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REVIEW ARTICLE

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Behavioral strategies for periodontal health

Jean E. Suvan[1] | Maja Sabalic[1] | Mário R. Araújo[2] | Christoph A. Ramseier[3]

[1]Unit of Periodontology, Eastman Dental Institute, University College London (UCL), London, UK

[2]Department of Dental Hygiene, Escola Superior de Saúde de Portalegre, Portalegre, Portugal

[3]Department of Periodontology, University of Bern, Bern, Switzerland

Correspondence
Jean E. Suvan, Unit of Periodontology, Rockefeller Building, 21 University Street, London WC1E 6DE, UK.
Email: j.suvan@ucl.ac.uk

1 | INTRODUCTION

We live in a world of unprecedented technological and medical advancement. Life expectancy is increasing despite many risk factors for disease. Perhaps the challenge today is not running out of quantity of years, but rather quality of years. In other words, if we consider the health risks individuals are facing, one of the greatest is not dying but living, that is, living beyond the age that they can live in a healthy state with quality of life. This is associated with the mere nature of chronic diseases. Some may result in premature death, but chronic diseases, characterized by their need to be controlled and impossibility of being cured, often result in a compromised quality of life for many.

Over the past century, medical and dental care have advanced significantly, with many novel innovations to prevent and treat disease or provide symptom relief. Research has provided the signposts suggesting that lifestyle factors are the critical issue in maintaining health or controlling disease. If we wish to provide healthcare including oral healthcare, the solution lies in addressing lifestyle issues with our patients.[1] It has been suggested that the greatest impact dental professionals may potentially have on chronic disease management is through concentrating on lifestyle behaviors.[2]

The field of periodontology is unique in this respect. Maintaining periodontal health requires interventions performed by the patient in the form of self-care of attention to lifestyle factors. A common disease, periodontitis shares characteristics with other noncommunicable diseases, and perhaps most important, merits a common risk factor approach to control it at the same time as contributing to the overall health of the patient.[3] This sounds easy in principle; however, many dental professionals lack knowledge, training, or confidence in facilitating modification of lifestyle changes in their patients. There has been increasing interest and research in this area within the field of oral care. This article aims to summarize the evidence surrounding behavioral strategies for periodontal health.

This review summarizes key elements of previously published evidence related to the implementation of health behavior change strategies to assist clinicians in actively facilitating patient management of periodontal health.

2 | BACKGROUND

The following sections serve as a brief background summary to understand periodontal health and disease, together with the role of lifestyle factors in disease prevention and pathogenesis. An overview of lifestyle modification and common principles of behavior change theories or models is presented as a basis to further consider evidence from identified systematic reviews of behavioral strategies that clinicians might implement to support patients in achieving or maintaining optimal periodontal health.

2.1 | Periodontal health and disease

As defined by the new classification, periodontal health can exist before disease occurs or can be restored to an anatomically reduced periodontium.[4] Accordingly, four levels of periodontal health were defined: pristine periodontal health, with a structurally sound and uninflamed periodontium; well-maintained clinical periodontal health, with a structurally and clinically sound (intact) periodontium; periodontal disease stability, with a reduced periodontium; and periodontal disease remission/control, with a reduced periodontium.

Gingivitis and periodontitis are common microbially induced disorders affecting supporting structures of teeth. They are initiated by oral pathogens that colonize the plaque biofilm on teeth, and their progression is modulated by local and systemic host factors.[5–8] A number of hypotheses have been proposed to explain the etiology of periodontitis, including the nonspecific and the specific plaque hypothesis, a microbial shift hypothesis, the ecological catastrophe hypothesis, and the disruption of periodontal tissue homeostasis.[9–20]

It has been established that the composition of the periodontal bacterial community differs in health and disease, and keystone periodontal pathogens (the red complex bacteria) that relate to clinical measures of periodontal disease were identified.[14,18] More recent studies found high variability in microbial composition among diseased individuals and utilized gene expression profiling to identify specific gene combinations in periodontal disease-associated microbiota suggesting that the collective virulence of the polymicrobial community and specific highly conserved genes are implicated in dysbiosis.[20–25] Based on these findings it has been further proposed that periodontitis is initiated by a polymicrobial community consisting of species with distinct functions working in synergy to create a microbial imbalance in the oral cavity (ie, the polymicrobial synergy and dysbiosis model).[20,26,27]

Although it is now well accepted that compromised host-microbe homeostasis is a requirement for the initiation of the periodontal disease, mechanisms of the pathogenesis of periodontal diseases are not yet fully understood, limiting successful outcomes in prevention and treatment.[28,29] The host's defense mechanisms can generally control small amounts of plaque, but in susceptible individuals, the microbial challenge, or the interplay of dysbiosis and inflammation, can rapidly lead to the destruction of the periodontium. Furthermore, systemic host factors in a susceptible host can reduce resistance to periodontal disease, while local infection in the periodontium can also adversely affect systemic health.[30]

It has, therefore, been accepted that periodontal diseases result from an interplay between the commensal microbiota, host, and environmental factors that have been recognized as determinants of periodontal health.[4,31] Assessing the predisposing factors (eg, tooth anatomy, position, and restorations), modifying factors (eg, smoking status, genetics, and systemic health), and environmental factors (eg, stress, nutrition), and how controllable these are on an individual basis, are of major relevance to the host response to the etiological agent (bacteria plaque), and therefore for the attainment and maintenance of oral health.

