Original Article

Identification of essential competencies for the pediatric dentistry curriculum at Damascus University: A Delphi study

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Abstract

Background & Objective: Global education is focusing on the significance of developing competency-based curricula nowadays. This study aims to establish a comprehensive set of essential competencies in pediatric dentistry designated for the curriculum at Damascus University to ensure that the graduates are equipped with the knowledge, skills, and professional attitudes to deliver effective pediatric dental care.

Materials & Methods: This qualitative exploratory study used Delphi techniques to build a consensus among experts on the core competencies of the pediatric dentistry curriculum at Damascus University in 2024. This study used two sequential qualitative methods: a focus group and the Delphi technique. A focus group was conducted with one medical education expert and three specialists in pediatric dentistry to develop an initial list of competencies. This list was assessed using a two-round Delphi technique utilized for this purpose. 25 participated in the process, and out of the 34 experts invited, Competencies that garnered at least 80% agreement among the experts were included in the final list. The analysis included descriptive statistics such as mean and standard deviation.

Results: The study identified 47 core competencies, of which 15 were related to knowledge: facts and concepts in pediatric dentistry; 21 were related to skills: abilities to perform an activity or a task; and 11 were related to attitudes: feelings or opinions that guide behavior.**Conclusion:** The application of theoretical knowledge acquired in various aspects of clinical education is hampered by diverse challenges. These challenges manifest at different levels, encompassing management, policy, infrastructure, and human and material resources. Prioritizing identified issues and implementing corrective actions based on existing capacities is the initial step in overcoming these challenges.

Conclusion: Identifying a comprehensive framework of essential competencies for the pediatric dentistry curriculum at Damascus University has been successfully established. This framework is good because it aligns differently with global education trends. Still, it aims to improve the dental care provided by future practitioners. The results will be an asset to the curriculum developers and educators in pediatric dentistry to ensure that graduates are better equipped to provide quality care to their young patients.

Keywords: pediatric dentistry, educational curricula, competency-based medical education, Delphi technique.

Introduction

Competency-Based Medical Education (CBME) is an outcome-oriented approach focused on designing, implementing, and evaluating educational programs [1]. Its first aim is to identify the skills, knowledge, and professional attitudes that learners should be able to practice independently [2]. Knowledge entails acquiring, retaining, and effectively utilizing information, requiring mental effort and the capacity to grasp concepts while distinguishing between right and wrong. While skill aims to represent the practical application of knowledge and established rules, leading to actions guided by specific ethical principles, an example of that is balancing expected benefits with potential risks. Attitude refers to predispositions that

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shape how responding to a particular situation differs individually, including interpreting events, organizing opinions into coherent structures (such as values), and articulating ethical actions [3]. These competencies are defined according to the needs of patients, the community, and the health care system [4]. The advantages of CBME include developing competent clinicians who can work through problem-based learning, communicate effectively, and think critically [5]. As we all know, for graduates, competency-based education was first adopted by the University of Puerto Rico, one of the dental schools. Then, the American Association of Dental Schools took the leadership role in organizing the execution of this educational model in various specialties [6]. More recently, the National Dental Examining Board of Canada has designed a competency standard that is considered sufficient for certificate awards to dental graduates [7].

Pediatric dentistry, also known as pedodontists, is a specialty that provides both primary and comprehensive preventive and therapeutic dental care for children from birth through adolescence, including those with special needs [8]. This specialty incorporates, in addition to the distinct techniques specifically designed to address children's unique requirements, a variety of skills and procedures that are common to other dental disciplines [9]. Consequently, what is vital in pediatric dentistry is focusing on evidence-based interventions—whether preventive, diagnostic, or -therapeutic [10]. The current curriculum covers essential topics in pediatric dentistry, including behavior management techniques, preventive and restorative treatments, trauma care, and preventive and interventional orthodontics. On the contrary, it lacks modernization, depth, and timely updates on the latest advancements in these areas [11]. However, what is regrettable is that there is currently no standardized curriculum for pediatric dentistry, resulting in substantial variation in educational context across different regions. Many factors influence this disparity, including regional societal and capacity [12]. Recently, there has been a movement towards establishing universally accepted competencies and defining quality standards in education on every continent. These efforts to cover curricula are expected to promote the exchange of experiences and enhance communication and collaboration among professionals worldwide [13].

