ORIGINAL ARTICLE

DEVELOPING CONSENSUS OVER COURSE CONTENTS OF UNDERGRADUATE ORAL AND MAXILLOFACIAL SURGERY CURRICULUM

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ABSTRACT

The objective was to develop consensus over oral & maxillofacial surgery course contents for Pakistani undergraduate dental students using Modified Delphi technique. This study was conducted in the Institute of Health Professions Education & Research, Khyber Medical University, Peshawar from Jan, 2015 to June, 2016. The study comprised two iterative rounds of opinion seeking Delphi survey based on Pakistan Medical & Dental Council (PMDC) Oral & maxillofacial undergraduate syllabus, interspersed with three sessions of meetings with the subject experts. The response rate on Likert scale to the first round was 89% (33/37) whereas to the second round was 82% (27/33). The analysis of the first round revealed, four items in the theory and seven items in the practical could not achieve consensus. In the second round theory topics were divided into the categories of essential (21), important (5), supplementary (3) and questionable (2) as final consensus. The practical topics were divided into the categories of essential (3), important (1), supplementary (5) and questionable (3) as final consensus

The ranking of the contents is based on significance in the syllabus as essential, important, supplementary and questionable so as to align the contents with other curricular contents especially assessment.

INTRODUCTION

The oral and maxillofacial surgery is defined[1] as the branch of dentistry that deals with the diagnosis and treatment of dental and oromaxillofacial injury, deformity, and disease by manual and instrumental means. A surgical operation or procedure, especially one involving the removal or replacement of a diseased tooth / teeth or orofacial tissue involved.[2] Curriculum has four elements: course contents; teaching and learning strategies; assessment processes; and evaluation.[3] Course contents are required to be based on academic, professional, psychological, practical and student criteria and should be very explicit. Contrary to this the course contents of under graduate oral and maxillofacial surgery curricula are generally irrelevant, redundant, and ambiguous and not in alignment with other components.[4,5,6] Multiple factors like new surgical techniques[7], emerging technology, newer educational strategies like PBL[8] and outcome based education, and the curricular overlap in the presence of multiple curricula[9], necessitate curricular change with consensus.[10,11]

The present Pakistan Medical & Dental Council (PMDC) web site[12] displays three different BDS Curriculum documents namely, Revised BDS Curriculum (A meeting of NCRC BDS was held on 19.8.2003), Draft Curriculum 2011 (A meeting of NCRC BDS was held in 2009) and Regulations for the Degree of Bachelor of Dental Surgery (BDS) Requirements for BDS Degree.

After scrutinizing theses and other documents, one finds disparity, repetitions and ambiguities.[13] Likewise the importance of topic of oral oncology has been, keeping in view the high prevalence of oral cancer in our society , under rated in the 2011 draft curriculum.

METHODOLOGY

The study comprised two iterative rounds of opinion seeking Delphi survey[15] through self-administered questionnaire via Email. In between these two rounds, there were three sessions of meetings with the subject experts. The emerging opinion and feedback prepared for next round.

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The accessible population was decided by a panel of five senior oral and maxillofacial faculties of different dental colleges of Pakistan. They included 33 faculty members with at least 03 years of teaching experience. A self-administered pilot tested questionnaire was developed with item responses based on 5-point Likert Scale.[15,16] The questionnaire design was adapted from a previous study conducted by Rohan D et al[16,17] and was based on AMME Guide 87 by AR Artino et al.[18]

The 2nd questionnaire had same numbers of items but instead of having Likert scale, it had essential, important and supplementary as opinion seeking terms. Moreover every item also had a mean and standard deviation based on first round results. The items arranged in descending order from higher to lower values of means.

The Delphi first phase concluded after when the desired target of more than 30 participants reached from all over the Pakistan. The item with a mean score (support) greater or equal to 4 and standard deviation(agreement) of 1 or less was deemed to achieve consensus as mentioned in the literature by Rohan D et al. These results were discussed for further steps of research with various senior as well as junior colleagues in meeting with the subject experts.

