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Online Learning and Evidence-Based Clinical Decision-Making in Oral Pathology Among Practicing Dentists: A Cross-Sectional Study

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Abstract

Background: Oral mucosal lesions may present diagnostic challenges to practicing dentists, particularly when clinical findings are unfamiliar or potentially suspicious. Online learning and evidence-based information seeking may support continuing professional development and clinical decision-making.

Objective: To assess online learning behavior, evidence-seeking practices, confidence in oral pathology-related decisions, and responses to clinically relevant oral lesion scenarios among practicing dentists.

Methods: A cross-sectional questionnaire comprising 22 items was organized into six domains: demographic characteristics, oral pathology experience, online learning, evidence-based practice, clinical decision-making, and two clinical scenarios. Data were collected electronically using Google Forms from the end of December 2025 through mid-June 2026, and 460 respondents were included. Data were summarized using frequencies and percentages. Associations between categorical variables were examined using Pearson's chi-square test, with $p<0.05$ considered statistically significant.

Results: Of 460 respondents, 254 (55.2%) were female and 149 (32.4%) were aged 25–34 years. BDS/DDS was the most common qualification (208, 45.2%). PubMed/Google Scholar was the leading online resource (158, 34.3%), and lack of time was the most frequently reported barrier (169, 36.7%). Most respondents reported using online learning at least weekly (287, 62.4%) and searching the scientific literature often or very often (288, 62.6%). For a persistent non-healing tongue ulcer, 322 (70.0%) selected urgent biopsy/referral. For an unfamiliar oral lesion, 326 (70.9%) selected searching reliable scientific literature/guidelines. Highest qualification was significantly associated with primary evidence source ($\chi^2=30.75$, df=12, $p=0.002$), and online learning frequency was significantly associated with scientific literature-searching frequency ($\chi^2=21.73$, df=12, $p=0.041$).

Conclusion: The findings indicate substantial use of digital and scientific information resources among practicing dentists, but time constraints and difficulties judging information quality remain important barriers. Continuing education should emphasize efficient evidence retrieval, critical appraisal, recognition of red-flag oral lesions, and appropriate biopsy/referral pathways.

Keywords: oral pathology; oral lesions; evidence-based dentistry; online learning; continuing dental education; clinical decision-making; dentists.

Introduction

Oral mucosal lesions range from benign and self-limiting conditions to potentially malignant disorders and oral squamous cell carcinoma. Their clinical presentation may be variable, and visual recognition alone does not always allow reliable discrimination between benign and suspicious lesions. Sbricoli et al. reported an overall sensitivity of 57% for recognizing suspected malignant lesions and emphasized the need for improved education and continuing professional development.[1]

Digital technologies have increasingly expanded opportunities for continuing dental education. Online learning can provide flexible access to educational materials, facilitate rapid updating of clinical knowledge, and reduce geographic barriers to professional development. Cheng et al. reported favorable learning outcomes following an online continuing dental education course and suggested that online education is likely to remain an important component of dental professional development.[2] In Libya, Elemam et al. also reported favorable attitudes toward online continuing dental education among dental practitioners, supporting the relevance of digital education within the regional context.[3]

Access to information, however, does not necessarily translate into evidence-based practice. Evidence-based dentistry requires clinicians to formulate clinical questions, locate relevant evidence, appraise its validity and applicability, and integrate the evidence with clinical expertise and patient needs. A systematic review by Feres et al. found generally positive attitudes toward evidence-based dentistry, while also emphasizing uncertainty regarding the extent to which reported attitudes reflect actual evidence-based practice.[4]

Several barriers can limit evidence-based practice, including lack of time, financial constraints, difficulty evaluating the quality of available evidence, and insufficient critical-appraisal skills.[5] Studies from different settings have similarly identified time limitations and difficulties assessing the reliability of online information as important barriers.[6,7] These challenges are especially relevant to oral pathology, where delayed recognition or inappropriate management of suspicious lesions may affect patient outcomes.

