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In defense of flossing: Part II-can we agree it's premature to claim flossing is ineffective to help prevent periodontal diseases?

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Abstract

Periodontal diseases (PD) are complex, multifactorial disorders. Effective daily plaque control promotes gingival/periodontal health. Recent meta-analyses and other reviews have found inconclusive evidence to support that tooth flossing promotes gingival/periodontal health. Ideally, the claim should have been that, "at present, *we do not have high-quality evidence from well-designed randomized clinical trials (RCTs) to determine whether flossing lowers the risk for periodontal diseases."* Rather than "not proven to be effective," the lay public may now think that flossing is "almost entirely unhelpful and/or unnecessary." How does the dental community communicate the nuances of this topic? Herein, we examine the key structural issues underlying this area of research. We assert that effective flossing between specific teeth can promote gingival/periodontal health. Further, we explore the nuances of for whom this may be true and untrue, why our evidence is lacking and what can be done to clarify the effectiveness of flossing on clinical outcomes.

Keywords

flossing; oral hygiene; periodontal diseases; interpreting evidence; self-report; behavior change

Introduction

A majority of oral health care providers in the United States of America probably still recommend flossing and likely believe that *effective* tooth flossing can promote gingival and periodontal health. And yet, by examining recent Cochran Reviews (CRs)[1, 2] and meta-

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reviews[3, 4], the media and lay public has begun to seriously question whether flossing should be performed at all. Is such a conclusion potentially flawed? We would argue that at the very least, this conclusion is premature and maybe fundamentally inaccurate. Here is why:

1. POOR QUALITY EVIDENCE: Even the authors of the recent CRs examining flossing state that "The trials [used in their review of flossing] were of poor quality and conclusions must be viewed as unreliable."[1] While technically the evidence for flossing is weak, more importantly the methodology and rigor of the studies examining flossing effectiveness are also weak. The latter statement appears not to be stressed enough.

2. LIMITED SCOPE OF RESEARCH QUESTIONS ADDRESSED: CR's, the primary source of the media reasoning, use only a handful of all available RCTs to answer very narrow questions. For example, the CR's examined RCTs that studied tooth brushing and flossing versus flossing alone at 1, 3 and 6 months and using only plaque and gingival indices as outcomes (i.e., surrogate endpoints instead of long-term measures of periodontitis) [1].

3. LIMITED EVIDENCE/ OTHER AVAILABLE EVIDENCE: CRs focus solely on RCTs (a small percent of all types of studies), and not all questions can be easily or, at times, ethically be addressed by RCTs (e.g., randomizing people to not brush their teeth). Focusing on CRs and a limited number of RCTs that were based upon low-quality evidence at the expense of the complete body of evidence may be limiting and could be viewed as selectively interpreting findings out of context. As well, there is a plethora of evidence (albeit from studies that are not RCTs) to support that regular effective flossing can promote gingival and periodontal health. If the current "best evidence" is of admittedly low-quality, how can we trust conclusions based upon these data? As well, the FDA classifies floss as a Class I device, meaning it has the lowest risk and no mandate for manufacturers to perform evaluative studies[5, 6]. This may help explain the lack of more extensive research in this area.

4. SELF-REPORTED DATA: The CRs examining flossing are based on RCTs that rely on patient self-reported assessments of flossing behavior. Notably missing from these studies is both independently verified patient frequency of flossing and, importantly, reliable assessments of the *quality* of patients' flossing [7].

5. INTERPRETATION OF REPORTED FINDINGS: Guidelines are not well established for how dental clinicians should interpret CRs within the context of other evidence, especially when such findings are applied to a specific patient's unique clinical presentation.

As with the implementation of almost all health behaviors, there are many nuances that scientists and practitioners must understand and address in order to conduct rigorous research and/or adequately advise individual patients in a clinical setting. For example: which individuals need to floss? How often? Does one need to floss all their teeth? At what level of skill does one need to floss (i.e. average or expert skill level)? To what degree can one's flossing skill be improved? Also, PD are multifactorial disorders; there are numerous

and complex risk factors for PD as well as many different phenotypes[8, 9] or classifications of PD. Further, not all risk factors are under a person's control. Is the dental research community and the media taking a single prevention modality (e.g., flossing) out of the context of its multifactorial causation[10, 11]? When we do not consider factors such as patient skill level and frequency of tooth brushing behavior, level of motivation, specific type of PD, genetic predisposition, medical status and socio-economic factors—then, are we being, well, just too reductionistic?