A very useful concept[19] of essential, important, supplementary and questionable is adopted by CPSP for developing MCQs banks for its membership and fellowship exams. The participants of experts meeting suggested incorporating this concept into the categorization of the contents of syllabus of oral and maxillofacial surgery based on the results of first phase of Delphi. The participants also suggested giving weight age of 60, 30, 10 and 0% to essential, important, supplementary and questionable respectively to each category in various elements of curriculum such as syllabus, teaching & learning and assessment. The item achieving questionable grade was suggested for removal from contents of syllabus or given as electives.

In the 2nd phase Delphi, all thirty three participants of first phase were sent second questionnaire, the questionnaire had items arranged in descending order, as per average scores, mentioned in front of each item, achieved in first phase as an average given by 33 participants, with four categories in front of each item as first alphabet of the category e.g., essential as E, important as I, supplementary as S, and questionable as Q for recording the response.

RESULTS

There are 146 oral & maxillofacial surgeons in Pakistan and 114 are registered as faculty members in forty two dental colleges of Pakistan with PMDC. Out of these, 37 faculty members of 19 dental colleges of all four provinces were approached and first round questionnaire was sent to them. Thirty three (89%) responded in the first round. The composition of the respondents, their position and experience was as in fig 1.1. The numbers and percentage of the participants giving particular option have been described in Tables 1.1, 1.2, & 1.3, for theory and practical respectively in both rounds. The legends for the options are, strongly agree (SA), agree (A), undecided (U), disagree (D), and strongly disagree (SD).Four items in theory and 9 items belonging to practical could not achieve 80 % agreement Tables 1.1. However in practical, two items pertaining to extractions under local anesthesia and alveolectomy could get more than 75% agreement. They have been highlighted along with two other items gaining more than 80% agreement. Majority of the participants were of the opinion of reducing the number of extractions as stated by the participants in free text response.

By considering mean with standard deviation of the values assigned by the participants with respect to the options and taking mean value 4 as a cut off and standard deviation of 1 or less for defining agreement then the same four items in theory and 9 items in practical could not achieve agreement (highlighted items in both tables). However two more items in practical can be added to agreed items. These are extractions under local anesthesia and alveoloplasty.

All thirty three participants were sent second questionnaire. Twenty seven of them (82%) responded to the 2nd round questionnaire. The Tables 1.2 and 1.3 give details as highlighted figures of response by the faculty for theory and practical topics with respect to their rating as Essential (E), Important (IMP), Supplementary (S) and Questionable (Q) in round 2. The theory topics divided into the categories of essential (21), important (5), supplementary (3) and questionable (2) as final consensus. The practical topics divided into the categories of essential (3), important (1), supplementary (5) and questionable (3) as final consensus.

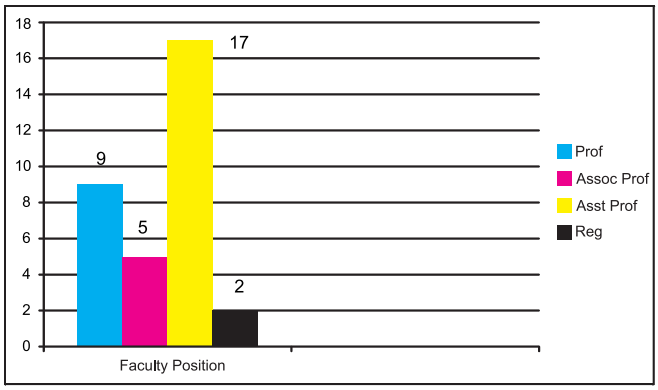

Fig 1: Error! Main Document Only. Faculty Positions There were 9 professors, 5 associate professors, 17 assistant professors and 2 registrars fig 4.1