Clinical decision-making for suspicious oral lesions requires recognition of red flags, appropriate investigation, and timely referral or biopsy. Previous research has shown that dentists vary in their diagnostic and biopsy approaches and that training and access to oral pathology services may influence management decisions.[8,9] Current clinical guidance also emphasizes prompt assessment of persistent unexplained oral ulceration and appropriate biopsy or referral of suspicious mucosal lesions.[10,11]

Despite the importance of digital learning and evidence-based practice, relatively few studies have examined online learning behavior, evidence-seeking, confidence, and oral pathology decision-making within a single questionnaire framework. Therefore, this study assessed these domains among practicing dentists and examined selected associations between learning behavior, evidence use, and professional characteristics.

The objectives of this study were to assess online learning and evidence-based clinical decision-making in oral pathology among practicing dentists; identify the commonly used online and scientific information sources; determine the principal barriers to online learning and the use of evidence-based information; assess dentists' confidence in oral lesion recognition, diagnosis, biopsy or further investigation, referral, and identification of reliable information sources; evaluate responses to two clinically relevant oral pathology scenarios; and examine selected associations between professional characteristics, online learning practices, and evidence-seeking behaviour.

2. Materials and Methods

2.1 Study design and questionnaire

This was a cross-sectional, questionnaire-based study involving 460 practicing dentists. Data were collected electronically using a Google Forms questionnaire from the end of December 2025 through mid-June 2026 distributed to different countries. The questionnaire contained 22 items organized into six domains: demographic and professional characteristics; oral pathology experience; online learning; evidence-based practice; clinical decision-making; and two clinical scenarios. The questionnaire assessed self-reported learning frequency, information sources, perceived usefulness, barriers, literature-searching behavior, primary evidence sources, consideration of evidence quality, confidence in identifying reliable information, diagnostic and referral confidence, and responses to oral pathology scenarios.

2.2 Variables and clinical scenarios

Professional variables included age group, gender, years of practice, highest qualification, main practice area, and frequency of encountering oral lesions. Online-learning variables included learning frequency, main online resource, perceived usefulness, and the principal barrier. Evidence-based practice variables included scientific literature-searching frequency, primary evidence source, and frequency of considering evidence quality. Clinical decision-making variables included confidence in identifying reliable information, initial diagnosis, biopsy/further investigation, referral, and the influence of scientific evidence. Two scenarios addressed a persistent non-healing tongue ulcer and an unfamiliar oral lesion. Participants were recruited from different cities and geographic locations, and the survey was not restricted to a single city, dental institution, or practice setting. Items addressing scientific information sources, literature searching, and barriers to the use of evidence were informed by and adapted from items in a previously published, pretested questionnaire developed for dentists by Oliveira et al.[7] Additional items concerning oral lesion recognition, diagnostic confidence, biopsy/further investigation, referral, and clinical decision-making were informed by published studies of dentists' self-efficacy and management of oral lesions.[5,6] Before the main survey, the adapted questionnaire was administered to a small group of dentists to assess its practical clarity and suitability. No formal psychometric validation was performed.

2.3 Statistical analysis

Categorical variables were summarized using frequencies and percentages. Associations between categorical variables were assessed using Pearson's chi-square test. Two prespecified associations were examined: highest qualification versus primary evidence source, and online learning frequency versus scientific literature-searching frequency. Statistical significance was set at $p<0.05$. The analyses were based on the 460 respondent-level records supplied with the study dataset.

2.4 Ethical considerations

The study was conducted in accordance with the ethical principles

of the Declaration of Helsinki. Participation was voluntary, and informed consent was obtained electronically from all participants before completing the questionnaire. The questionnaire was administered anonymously through Google Forms, and no personally identifying information was collected. Participants were informed about the purpose of the study and their right to decline participation or discontinue completing the questionnaire at any time. The study involved an anonymous, voluntary questionnaire and did not collect identifiable personal or clinical information.

3. Results

3.1 Participant characteristics

A total of 460 respondents were included. Females represented 254 (55.2%) participants. The largest age group was 25–34 years (149, 32.4%), followed by 35–44 years (124, 27.0%) and 45–54 years (118, 25.7%). Regarding professional experience, 154 (33.5%) had practiced for 11–20 years and 141 (30.7%) for 5–10 years. BDS/DDS was the most common highest qualification (208, 45.2%). Private practice was the most frequently reported main practice area (136, 29.6%), followed by general dentistry (125, 27.2%). Most respondents encountered oral lesions often or very often (265, 57.6%).

