries or other experts who participate in international networking.

Information was confirmed by electronic mail and followed up through correspondence, supporting studies and reference literature. Results are subject to inaccuracies inherent in the use of secondary data sources.

Results

Results from the following EU/EEA member states are presented: Austria, the Czech Republic, Denmark, Germany, Finland, Hungary, Iceland, Italy, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, the Republic of Ireland, Romania, Slovenia, Slovakia, Sweden, Switzerland and the UK (Table 1). Spain was the only country for which no current data could be obtained. E-mail contacts with IFDH and EDHF delegates and repeated follow-ups requesting reply were not answered. An informal conversation with the CDO of Spain suggested that dental hygiene education in Spain remains at a 2-year Diploma status with no new academic programmes in planning. However, this information could not be verified and is therefore not presented in the summary tables of the study. The authors were also informed that there are seven 2-year Diploma programmes in Russia, which are to be converted to 3 years and that a programme is expected to open in Turkey. This information, however, could not yet be verified employing the methods cited above and will therefore not find entry into the tables.

Current education trends in Europe

The results of this study show that dental hygiene education in Europe continues to expand and is becoming increasingly academic (Table 1). However, these findings do not pertain to all EU/EEA Member States. Dental hygiene studies varied in prerequisites, duration, educational attainment and institutional settings. In the majority of EU/ EEA Member States, two models of dental hygiene education predominated, Diploma and Bachelor degrees (Table 1). Study duration varied from 2 to 4 years, with an average of 3 years. Since 2003, 2-year Diploma programmes appear to have been gradually phased out. Only four countries provided or were planning to provide postgraduate educational opportunities at Master levels in dental hygiene. Of course all Bachelor degree holders may enter graduate studies in health related fields.

Inquiries indicated that in Germany, Hungary, Switzerland and the UK, there was still two-tier entry into educational programmes for dental hygiene, requiring candidates either to demonstrate a high standard of matriculation or that they had studied and qualified as dental assistants or medical nurses.

After the educational process, entry into the dental hygiene profession is most often preceded by graduation from an accredited programme and independent testing of clinical ability and theoretical knowledge (1–3, 31). Only Germany, Romania and Hungary followed a part-time model of dental hygiene education. In Germany and Hungary, change to full-time Bachelor degree models is imminent.

Shift from Diploma programmes to Bachelor degree programmes

Results indicate that since 2003, in Europe, a shift from 2- to 3-year Diploma programmes to Bachelor degree programmes had occurred. Then, only seven countries offered dental hygiene education at Bachelor level. Today, 15 countries already offer or planned to offer Bachelor level dental hygiene education. In 2003, 11 European countries provided dental hygiene education at Diploma level only. Today, six of these countries had either already introduced at least one Bachelor degree programme or planned to do so. Bachelor programmes in dental hygiene existed in the Czech Republic, Denmark, Finland, Italy, Lithuania, the Netherlands, Norway, Portugal, the Slovak Republic, Sweden and the UK, and are were about to commence in the Republic of Ireland, Latvia and Poland. They were at the planning stage in Croatia, Germany, Hungary, Malta and Switzerland. Since 2003, the number of countries, which offered dental hygiene education exclusively at Bachelor level, had increased from three (Finland, the Netherlands and Portugal) to five, with the addition of Norway and the Slovak Republic. In Denmark and Sweden, Bachelor degree entry to the profession was pending. In Sweden, seven of eight programmes were offered optional Bachelor levels after the 2-year Diploma course (Table 1). In the UK, 16 of 20 programmes led to dual qualification in dental hygiene and dental therapy. An increase in the number of Bachelor programmes and a reduction in the numbers of Diploma programmes were planned.

Trend towards harmonization of Bachelor programmes

Since 2003, additional Bachelor degree programmes had adapted to the ECTS. Accordingly, students earn 60 credits (42 weeks of study) for a total of 1680 h year. Ten countries (Bachelor programmes in the Czech Republic, Denmark, Finland, Italy, the Netherlands, Norway, Portugal, the Slovak Republic, Sweden and the UK) had introduced this system,

and it was planned in Croatia, Hungary, Iceland, the Republic of Ireland and possibly Malta (see in Discussion). In 2003, only six countries had introduced the ECTS for all or some of their BA programmes (Finland, Italy, the Netherlands, Portugal, Sweden and the UK). The adaptation process led to an overall increase in study hours, leading to extended academic content, the basis for research and EB care.

