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Abstract

Health Social networking sites offering search, reviews and recommendation are gaining popularity. This paper reviews the most popular social networking sites related to dental care. Social networks such as DrOogle and Yelp enable their users to review and rate their dentists and dental practices. Such information is then used to rank and recommend dentists or dental practices to new users/patients. This paper compares the dental care social networking sites in terms of their features and criteria supported for search, reviews and recommendations of dentists or dental practices. Mismatches between features and criteria among different dental care reviews sites are identified, which may cause inconsistency in the recommendations in the dental care. Therefore, this paper proposes a new framework for dynamic dental care recommendation system which takes both local (personalised) and global (crowdsourced) trust into account. It analyses the impact of current social networks on dentists, dental practices and their patients. Finally, it identifies the open issues and challenges that need to be addressed to design a trustworthy recommendation system for both the dental professionals and their patients.

Keywords: health social networks, dental review sites, search, ratings, rankings, recommendations, trust.

1. Introduction

The use of Social Networking Sites (SNSs) has made a substantial impact on the revolution of health care digital communications and has changed the role of both health care professionals and patients. Healthcare consumers have moved from searching information online to sharing

information and in fact interacting with other users within a platform (Lober and Flowers 2011). These platforms are referred as Health Social Networks (HSNs). They allow their members to create, retrieve and share information and experiences. Examples include MedHelp[1], PatientsLikeMe[2], DailyStrength[3], CureTogether[4], Tudiabetes[5], Asthmapolis[6] etc. (Swan 2012). These popular platforms provide valuable information about symptoms and treatments of various illnesses as well as opportunities for people to discuss their experiences with health professionals or other users with similar symptoms and experiences.

Pew Research Center (Lee 2012) reported a rising number of e-patients stating that 80% internet users in the US get health information online, third most popular online activity after email and search (Gallant et al. 2011), 60% use social media and 19% consult rankings of the providers. One of the most popular features of the online world is 'peer review' and ratings on any product or service. These ratings are shaping and influencing public views on health issues such as vaccines, mental health, and dental implants. By doing so, healthcare patients are empowered and able to find other patients in similar illnesses or health situations. They are able to interact with each other about conditions, symptoms and treatments (Swan 2009). The HSN platforms provide opportunity to be able to connect and relate with each other. It has been reported that 23% of chronic health e-patients have searched for other patients with similar conditions (Lober and Flowers 2011).

Dental care falls under the category of health care and a specialized social network for dental care has not been emerged yet. However, dental reviews and rankings sites in the form of social networks have emerged to help their users finding a dentist or dental practice in a given location. These sites allow users to review or rate their dentists or dental practices and based on that information, the sites provide rankings or recommendation.

The contribution of this paper can be summarized as follows:

- It provides an overview of HSNs and existing dental search, reviews and recommendation sites.
- It compares the features and criteria used in different sites to search, rate and rank the dentists or dental practices.
- It identifies the criteria these sites are using to help users/patients find the right dentist or dental practice. However, there are many mismatches of the criteria amongst the sites.
- It briefly analyses the impacts of these sites to the dentists or dental practices and their patients.
- It proposes a new framework for dynamic dental care recommendation system to find the most suitable and trustworthy dentist or dental practice. The new framework is dedicated to reduce any negative impacts in the dental care society.

The remainder of this paper is organised in the sections. Section 2 discusses the popularity of HSNs and introduces the emerging dental specific search and review sites. Section 3 focuses on dental care social networks and it compares their features and their search, review and recommendation criteria. Section 4 introduces a proposed framework for dynamic dental care recommendation system by incorporating preferred criteria and trust derived from social

1 www.medhelp.org
2 www.patientslikeme.com
3 www.dailystrength.org
4 www.curetogether.com
5 www.tudiabetes.org
6 www.asthmapolis.com

networks as well as crowdsources of dental information. The paper concludes with a discussion on impact on Dentists, Dental Practices and their Patients and on open issues.