The aim is to focus and structure educational programs, and this paper argues for developing a global competency-based curriculum in pediatric dentistry. It asserts that adopting a CBME framework can achieve such an outcome. This approach effectively fosters the necessary skills, knowledge, and attitudes among learners [14, 15]. Establishing the CBME framework is crucial to identifying the competencies required to perform the job [16]. Various techniques, including expert panels and critical assessments, have been employed to determine the competencies, learner surveys, and task analysis [17]. The Delphi technique is more precisely a systematic method developed to collect expert opinions on topics that may not come under existing knowledge and concepts by consensus [18]. This method makes it easier for a group of experts engaging in structured, repetitive discussions to derive collective judgments, often more insightful than individual opinions [19]. While traditional surveys typically determine 'what is' the Delphi method focuses on "what should be" [20]. The advantages of the Delphi technique are reliability, diversity of expert opinions, and the capacity to be conducted remotely without face-to-face interaction [21]. This method allows experts to communicate anonymously and easily to exchange information, encouraging independent thought. We can enhance the validity of the content by engaging experts in multiple review rounds.

Moreover, for objectivity's sake, the technique upholds anonymity and confidentiality to avoid the influence of dominant individuals, group pressures, and groupthink. This anonymity encourages the free and frank expression of opinion, and repeating review rounds allows participants to reconsider their ideas, further enhancing the robustness of findings [22]. The Delphi technique has been used extensively in health to reach consensus and determine competencies in medical specialties [23-26]. This study aims to establish a complete umbrella set of essential competencies in pediatric dentistry, adapted for the curriculum at Damascus University, to enable graduates to possess the knowledge, skills, and professional attitudes necessary for effective pediatric dental care.

Materials & Methods

Design and setting(s)

This is a qualitative exploratory study with Delphi elements to build expert consensus on the core competencies of the pediatric dentistry curriculum at Damascus University in 2024. Two sequential qualitative methods, focus group and Delphi technique, were used.

The current research has been approved by the Scientific Research Ethics Committee of Damascus University,

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No. 482, dated 04/02/2024. Written informed consent was sought from the survey participants and attached to the front page of the e-questionnaire.

This study was carried out according to the recommendations of Delphi Studies (CREDES) [27].

Participants and sampling

The principal researchers, F.B. and M.S., prepared an initial list of 113 items through a comprehensive review of the medical literature and global competencies [28] and interviews with members of the Syrian Association of Pediatric Dentistry, the Dental Association, and professors of pediatric dentistry at public and private universities who are physicians. Acknowledging that the Delphi Technique has been approved over time, it is qualitative as it gathers subjective opinions and insights from experts; traditional coding might not be directly involved. This technique has been employed by designing a list of suggested competencies and gathering expert opinions to achieve consensus. The supervisor, an M.D., an expert in medical education, reviewed and refined the initial list, made the necessary changes, adjusted the wording of some competencies, and added or removed items to ensure clarity and comprehension. Following this, a focus group of four experts (one in medical education and three in pediatrics) reviewed the initial list and made necessary modifications. As a result, 63 items were agreed upon, documented, and categorized into knowledge, skills, and attitudes.

Tools/Instruments

The questionnaire was designed on Google Forms, an online survey platform. It was composed of 6 sections. Section 1 was an introduction explaining the purpose of the study and the policy protecting the privacy and confidentiality of the participants' data. Each fully completed questionnaire was assigned an identification code to keep it anonymous, considered one of the major aspects of Delphi surveys. Besides, an implied agreement is clearly stated.Section 2 gathered information on demographics: gender and years of practice. Sections 3, 4, and 5 identified the core knowledge, skills, and attitudes competencies. Section 6 had a free text field where the respondent could suggest a new competency not listed in the preliminary list.

Data collection methods

Delphi expert panel

According to Dalkey, Delphi experts are individuals with knowledge and skills in a specific field who meet four requirements: knowledge and experience of the issue, ability and willingness to participate, sufficient time to participate in the Delphi, and effective communication skills [29]. In line with these criteria, 34 experts were invited to participate, comprising faculty members from public and private universities and directors of training and specialization programs within the Department of Pediatric Dentistry of the Syrian Society of Pediatric Dentistry. Each expert had a minimum of 5 years of experience. Out of those invited, 25 experts responded, resulting in a response rate of 73.5%.