2.1.1 | Role of lifestyle behaviors

It is evident that the key to preventing chronic diseases or chronic disease management, keeping in mind that such conditions are controlled, not cured, lies in maintaining an optimal host response. As highlighted in the previous section, immunologic responses of the host underpin the proper balance between health and disease. In turn, environmental and behavioral factors play a key role in those host responses. Although genetic factors are predetermined, and the socioeconomic or physical environment cannot be directly controlled, there are opportunities to improve the oral health of individuals on a long-term basis by behavior management. Behavioral factors linked to poor periodontal status include insufficient plaque control regime, tobacco use, sedentary lifestyle, alcohol abuse, stress, and unhealthy dietary habits.[32] Although modifiable, these lifestyle behaviors still result in significant disease and financial burden globally.[33] This is probably because lifestyle behaviors, although facilitating health, are often not easy to adopt or change.[34] Public health initiatives and community programs have their place in increasing patient awareness of healthy habits; however, in-office interventions to facilitate lifestyle behavior change still play an important role in promoting health. It has been stated that the value of treatment is significantly compromised without an efficient patient self-care routine to control plaque levels.[35] Therefore, it is imperative that behavior management is seen as a part of both prevention and therapy of periodontal diseases.[4]

2.2 | The challenge of lifestyle behavior change

Behavior change is not to be taken lightly and is, in fact, complex. Reflection on a few foundational concepts of behavior change help in understanding why changing behavior takes effort for all human beings. Fundamentally, it consists of consciously making new choices of habits or life patterns, then putting them into action. It is seldom comfortable, easy, automatic, or even remotely convenient. Behaviors are interwoven with habits; but these are separate entities, with a habit being a behavior that takes place as a routine without thought.[36]

In the context of healthcare, behavior change often feels like a struggle for both patients and clinicians, resulting in frustration on both sides. Behavioral scientists across many disciplines have struggled with the question of what makes people act in certain ways in relation to their improved health. Many would agree that positive change occurs outside of the healthcare facility or the dental practice, that is, it happens in the patient's own natural environment in their own way. It is not something that can be forced upon someone, in fact force is most often counterproductive, resulting in accentuation of the undesired behavior. In this sense, the clinician's role is to facilitate what might be seen as a naturally occurring process toward improvement.[37]

Health instruction or education approaches provided by oral health professionals may facilitate establishment of habits for some but are often ineffective in achieving lasting change in some patient behaviors. In periodontal care specifically, conventional oral hygiene instructions frequently lack a long-term effect and thus appear to need repetition.[38] Considerable behavioral research suggests that the root of this common problem can be traced back to a false assumption inherent in the health education approach itself. When educating patients, one assumes that behavior change is simply a function of the patient having a requisite knowledge or understanding, and that it is up to the practitioner to provide the relevant information. This, however, is contrary to behavior change principles and theories.[39,40]

2.3 | The roles of the patient and dental team in behavior change

2.3.1 | The role of the patient

As previously inferred, the patient plays a key role in the maintenance of periodontal health through the practice of self-care to maintain low bacterial plaque levels and minimization of lifestyle-related risk factors. As for their role in behavior change, patients are at the center of any efforts or interventions.[41] The motivation underpinning any behavior in life comes from within the individual and is linked to their values and perceptions. It is the patient who weighs up the advantage versus the disadvantage of any action, for example, the potential benefit of low oral plaque levels vs the effort it takes practice self-care, considered within the context of the time and energy required to reach that goal. A simple reminder is that motivation is neither a procedure nor something we can give a patient, but rather something that can be awakened by others around them.[42]

2.3.2 | The role of the dental team

With the role of the patient clarified, the role of the dental team needs minimal little definition. It is to facilitate patient choice and enactment of that which the patient chooses as appropriate goals, through patient engagement or activation of the patient's own values. At the individual level, patients need to be supported in health behavior change by oral health professionals, but the clinician's role is to guide or coach.[43] Routine clinical assessment of lifestyle factors carried out at regular intervals includes both understanding of a patient's level of risk and behavioral change goal setting, while providing information or teaching skills when the patient is open to listening.[44]

Looking at behavioral models and their complexity raises the question of how to best translate the concepts into daily clinical work.[40] It could be agreed across all the models presented that the manner of clinician delivery of the "relationship" with the patient will work as the "active ingredient" in behavior change interventions. More than merely a result of theory and behavior change techniques, the way we interact with patients is crucial. It is the professional soul, the format, the tools, the setting, the passion, the tailoring, and the style of clinician–patient interactions that make a difference. If it is perceived to be just asking for things to be done, it will be met with resistance.[45]

3 | OVERVIEW OF BEHAVIOR TOOLS, TECHNIQUES, AND STRATEGIES FOR ORAL HEALTH

To explore and provide an overview of behavioral strategies for periodontal health, databases were searched for existing evidence. Because there have been many publications, the search was focused on systematic reviews. The specific aim was to answer the question: What are the potential behavior tools, techniques, and strategies available to clinicians to facilitate periodontal health in adults? A secondary area of interest was: What is the best method to teach oral health professionals tools and techniques that facilitate health behavior change in patients?

Seven systematic reviews[44,47-52] published from 2015 to 2021 pertaining to the primary focused questions were identified. One meta-review[46] was identified summarizing the content of a number of previous systematic reviews, therefore the meta-review was used as a source of information pertaining to those included reviews. In addition to the reviews pertaining to behavior change techniques, four systematic reviews[53-56] pertaining to healthcare professional education were identified. Of the four systematic reviews on education approaches, one was based on dental education[53], while the other three focused on the education of healthcare professionals.[54-56]

Table 1 summarizes the findings of the systematic reviews. Tables 2 and 3 summarize four additional systematic reviews deemed relevant to the topic and based upon education in both dental and medical settings.