Postgraduate education in dental hygiene

Postgraduate level programmes such as Masters or doctorates in related health fields are open to all dental hygienists with Bachelor degrees. Masters programmes in dental hygiene were only offered in Sweden and Italy. Two additional Masters programmes were pending in Italy, and in Norway, where a doctorate programme in a related field was also reported as being planned.

Eclectic programmes reported in Germany and Austria

In Germany, through the influence of various regional dental chambers (associations), an eclectic model referred to as dental hygiene education has emerged. It was (and still is) a continuing education (CE) model for working dental assistants, not comparable with the 2-, 3- and 4-year full-time Diploma or Bachelor degree courses found in accredited dental hygiene programmes. First, it awards neither a Diploma nor a degree. Secondly, by the time assistants have fulfilled all the CE requirements to become a German dental hygienist, it was reported that they had engaged in courses and work experience for nearly 7 years, but that they had completed only about 900 h of face to face instruction.

In 2004, one 3-year full-time Diploma course commenced in Munich, Germany. It was founded in cooperation with a Swiss Dental Hygiene School in Bern. The curriculum was tailored after the Swiss model of education but did not award a Swiss Diploma in dental hygiene. In 2006, the programme was closed. It was reported that a political lack of acceptance and lack of support by dental associations and the lack of a Diploma led to a decline of interest and to economic difficulties (32). A 3-year Bachelor programme planned at Steinbeis University in Berlin has already passed the accreditation process and, at the time of the present survey, was expected to commence educating dental hygienists in the very near future.

Austria is also unique in that the Ministry of Health, in collaboration with the dental chamber, was attempting to implement a 144 h CE course for dental assistants, permitting them on completion of training, to perform nearly the full range of basic dental hygiene care (including full oral examination and assessment and periodontal therapy such as subgingival scaling and root planing). The proposal was under evaluation, with the majority of respondents objecting to this plan. The Ministry of Health, on advice of dentists, had refused to plan a dental hygiene curriculum before the proposed model for assistants was legally sanctioned. However, at present a study has been commissioned by the Ministry to establish whether or not there is a need for this profession in Austria.

The emergence of dual qualification in dental hygiene and dental therapy

In the UK (33) and in the Netherlands (34), 3- and 4-year dental hygiene programmes had expanded to include dental therapy curricula to educate 'oral therapists', who have skills in dental hygiene and in some aspects of restorative care. The curriculum includes instruction in restorative procedures for primary caries such as the placement of direct restorations on permanent and primary teeth (the Netherlands and UK), and pulpotomies, pre-formed crowns and extractions for primary teeth (only in the UK). In the Netherlands, all dental hygiene programmes educate dental hygienists with such extended duties and in the UK, 16 of 20 dental hygiene programmes had shifted towards dual qualifications.

Trends in dental hygiene regulation in Europe

In EU/EFA Member States, regulations imposed to limit dental hygiene care to work settings controlled by dentists are slowly disappearing (Table 2). In 2003, dental hygienists in Sweden, Denmark and most Swiss cantons had the option to practise independently and treat patients without referrals from dentists. Independent referred practice, which means that dental hygienists may operate their own practice but treat patients only after referral from a dentists, had been introduced in Norway, the UK, the Netherlands, Finland and in one Swiss Canton. This meant that, in 2003, dental hygienists in seven countries could carry out their own practice and provide patient care autonomously.

The current survey showed a significant increase in the legal option to practise autonomously. Since 2003, there had been an increase in opportunities for dental hygienists to practise autonomously, free from any requirements for referral from or supervision by a dentist (Table 2). In countries where this possibility exists, dental hygienists may be consulted as primary oral healthcare providers who refer patients to dentists when needed. By 2008, dental hygienists could offer their services

Table 2. **Requirements for Supervision of Dental Hygiene Practice in Europe (2007–2008)**

Country	Independent practice	Independent referred practice	Off-site supervision	On-site supervision	Expected changes
Czech Rep.			√		More autonomy after BA
Denmark	√				Functions to be expanded
Finland	√				
Germany		√*	√†		
Hungary				√	
Iceland			√		Independent practice expected
Ireland			√§		Indep. pract. expected in 2008
Italy	√				More independent practices
Latvia	√‡		√		
Lithuania	√‡		√		
Malta		√			
The Netherlands	√				More independent practices
Norway	√				More independent practices
Poland			√		
Portugal			√		More autonomy, expand. functions
Slovenia			√		
Slovakia	√**		√		Greater autonomy
Spain			√		Greater autonomy
Sweden	√				More independent practices
Switzerland	√¶				More independent practices
UK		√			Removal of referral