Delphi protocol-first round

During the first round, experts were asked to rate the importance of each competency on a five-point Likert scale (1 for "strongly disagree" to 5 for "strongly agree"). They were also encouraged to comment on any competencies they felt should be changed or added. The first-round survey deadline was two weeks, and reminders were sent to those who still needed to respond on the seventh day.

Delphi data analysis-first round

The competencies were reviewed based on expert feedback in the first round. Additional competencies suggested in the free-text comments were included in the second round. Data was collected, and weighted responses were calculated for each competency.

Delphi protocol-second round:

The second round consisted of a list sent to all experts to re-evaluate the importance of each competency since this list included all competencies. Their corresponding weighted responses were created, adding the new competencies suggested during the first round. Thus, the updated version was sent to them on a five-point Likert scale, considering their colleagues' responses from the first Delphi round. The second survey deadline was two weeks, and a reminder was sent on the seventh day. The first round occurred on 14/03/2024, and the second on 15/04/2024.

Delphi data analysis-second round

The agreement below was extracted using a common approach: the percentage agreement method, which establishes consensus in the Delphi technique. This method only lists competencies where at least 80% of experts agree.

Data analysis

Data analysis was done using the IBM SPSS statistical package, with descriptive statistics such as the mean of

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responses on the Likert scale used to determine the direction of the response and the standard deviation used to gauge the homogeneity of the responses. See **Figure 1** for the study flow chart.