3.1 | Behavior change theories/models

The complexity of behaviors has absorbed the efforts of behavioral scientists for decades. The result has been the emergence of numerous behavior change theories and models to help healthcare professionals understand the elements driving behaviors plus factors facilitating change of those lifestyle choices or behaviors. A patient's intrinsic motivation has been proposed to be related to patient values, experiences, understanding of risk, feelings of confidence, and self-esteem, to name a few.[42,57] As a result, substantial research has been aimed at providing clinicians with guidance on tools and techniques that might stimulate patients' intrinsic motivation.

Some of the most common theories or approaches referred to in the dental literature include Prochaska's model of change, cognitive behavioral theory, the health action process approach, motivational interviewing, and the capability, opportunity and motivation model of behavior (COM-B). Although it is impossible to reduce the concepts behind these theories and models to a few sentences, a simple definition of each appears in Table 4 to provide an overview of the essence of each.

3.2 | Evidence from the systematic reviews

The findings of this narrative meta-review indicate that although evidence supports the positive impact of health behavior change interventions for plaque control, tobacco use cessation, and dietary advice, the results are variable dependent on many possible confounders. None of the reviews identified studies in the field of periodontology investigating the effect of behavior change interventions rendered by a dental professional to reduce alcohol consumption,

TABLE 1 Behavior change approaches in dental settings

Publication (first author, year, citation, article title)	Behavior interventions	Results	Author conclusions
Ramseier CA (2015)[46] EFP Workshop, Spain Behavior change counseling for tobacco use cessation and promotion of healthy lifestyles: a systematic review	Behavior: tobacco use, unhealthy lifestyles Oral hygiene was not within the assigned scope Interventions: brief interventions for tobacco use cessation, dietary brief interventions, and other health counseling by dental professionals	No. of included studies: 7 systematic reviews Meta-analysis: none All included reviews were of moderate to high quality according to AMSTAR Limited evidence to support the effectiveness of tobacco use prevention provided by healthcare workers Good evidence of the effectiveness of smokeless tobacco use cessation provided in the dental setting Strong evidence of the effectiveness of smoking cessation provided in the dental setting Moderate evidence that one-to-one dietary interventions aimed at changing fruit and vegetable consumption provided in the dental setting can change behavior Limited evidence for the impact of dietary interventions on sugar consumption Moderate strength of evidence for behavior change following alcohol consumption counseling Limited evidence for a positive impact of interventions aimed at increasing physical activity on behavior change Limited evidence of the effectiveness of dental counseling in the management of diabetes mellitus	Behavioral change counseling for tobacco use cessation in a dental practice setting was found to be effective in adults Dietary brief interventions conducted in the dental setting may be effective in adults
Newton TJ (2015)[44] EFP Workshop, Spain Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behavior change for improved plaque control in periodontal management	Behavior: plaque control in periodontal patients Tobacco cessation was not within the assigned scope Interventions: psychological interventions varied across studies and included goal-setting, self-monitoring and planning, a diary on adherence to oral hygiene routine, motivational interviewing, cognitive behavioral interventions	No. of included studies: 15 reports from 14 separate cohort and RCT studies across 7 theoretical models Meta-analysis: none The overall risk of bias for observational studies included was low (Newcastle-Ottawa Assessment). Older trials had a high risk of bias, but more recent trials had a low risk of bias (Cochrane handbook) Measures of adherence were self-report or measures of periodontal status The HBM played a small role in predicting oral hygiene-related behavior of individuals with periodontitis in 2 studies 3 studies investigating interventions based on social learning theory showed that interventions including elements such as target setting, introducing cues to behavior and providing feedback are superior to standard care, but the studies were at high risk of bias The extended Theory of Reasoned Action model was a predictor of gingival outcome scores at 12 mo in 1 study. High levels of self-efficacy at baseline were associated with higher frequencies of oral hygiene behavior at 3 mo An action-control behavioral intervention (a diary) on adherence to flossing led to improvements in self-reported flossing frequency, dental plaque and bleeding scores at 4 wk postintervention in 1 study Behavior change delivered by a dental hygienist trained in psychological methods in 2 trials was effective in leading to improved clinical indices of periodontal status and self-reported behavior in 2 trials with 3- and 12-mo follow-up periods Interventions based on MI were reported in 3 studies at low risk of bias. 1 study reported a significant effect on plaque levels 1-mo postintervention	Behavioral change interventions based on the use of GPS were found to be effective in improving oral health-related behaviors in periodontal adult patients as assessed by clinical status

TABLE 1 (Continued)