Variable	Category	n	%
Age group	25–34	149	32.4
	35–44	124	27.0
	45–54	118	25.7
	55+	69	15.0
Gender	Female	254	55.2
	Male	206	44.8
Years of practice	<5	77	16.7
	5–10	141	30.7
	11–20	154	33.5
	>20	88	19.1
Highest qualification	BDS/DDS	208	45.2
	Master's	128	27.8
	Postgraduate Diploma	84	18.3
	PhD/Board	40	8.7
Main practice area	Private Practice	136	29.6
	General Dentistry	125	27.2
	Public Sector	73	15.9
	Specialist Practice	73	15.9
	Academic/Teaching	53	11.5

Table 1. Demographic and professional characteristics (N=460).

3.2 Oral pathology experience and online learning

Confidence in recognizing common oral lesions was moderate or very high in 293 (63.7%) respondents, while 167 (36.3%) were slightly or not confident. Uncertainty about diagnosis was reported often or very often by 167 (36.3%) respondents. Online learning was reported several times per week by 166 (36.1%), weekly by 121 (26.3%), monthly by 113 (24.6%), and rarely by 60 (13.0%). Thus, 287 (62.4%) reported learning online at least weekly. PubMed/Google Scholar was the leading online resource (158, 34.3%), followed by professional websites (107, 23.3%) and online courses/webinars (90, 19.6%).

Variable	Category	n	%
Confidence recognizing common lesions	Very confident	112	24.3
	Moderately confident	181	39.3
	Slightly confident	123	26.7
	Not confident	44	9.6
Uncertain diagnosis	Very often	35	7.6
	Often	132	28.7
	Sometimes	173	37.6
	Rarely	120	26.1
Online learning frequency	Several times/week	166	36.1
	Weekly	121	26.3
	Monthly	113	24.6
	Rarely	60	13.0
Main online resource	PubMed/Google Scholar	158	34.3
	Professional websites	107	23.3
	Online courses/webinars	90	19.6
	YouTube/video lectures	68	14.8
	Social media/dental groups	37	8.0

Table 2. Oral pathology experience and online learning behavior.

3.3 Evidence-based practice

Online learning was considered very useful by 133 (28.9%) respondents and moderately useful by 215 (46.7%). Lack of time was the most frequently reported barrier (169, 36.7%), followed by difficulty judging information quality (99, 21.5%) and information overload (94, 20.4%). Scientific literature was searched often by 170 (37.0%) and very often by 118 (25.7%), giving a combined proportion of 62.6%. PubMed/Google Scholar was the most common primary evidence source (190, 41.3%), followed by clinical guidelines (91, 19.8%). Considering evidence quality was reported always by 159 (34.6%) and often by 174 (37.8%) respondents.

Variable	Category	n	%
Usefulness of online learning	Very useful	133	28.9
	Moderately useful	215	46.7
	Slightly useful	90	19.6
	Not useful	22	4.8
Main barrier	Lack of time	169	36.7
	Difficulty judging quality	99	21.5
	Information overload	94	20.4
	Limited internet/access	66	14.3
	Cost of courses/resources	32	7.0
Scientific literature searching	Very often	118	25.7
	Often	170	37.0
	Sometimes	125	27.2
	Rarely	47	10.2
Primary evidence source	PubMed/Google Scholar	190	41.3
	Clinical guidelines	91	19.8

	Textbooks	79	17.2
	Professional websites	51	11.1
	Colleagues	49	10.7
Considering evidence quality	Always	159	34.6
	Often	174	37.8
	Sometimes	98	21.3
	Rarely	29	6.3

Table 3. Online learning and evidence-based practice.

3.4 Clinical decision-making and scenarios

Confidence in identifying reliable information was moderate or very high in 312 (67.8%) respondents. For initial diagnosis, 313 (68.0%) were moderately or very confident. Confidence regarding biopsy/further investigation was moderate or very high in 306 (66.5%), while confidence regarding referral was moderate or very high in 349 (75.9%). Scientific evidence influenced clinical decisions often or very often in 261 (56.7%) respondents.