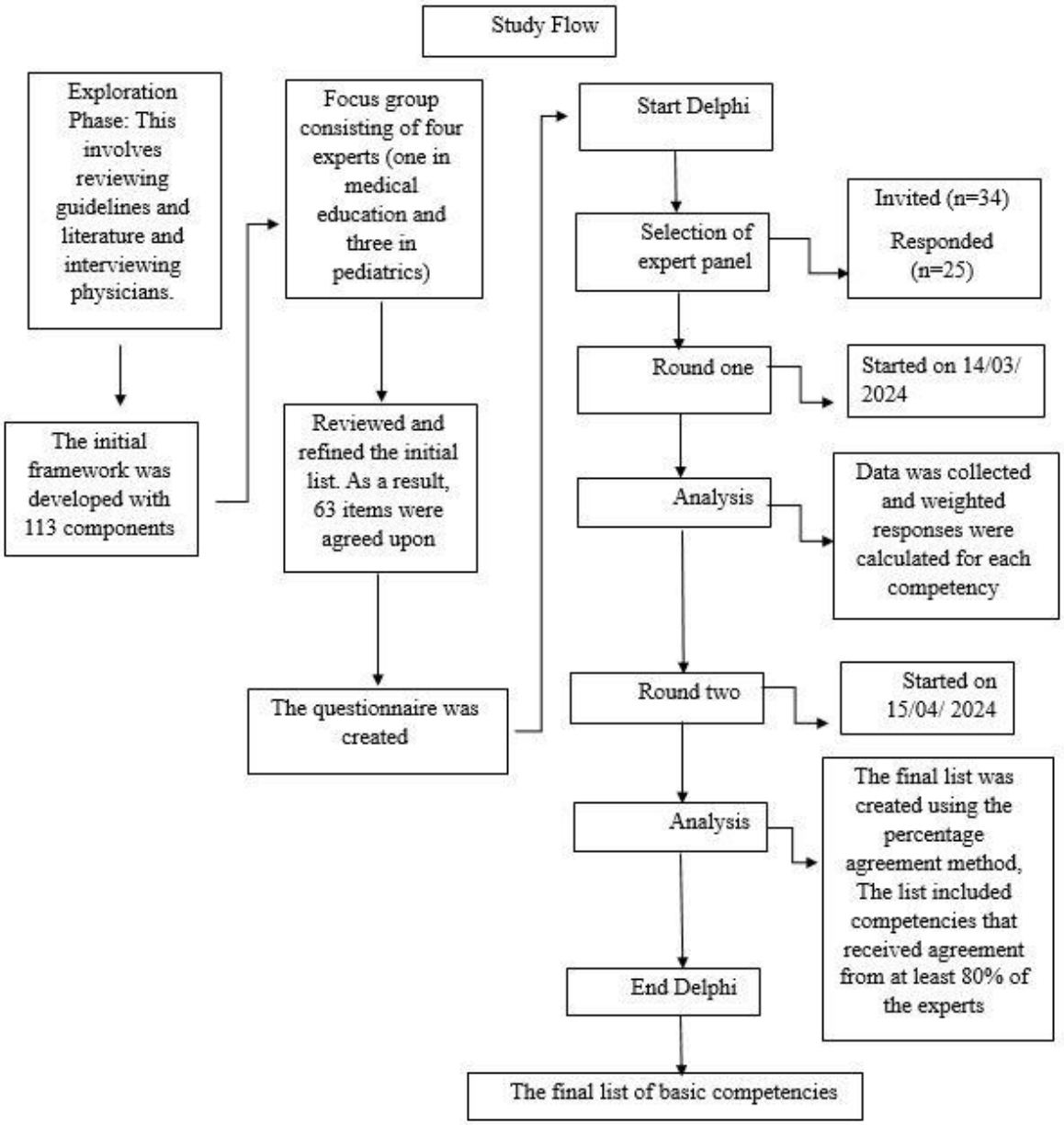


Figure 1. Flow chart of the study

Results

Of the 34 physicians invited to participate in the questionnaire, 25 expert physicians responded, resulting in a response rate of 73.5%. For details on the demographic characteristics of the participants, please refer to **Table 1**. During the focus group meetings, a preliminary list of 63 competencies was identified: 16 in the knowledge domain, 31 in the skills domain, and 16 in the attitude domain.

Table 1. Demographic characteristics of the participants

Characteristics		n (%)
Gender	17 (68)	Female
	8 (32)	Male
Years of experience	16 (64)	5-10 years
	9 (36)	More than 10 years

Abbreviations: n, number of participants; %, percentage.

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In the first round of the Delphi process, three additional competencies were suggested, two of which were added to the knowledge domain and one to the skills domain. This brought the total to 66 competencies, distributed as follows: 18 in the knowledge domain, 32 in the skills domain, and 16 in the attitude domain.

Competencies with a weighted response of 2.5 or higher were considered during the first Delphi round. Four competencies (one from the knowledge domain and the others from the attitude domain) were excluded. This left 62 competencies for the second round, distributed as follows: 17 within the knowledge domain, 32 within the skills domain, and 13 within the attitude domain.

The second Delphi round evaluated the 62 competencies by 25 experts. The level of agreement responses ranged from neutral to agree to strongly agree, with a low standard deviation showing some homogeneity and agreement among the experts.

The last basic list was limited to the competencies rated on average higher than 4.21 (80%, being 'strongly agree') as valid competencies. Hence, 15 competencies (two from the knowledge domain, eleven from the skills domain, and two from the attitudes domain) that obtained an average rating of less than 4.21 were deleted (**Appendix 1**).

Appendix 2 presents the essential competencies assumed for postgraduate students of the Department of Pediatric Dentistry. The competencies were developed through the Delphi technique and consist of 47 items, 15 of which are on the cognitive dimension, 21 on the skills dimension, and 11 on the attitudinal dimension.

Discussion

This study focuses on the fundamental competencies that postgraduate students should possess to offer quality services to patients without compromising social accountability. The focus is most certainly on enhancing the quality of education and training, which requires developing an integrated course to fill the educational gaps [30].

A modified Delphi technique has been employed to increase the likelihood of reaching a consensus in competency identification in medical education. It comprises deliberate and progressive interactions of a specific group of specialists, and the consensus is reached through a set of systematic, interactive procedures whereby each participant can change their view and include new ones if needed [31].