Publication (first author, year, citation, article title)	Behavior interventions	Results	Author conclusions
Werner H (2016)[47] Sweden Psychological interventions for poor oral health: A systematic review	Behavior: poor oral health (dental caries, periodontal disease or peri-implantitis in adults and adolescents Interventions: interventions based on psychological and behavioral models and theories. Interventions and theoretical framework varied across studies. Several studies used MI, based on self-regulatory theory, whereas others used components of the method. Other theories represented were the client empowerment model, the explanatory model, and the human needs conceptual model, as well as the behavioral cognitive method, social learning theory, and self-efficacy theory and the theory of reasoned action	No. of included studies: 11 included articles reported on 9 RCTs Studies analyzed had low certainty of evidence (GRADE system) The meta-analysis showed no statistical difference in gingivitis or plaque presence. A meta-analysis on MI compared with education/information found no statistically significant differences in gingivitis presence. Only the meta-analysis on psychological interventions vs education/information regarding the plaque index showed a small but statistically significant difference. There were also statistically significant differences in oral health behavior and self-efficacy of toothbrushing in favor of psychological interventions Reported outcomes in studies analyzed were periodontitis measured as pocket depth or probing pocket depth, gingivitis measured as gingival index and bleeding on probing, dental plaque measured as plaque index or present/absent, oral health behavior measured as interdental cleaning and brushing, health beliefs and attitudes, and oral-health related quality of life measured with questionnaires. Dental caries and peri-implantitis were not measured	Psychological interventions did not result in statistically significant difference concerning gingivitis and plaque presence. A small significant reduction in plaque was found when compared with traditional oral health education
Kopp SL (2017)[48] Germany Motivational interviewing as an adjunct to periodontal therapy—A systematic review	Behavior: plaque control in periodontal patients as measured by at least one inflammatory index and one plaque index Interventions: MI intervention as an adjunct to periodontal therapy. MI was based on Miller and Rollnick[37] or a combination of MI and cognitive behavioral principles. 1 study did not specify the type of MI	No. of included studies: 5 RCTs Meta-analysis: none The risk of bias assessment ranged from 72% to 88% regarding the MI-related bias, the periodontal study-related bias, and the Cochrane Collaboration Handbook. Main limitations were the insufficient presentation of inclusion and exclusion criteria and the number of counselors 3/5 studies showed a positive outcome regarding the effects of additional MI interventions in periodontal therapy, while 2 studies showed no significant effects. In 2 studies, MI showed a significant positive effect on bleeding on probing and plaque values, and 1 study showed improvement of self-efficacy in interdental cleaning	MI as an adjunct to periodontal therapy might have a positive influence on clinical periodontal parameters and psychological factors related to oral hygiene
Newton TJ (2018)[49] UK Behavioral models for periodontal health and disease	Update to 2015 review Behavior: plaque control in periodontal patients Interventions: psychological interventions included goal-setting, self-monitoring and planning, interventions based on motivational interviewing, cognitive behavioral interventions	No. of included studies: 15 reports from 14 separate cohort and RCT studies across 7 theoretical models Meta-analysis: none The overall risk of bias for observational studies included was low (Newcastle-Ottawa Assessment). Older trials had a high risk of bias, and more recent trials a low risk of bias (Cochrane Collaboration Handbook) Interventions incorporating elements of goal setting, planning the behavior change, self-monitoring or monitoring by a health professional appear to be effective, while interventions based on motivational interviewing are less consistently effective across studies	Brief behavioral change interventions based on the use of GPS were found to be effective in improving oral health-related behaviors in adults with periodontitis

(Continues)

TABLE 1 (Continued)

Publication (first author, year, citation, article title)	Behavior interventions	Results	Author conclusions
Nasab HS (2019)[50] Iran The role of psychological theories in oral health interventions: A systematic review and meta-analysis	Behavior: oral health-related behaviors recorded as knowledge, attitude, tooth decay, plaque, bleeding gums Interventions: oral health interventions based on psychological theories: HBM, TPB, SCT, clinical theories, and other theories	No. of included studies: 19 studies included in the systematic review and meta-analysis Meta-analysis was performed Heterogeneity of studies was >50% (Cochran's Q test) Habbu's checklist-performed qualitative assessment of studies The SMD of HBM, TPB, clinical, and other theories were statistically significant in improving oral health while the SMD of SCT was not significant/did not have an effect on improving oral health status	Conclusions: the meta-analysis showed that in psychological interventions that used clinical theories, HBM, TPB, and other theories were effective in enhancing oral health status, and interventions that used the SCT did not have an effect on improving oral health status
Toniazzo MP (2019)[51] Brazil Effect of mHealth in improving oral hygiene: A systematic review with meta-analysis	Behavior: plaque control in adults, adolescent orthodontic patients, and mothers of young children Interventions: mobile applications or text messages related to oral hygiene and oral health education	No. of included studies: 15 RCTs Meta-analyses: 2 performed A substantial risk of bias was determined for 2 studies and a moderate risk of bias for the other 13 studies (Cochrane tool for randomized clinical trials and the GRADE system) 13/15 studies showed better results when mobile technology was used The use of mobile health provided significant improvements in reducing dental plaque and gingivitis in adolescents, but the quality of evidence and the strength of recommendation were very low (GRADE system)	mHealth strategies can be used as an adjunct component in the improvement of daily self-performed oral hygiene
Carra MC (2020)[52] EFP Workshop Spain Promoting behavioral changes to improve oral hygiene in patients with periodontal disease: A systematic review	Behavior: plaque control in adults, adolescent orthodontic patients, and mothers of young children Interventions: interventions associated or not with periodontal therapies such as scaling and root planing, delivered by oral health professionals and/or psychologist/counselor, and aimed at improving oral hygiene, eg, individually tailored patient's education, MI, psychological interventions, CBT, feedback, use of videotape, text messaging, mobile applications, and combined techniques	No. of included studies: 14 articles, 12 RCTs, and 2 NRCTs Meta-analysis was performed For RCTs, RoB-2 was used, while for NRCTs, ROBINS-I was applied Overall quality of evidence was low with a high risk of bias High level of heterogeneity was observed in the study designs, interventional protocols, study duration, and types and definitions of periodontal diseases 4 studies evaluated the effect of MI associated with oral hygiene instructions, 7 the impact of oral health educational programs based on CBTs, and 3 the use of self-inspections/videotapes Meta-analyses for psychological interventions showed no significant group difference for both plaque and bleeding scores. No effect was observed in studies applying self-inspection/videotapes	No conclusion could be drawn on clinical efficacy of psychological interventions based on cognitive constructs and MI principles provided by oral health professionals, as measured by the reduction of plaque and bleeding scores over time. No evidence supports the effectiveness of self-inspection and use of videotape communication techniques to improve oral hygiene

Abbreviations: AMSTAR, A MeaSurement Tool to Assess systematic Reviews; CBT, cognitive behavioral therapy; CSCCM, client self-care commitment model; GPS, goal setting, planning and self-monitoring; GRADE, Grading of Recommendations Assessment, Development and Evaluation; HBM, health belief model; MI, motivational interviewing; NRCT, nonrandomized controlled trial; RCT, randomized controlled trial; RoB-2, revised Cochrane risk of bias tool for randomized trials; ROBINS-I, Risk Of Bias In Non-randomized Studies of Interventions; SCT, social cognitive theory; SMD, standardized mean differences; TPB, theory of planned behavior.