2. Health Social Networks (HSNs)

The growing popularity of social media has made it easier to collect and rapidly analyse public health information such as data from food-borne illness or infectious disease outbreaks or dental implants. Nowadays, not all patients are automatically accepting doctors' or dentists' recommendation without doing their own online research (Ratzan 2011). If patients fail to have their need (e.g. questions, certainty of illness, understanding, etc.) fulfilled through direct communication with health professionals they may become frustrated and experience increasing uncertainty of their illness which would lead them to search on Internet, an alternative source (Hou & Shim 2010 and Tustin 2010). Indeed, unsatisfying interpersonal channel for patients has been a significant motivator for mediated channel such as HSNs. The Internet has become a better source of information in some cases than physical healthcare providers for patients (Hou & Shim 2010). Moturu & Liu (2010) quoted that a survey indicated 81% of adult users have used the Internet for health information and acknowledged that the Internet is the most widely used source for health information ahead of doctors, friends and families. But, is the information trustworthy? And is the data accurate? Search engines cannot provide answers to these questions (Moturu & Liu 2010).

Nonetheless, the users of HSNs are increasing as they can find comments or information related to the specific health condition or symptoms or find others who have experienced similar health issues. The users are not only able to retrieve related information but also create and share their experiences through the platform. Moreover, the users/patients can get emotional support by seeing others with similar health symptoms/conditions and feel "I am not alone", which empowers users/patients and give them a sense of community so that they would go back and share more in the same platform (Swan 2009). It is one of the most efficient approaches to win users/patients' hearts or allow them to trust the platform. Some of the HSN platforms are successful in allowing their users to share a lot of information about their medication, side effects, and types of therapies along with their symptoms. The HSNs have been used by both health professionals and patients, transforming the way health consumers connect, search and communicate. One of the most important factors for users/patients to use such platform is trust. Trust plays an important role for healthcare consumers to reduce uncertainty in technology-mediated environment (Hernández-Ortega 2011) and to decide whether to use the information or not to make their health related sensitive decisions.

The similar trend exists for dental care services as well. A website dedicated to dentist reviews quoted, "*About 60% of population has some fear of dentist… and the best way to find a dentist is through unbiased patient reviews of dentists*." (TheDentistReviews.com). It also provides a list of dentists reviews sites, such as DentalCenter[7], DentalFearCentral[8], DentistDig[9], DentistReviewsOnline[10] and DrOogle[11]. Dental professionals are also listed under other health professionals review sites such as RateMDs[12] and HealthGrades[13]. In addition, a generic review site Yelp[14] has been gaining popularity in the US for dentist

7 www.dentalcenter.com
8 www.dentalfearcentral.org
9 www.dentistdig.com
10 www.dentistreviewsonline.com
11 www.doctoroogle.com
12 www.ratemds.com
13 www.healthgrades.com
14 www.yelp.com

reviews, which allows patients to post reviews/comments about their visits to their dentists. Amongst all, DrOogle is one of the most dedicated sites for dental professionals in the US, which provides rankings on dentists based on patients' positive reviews (Dr.Oogle.com). However, the problem is not only there are many different sites available but also the different measuring criteria amongst the sites make it harder to choose the right dentist.

As mentioned earlier, trust is crucial for users/patients to use the information available online and it is paramount for dental care due to the invasive nature of treatment and the level of fear people have towards the dental treatment. For instance, a study in dental care patients by Rodriguez-Vazquez (2008) revealed that 96.8% of the participants in Spain (out of total 804 patients) showed some degree of stress about dental treatment. The same study also quoted that dental fear can upset up to 50% of the general population. Another dental health survey showed that 46% of the participants in Australia were anxious about going to the dentist (Armitage & Reidy 2012). Armfield (2010) defined a term 'dental beliefs scale' as a measurement of dental fear, which calculates subjective perception of dentist behaviour and beliefs related to lack of power, control, and trust.

3. Dental Care Social Networks – State of the art

Many researchers in the area of dental care has been exploring subjective attributes which affects patients during the visit to the dental clinic such as dental fear (Armitage & Reidy 2012, Armfied 2010, Armfield et al. 2009, McNeil et al. 2011, Ng & Leung 2008 and Rodriguez-Vazquez et al. 2008) and quality of care (Clarkson et al. 2010, Eriksen et al. 2008, Elgin 2012, Merijohn et al. 2008, Sbaraini et al. 2012, St. Louis et al. 2009 and Yarascavitch et al. 2009). Few other researchers discussed other attributes such as regular visits (Beirne et al. 2008 and Ito et al. 2012) safety (Perea-Perez et al. 2011) knowledge and education (Hedman et al. 2009). Sbaraini et al. (2012) stated that dental patients' expectations are proportionately related to dental professionals' friendly caring attitudes, confidence and communication; and also quoted, "*The experience of having a dedicated, supportive and caring dental team helped patients to take control of their own oral health*."