In the persistent non-healing tongue ulcer scenario, 322 (70.0%) selected arranging urgent biopsy/referral. The remaining responses were observation without further action (56, 12.2%), symptomatic treatment only (48, 10.4%), and reassurance with later review (34, 7.4%). In the unfamiliar oral lesion scenario, 326 (70.9%) selected searching reliable scientific literature/guidelines, 69 (15.0%) would ask a colleague only, 39 (8.5%) would ignore the lesion unless symptoms worsened, and 26 (5.7%) would treat empirically without further assessment.

Variable	Category	n	%
Reliable information	Very confident	138	30.0
	Moderately confident	174	37.8
	Slightly confident	108	23.5
	Not confident	40	8.7
Initial diagnosis confidence	Very confident	96	20.9
	Moderately confident	217	47.2
	Slightly confident	106	23.0
	Not confident	41	8.9
Biopsy/further investigation	Very confident	91	19.8
	Moderately confident	215	46.7
	Slightly confident	114	24.8
	Not confident	40	8.7
Referral confidence	Very confident	123	26.7
	Moderately confident	226	49.1
	Slightly confident	85	18.5
	Not confident	26	5.7
Scientific evidence influence	Very often	100	21.7
	Often	161	35.0
	Sometimes	142	30.9
	Rarely	57	12.4
Tongue ulcer scenario	Urgent biopsy/referral	322	70.0
	Observe	56	12.2
	Symptomatic treatment	48	10.4
	Reassure/review later	34	7.4
Unfamiliar lesion scenario	Search literature/guidelines	326	70.9
	Ask colleague only	69	15.0
	Ignore unless worse	39	8.5
	Empirical treatment	26	5.7

Table 4. Clinical decision-making confidence and scenario responses.

3.5 Associations

Highest qualification was significantly associated with primary evidence source (Pearson χ^2=30.75, df=12, p=0.002). Online learning frequency was also significantly associated with scientific literature-searching frequency (Pearson χ^2=21.73, df=12, p=0.041). These associations indicate that professional educational background and patterns of online learning may be related to how dentists seek and access scientific evidence; however, their cross-sectional nature does not establish causality.

Association	Test	χ^2	P value
Highest qualification × primary evidence source	Pearson χ^2	30.75	p=0.002
Online learning frequency × literature-searching frequency	Pearson χ^2	21.73	p=0.041

Table 5. Prespecified associations between professional/learning variables and evidence-seeking behavior.

4. Discussion

The present study examined online learning, evidence-seeking behavior, and oral pathology clinical decision-making among 460 practicing dentists. The overall pattern indicates substantial engagement with digital and scientific information: 62.4% reported online learning at least weekly, while 62.6% reported searching the scientific literature often or very often. PubMed/Google Scholar was the leading online resource and the leading primary evidence source. This pattern is consistent with previous evidence indicating that dentists commonly rely on scientific journals, guidelines, and electronic databases, although reported use does not necessarily demonstrate high-quality evidence-based practice.[12,13]

The favorable role of online continuing education is also supported by studies of dental professionals. Online continuing dental education has been associated with positive learning experiences and may reduce geographic barriers to professional development.[14] In the Libyan context, previous work has likewise demonstrated positive attitudes toward online continuing dental education, while highlighting infrastructure and connectivity challenges.[3] More broadly, systematic evidence suggests that continuing professional development can influence learning and, when designed using multiple methods, may also influence professional behavior and patient care.[15] These findings support the use of online learning as a component of continuing education, but not as a substitute for clinical skills training.

Lack of time was the most frequently reported barrier in the present study (36.7%). This finding closely aligns with systematic and cross-sectional evidence identifying time constraints as a persistent barrier to the implementation of evidence-based dentistry.[16,17] The Moroccan survey by Kadri et al. similarly identified lack of time and inadequate training in critical appraisal as major obstacles

to EBD implementation.[18] These findings suggest that simply increasing the volume of available educational content may have limited value. Instead, continuing education should prioritize concise, clinically relevant resources, efficient search strategies, evidence summaries, and point-of-care decision aids.

Difficulty judging information quality was the second most common barrier (21.5%). This is consistent with evidence from Brazilian dentists, among whom difficulty determining the reliability of online scientific content was a leading barrier to incorporating evidence into practice.[13] Evidence-based dentistry requires more than retrieving information; clinicians must judge validity, relevance, applicability, and the balance between evidence, clinical expertise, and patient preferences.[16,19] The current finding therefore supports integrating critical appraisal and information-literacy skills into continuing education rather than focusing solely on database access.