TABLE 2 Education studies in dentistry

Publication (first author, year, citation, article title)	Teaching methods or behavioral interventions	Results	Author conclusions
Carey JA (2010)[53] UK Communication skills in dental education: A systematic research review	Teaching methods: didactic behavioral sciences teaching, and role-play scenarios with feedback given to the learner after the interaction Interventions: communication skills training for dental undergraduates by a variety of methods	No. of included studies: 11 studies No meta-analysis was performed The evidence for learning and assessment of communication skills in dentistry appears to be of variable quality and indicates that most students are receptive to communication skills learning and to the use of simulated patient interactions as a pedagogic tool The use of video-reviewing in learning and assessment seems to be a valuable tool for both learner and tutor The outcome measures were a student evaluation questionnaire in 3 studies, interview rating tools in 6 studies, a Dental Consultation Communications Checklist developed in 1 and evaluated in 2 studies, a multiple-choice questionnaire to test student knowledge in 1 study, and video-taping in several studies Studies were assessed based on the scoring criteria presented in the review	Extensive use of didactic learning and clinical role-play using simulated patients was found in dental education studies analyzed Reported assessment methods focused mainly on observer evaluation of student interactions at consultation. Patient involvement in training was found to be minimal, and it was proposed that patients should play a more active role in future training There is evidence to suggest that enhancement of communication skills among undergraduate dental students may decline between learning episodes

reduce stress, improve medication adherence, improve diabetes self-management, or increase physical activity. Table 5 provides a summary of the various behaviors, the behavioral intervention applied, and details of evidence pertaining to them. Interventions were based on various behavior change models or theories, although interestingly, the common element across most approaches was a focus on patient engagement and autonomy, clinician–patient rapport or relationship, and communication tools or techniques to facilitate these aspects.

4 | STRATEGIES FOR PRACTICE

A summary of the evidence suggests that the dental clinician may play a role in predictably facilitating healthy lifestyle behaviors through routine discussions during dental visits. Results are variable in terms of quantitative outcomes, such as the effect on plaque index, gingival bleeding, or tobacco cessation rates. However, consideration of fundamental principles of behavior change raises the question on whether such quantitative clinical measures are the best outcome to assess behaviors. Given that behavior change is a process occurring over weeks, months, or sometimes years, might such outcomes be clinically relevant when reported over the short term? The additional challenge is that plaque or gingival bleeding are not behaviors but rather surrogate measures of behaviors. However, assessing long-term qualitative outcomes such as self-efficacy or behaviors are also problematic with potential for bias.

It is generally agreed across reviews and compatible with current concepts of medical practice that the days of a clinician paternalistic approach to patients is obsolete. Current regulations and laws guiding clinical practice emphasize the concept of patient autonomy from many perspectives, including patient rights in choosing (from options presented by the healthcare professional) the best care to fit their best interests. This is, however, not the reason for the emphasis on patient autonomy or self-efficacy in the application of health behavior change strategies, but rather is synergistic, which we know enhances behavioral choices, that is, a patient's sense of self-control. It is well documented that paternalistic dependence upon giving knowledge and skills with an expectation of behavior change puts the patient in a reactive rather than a proactive mode.[66] Rapport or the so-called therapeutic alliance, an essential element to establish and maintain patient autonomy, is vital to allow transparent clinician–patient discussions.[67]

TABLE 3 Education studies in healthcare (nondental)

Publication (first author, year, citation, article title)	Teaching methods or behavioral interventions	Results	Author conclusions
Gysels M (2004)[54] UK Communication training for health professionals who care for patients with cancer: A systematic review of training methods	Teaching methods: instruction, modeling, role-play, feedback, and discussion Interventions: interventions for training in communication skills were characterized by the variety of communication approaches used and a diversity of methods	No. of included studies: 16 studies No meta-analysis was performed Communication training was mostly provided by a combination of cognitive and experiential elements Studies with the aim of enhancing objective communication skills achieved positive outcomes 3 studies found that the interventions failed to change clinical practice unless behavioral components were integrated Duration of training, content, teaching methods, constellation, and number of participants and timing of the training in the course of a career in clinical oncology should be considered when developing communication programs The risk of bias was not assessed	Learner-centered programs using several methods combining a didactic component focusing on theoretical knowledge with practical rehearsal and constructive feedback from peers and skilled facilitators proved to be effective. The best results are expected when the training is carried out over a longer period of time. Small groups encouraged more intense participation. Training in communication for medical students, nursing students, and health professionals is advisable
Lindhe Söderlund L (2011)[55] Sweden A systematic review of motivational interviewing training for general health care practitioners	Training and interventions: MI training provided for general healthcare practitioners who planned to use or were already using MI skills in counseling with patients/clients in general healthcare. Duration of the MI training varied, from a 20-min video to a 2-d workshop followed up by another day, that is, a total of 24 h MI was used for alcohol counseling with pregnant women, abuse-related counseling in general healthcare, smoking counseling, medication adherence, diabetes counseling, weight, diet, and physical activity counseling	No. of included studies: 11 articles reporting results from 10 studies No meta-analysis was performed A checklist consisting of 7 questions was constructed by authors to assess the reporting and methodological quality of the included studies. The study design of the individual studies was assessed using the MSSM In studies examining participants' reactions to training using a questionnaire or an interview, participants seemed generally satisfied with the training offered. Participants' MI competence was evaluated favorably Results suggested that MI is best learned in workshops of sufficient duration, incorporating follow-up sessions or some form of postcourse supervision, by applying MI in routine clinical practice with clients, and by practicing MI on one's own and with someone else (a hired coach or a colleague) who is more proficient in MI. Tape-recorded MI sessions and use of coding instruments for learning can be beneficial More high-quality studies are needed to inform on how to best conduct and evaluate MI training	Outcomes of MI training to improve client communication and counseling concerning lifestyle-related issues in general healthcare are generally favorable. More high-quality research is needed to help identify the best practices for training in MI