There are many sites where the Internet users can search for dentists and get reviews. In an attempt to alleviate and compromise the dental anxiety and give confidence to the patients, dental reviews and ratings sites are emerging in the Internet world. However, some of them have only basic functionality such as location (postal code or suburb) whereas some others are gaining popularity and acquainting more features such as specialities of dentists, service looking for and even insurance plans. Table 1 shows some of the dental review sites, their established year, average monthly visitors in the year of 2009 and membership fees. The table is sub-categorised into dentistry, healthcare and business sectors because the review sites for dentists are also spread across both healthcare and general business reviews as well.

Review Site Address	Established Year	Monthly visitors as of 2009	Membership fee
doctoroogle.com	2004	60,000	US$18 (one off)
dentalfearcentral.org	2005	19,500	free
dentalcenter.com	1996	11,000	free
dentistdig.com	2009	5,200	free
dentistreviewsonline.com	2008	100	free
dentist-ratings.net	2008	N/A	free
nationaldentalreviews.org	2011	N/A	free
1800dentist.com	N/A	N/A	free
Healthcare – the following sites also allow patients to review on dentists			
ratemds.com	2003	450,000	free
healthgrades.com	1999	2,000,000	free
Business – the site below is popular for reviews on dentists among other local businesses.			
yelp.com	2003	6,500,000	free
Angieslist.com	1995	65,000	US$26 per year

Table 1. Reviews or Rating sites (source: thedentistreviews.com)

Summary of some of the dental specific platforms are given below.

DrOogle: This site allows dental patients to write reviews and personal feedbacks to their dentists or dental practices. The patients can rate the dentists or dental practices on specific criteria with a likert scale between 1 to 4 on 'facilities', 'service', 'painless', 'results' and 'cost'. In addition to the reviews/feedback and ratings on their dental visits, the patients are also asked to provide feedback on dental hygienist. Based on positive reviews and ratings, the dentists are ranked within a particular location/suburb of the US. This site is paid service (US$18 to become a member) and it is regulated so that the users can only post one review per dentist. This site also monitors shilling attacks (biased behavior and in fact making positive reviews to yourselves) to provide fair ratings to the users. At the time of writing, there are 171,796 reviews available from the patients and it is increasing everyday (Doctoroogle.com).

Dental Fear Central: This is a non-commercial site which provides awareness to the public about the dental anxiety/fear. It is based in UK but it has been gradually expanded around the world. The dentist reviews and recommendations forum is now expanded to Australia, Europe, New Zealand and other countries in the world. This site provides the services such as 'dental phobia support forum', 'commons fears in dental' and 'tips to deal with them', 'step by step guide to search for a dentist', 'psychological ways of tackling dental phobia', 'tips for dentists' and 'dental FAQ'.

All dental patients, students and professionals are welcomed in this site. Main motive is to spread awareness in regards to dental anxiety. Dental fear central site has put quotes from its users such as, " *So much of it is about having the right dentist, one who will stop when you tell them to stop and who you trust 100%. I was ….. and who understood my fears.*" and "*Just*

want to say a big thank you – I had a very bad fear of the dentist ….. I now have a beautiful mouthful of teeth ….information you supplied me."

Other Dental Search, Reviews sites: There are many other dental search and reviews sites emerging. Most of them allow users to find the dentist based on the location (post code) and their own criteria and patients' reviews. For example, National Dental Reviews[15] has come up with the rating criteria: 'office cleanliness', 'staff cleanliness', 'short wait time', 'chairside manner' and 'explained treatment' for patients to rate between 1 to 5 stars.

HealthGrades: This is another site in the healthcare sector which helps to find doctors, dentists and hospitals based on location. It does not allow writing reviews in free text but shows the result of short online survey filled by the patients' satisfaction. The criteria used on the short survey are divided into 5 likert scales from 'poor' to 'excellent' and 'definitely not' to 'definitely yes'. The survey question includes 'scheduling appointments', 'office environment', 'office friendliness', 'wait time', 'level of trust', 'helps patients understand their condition', 'listens and answers questions', and 'time spent with patient'. In addition, it exclusively asks the question 'would you recommend to family and friends?'