TABLE 1.1: THEORY AND PRACTICAL TOPICS BASED ON (NUMBERS (%) AGE) ALONG WITH MEAN AND S.DEV

S. No.	Item	Mean	S. Dev	SA5	A4	U3	D2	SD1
1.	Developmental deformities of the jaws (prognathism, micrognathia Cleft plat, etc.)Management and surgical treatment	3.9	0.7	3(9)	19(58)	8(24)	2(6)	1(3)
2.	Historical introduction, indications and contra indications, Preparation of the patient for general anaesthesia, stages of General Anaesthesia	3.9	0.8	7(21)	18(55)	7(21)	1(3)	
3.	Apparatuses used for general anaesthesia, techniques for administration of general anaesthesia, inhalation and intravenous anaesthesia	3.6	0.8	3(9)	11(33)	13(40)	6(18)	
4.	Bone and fibro osseous lesions,Osteopetrosis, Paget's Disease, Hyperparathyroidism, Rickets, Fibrous Dysplasia	3.3	0.8	7(21)	19(58)	5(15)	1(3)	1(3)
5.								
6.	5 extractions under general anesthesia (Assistance	3.9	0.7	9(27)	10(31)	8(24)	6(18)	
7.	5 fractures of jaw (assistance/ Observation)	3.6	0.9	6(18)	13(40)	10(30)	4(12)	
8.	Cryosurgery	3.6	1.0	1(3)	7(21)	8(24)	13(40)	4(12)
9.	Frenectomy Labial & Lingual	3.6	0.9	5(15)	18(55)	5(15)	5(15)	
10.	Laser Excisions	3.3	1.2	1(3)	6(18)	7(21)	12(37)	7(21)
11.	Operculectomy	3.2	1.1	4(12)	16(49)	3(9)	7((21)	3(9)
12.	Tongue tie	3.2	1.1	5(15)	8(24)	12(37)	5(15)	3(9)

Round 1. The theory and practical items which could not gain consensus, values are numbers (%) along with mean and S.Dev of panel giving the rating stated strongly agree (SA), agree (A), undecided (U), disagree (D), and strongly disagree (SD).

TABLE 1.2: FINAL RESULTS THEORY TOPICS, ITEMS WITH AVERAGE OF FIRST ROUND ALONG WITH THE FINAL RANKING AS PER THEIR SIGNIFICANCE

S. No.	Items	Average 1st round	Category	E	Imp	Sup	Q
1.	Principles of surgery, incisions, flaps, sutures, biopsies, MOS techniques, bone cutting and removal.	4.94	Essential	25(9)	02(7)		
2.	Preparation of patients for surgical procedure and their post-operative care	4.91	Essential	19(7)	08(3)		
3.	Emergency in dental office, Chest Pain, Fainting, Inhalation, Respiratory Embarrassment	4.88	Essential	23(8)	04(14)		
4.	Introduction to dental/surgical instruments	4.79	Essential	23(86)	04(14)		
5.	Exodontias: Simple and complicated extractions	4.76	Essential	20(74)	07(26)		
6.	Medically Compromised Patients	4.76	Essential	21(78)	06(22)		
7.	First aid management and treatment of Shock, Hemorrhage: Prevention and treatment	4.73	Essential	16(59)	3(11)	8(30)	
8.	Anatomical consideration for local anesthesia, Anesthetic solutions and their preparations indications. Armamentarium. Methods and techniques employed. Complications, emergencies, their prevention and treatment	4.73	Essential	21(78)	06(22)		