The significant association between highest qualification and primary evidence source suggests that educational background may influence information-seeking preferences. This interpretation is compatible with systematic evidence showing that dentists generally value scientific journals, clinical practice guidelines, and trusted professional sources, while actual EBD practices vary considerably.[12] Earlier work on clinical information resources also demonstrated differences in information-seeking patterns according to professional background and experience.[20] Because the present study is cross-sectional, however, the association should not be interpreted as evidence that higher qualifications cause better evidence use.

The significant association between online learning frequency and scientific literature-searching frequency is particularly relevant to professional development. Dentists who engage more frequently with online learning may also be more likely to search scientific literature, although the direction of this relationship cannot be determined from the present data. The finding is nevertheless compatible with evidence that online learning can facilitate access to continuing education and that structured EBD training can improve clinicians' ability to use evidence.[14,18] Future intervention studies should test whether targeted online training actually changes literature-searching behavior and clinical decisions rather than relying on self-reported frequency alone.

The clinical scenarios provide an important complementary perspective. Seventy percent of respondents selected urgent biopsy/referral for a persistent non-healing tongue ulcer. This is broadly aligned with current guidance recommending urgent investigation/referral for unexplained oral ulceration persisting beyond three weeks and biopsy or specialist referral for suspicious lesions.[10,11] The response pattern is also comparable with research showing that most U.S. general dentists refer suspicious oral lesions for consultation or biopsy.[21] However, questionnaire responses represent intended management rather than observed practice, and therefore should not be interpreted as proof of diagnostic competence.

Similarly, 70.9% of respondents selected searching reliable literature or guidelines when faced with an unfamiliar oral lesion. This suggests an evidence-oriented response among a substantial proportion of participants. Nevertheless, evidence retrieval must be accompanied by appropriate interpretation and clinical examination. Studies of dentists' knowledge of oral potentially malignant disorders have demonstrated meaningful gaps, particularly among general practitioners, supporting the need for continuous education in recognition, risk factors, and management.[22] Studies from Libya and other settings have likewise reported gaps in oral cancer knowledge and confidence among dentists.[23,24]

The moderate rather than uniformly high confidence levels in the present study are clinically important. Although 67.8% were moderately or very confident in identifying reliable information and 66.5% were moderately or very confident regarding biopsy/further investigation, confidence is not equivalent to accuracy. Diagnostic image-based research has demonstrated limitations in recognizing suspected malignant oral lesions even among experienced dental professionals.[1] Recent surveys have also identified gaps between knowledge and clinical practice among dental professionals, reinforcing the need to combine knowledge acquisition with case-based and practical training.[25]

Biopsy and referral decisions deserve particular attention because they are influenced by training and access to specialist support. A recent study found that previous biopsy experience during training and access to oral pathologists were associated with dentists' biopsy practices.[9] Position guidance for general practitioners similarly emphasizes systematic evaluation of oral lesions, appropriate biopsy techniques, and referral pathways.[26] These findings reinforce the value of structured exposure to oral pathology during undergraduate and continuing education, especially where specialist services may be less accessible.

The educational implications are strengthened by recent evidence on oral cancer training. A 2026 systematic review and meta-analysis found that training programs for frontline health workers can improve knowledge and diagnostic performance, although substantial heterogeneity limits certainty about the size of the effect.[27] A 2026 scoping review of oral cancer education identified a wide range of delivery methods, including lectures, hands-on examination training, case-based learning, clinical observation, and biopsy training, with no single universally superior method.[28] Together, these findings support a blended educational model rather than relying on online lectures alone.

From an evidence-based practice perspective, the results also support a shift from simply providing more information toward providing better access to trustworthy, synthesized evidence. Evidence-based dentistry has long emphasized the integration of research evidence with professional expertise and patient needs, while more recent commentary has highlighted information overload, limited time, and difficulties translating evidence into routine practice.[19,29] For busy dentists, searchable summaries, guidelines, structured clinical questions, and practical decision algorithms may be more usable than large volumes of unfiltered online content.