RateMDs: It is a dedicated site to find and rate doctors and dentists. The patients can rate them on the criteria such as 'staff friendliness', punctuality', 'helpfulness' and 'knowledge'. The site allows users to search the doctors or dentists for a location and provides a list with scores as shown above. It allows adding doctors or dentists if they are not already in the list.

	Name	Sex	Specialty	City	Last Rated	# of Ratings	Average Rating
RATE	Copp, Duncan	M	Dentist	Sydney, **NSW**	8/6/12	9	4.9
RATE	Churchin, John	M	Dentist	Sydney, **NSW**	7/8/11	2	5.0
RATE	Licenblat, Dean	M	Dentist	Sydney, **NSW**	5/10/12	2	5.0
RATE	Jacobson, Ivor	M	Dentist	Sydney, **NSW**	6/7/12	1	5.0
RATE	Pechanats, Goran	M	Dentist	Sydney, **NSW**	8/19/12	1	5.0

Figure 1. Dentist search result for Sydney Australia (Source: RateMDS.com).

Yelp: This is a general business review site which helps people to find great local businesses including dentists or dental practices based on reviews provided by the users. Yelp claims that in second quarter of 2012, there were approximately 78 million unique visitors monthly. This site is increasingly getting popular to find the dentists in the local area in the US. It allows users to give an overall rate out of 5 stars and write feedback/reviews. This site also allows the readers of the reviews to mark whether the feedback was 'useful', 'funny' or 'cool'.

3.1 Analysis on Dental Reviews Sites

Different criteria are used amongst different dental reviews sites to find or recommend a right dentist, which makes it difficult for users/patients. The table 2 below shows the summary of how some of the reviews sites mentioned in the above section differ in the services provided.

15 www.nationaldentalreviews.org

Sites	Search	Reviews	Rate	Rank	Recommendation
DrOogle	√	√	√	√	√
Dental Fear Central	√	√	×	×	√
National Dental Reviews	√	√	√	×	×
RateMDs	√	√	√	√	√
Health Grade	√	×	√	×	√
Yelp	√	√	√	×	×

Table 2. Comparison of the services provided by the sites (√ - Yes and × - No)

All the reviews sites allow the users/patients to search for a dentist based on the specific location such as suburb or postal code. Most of them allow the users/patients to provide free textual comments/feedbacks reviews on anything about the dental service. Only in the Health Grade site, there is a short survey questionnaire to measure patient satisfaction. However, almost all the reviews sites have different measuring criteria to rate a dentist or dental care practice. The table 3 below shows a brief summary of the comparison of the criteria used on some of those sites.

Sites	Criteria used likert scale
DrOogle	'like a health spa', 'first class service', 'painless procedures' and 'superb results'
Dental Fear Central	None
National Dental Reviews	'office cleanliness', 'staff cleanliness', 'short wait time', 'chairside manner' and 'explained treatment'
RateMDs	'staff friendliness', punctuality', 'helpfulness' and 'knowledge'
Health Grade	'scheduling appointments', 'office environment', 'office friendliness', 'wait time', 'level of trust', 'helps patients understand their condition', 'listens and answers questions', and 'time spent with patient'
Yelp	Overall

Table 3. Comparison of the criteria used in the sites

As shown in the Table 3 above, Dental Fear Central does not rate dentist because it is dedicated to provide awareness of dental fear to the community, hence it provides a forum to discuss about the dental anxiety and many other tips to overcome the dental fear. Based on specific location, the sites, DrOogle and RateMDs rank the dentists based on the positive reviews and ratings. But exact algorithm for the ranks is not known. It is apparent that different sites have different system in place to recommend the best dentists to the users. Although some sites including Yelp do not directly recommend to the users/patients they provide extensive reviews of users/patients which eventually mean indirect recommendations.

Since these sites are using different vocabulary terms for the criteria to rate the service, the criteria in the above table 3 are re-arranged on the categories of: 'quality of service', 'quality of care', 'quality of staff', 'quality of environment', 'scheduling appointments', 'waiting time', 'specific knowledge' and 'explanation to the patients'. The table 4 compares the sites based on these categories of criteria.