Continued on next page

9.	Traumatic injuries of teeth, alveolar processes jaws, facial skeleton and soft tissue	4.67	Essential	19(70)	08(30)		
10.	Oral facial and neck infections: acute, chronic and specific infections, their surgical relationship, diagnosis and treatment	4.64	Essential	18(67)	05(19)	04(14)	
11.	Clerking & Consent, History taking, Examination, Investigations, Role of Consent	4.61	Essential	20(74)	05(19)	02(7)	
12.	Methods of Pain Control Including Analgesics, Pain Control in Neuralgias	4.58	Essential	18(67)	05(19)	04(14)	
13.	Diagnosis and treatment of oral and facial pain	4.52	Essential	18(67)	05(19)	04(14)	
14.	Disorders of tempromandibular joint; diagnosis and treatment	4.45	Essential	18(67)	05(19)	04(14)	
15.	Apicectomy (Surgical Endodontics, Indications, Assessment, Flap Design, Technique, Wound Closure, Post-Operative Instructions and Complications)	4.45	Essential	18(67)	06(22)	03(11)	
16.	Routine Investigations Interpretation of Routine of Hematological, Chemical and Radiological Investigations	4.42	Essential	22(81)	03(11)	02(7)	
17.	Analgesia: Analgesic and techniques of administration. Anaesthetic Agents	4.39	Essential	19(70)	04(15)	04(15)	
18.	Diagnosis of diseases, injuries and defects of jaws, associated structure and oral cavity	4.30	Essential	17(62)	05(19)	05(19)	
19.	Maxillary sinus disorders, Definition, Classification, Clinical Features, Diagnosis, Management & Complications	4.30	Supplementary	06(22)	05(19)	16(59)	
20.	Surgical accidents, complications associated with oral surgery: avoidance and treatment	4.27	Essential	15(55)	09(33)	03(11)	
21.	Post-operative care, complications, emergencies, prevention and treatment	4.24	Essential	16(59)	09(33)	02(7)	
22.	Surgical treatment of cysts and non malignant tumors of oral cavity	4.21	Important	12(44)	13(49)	02(7)	
23.	Diseases of salivary glands; diagnosis and treatment	4.12	Important	03(11)	14(52)	10(37)	
24.	Oral malignancies, their diagnosis and management	4.09	Important	04(15)	12(44)	11(41)	
25.	Dental Implant introduction, Indication, Types, Procedures and Complications	4.06	Important	03(11)	12(44)	12(44)	
26.	Sterilization	4.03	Essential	15(55)	10(38)	02(7)	
27.	Oral Surgery for dental prosthesis, and as an aid for periodontal and orthodontic treatment	4.03	Important	3(11)	12(44)	06(22)	06(22)
28.	Historical introduction, indications and contra indications, Preparation of the patient for general anesthesia, stages of General Anesthesia	3.94	Supplementary	—	02(7)	15(56)	10(37)
29.	Bone and fibro osseous lesions, Osteopetrosis, Paget's Disease, Hyperparathyroidism,Rickets, Fibrous Dysplasia	3.91	Questionable	—	03(11)	11(41)	13(48)
30.	Developmental deformities of the jaws (prognathism, micrognathia Cleft lip	3.64	Supplementary	—	—	17(63)	10(37)
31.	Apparatuses used for general anesthesia, techniques for administration of general anesthesia, inhalation and intravenous anesthesia	3.33	Questionable	—	—	—	27(100)

The values are, average(Ave) of values of round 1,number (%) of the participants giving ratings of Essential(E), Important(IMP), Supplementary(S) and Questionable(Q) in round 2.

TABLE 1.3: FINAL RESULTS PRACTICAL TOPICS, ITEMS WITH AVERAGE OF FIRST ROUND ALONG WITH THE FINAL RANKING AS PER THEIR SIGNIFICANCE

S. No.	Topic	Average 1st round	Category	E	Imp	Sup	Q	Remarks
1.	Dry socket	4.46	Essential	26(96)	01(4)	—	—	
2.	Biopsy	4.06	Essential	22(81)	04(19)	01(3)	—	All focal groups agreed on biopsy in the wake of increasing oral cancer
3.	200 extractions under local anesthesia	3.94	Essential	27(100)	—	—	—	Number of extractions were recommended to be reduced
4.	Alveolectomy & Alveolplasty	3.94	Important	9(37)	04(19)	11(41)	03(11)	
5.	Frenectomy Labial & Lingual	3.70	Supplementary	1(4)	02(7)	14(52)	10(37)	
6.	5 extractions under general anesthesia(Assistance)	3.67	Supplementary	2(7)	02(7)	15(56)	8(30)	
7.	5 fractures of jaw (assistance/ Observation)	3.64	Supplementary	5(18)	05(18)	09(34)	8(30)	
8.	Operculectomy	3.33	Questionable	2(7)	4(19)	10(37)	11(41)	
9.	Tongue tie	3.21	Supplementary	—	9(34)	10(37)	8(30)	
10.	Cryosurgery	2.64	Questionable	—	2(7)	5(18)	20(74)	
11.	Laser Excisions	2.46	Questionable	—	—	—	27(100)	

The values are, average(Ave) of values of round 1,number (%) of the participants giving ratings of Essential(E), Important(IMP), Supplementary(S) and Questionable(Q) in round 2.

DISCUSSION

There is acute shortage of oral and maxillofacial faculty in the country as fellowship program of CPSP in the specialty of oral and maxillofacial surgery is just about a decade old. There is mushrooming of dental colleges in the very recent past in the country. Many of these colleges do not even have final year class as yet, and OMFS is a final year subject. So it was difficult to get well experienced OMFS faculty. This resulted in a wide variation in the teaching experience. The response rate of first and second round in our study were 89% and 82% respectively as compared to some other similar studies[20], where it varied from 59% to 85% and in another study the second round response was 49%.