This study constitutes the first attempt to define all necessary competencies for postgraduate students of pediatric dentistry curricula. The Delphi method was applied, and as a result, the panel of 25 experts agreed on 47 competencies arranged in three specific areas. These competencies will be the first step toward formulating a competencies-based program focusing on pediatric dentistry. The list incorporates important knowledge and competencies that cover general and behavior management concepts related to pediatric dentistry. It also touches upon general pediatrics and its sub-specialties, dealing with medically compromised and children with special needs, management of pain, oral medicine and surgery, techniques of sedation and general anesthesia, dental materials, interceptive orthodontics, pharmacology, epidemiology, prevention, restorative dentistry, dental trauma, research design, statistics, dental and maxillofacial radiology. Besides, the set includes the duties that the practitioners will perform. They must perform routine diagnostic and therapeutic measures, care for patients and their feelings and needs, and build trust. Dedication to self-evolution, patient safety and confidentiality, adherence to legal procedures, and obtaining informed consent are crucial aspects of a dentist's professional duty.

The optimal size of experts participating in Delphi studies varies and ranges from 5 to more than 1000 participants [32]. Loo emphasized that the purposeful selection of experts yields consensual data rather than large, randomly selected numbers [33].

A systematic review determined that most Delphi studies included ≥ 25 participants [32]. Only seven experts were included in the Delphi study by Dalkey and Helmer [34]. In comparison, this study included 25 pediatric dentistry experts with a response rate of 73.5%.

Answers were recorded using a five-point Likert scale, including a neutral point. Eliminating the neutral point may prompt respondents to adopt a clearer stance. However, its deletion results in a distortion in the responses toward negative responses, particularly in the case of ambivalent respondents [35].

This study employed two research methodologies. First, a focus group method was used to create an initial list of competencies. Second, the Delphi technique was used to restructure and develop a list of core competencies based on recommendations from previous studies [36].

The knowledge competency with the highest score was "construct effective and appropriate preventive plans for children with dental caries." This is crucial due to the significance of preventive strategies in halting caries development in children. Traditional pediatric dentistry residency program curricula have excessively

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emphasized restorative dentistry while neglecting early diagnosis and preventive management. This has contributed to a concerning increase in detected, missing, and filled teeth (DMFT) indicators in recent epidemiological studies conducted in Syria [37].

It is important to emphasize that preventive dentistry constitutes the most essential component of training in pediatric dentistry, as prevention is the foundation of the specialty. Previous studies have reported similar findings, highlighting that most universities in Brazil and Malaysia emphasize the knowledge and application of preventive materials in undergraduate dental education [38, 39]. The highest score regarding skill competencies was "critically appraise biomedical research and clinical research papers." Maintaining competency and continuing professional development are essential to providing up-to-date, high-quality patient care.

The postgraduate students will be able to confidently take responsibility for pediatric problems regarding evidence-based practice. They need to be equipped to research, select, analyze critically, and apply valid information based on evidence to sustain lifelong learning. Research studies in Chile and Latin America have supported the scientific basis that teaching and professional development involve research. These studies have also emphasized a need for more support, encouragement, and promotion of research culture within dental schools [40]. A study assessing the educational program given to postgraduate students in pediatric dentistry in Egypt revealed areas for improvement regarding scientific research. This was attributed to a need for more sufficient attention paid by faculty members to research and the lack of financial resources as significant obstacles to postgraduate research [41]. The data indicated that "compliance with infection control practices" was the most important attitude competency. This competency is crucial because infection control protects patients and healthcare workers, including pediatric dentists. Dentists work in an environment characterized by close contact with patients and the production of aerosols; therefore, the chances of infection transmission from an infected patient are very high. Thus, pediatric dentists should be informed and educated on the absolute adherence to infection control.

A recent review of emerging viral diseases in the new millennium concluded that infection control is as important in dental practice as understanding oral manifestations and diagnosing and managing viral infections [42]. Another important benefit of this study would be to aid the curriculum planners in making a pediatric dentistry curriculum comprising a prioritized list of competencies established by experts.

There are several limitations of the Delphi survey. First, the repetitiveness of the survey set may easily cause a loss of interest in the participants over time, hence putting pressure on the study supervisors to keep the participants' motivation going after every round. Secondly, targeted postgraduate students participating in the study did not contribute to developing these competencies and thus may not be reflected in the identified competencies. Therefore, a comprehensive review of the pediatric dentistry curriculum is required to create appropriate structured curricular guidelines that answer the needs of learners and the community. These guidelines should standardize the content of undergraduate pediatric dentistry curricula in keeping with contemporary evidence-based dentistry, recommend the most effective educational methodology for delivering this content, and suggest the most appropriate assessment tools in light of the need to adopt a competency-based approach.