Criteria	DrOogle	National Dental Reviews	RateMDs	HealthGrade	Yelp
Quality of Service	√	×	×	×	×
Quality of Care	√	×	×	√	×
Quality of Staff	×	√	√	√	×
Quality of Environment	√	√	×	√	×
Schedule appointments	×	×	×	√	×
Wait time	×	√	×	√	×
Specific Knowledge	×	×	√	√	×
Explanation	×	√	√	√	×

Table 4. Comparison of the criteria used in the sites (√ - Yes and × - No)

This table highlights that the popular sites such as Yelp and DrOogle are more focussed on providing free text reviews and comments rather than ratings on specific criteria.

There are no consistencies on the words the users/patients use to describe the same experience or feelings. That has an impact on how it has been read or understood (or misunderstood). In any activities on social media such as chatting, blogging, posting or twitting in the social networks, a level of trust is inherent. In that environment, the user has a choice to trust the media (particular website) especially for health related information (Hou and Shim 2010) at the first instance, and then the information posted (content) on the media and 'who has posted' and so on. Trust from own social networks could be integrated with the HSNs to enhance the trust and refine the search list. Even the search criteria can be made flexible depending on the situation the users/patients are in to make it flexible and more trustworthy altogether.

4. Proposed Framework for Dental Care Recommendation

Most people make their healthcare decisions based on recommendations from people they trust the most. The trust can be developed by number of ways in online environment such as from the interactions, or previous postings, or similarity in dental symptoms or their expertise in the domain. Due to the invasive nature of treatment and level of dental fear, trust becomes very important factor while recommending a good dentist online. Trustworthiness of the sites which provides reviews and recommendations as well as the users who provided reviews and ratings are very important while searching for the right dentist or dental information. In this social media age, where everyone has own social network, it would sound logical to integrate personal social network with the HSNs to enhance trust (both local and global) of the sites, reviews and recommendations.

We have proposed a trust-based framework for dynamic dental care environment to show how a dental patient can refine the search by measuring trust from the social networks. A framework for dental care recommendation backed up by profile-based (local) trust and global trust from crowdsourced dental sites can incorporate the concerns people usually have for dental treatments. The proposed framework is shown in the figure 2.

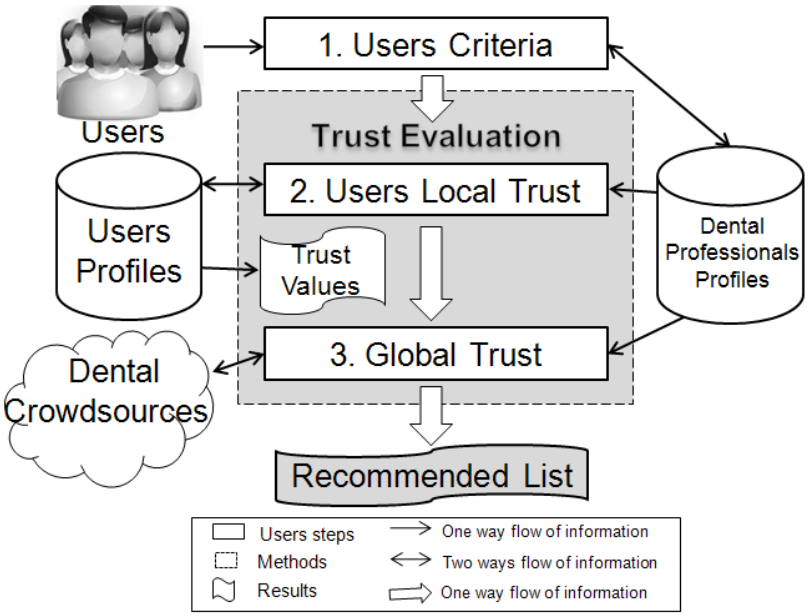

Figure 2. Proposed framework for Dynamic Dental Care Recommendation.

In the framework, the patients/users select their objective and subjective criteria while searching for the most suitable dental professionals initially. Some of the criteria are shown in the table 4. Computation of personalised profile-based trust derived from major components analysis (dental context, relationships and expertise) for dental care is the second step. It will include system trust (trust of the HSNs), content trust (information or reviews) and personal (relationship driven) trust.