TABLE 3 (Continued)

Publication (first author, year, citation, article title)	Teaching methods or behavioral interventions	Results	Author conclusions
Batt-Rawden SA (2013)[56] UK, USA Teaching empathy to medical students: an updated, systematic review	Teaching methods/ interventions: interventions promoting empathy among medical students such as patient narrative and creative arts interventions, writing, drama, communication skills training, problem-based learning, interpersonal skills training, patient interview, experiential learning, empathy intervention	No. of included studies: 18 articles (15 quantitative and 3 qualitative studies) The quality of quantitative studies included was performed using the MERSQI. The mean MERSQI score (possible range 5-15.5) for the 15 included quantitative studies was 10.13. The lowest score was 6.5, and the highest was 14 Studies included used validated outcome measures including self-report questionnaires (JSPE, Empathy Tendency Scale, the Empathic Skill Scale, the BEES and the ECRS), observed measures (CARE from the point of view of first-person patient, SPIR from the point of view of third-person assessors), as well as nonvalidated, self-report measures developed by the study investigators 15/18 articles reported a significant increase in empathy It was found that educational interventions can successfully cultivate empathy in undergraduate medical students and that such interventions are well received by participants Studies were limited by common methodological flaws, including lack of control groups, small sample sizes, single institutions, lack of preintervention or baseline measurements, and lack of long-term follow-up	Educational interventions can be successful in maintaining and enhancing empathy in undergraduate medical students. More rigorous research is needed to inform recommendations for medical education

Abbreviations: BEES, Balanced Emotional Empathy Scale; CARE, Consultation and Relational Empathy; ECRS, Empathy Construct Rating Sca; JSPE, Jefferson Scale of Physician Empathy; MERSQI, Medical Education Research Study Quality Instrument; MI, motivational interviewing; MSSM, Maryland Scale of Scientific Methods; SPIR, Staff–Patient Interaction Rating Scale.

TABLE 4 Common behavior change models, theories, or approaches

Theory/model/approach	Definition/key concepts
Prochaska's stages of change (the transtheoretical model)[58,59]	The model postulates that in the process of intentional behavior change, individuals go through 6 stages: precontemplation, contemplation, preparation, action, maintenance, and termination
CBT[60]	CBT is based on the idea that thoughts, emotions, and behavior interact together. It is an intervention that helps individuals understand the thoughts and feelings that influence behaviors
HAPA[40]	A model that suggests that the adoption and maintenance of a behavior is a structured process involving a motivation phase (intention formation), and a volition phase (initiative, maintenance, and recovery), and emphasizes the role of perceived self-efficacy at different stages of behavior change
MI[61,62]	A client-centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence. The main elements of MI are a collaboration between the patient and clinician, evocation (eliciting the motivation from within the patient, and autonomy (allowing the patient freedom to make their own choices)
COM-B model[63,64]	A model of behavior and behavior change that recognizes that a change must occur in "capability" to perform the behavior and "opportunity" and 'motivation' to carry out a change in behavior

Abbreviations: CBT, cognitive behavioral therapy; COM-B, capability, opportunity and motivation model of behavior; HAPA, health action process approach; MI, motivational interviewing.

TABLE 5 Summary of studies and recommendations/tools

	Behavior	Intervention/behavioral technique/model/tools	Setting/provider/patient group	Effectiveness/level of evidence/recommendations
Practice	Tobacco use prevention[46]	Variety of approaches	Healthcare workers	Limited evidence
	Smokeless tobacco use cessation[46]	Brief interventions, extensive interventions, CBT with and without the use of NRT, distribution of informative brochures	Dental	Good evidence
	Smoking cessation[46]	Brief interventions, extensive interventions, CBT with and without the use of NRT, distribution of informative brochures	Dental	Positive effect on quit rates, strong evidence
	Alcohol counseling[46]	Brief and extended interventions	Dental	Significant effect, moderate evidence
	Diet advice (fruit and vegetable consumption)[46]	One-to-one interventions, advice	Dental	Moderate evidence
	Diet advice (sugar consumption)[46]	Various form of dietary counseling such as advice	Dental	Limited evidence
	Physical exercise advice[46]	Brief interventions, physical exercise advice	Other healthcare workers	Short-medium term effects, Limited evidence
	Management of diabetes mellitus[46]	Counseling	Dental	Limited evidence
	Improving oral health-related behaviors[44]	Behavioral change interventions based on the use of GPS	Dental, periodontal	Effective
	Adherence to flossing[44,49]	Action-control intervention, diary	Dental	Improvements in self-reported flossing frequency and periodontal indices reported
	Oral hygiene and oral health behavior change[44,50,65]	Interventions based on MI	Dental, periodontal patients	Not consistently effective across studies
	Enhancing oral health status[47,50]	Psychological interventions based on CBT, HBM, TPB	Dental	Effective
		Psychological interventions based on SCT	Dental, periodontal	Not significant
		Interventions based on CSCCM	Dental, periodontal	Improved oral health behavior, low certainty of the evidence
		ITOHEP including MI	Dental, periodontal	Improved oral health behavior, low certainty of the evidence
	Improvement of clinical periodontal parameters (plaque values, gingival, and periodontal inflammation) and psychological factors related to oral hygiene[48]	Interventions based on MI as an adjunct to periodontal therapy	Dental, periodontal	Low body of evidence further long-term studies are needed
	Enhancing oral hygiene and oral health status[51]	Use of technology (mobile applications and text messages) for oral hygiene and oral health education	Dental, mainly orthodontic adolescent and adult patients	Effective, very low quality of evidence