Conclusion

Forty-seven competencies have been identified that are expected to facilitate pediatric dentists' providing the highest quality patient health care. These competencies will also contribute to decision-makers developing more focused educational curricula that can dramatically enhance the evolution of competency-based education in pediatric dentistry.

Ethical considerations

This study got the Ethical Committee's approval, Damascus University, No. 482, on 04/02/2024, and it was mentioned in the introductory paragraph that this is an informed consent while filling out the electronic survey form.

Artificial intelligence utilization for article writing

Grammarly was used to correct grammar, punctuation, spelling, and paraphrasing in a critical review according to the ethical code.

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Conflict of interest statement

The authors confirm that they have no conflicting financial interests or personal relationships that could bias the work reported in this paper.

Author contributions

FB and MS collected the focus group data and employed the Delphi technique. MD oversaw the study's design and execution. FB and MD contributed to data analysis, interpretation, and manuscript drafting and reviewed the manuscript before submission. All authors have reviewed and approved the final manuscript.

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Data availability statement

Data are available upon reasonable request. They are stored as de-identified participant data, which are available upon request to babakrdfarah@gmail.com.

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Appendix 1. List competencies after the 2nd cycle of the Delphi technique

Knowledge Competencies (facts, and concepts in the area of pediatric dentistry)				
Knowledge				
	Items	**Mean**	**SD**	**Answer**
1	Construct effective and appropriate preventive plans for children with dental caries.	4.96	0.20	Strongly agree
2	Identify the effects of nitrous oxide/oxygen on breathing, blood circulation, and protective reflexes.	4.92	0.27	Strongly agree
3	Describe the physiologic responses that are consistent with pediatric minimal sedation.	4.92	0.27	Strongly agree
4	List indications and contra-indications for the use of general anesthesia.	4.92	0.27	Strongly agree
5	Recognize the treatment in immature permanent teeth.	4.88	0.33	Strongly agree
6	Recognize design cavities with tooth anatomy and the characteristics of the restorative material.	4.76	0.43	Strongly agree
7	List indications and contra-indications of sedation by nitrous oxide hazards to the health of patients and personnel.	4.76	0.66	Strongly agree
8	Provide comprehensive restorative care for children under general anesthesia.	4.76	.83	Strongly agree
9	Identify the properties and composition of materials used in pediatric dentistry.	4.72	0.61	Strongly agree
10	Identify the principles of the prevention of injuries including early reduction of overjet, correction of habits, and construction of mouth guards.	4.72	0.61	Strongly agree
11	Recognize normal and abnormal behavior patterns in children.	4.64	0.63	Strongly agree
12	Recognize psychological growth and development.	4.28	0.61	Strongly agree
13	Examine oral manifestations of systemic disease in the soft and hard oral tissues, especially in children with (Cardiac disease, bleeding disorders ...).	4.28	1.40	Strongly agree
14	Describe craniofacial malformations.	4.24	0.77	Strongly agree
15	Identify ethical aspects of research on animals and humans.	4.24	0.72	Strongly agree
16	Identify the growth and development of the human body.*	4.08	1.03	Agree
17	Apply the principles of differential diagnosis of dento-alveolar and jaw lesions.*	3.56	1.04	Agree
Skills competencies (abilities to perform an activity or a task)				
	Items	**Mean**	**SD**	**Answer**
18	Critically appraise biomedical research and clinical research papers.	4.96	0.20	Strongly agree
19	Evaluate the validity of statistical methodology in research papers.	4.92	0.27	Strongly agree
20	Apply pulp treatments (pulp capping, partial pulpotomy, pulpotomy pulpectomy).	4.92	0.27	Strongly agree
21	Apply space maintainer tools in the primary and mixed dentition.	4.92	0.27	Strongly agree
22	Select the nitrous oxide level based on the procedure's difficulty, andmodify levels within a procedure as needed.	4.92	0.27	Strongly agree
23	Select the recovery from inhalational minimal sedation and appropriate discharge criteria.	4.84	0.37	Strongly agree
24	Apply knowledge of behavioral patterns and psychology in the management of anxiety and anxiety-related behavior in the dental setting.	4.80	0.40	Strongly agree