*One autonomous practice in Munich run by US educated and Swiss licensed DH.
†DH education is eclectic, DH are not licensed.
‡Only in public sector.
§Direct supervision during administration of local anaesthesia.
¶In all cantons except for Tessin, scope restricted.
**In underserved areas only.

independently and without referral from a dentist in Denmark, Finland, Germany (so far only one practice in Munich), Italy, Norway, Sweden, Switzerland (most Cantons) and the Netherlands, where one-third of all dental hygienists operated their own practice (however, referral is required for several items like restorative work and radiographs).

Special regulations for independent practice were applied in Latvia and Lithuania, where, in the public sector, dental hygienists may practise without supervision, and in the Slovak Republic, where independent practice was (and still is) restricted to areas underserved by dentists or dental hygienists. Independent referred practice still prevailed in the UK and in Malta. It was reported that, in the UK as in the Netherlands, the referral requirement has led, in rare cases, to dental hygienists owning an office and employing a dentist to work at their facility, who then refers patients to dental hygiene care on-site.

In summary, the option for dental hygienists to operate their own practice or work independently in the public sector or other settings was extended to 13 countries, compared with seven in 2003. This constitutes a significant increase, comparable with the increase in the number of Bachelor degree programmes. All countries permitting independent practice have introduced dental hygiene education at Bachelor level, with the exception of Switzerland and Malta (a country which used to educate dental hygienists and is about to reopen an educational institution), suggesting a very strong correlation between the attainment of a Bachelor degree and autonomous practice.

Discussion

As mentioned at the end of the methods section of this article, some of the results of this study are subject to inaccuracies inherent in the use of secondary data sources. A further potential problem is that some of the information provided by respondents could have been personal opinion rather than objective fact. However, as far as possible, several different sources of information were accessed in an effort to try to ensure objectivity. Furthermore, wherever possible, statements were corroborated by searching databases of peer-reviewed literature.

In most European countries, dental hygienists are expected to provide care safely and independently in various settings, such as in private practice, public service, hospitals, or facilities of permanent care. Dental hygiene students tend to receive qualifications in EB clinical care, diagnostic assessment and

intervention planning, life-style consulting, counselling for risk behaviour modification, public health promotion, teaching, research and programme administration.

These opportunities prepare dental hygienists for advanced careers in academia, research and administration, and provide skills in advanced clinical procedures. It must be remembered that scientific advances occur at an ever-increasing rate and that new knowledge and technologies have the potential to transform all forms of dental practice including dental hygiene (35). It is therefore not surprising that European dental hygiene curricula increasingly prepare students for independent EB practice and for critical decision-making, aiming at the ability to recognize when to refer patients. Bachelor degree curricula incorporate more EB principles and research utilization than Diploma programmes (36). Graduates from non-Bachelor programmes demonstrated less application of EB findings to clinical situations and patient treatment than Bachelor graduates. In addition, those educated to Bachelor level and beyond tend to hold dental hygiene faculty positions and other non-dental hygiene teaching positions and have greater involvement with research than graduates from non-BA programmes (37). However, rather unfortunately, there is evidence of a lack of personnel with adequate academic training/experience to integrate new knowledge into curricula and assessment processes to develop EB practice (35). Another aspect of the problem is that few countries offer opportunities for postgraduate education in dental hygiene, although it is essential to provide academic education for dental hygienists to address the documented lack of qualified dental hygiene faculty with a background in research and EB decision-making skills (38). One possibility would be to create on-line degree programmes (common in the US) to facilitate degree completion from distant locations. This approach would save costs for educational facilities and might circumvent the shortage of academically educated dental hygiene instructors foreseen in the near future. Harmonized e-learning, as support to clinical skill instruction, may create opportunities for equitable educational attainment in Europe (39, 40).

There has been concern that research output by dental hygienists has been limited, leading to the suggestion that dental hygiene could strengthen its value to society by investigating and publishing the results of dental hygiene interventions, which lead to improved oral health outcomes (9). Research is more likely to be taught and conducted in Bachelor and postgraduate programmes. In the US, a study showed that over 60% of Bachelor programmes provide a separate course on research (compared with 8% of Diploma programmes) (36).