The experts in medical education[21] for development of medical curricula have traditionally used Delphi technique. This study has also used Delphi technique for consensus development for OMFS syllabus for undergraduate BDS students and can be compared with other studies such as defining the dermatological content of the undergraduate medical curriculum by Clayton et al.[22] The similarities were two rounds modified Delphi, an email questionnaire of explicit learning outcomes and results were obtained by using values as modes and numbers (%) of panel giving the mode. The differences were, multidisciplinary panel of 66 individuals, fifty-three learning outcomes were rated 'very important.' The limitation of their study was weak piloting of questionnaire and guidance provided to the panels influenced the outcome. This limitation was addressed by multiple meetings with the experts and piloting of the questionnaire based on PMDC curricular documents. The guidance was as required and limited, as the panel in this study comprised only

experts. However their strength was a multidisciplinary panel to overcome bias.

A generic consensus on assessment of undergraduate competence in forceps exodontias in the United Kingdom, a study by Durham et al[23] comprising three rounds of Modified Delphi used an email questionnaire. Only academicians were involved in their study as in this present study. The contents were already laid down in both studies, so the absence of multidisciplinary panel was not weakness. They used content analysis of the notes from the meetings to identify domains and sub domains but in this study, meetings with experts for questionnaire design and piloting were adopted.

A Delphi study by Rohan et al comprising three iterative rounds for Defining an anesthetic curriculum for medical undergraduates is another study which closely resembles the present study. The similarities included, 27/310 member panel expert in undergraduate anesthesia education were consulted via post and telephone for their response on 5 point likert scale. Mean score of 4 and standard deviation of 1 or less were used to reach at consensus on individual items. Panel selection was purposive as in present study. There was 67% and 59% response rate to the first and 2nd round which is different from the present study.

Planning the content of a brief educational course in maxillofacial emergencies for staff in accident and emergency departments by Ross et al[44] is a 3-stage modified Delphi study. In this study a questionnaire using on line electronic survey tool was sent to 188/890 members of British Association of Maxillofacial Surgeons. Likert scale was used for measuring opinion. Mode value was used along with %age of respondents giving opinion of agreement and retention in subsequent stages. Response rate to the 2nd and 3rd round was 21% and 12% respectively. There could be selection and response bias due to low response rate. The relevant expertise was consulted. The piloting of questionnaire was done using local emergency and accident dept with oral and maxillofacial surgeons. Except for the response rate which was the limitation of the study, number of rounds and on line electronic survey tool, the rest was comparable to the present study.

Development of an ENT undergraduate curriculum using a Delphi survey by Lloyd et al used two round Delphi survey, and an email questionnaire. Wider participation of the stake holders was the strength of the study. Instead of exclusion and elimination, the ranking was done based on significance of the topic like important or otherwise. The difference was, the present study used both exclusion and ranking based on significance. This innovation is the strength of present study. Moreover, the ranking of significance also included the rank 'essential' to align it with Kauser and Halsgrove concept of assessment. They used mode and median scores for individual learning outcome and mode of 7 was used as the cut off. In case of same mode then mean was used for ranking. The response rate for the 2nd round was 49 % of the first round while in the present study it was 82%. The limitation was heterogeneity of experts, due to which some of the relevant categories could not get consensus such as diseases of nose. However involvement of only academician as stake holders in the present study addressed this limitation effectively.

CONCLUSION

A consensus on course contents of undergraduate oral and maxillofacial surgery has been developed in this study. The ranking of the contents based on significance in the syllabus as essential, important, supplementary and questionable so as to align the contents with other curricular contents especially assessment has also been proposed. This, to our knowledge, is a debut study in creating this alignment and can be used for further research in other disciplines. The results of the study can be used as guide by PMDC for Undergraduate OMFS syllabus.

REFERENCES

1 Pakistan Association of Oral & Maxillofacial Surgeon: POAMS. http://paoms.org.pk/ (accessed on 17 November 2016).

2 ABAOMS national education group's pages. 2009. Available at http://www.abaoms.org.uk/Pages/UgUKEduc.htm (Accessed 18 October 2015).

3 Newble D, Cannon R (eds.) Planning A Course. In; A Hand Book for Medical Teachers .4th revised edition. Dordrecht: Kluwer Academic Publishers; 2001. p91-92.