25	Construct effective and appropriate preventive and restorative treatment plans for children with non-carious tooth surface loss TSL.	4.76	0.43	Strongly agree
26	Recognize the etiological factors of child abuse.	4.64	0.86	Strongly agree
27	Demonstrate an ability to write a correct handwritten prescription.	4.64	0.70	Strongly agree
28	Identify different modes of breathing, normal and abnormal speech, and various ways of swallowing.	4.64	0.63	Strongly agree
29	Diagnose problems in the developing occlusion including • teeth of poor prognosis• impactions and ectopia• hypodontia• cross-bites.	4.56	0.71	Strongly agree
30	Use appropriate physiologic monitoring equipment.	4.56	0.86	Strongly agree
31	Interpret the results of laboratory tests correctly.	4.52	0.87	Strongly agree
32	Evaluate the patient's comprehensive orthodontic treatment needs.	4.52	0.50	Strongly agree
33	Provide different diagnoses of maxilla-facial injuries.	4.36	0.63	Strongly agree
34	Implement commonly used statistical methods.	4.36	0.95	Strongly agree
35	Analyze research findings.	4.36	1.07	Strongly agree
36	Demonstrate the ability to ensure and record patient informed consent for treatment.	4.28	0.67	Strongly agree
37	Provide effective dental care for children with cleft lip and palate (CLP).	4.28	0.73	Strongly agree
38	Interpret advanced head imaging and radiology and recognize deviations from normal.	4.22	0.91	Strongly agree
39	Demonstrate the ability to treat emergencies related to the next deeper level of anesthesia than intended.*	4.16	0.94	Agree
40	Provide management of periodontal diseases in children.*	4.16	0.89	Agree
41	Identify theconcept of biological age and determination of skeletal age.*	4.12	0.97	Agree
42	Recognize drugs used in general anesthesia. *	4.08	0.81	Agree
43	Provide appropriate treatment of maxilla-facial injuries.*	4.00	1.04	Agree
44	Classify syndromes about etiology, reaction to treatment, and prognosis.*	3.76	0.92	Agree
45	Provide effective dental care for children with craniofacial anomalies.*	3.68	0.98	Agree
46	Use various headgear types, facial masks, chin caps, and combined extra-oral/functional appliances.*	3.56	1.15	Agree
47	Interpret the unfavorable influence of etiological factors and their interception.*	3.48	0.82	Agree
48	Identify relevant anatomical structures on cephalograms.*	3.32	1.34	Neutral
49	Perform oral biopsy techniques (excisional and incisional) of pathological lesions in children.*	3.28	1.48	Neutral
Attitude competencies (feelings, or opinions that guide behavior)				
Items		**Mean**	**SD**	**Answer**
50	Comply with infection control practices.	5.00	0.00	Strongly agree
51	Maintain the confidentiality of medical information.	4.92	0.27	Strongly agree
52	Demonstrate respect to colleagues and other medical team members.	4.92	0.27	Strongly agree
53	Demonstrate an understanding of the ethical and legal aspects of managing child behavior in the dental setting.	4.84	0.37	Strongly agree
54	Accept constructive criticism from supervising doctors.	4.84	0.37	Strongly agree
55	Understand roles and responsibilities and know his/her limitations.	4.80	0.40	Strongly agree

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56	Demonstrate empathy while acting in the child's/family's best Interests.	4.76	0.59	Strongly agree
57	Commit to the clinical training timeframe.	4.72	0.45	Strongly agree
58	Demonstrate an understanding of when to refer to other specialties.	4.68	0.85	Strongly agree
59	Demonstrate an understanding of the role of the pediatric dentist in health education and promotion.	4.60	0.86	Strongly agree
60	Demonstrate an understanding of the legal aspects relating to holding written records.	4.60	0.64	Strongly agree
61	Demonstrate an understanding of the impact of abnormalities in general, craniofacial, or dentoalveolar development on patients and their families.*	4.04	0.97	Agree
62	Demonstrate an understanding of the pressures that may lead children to smoke use illicit drugs abuse alcohol engage in substance abuse.*	3.32	1.31	Neutral

Note: In the second Delphi round, 25 experts evaluated the 62 competencies. The responses varied between neutral, agree, and strongly agree. Only competencies with an average rating above 4.21 (80%, indicating 'strongly agree') were accepted as valid competencies for the final basic list. Consequently, 15 competencies (two from the knowledge domain, eleven from the skills domain, and two from the attitudes domain) with an average rating below 4.21 were excluded (*).
Abbreviations: SD, standard deviation.