While previously we addressed the issue of whether flossing could help protect against dental caries[7], in this article we extend the focus of this piece to include emphasis on point #3, mentioned earlier, to support that, for most people, *effective* flossing (see YouTube video[12]) and/or interproximal cleaning can promote gingival and periodontal health.

First, let us take a step back and re-frame the utility of flossing from another perspective. To further highlight the central issues, we will ask and answer a series of questions. We chose this question and answer format in order the specifically highlight the issues central to our argument and our point of view. Using this approach, we will "unpack" the recent media story (Saint Louis, New York Times (NYT), Aug 2, 2016) that was, at best, suspicious of flossing to prevent PD. As well, the European Federation of Periodontology (EFP) recent reports have recommend interdental brushes and essentially stopped short of endorsing flossing, but suggested it could have some value in limited circumstances[13, 14].

Question (Q1A) The media report (Saint Louis, NYT, Aug 2, 2016), suspicious of flossing, was based on what evidence? **(Q1B)** What about the recent EFP reports[13, 14]?

Answer (A1) The primary source information was a CR that itself was based on 16 studies, all RCTs, in which the authors found little evidence to support flossing as being an effective preventative practice; however, the caveat is that the authors also clearly stated that: "The trials [RCTs used in their review] were of poor quality and conclusions must be viewed as unreliable"[1]. **(A1B**) Much like the primary CR, the analyses and reviews cited by the EFP [13, 14] also had significant methodological limitations[7] (also see discussion of limitations later question #6 of 10 Critical Questions to Establish the Effectiveness of Flossing).

(Q2) Is there reasonable evidence from studies other than RCTs (described later, see question #5 of 10 Critical Questions to Establish the Effectiveness of Flossing) to inform us on the usefulness of flossing?

(A2) Yes, but we would need to critically evaluate and integrate these studies into logical conclusions which would also have significant limitations. Therefore, herein we have tried to pinpoint the most critical limitations of the current evidence in hopes that they can be addressed in future research.

(Q3) How can we establish guidelines for whom dental flossing is clinically meaningful?

(A3) We would need new studies that: i) use a valid and reliable measure of tooth brushing and flossing skill[7], ii) thoroughly characterize research participants at study entry (assess all relevant clinical and socio-demographic characteristics) and identify critical variables

(quantify/verify daily oral hygiene behaviors; identify the type/extent/severity of PD at study entry) as well as potential confounding variables and/or covariates (i.e., age, number of teeth, risk factors for PD, access to and prior use of oral health care services), and then iii) implement next-generation sequential multiple assignment randomized trials (SMART Studies) [15, 16] that follow and assess participants longitudinally and, based upon assessment of clinical outcomes at pre-determined time points, allow multiple randomizations per study participant[15, 16]. The use of randomized longitudinal, intra-individual designs in which patients are matched based upon similar baseline characteristics, would allow for more thorough assessment of the nuances and confounding factors that we believe may previously have comprised the outcomes of flossing effectiveness studies. Such SMART studies could even be coupled with a split mouth study design to help determine the requisite level of oral hygiene self-care for a given person with a specific baseline presentation. Findings from such studies could help provide guidelines for oral health providers to address the needs of specific individuals that present in a clinical setting.

Background/Overview

To fully address flossing in the context of PD, there are a number of important topics that need to be understood in some detail. We will ask a series of question and answer them in paragraph form. These questions include: 1) What is PD? 2) How do we define PD? 3) Is it Fair to Say There Are Phenotypes of PD? If so, Why Does it matter? 4) Does lack of plaque control contribute to PD? 5) Does *effective* flossing promote gingival and periodontal health? 6) How are systematic reviews and meta-analyses a source of controversy? 7) Do multi-level influences of PD add complexity to longitudinal studies? 8) Flossing vs. the use of inter-dental brushes(IDB)—do we know all we need to know yet? 9) How can an objective measure of tooth brushing and flossing help clarify this topic? 10) How can SMART studies help us gain clarity on the utility of flossing?

10 Critical Questions to Establish the Effectiveness of Flossing

1) What is PD?