Incorporating trust based on similarities of dental symptoms, hereditary, side-effects and dental fear in the context analysis enhances the accuracy of measuring users' trust. In addition, relationships with other patients/users (including FOAF – Friend of a Friend) and their expertise in the dental care area refine and measure trust efficiently. Figure 3 shows the snapshot of these components which have significant impacts to build personalised trust while searching for a trustworthy dental information and professional for users/patients.

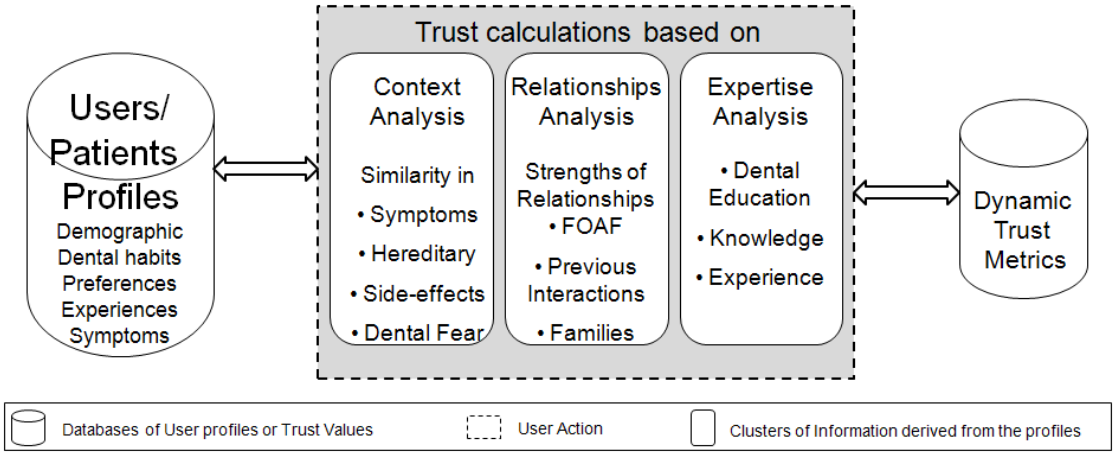

Figure 3. Components of Personalised Local Trust

In the framework (figure 2), the list after second step can further be refined by cross-checking with existing crowdsourced dental reviews and rating sites (global trust) which is shown in the table 1. Overall, the information in the form of reviews and feedbacks in those specific dental reviews and rating sites are impacting the dentists and dental practices.

5. Open Issues and Impacts

The number of dental reviews sites is growing and they allow the patients to leave reviews after their visit to the dentist. As it is the case for a lot of new recommendation systems, the majority of the ratings and feedbacks are done by the patients who are either terribly dissatisfied (negative feedback) or very happy with the service (positive feedback). There is also sometimes a lack of understanding on how to use review sites: for example, a user used one star instead of 5 stars thinking that 1 star is better than multiple stars. Another example on the DrOogle site, '$' sign for cost, some users are using only one or two $ signs to say the pricing/cost is not that bad. It should have been more $ signs. This individual rating does impact overall ratings of the particular dentist and therefore overall rankings. In some cases, the same dentist has been listed twice with two different ratings on DrOogle site. Similar errors are also found in Yelp site. More interestingly, the same dentist has been rated and ranked differently amongst various reviews sites, how can that be combined as a federated reviews or ranking?

The HSNs have changed the way both health professionals and patients communicate with each other. Dental social networks have an impact on the patients' decisions to visit a dentist or dental practice through the ratings and reviews from other users/patients. Besides the positive benefits from the dental review sites such as time savings, faster access, ability to collaborate and advertisements, there are some potential negative impacts to both sides. From time to time lawsuits have been filed in the US due to the negative reviews on these sites for dentists. Some dentists are trying to silence their critics by using legal system in the US (Mascagni 2012). People have been raising the voice via blogs and articles about how the reviews are flawed (Connelly 2012) despite the HSNs claiming to be flawless. Due to such issues, it is for sure that the dentists have to be aware of the possible danger, so do the patients. If not managed properly one bad interaction may jeopardize the dentist's reputation. Therefore, it is important for the dental profession to get involved in dental social network design and management. Dental associations and other regulatory bodies should be involved in the process of designing recommendation systems that are suitable for dentists and dental

practices. In addition, other challenges such as anonymous user identity, cold start problem when new dentist is added, or when there is a unique dental situation. Finding a solution to these challenges needs the involvement of researchers, patients and dental health professionals.

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