Unfortunately, there is still a lack of harmonization in dental hygiene education between EU/EEA Member States, which leads to variable standards in the provision of patient care. Few countries offer alternatives to full-time academic dental hygiene education. Dental chambers wishing to stay in control of the profession favour Germany's part-time CE model for dental assistants. France is currently contemplating such a model and there is discussion about implementation in Austria. All of these countries have powerful dental associations that currently have enough political impact to prevent or shape the dental hygiene profession. Study outcomes of such programmes do not match full-time academic programmes found in most EU/EEA states (32, 41).

The EDHF does not support this model of CE for three reasons:

- A total of 900 h of CE instruction time coupled with supervised practice (as is the case in Germany) cannot transfer the skills and scientific EB knowledge offered in a 3-year full-time academically oriented programme.
- The number of dental hygienists qualifying in Germany is very low. A 7-year educational process to acquire only a fraction of the dental hygiene skills taught in an ECTS adapted 3-year Bachelor programme appears too long to respond to the treatment needs of the population.
- The absence of a Diploma or a Bachelor degree interferes with transparency and harmonization, thus closing the path for postgraduate academic educational attainment. Such a model not only prevents the emergence of educated dental hygiene faculty, but it is also discriminatory as it interferes with access to higher education and autonomy of practice.

Although the number of ECTS programmes continues to increase, the above-mentioned heterogeneity of the educational process clearly underscores the need for further Pan-European Convergence in Higher Education, not only at undergraduate, but also at postgraduate level. In those few countries where dental hygiene is not officially recognized, it is evident that a broad range of procedures, which require dental hygiene education, are either not carried out at all or undertaken by dental assistants (nurses) with questionable skills and education which have not been assessed independently (42). This poses an important problem, as some of these procedures are among those most frequently demanded by patients. The discrepancies mentioned above have clear implications for consumer safety and quality assurance. Lack of transparency in relation to provider qualification can also cause major problems for both public and private oral health insurances, as in many instances it is difficult to see how they can reconcile their

regulations with those currently in place in other EU Member States.

European dental and dental hygiene associations have proposed curricula and criteria for dental hygiene education. For example, the European Federation of Periodontology (43) strongly believes that some minimum standards in all fields of dental education should be provided and enforced and, accordingly, published guidelines for the dental hygiene profession. It also encourages member countries where dental hygiene is not legally regulated to implement educational curricula and criteria for dental hygiene education. The IFDH and EDHF have also worked on proposals for convergence of education (44). Results of this study suggest that harmonization and convergence could best be achieved by installing Bachelor degree dental hygiene education following the model of The Bologna Declaration. This constitutes duration of 3 years (equivalent to 180 European credits) and would provide a qualification relevant to the European labour market. For dual degree programmes, an additional year would be advisable (as is the case in the Netherlands).

Furthermore, the lack of harmonization of regulations for dental hygienists in EU/EEA Member States may exclude qualified professionals from providing service or permit unqualified persons to deliver care in some Member States. Examples of this difficulty occur in France, where no one other than a dentist is permitted to deliver oral health care. This policy excludes qualified, EU/EEA licensed dental hygienists from practising their profession in France (45). This anomaly is somewhat surprising as in Quebec, dental hygienists have worked for many years, suggesting that the opposition to dental hygienists in France is not because of cultural reasons. Another example is in Austria, where dentists (with full knowledge of the Ministry of Health) delegate a number of patient therapies, such as non-surgical periodontal treatments, to unqualified and unlicensed staff members. Licensed 'imported' dental hygienists must work in a legal grey zone in which their title is neither protected nor registered nor their scope of practice legally defined (2). A proposed new law in Austria suggests that they could become regulated as prophylactic assistants. Interviews for this study have elicited information that dental hygienists who have been educated and licensed in EU/EEA Member States, work illegally in five EU/EEA member states: Belgium, France, Greece, Liechtenstein and Luxembourg.

A comparison of employment of dental hygienists between European and non-European countries shows that finance did not seem to be a factor to explain the disparity concerning a regulated and educated dental hygiene work force (46). Historically, in most countries, the development of the dental hygiene profession was met with objections by dentists when first introduced. Opposition is often fuelled by a lack of understanding of exactly what dental hygienists and therapists are educated to do (47). It has repeatedly been shown that, after an initial period of resistance, most dentists came to understand the valuable role of dental hygienists and dental therapists as integral members of the dental team (1, 2, 25). To counteract these misunderstandings, dental schools that favour a team approach, by integrating dental and dental hygiene education, may foster mutual understanding and recognition of task-related boundaries and of complementary contributions to oral health.