TABLE 5 (Continued)

	Behavior	Intervention/behavioral technique/model/tools	Setting/provider/patient group	Effectiveness/level of evidence/recommendations
Education	Communication skills for students caring for patients with cancer[54]	Variety of communication approaches	Medical and nursing students	Difficult to assess because of heterogeneity of approaches
	Communication skills training[53]	Variety of approaches	Dental undergraduate students	Variable quality of evidence
	MI training[55]	Training duration and content varied	General healthcare practitioners	Heterogeneous studies
	Interventions promoting empathy[56]	Variety of approaches	Medical students	More research is needed to inform recommendations

Abbreviations: CBT, cognitive behavioral therapy; CSCCM, client self-care commitment model; GPS, goal setting, planning and self-monitoring; HBM, health belief model; ITOHEP, individually tailored oral health education; MI, motivational interviewing; NRT, nicotine replacement therapy; SCT, social cognitive theory; TPB, theory of planned behavior.

4.1 | Behavior change tools/approaches

The evidence tables together with Table 5 summarize the multiplicity and complexity of the identified behavior change theories and models. However, an overview highlights some overlapping tools, techniques, and strategies within the reviews to help guide the clinician. Without adhering to one behavior change model, the examples below highlight practical aspects taken from the included systematic reviews.

4.1.1 | Motivational interviewing

Motivational interviewing has provided a wide range of practical tools to create an environment of change focused on patient engagement to facilitate patient autonomy.[34] The techniques focus on an empathetic, collaborative, guiding style of communication to elicit motivation to change from within the patient. Aligned with other approaches, it identifies motivation as something evoked from within rather than provided externally. It has been defined as "a client-centred, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence".[37] In particular, the oral health professional endeavors to engage the patient in order to (i) establish rapport with the patient, (ii) develop discrepancy, (iii) roll with resistance, (iv) resolve ambivalence, (v) elicit change talk, and (vi) support self-efficacy. It underscores the use of open questions, affirming statements, reflective listening, and summarizing communication techniques to enhance patient engagement and autonomy.

4.2 | The behavior change wheel (the COM-B)

As highlighted, numerous behavior change models and theories have emerged over recent decades. More recently, the behavior change wheel was presented by Michie et al[68] as a means to summarize 19 frameworks that materialized from a systematic review. It highlights that behaviors occur within a complex and intricately connected system encompassing aspects of capability, opportunity, and motivation, all of which contribute to behaviors (the COM-B). Therefore, they suggest that interventions to alter behavior should address these aspects. It also acknowledges that all of these aspects lie within the patient and ultimately rely on patient engagement or clinician–patient rapport to target these aspects of behavior.[68]

4.3 | Goal setting, planning, and self-monitoring

Newton and Asimakopoulou[44] reported various interventions that can facilitate improvement of a periodontal patient's behavior, further highlighting key elements such as goal setting, planning, and self-monitoring as important cornerstones. As behavior change theories suggest, one way to disrupt undesired habits is to bring habitual behavior and its context to conscious awareness. In this case, when considering altering a behavior (intention or goal setting), individuals compare their current performance with a behavioral goal, and in turn formulate a plan (to put into action).[69,70] This can be conducted in a collaborative manner between patient and clinician, but the patient should take the lead in identifying possible goals. Evidence suggests subsequent self-monitoring of progress as potentially one of the most important mechanisms in behavior change.[71]

4.4 | Technology-based tools

More recently, technological advances in consumer devices have provided new ways for clinicians to interact with patients and for their patients to self-monitor. From tablets and smart home devices to toothbrushes that connect to apps, the options open to patients are increasing. Dental professionals can use technology to individualize discussions concerning disease and risk status, to collaboratively formulate goals, or to design action plans with

their patients.[72,73] Ultimately, technology-based tools engage the patient, enhance the clinician–patient relationship, and encourage self-regulation. Many of these have become standard practice as they facilitate various aspects of care in the dental practice, and are seldom thought of as enhancing patient relationship or experience. For example, digital radiography, electronic clinical charts, intra-oral cameras, mobile apps, and online programs are all used to assess patient levels of risk.[74-76]

Although many technologies are available, there are still relatively few studies investigating their efficacy or best application in behavioral modification.[71,72,77,78] One study demonstrated a beneficial effect on plaque and bleeding levels as a result of the conjunctive use of an intra-oral camera with verbal explanations during clinical oral hygiene instructions.[79] A more recent study reported that the intra-oral camera contributed to improved gingival health, self-reported oral hygiene behaviors, and patient-perceived self-efficacy, supporting the notion of moving patients beyond knowledge to action.[75] The systematic review presented in Table 1 suggests that mobile digital technologies are consciousness raising, for example, through display of habit-disrupting cues such as light signals, sounds, or push messages.[71]

Text messages offer an opportunity to encourage patients to help meet their goals and achieve them in an appropriate amount of time. This occurs by creating moments of closer proximity between the patient and their oral health professional, adjunctive to the treatment and acting as an extension to the in-office visit or clinician–patient rapport.[51] It is unclear whether the benefits observed using technology-based tools are attributable to their ability to engage patients, thus facilitating self-efficacy, enhancing the clinician–patient relationship, helping patients understand their oral health better and break their habits, or by making them more customized to their specific status. Perhaps the benefits are a result of many factors working together, with some more responsible for the benefit in one patient while acting differently in another; or perhaps these benefits change over time. This co-action of different worlds, theory-based knowledge, communication skills, and technologies is in line with the concept of multiple strategies grounded in behavior change theories, supported by clinician communication methods.[51,71,80] The use of these devices or strategies can create a different state of curiosity, which is an approach-oriented motivational state that drips people to explore, learn, and get involved.[81]