4 Specialty Advisory Committee for Oral Surgery The Faculty of Dental Surgery The Royal College of Surgeons of England. SPECIALTY TRAINING CURRICULUM ORAL SURGERY. London may 2010.

5 Macluskey M, Durham J, Cowan G et al. UK national curriculum for undergraduate oral surgery. Eur J Dent Educ 2008; 12: 48-58.

6 ABAOMS national education group's pages. 2009. Available at http://www.abaoms.org.uk/Pages/UgUKEduc.htm (Accessed 18 October 2015).

7 Valley I.S, Argiris K.,Walker T.W.M. , Magennis P. Qualitative comparison of curricula in oral and maxillofacial surgery training. Part 1: dental foundation training . Br J Oral Maxillofac Surg. 2012; 50(5):464-67.

8 Specialty Advisory Committee for Oral Surgery The Faculty of Dental Surgery The Royal College of Surgeons of England. SPECIALTY TRAINING CURRICULUM ORAL SURGERY. London may 2010.

9 Reisha N. Rafeek, M.Sc., F.D.S.R.C.S.; Shivaughn M. Marchan,

M.Sc.; Rahul S. Naidu, M.Sc.; Peter V. Carrotte, M.D.S., M.Ed. Perceived Competency at Graduation Among Dental Alumni of the University of the West Indies. Journal of Dental Education 2004;68: 81-88.

10 Valley I.S, Argiris K.,Walker T.W.M. , Magennis P. Qualitative comparison of curricula in oral and maxillofacial surgery training. Part 1: dental foundation training . Br J Oral Maxillofac Surg. 2012; 50(5):464-67.

11 Walker T.W.M, Varley I.S., Argiris K., Magennis P. Qualitative comparison of curricula in oral and maxillofacial surgery training. Part 2: oral surgery. Br J Oral Maxillofac Surg 2012; 50(5): 468-69.

12 Pakistan Medical & Dental Council. PM & DC: Criteria/ accreditation Standards, Rules and Regulations :http://www.pmdc.org.pk/Home/tabid/36/Default.aspx/ (accessed 18 October 2015)

13 Macluskey M, Durham J, Cowan G et al. UK national curriculum for undergraduate oral surgery. Eur J Dent Educ 2008; 12: 48-58.

14 H Namrita. Oral Health Challenges In Pakistan And Approaches To These Problems PODJ. 2012;32,(3): 497-501

15 McKenna HP. The Delphi technique: a worthwhile research approach fornursing? J Adv Nurs 1994;19:1221-25.

16 Sullivan GM, Artino AR.. Analyzing and interpreting data from Likert type scales. J Grad Med Educ 2013; 5(4):541-42.

17 Rohan D, Ahern S & Walsh K. Defining an anaesthetic curriculum for medical undergraduates. A Delphi study.Medical Teacher 2009; 31:1-5.

18 Anthony R. Artino, Jr.1, Jeffrey S. La Rochelle1, Kent J. Dezee1 & Hunter Gehlbach2 Developing questionnaires for educational research: AMEE Guide No. 872014, 36: 463-74.

19 Holsgrove G, Kauser Ali S. Quality assurance, standard-setting and item banking in professional examinations. College of Physicians and Surgeons: Pakistan. 2004.

20 Lloyd, S.Tan, Z.E. Taube, M.-A & Doshi, J. Development of an ENT undergraduate curriculum using a Delphi survey. Clin. Otolaryngol. 2014; 39: 281-88.

21 Rohan D, Ahern S & Walsh K. Defining an anaesthetic curriculum for medical undergraduates. A Delphi study.Medical Teacher 2009; 31:1-5.

22 Mahboob U. Evan P. Key Steps for Managing Changes in the Curriculum . Journal of the College of Physicians and Surgeons Pakistan 2015, Vol. 25 (2): 85-86.

23 Clayton R et al. Defining the undergraduate dermatology curriculum, 2006 British Association of Dermatologists • British Journal of Dermatology 2006; 155:137-44.

24 Durham J, Balmer C, Bell A, et al. A generic consensus assessment of undergraduate competence in forceps exodontia in the United Kingdom.Eur J Dent Educ 2010;14:210-14.

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