Changes in education and legislation as well as in oral health care subsidy must be geared towards meeting the needs and demands of future oral healthcare provision. Projected developments in demographics, epidemiology and longevity call for cost-effective, flexible oral health care. Economic pressures and, in some Member States, an ageing dental workforce have placed emphasis on redistributing oral healthcare tasks among dentists, dental specialists, dental hygienists and dental therapists (25, 27, 48).

Safe patient care requires the development of an independent well-educated dental hygiene and dental therapy workforce, which would enable dentists to focus on more complicated care (18, 22, 25, 27, 49). A number of studies have shown that autonomous dental hygienists and oral therapists are in a better position, on one hand, to provide quality cost-effective clinical care, and on the other, to initiate and manage public oral health initiatives. Independent dental hygienist practice did not increase the risk to the health and safety of the public, but actually surpassed the standards achieved by dentist practices in infection control, follow-up to medical findings, updating the medical history at recall and documenting the evaluation of the periodontal status and soft tissues (50). In fact, independent dental hygiene practice provided access to dental hygiene care and encouraged visits to the dentist (51) and provided services at lower fees (52). It is also interesting to note that dental hygienists have been reported as complementing the services of dentists in the provision of periodontal services, rather than substituting for them (53).

Thus, European dental hygienists and oral therapists, on graduation, should be able to work independently in different settings, such as in privately run offices, in the public service, in hospitals, in facilities of permanent care or in mobile dental units, irrespective of the Member State or educational institution where they graduated. The problem of ageing of the European population requires addressing challenges unique to

this underserved population. The number of dependent elderly with natural teeth is expected to increase dramatically and there is grave concern about these elderly persons not receiving proper oral health care (54). Many have a heavily restored dentition and will require extensive and flexible maintenance care for the rest of their lives (55).

If dental hygienists were permitted to practise independently, it would help to facilitate the provision of dental hygiene services in remote areas, in public health services, in a variety of residential care facilities and in mobile dental units. The latter constitute a possible means of bringing services to an ageing non-mobile population, in a similar manner to mobile physical therapists, hairdressers, meals on wheels and medical home visits (56). It is an established fact that homebound patients or those in permanent care facilities are underserved by dental services (11, 24, 57). It is therefore important that barriers, which prevent members of the dental team from providing care are removed.

In summary, since 2003, trends in the EU/EEA for dental hygienists are as follows:

- An increase in Member States, which have introduced the dental hygiene profession.
- A significant shift from Diploma to Bachelor degree programmes.
- A significant increase in the number of Bachelor degree programmes, which have adopted the ECTS.
- An increase in countries requiring Bachelor degree entry into the profession.
- An increase in dual degree programmes for dental therapists and dental hygienists.
- A change in the legal regulations in a number of EU/EEA Member States to permit autonomous practice by dental hygienists with or without referral from dentists.

However, the lack of mutual recognition of the profession throughout the EU/EEA interferes with the convergence and harmonization of educational programmes and in the provision of equitable care for all EU/EEA citizens. In countries which do not educate or recognize dental hygienists, patients are frequently placed in the care of dental personnel without receiving a clear indication of their skills or training, but who call themselves dental hygienists. This practice bears a risk to patients' safety and impacts on efficacy of care (2, 45). The problem is less likely to occur in EU member states where the profession of dental hygiene is officially defined and the public is able to confirm training and skill aquisition. To assure equitable access to care and provide assurance of public safety, high-quality accredited programmes in dental hygiene and dental therapy are needed to produce a workforce with clearly defined clinical activities and competencies. The autonomous provision of care appears to correlate with higher educational attainment and vice versa.

Conclusions

There are still wide variations within the EU/EEA in the availability of oral health care provided by dental hygienists. However, the majority of European countries offer dental hygiene education at Bachelor degree level and there is an increase in the countries which permit autonomous dental hygiene practice. In member states where the profession is not legally recognized, there are grave doubts about the quality of preventive and periodontal care provided and concerns for public safety. To overcome these problems and provide European citizens with equitable access to oral health care, the formal recognition of the profession by EU legislation and agreement on a pan-European curriculum for dental hygienist training leading to defined professional competencies and learning outcomes is required. To achieve this, there is a need for better collaboration between responsible authorities including governments, universities and dental and dental hygienist associations to meet these challenges.

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