Appendix 2. Basic competencies required for pediatric dentists.

Domain		Competency
Knowledge Competencies	**1**	Construct effective and appropriate preventive plans for children with dental caries.
	2	Identify the effects of nitrous oxide/oxygen on breathing, blood circulation, and protective reflexes.
	3	Describe the physiologic responses that are consistent with pediatric minimal sedation.
	4	List indications and contra-indications for the use of general anesthesia.
	5	Recognize the treatment in immature permanent teeth.
	6	Recognize design cavities with tooth anatomy and the characteristics of the restorative material.
	7	List indications and contra-indications of sedation by nitrous oxide hazards to the health of patients and personnel.
	8	Provide comprehensive restorative care for children under general anesthesia.
	9	Identify the principles of the prevention of injuries including early reduction of overjet, correction of habits, and construction of mouth guards.
	10	Identify the properties and composition of materials used in pediatric dentistry.
	11	Recognize normal and abnormal behavior patterns in children.
	12	Recognize psychological growth and development.
	13	Examine oral manifestations of systemic disease in the soft and hard oral tissues, especially in children with (cardiac disease, bleeding disorders,).
	14	Describe craniofacial malformations.
	15	Identify ethical aspects of research on animals and humans.
Skills competencies	**16**	Critically appraise biomedical research and clinical research papers.
	17	Evaluate the validity of statistical methodology in research papers.
	18	Apply pulp treatments (pulp capping, partial pulpotomy, pulpotomy pulpectomy).
	19	Apply space maintainer tools in the primary and mixed dentition.
	20	Select the nitrous oxide level based on the procedure's difficulty, andmodify levels within a procedure as needed.
	21	Select the recovery from inhalational minimal sedation and appropriate discharge criteria.
	22	Apply knowledge of behavioral patterns and psychology in the management of anxiety and anxiety-related behavior in the dental setting.
	23	Construct effective and appropriate preventive and restorative treatment plans for children with non-carious tooth surface loss TSL.
	24	Recognize the etiological factors of child abuse.
	25	Demonstrate an ability to write a correct handwritten prescription.
	26	Identify different modes of breathing, normal and abnormal speech, and various ways of swallowing.
	27	Diagnose problems in the developing occlusion including• teeth of poor prognosis• impactions and ectopia• hypodontia• cross-bites.
	28	Use appropriate physiologic monitoring equipment.
	29	Interpret the results of laboratory tests correctly.
	30	Evaluate the patient's comprehensive orthodontic treatment needs.
	31	Provide different diagnoses of maxilla-facial injuries.
	32	Implement commonly used statistical methods.
	33	Analyze your research findings.
	34	Demonstrate the ability to ensure and record patient informed consent for treatment.
	35	Provide effective dental care for children with cleft lip and palate (CLP).
	36	Interpret advanced head imaging and radiology and recognize deviations from normal.
Attitude competencies	**37**	Comply with infection control practices.
	38	Maintain the confidentiality of medical information.
	39	Demonstrate respect to colleagues and other medical team members.
	40	Demonstrate an understanding of the ethical and legal aspects of managing child behavior in the dental setting.
	41	Accept constructive criticism from supervising doctors.
	42	Understand roles and responsibilities and know his/her limitations.
	43	Demonstrate empathy while acting in the child's/family's best Interests.
	44	Commit to the clinical training timeframe.
	45	Demonstrate an understanding of when to refer to other specialties.
	46	Demonstrate an understanding of the role of the pediatric dentist in health education and promotion.
	47	Demonstrate an understanding of the legal aspects relating to holding written records.

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