The findings have particular relevance for continuing dental education in Libya and comparable settings. Local studies have identified both enthusiasm for online education and persistent challenges related to infrastructure and professional confidence.[3,23] The present results extend that context by showing that digital learning and evidence searching are already common among a larger group of practicing dentists, while time and appraisal skills remain limiting factors. This combination suggests an opportunity to build targeted, locally relevant continuing education modules around oral lesion recognition, red-flag features, literature searching, critical appraisal, biopsy indications, and referral pathways.

Taken together, the results support an integrated model of professional development in oral pathology. Digital learning can

improve access to information, evidence-based skills determine whether that information is appropriately selected and interpreted, and clinical training is required to translate knowledge into accurate lesion recognition and timely management. The strongest educational strategy is therefore likely to combine online evidence retrieval with case-based learning, image interpretation, practical examination skills, and explicit referral/biopsy pathways.[27,28]

5. Implications

5.1 Clinical implications

The findings support strengthening dentists' ability to recognize oral red flags, identify lesions requiring further assessment, and use clear biopsy and referral pathways. Continuing education should emphasize persistent unexplained ulceration, suspicious red or red-and-white lesions, appropriate specialist referral, and the distinction between clinical confidence and diagnostic accuracy.[10,11,21,26]

5.2 Educational implications

Continuing dental education should use short, clinically focused online modules combined with image-based cases, case discussions, critical-appraisal exercises, and practical oral examination or biopsy/referral training. This approach addresses both the high demand for flexible online learning and the limitations of online information access without structured appraisal or clinical skills development.[14,15,27,28,29]

5.3 Research implications

Future research should move beyond self-reported behavior and evaluate objective diagnostic performance, changes in evidence-searching skills, and clinical behavior after educational interventions. Research should also examine whether targeted digital programs improve recognition of suspicious lesions, appropriate referral, and biopsy decision-making in different practice settings.

6. Strengths and Limitations

6.1 Strengths

A strength of the study is the inclusion of respondent-level records for all 460 participants, allowing the reported frequencies and associations to be checked against the supplied study records. The questionnaire also integrated online learning, evidence seeking, confidence, and clinically oriented scenarios within one framework. The study addresses an important intersection between digital continuing education and oral pathology decision-making that is relevant to contemporary dental practice.

6.2 Limitations

Several limitations should be considered. First, the cross-sectional design prevents causal inference, so the observed associations should not be interpreted as evidence that online learning or qualification causes particular evidence-seeking behaviors. Second, the study relies on self-reported behavior and confidence, which may be affected by recall and social-desirability bias. Third, the clinical scenarios were questionnaire-based rather than image-based diagnostic assessments and therefore cannot directly measure diagnostic accuracy. Fourth, participants were recruited through voluntary online distribution of the questionnaire, which may have introduced selection and non-response bias. Because the survey was distributed electronically without a defined sampling frame or a record of the total number of dentists invited, a formal response rate could not be calculated. Fifth, only two prespecified associations were analyzed, so the findings should not be generalized to other untested relationships. Finally, effect sizes and confidence intervals for the chi-square associations were not reported because the underlying cross-tabulation cell counts were not included in the manuscript.

6.3 Future Work and Research Implications

Future studies should use multicenter and probability-based sampling where feasible, incorporate image-based or standardized clinical cases, and evaluate objective measures of diagnostic accuracy rather than confidence alone. Longitudinal or intervention studies should test whether structured online EBD training changes information-searching behavior, critical-appraisal performance, biopsy/referral decisions, and diagnostic accuracy. Future work should also compare online-only, blended, and hands-on educational formats and assess whether locally adapted clinical decision aids improve implementation in routine dental practice. Recent evidence supports combining oral cancer education with practical examination, case-based learning, and structured skills development rather than relying on a single educational modality.[27,28,30-33]

7. Conclusion

Among the 460 practicing dentists surveyed, online learning and scientific information seeking were common, with PubMed/Google Scholar representing the leading evidence source. Lack of time was the principal barrier, followed by difficulty judging information quality. Most respondents selected urgent biopsy/referral for a persistent non-healing tongue ulcer and literature/guideline searching for an unfamiliar oral lesion. Highest qualification was associated with primary evidence source, and online learning frequency was associated with scientific literature-searching frequency. These findings support continuing dental education that integrates flexible digital learning with critical appraisal, oral lesion recognition, practical decision-making, and appropriate biopsy/referral pathways.

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