4.4.1 | Application to practice

These approaches and interventions have potential for all patients, even those who already seem motivated (ie, to maintain patient rapport and keep them motivated). In addition to treatment, they also form a key part of prevention, and therefore are suitable for everyone; however, these must always be tailored to the individual.[82] Regardless of the patient or situation, application requires setting a goal and adopting a strategy to help meet that goal.[44]

5 | DISCUSSION

5.1 | Pragmatic strategies

As demonstrated by our patients, having knowledge, understanding, and/or intentions does not necessarily translate into behaviors.[80,83] Aligned with this, it is equally challenging for health professionals to put behavior change techniques into practice (ie, to change their own practice behaviors). To implement the skills described in clinical practice, some pragmatic hints are valuable. The first of these is the importance of recording baseline behaviors and the results of those behaviors, followed by establishing easy ways for them to be monitored and updated. Personalizing conversations is essential, which depends upon detailed documentation of case histories and previous discussions.

A challenge in health behavior change assessment is determining the appropriate measure. As mentioned, for example, in the context of oral hygiene, plaque index is often used as an outcome. However, plaque index is not a behavior, but rather a result of behaviors. The patient may be taking steps to change their oral hygiene regime, but the effects are not yet seen in the plaque index for various reasons. Perhaps the level of skill needs supplemental guidance, despite the routine being sufficient.

Monitoring patient progress in adjusting behaviors is an additional aspect of the communication, in that commending or reflecting on progress made increases the patient's confidence and sense of self-efficacy, encouraging self-regulation. Moreover, behavior is a process rather than an event and if considered on a scale of 0-10, no patient starts at 0 and reaches 10 as it is continous through life with varying degrees at different timepoints. Behavior change is not about a destination but more about a journey characterised by strategies that facilitate adaptation along the way. Our task as clinicians is to engage and encourage our patients so that they can alter behaviors to fit their own level of risk, fitting these into their schedules with tools appropriate for their own oral health, all within the context of the many other aspects of their lives. Monitoring indicates merit in efforts taken to schedule each patient with the same clinician throughout their appointments, including behavior change conversations, as this enhances rapport.[67] With various tools or approaches to choose from, it is suggested to start with easily attainable goals to help the patient experience success, and then to use this success to propose tackling a more challenging goal. Evidence suggests that the changing of a single health behavior can have an inadvertent impact on additional health behaviors as the patient embraces self-efficacy.[84]

5.2 | Education/continuing professional development

The shift from paternalism to patient-centered care has been a transition and will continue to take time. Becoming proficient at behavior change approaches will require training to maximize the potential

of options available to clinicians. The optimal time to do this is during undergraduate dental professional education. Some institutions have done this and are citing the benefit. For example, a study by Woelber et al[85] demonstrated that providing motivational interviewing training to undergraduate dental students resulted in heightened interdental cleaning self-efficacy of periodontal patients.

Evidence Söderlund, et al[55] from the field of nursing suggests that short course training in motivational interviewing is successful at teaching clinicians about communication techniques to engage patients and maximize patient autonomy. However, just as behavior change is a process for patients, this is also the case for clinicians. It was commented by Söderlund, et al[55] that practical application in a clinic setting, ideally with an observer to provide feedback, was necessary to facilitate learning of the techniques.

5.3 | Limitations of the evidence

It is important to consider the potential impact of the limitations of the evidence included in this review on interpretation and ultimately the suggestions presented in the discussion section. As previously mentioned, the education of dental professionals in health behavior change techniques based upon evidence is important for the application of these approaches. Many of the studies included in the published systematic reviews lack detail and clarity as to the approaches taken, thereby leaving interpretation dependent upon the common threads and themes identified. It can be appreciated that communication techniques and psychological approaches are problematic to describe or reproduce in detail, partly attributable to the fact that each patient plays a role in the implementation.

To advance the body of evidence and enhance education initiatives, research should include clear descriptions of how a behavior change intervention was structured or implemented together with details of outcome assessment. Outcomes should include patient parameters or surrogates of behavior change such as measures of readiness to change, resistance toward change, level of ambivalence, self-efficacy, or data on patients' reasons to change, in addition to traditional periodontal clinical outcomes. Furthermore, scrutiny of potential publications by reviewers to ensure appropriate consistency and description of methods would serve to promote quality assurance in both the research and training of health behavior change techniques or interventions.

6 | CONCLUSIONS

Periodontal health can contribute to the overall health and well-being of patients. However, control of the etiologic agent and host inflammatory responses vital to maintaining health relies upon patient self-care and lifestyle behaviors. Therefore, behavior change interventions are an essential part of the therapy choices in periodontal care. Based upon evidence from the field of psychology, health behavior change should be acknowledged as complex.

6.1 | Implications for clinical practice

There is much to be learned about the application of behavior change principles in the dental setting; however, increasing evidence exists concerning strategies that facilitate clinician–patient rapport, and techniques to enhance patient self-efficacy to encourage healthy lifestyle behaviors when implemented in a personalized manner for each patient. Predictable approaches using simple and reliable methods or tools should be taught as part of the dental curriculum and implemented in daily clinical practice.

6.2 | Implications for further research

Based upon the evidence presented in this paper, there is a need for additional clinical research evaluating the efficacy of health behavior change interventions in the dental setting. Future research should include clear intervention descriptions, have a longer follow-up incorporating various behaviors relevant to oral health, and assess patient outcomes in addition to clinical outcomes.

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