Periodontal diseases (PD) are comprised of gingivitis and periodontitis[17].PD are multifactorial disorders that involve inflammation-mediated destruction of tooth-supporting tissues and bone. Influenced by genetic predisposition, lifestyle and environmental factors[14] —PD is played out in an ongoing interaction between the dental biofilm and the host's immune system. Both gingivitis and periodontitis develop in response to bacterial biofilms (also termed "dental plaque"). Dental plaque is a dynamic microbial biofilm/ecosystem that contains hundreds of bacterial species[18]. The biofilm initiates with adherence of certain bacteria, such as *Streptococcus* species, to oral surfaces that contain saliva. Then, later-colonizing species attach to the primary-colonizing bacteria. In the absence of established oral hygiene for 2–3 weeks, individuals can develop gingival inflammation[19]. Gingivitis does not always evolve into periodontitis[20]; however, periodontitis is always preceded by gingivitis[21]. According to Kinane and Attstrom, 2005, gingivitis and periodontitis are on a continuum of the same inflammatory disease[17].

Whether an individual develops periodontitis depends on the host's susceptibility to elicit an inflammatory response when dental plaque has accumulated on teeth at and below the gingival margin. This predisposition is in part governed by genetic factors as well as and behavioral factors such as smoking[22], nutrition[14] and medical illnesses such as diabetes [23], HIV-related immunosuppression[24] and other factors [23].

2) How do we define PD?

Past research studies have used various definitions or classifications of PD[25–27]. This factor alone can influence study findings and complicate comparing findings across studies. Presently, investigators can help address the issue of how to define /classify PD by using multiple definitions, which can allow for greater comparison across studies.

3) Is it Fair to Say There Are Phenotypes of PD? If so, Why Does it Matter?

It is now recognized that there are distinct phenotypes of cancer[28] and obesity[29]. Based on the work by Offenbacher et al, 2007 and 2008[8, 9], one can also argue that there are phenotypes of PD within a population. Using a sample size on nearly 6,768 patients, Offenbacher et al (2007) developed new clinical categories of gingivitis and PD representing distinct biological phenotypes; these were based on distinct patterns of biofilm composition, humoral antibody response, and local inflammatory mediator levels thus characterizing the biology of the biofilm–gingival interface (BGI). The five BGI clinical conditions, each reflecting different underlying biological phenotypes, were defined using varying levels of probing depths (PDs) and sites with bleeding on probing (BOP)[8, 9]. The BGI clinical categories are clearly different from the more established or "traditional" definitions of periodontitis that focus on clinical attachment loss (CAL)—perhaps because it was developed with an intent of examining a periodontal-systemic link. Recently, a longitudinal intervention study by using an HIV+ cohort found that biologically-based BGI classification differentiated baseline profiles of PD and changes over time in levels of PD [30] better than traditional measures such as the American Academy of Periodontology (AAP) [26] and the Centers for Disease Control with the American Academy of Periodontology (CDC/AAP)[31] which focus on CAL. Such results suggest that the BGI system may have utility in longitudinal studies of flossing/interproximal cleaning.

If indeed there are phenotypes of PD, then baseline characterization of PD is critical because it is possible that the individual/group-level natural progression and/or response to treatment may differ across phenotypes. This could be an important consideration for sampling. Lumping all subjects into one definition of PD (e.g., those based on CAL) may, however, lead to misclassification which can limit the reliability and/or generalizability of research findings.

4) Does the Lack of Plaque Control Contribute to PD?

Unremoved dental plaque can lead to gingival tissue irritation/inflammation which may then also promote PD. In a classic naturalistic study by Loe et al, 1986, a caries-free cohort study of male Sri-Lankan tea workers were followed longitudinally[32]. Individuals in this cohort did not perform oral hygiene and had no treatment or prevention of oral diseases. Across 15 years, 8% had rapid progression of PD (aggressive periodontitis), 81% had moderate

progression (chronic periodontitis) and 11% had no progression of PD (they were healthy without prevention)[32]. Tooth loss increased with severity of periodontitis. Findings from this study suggest that, in the absence of oral health prevention and dental treatment, most people developed at least moderate PD[32].

Conversely, Lang et al, 1973 demonstrated that plaque removal by tooth brushing, coupled with effective interproximal plaque removal at least once every 24 hours, can prevent the onset of gingivitis[33]. As well, effective interproximal oral hygiene helps to reduce the extent and severity of PD, and (if also coupled with effective scaling and root planing, when indicated) may even help halt the progression such oral diseases[34].

5) Does *Effective* Flossing Promote Gingival and Periodontal Health?

There are a number of cross-sectional and longitudinal (non-RCT) studies that conclusively support the utility of effective flossing to promote oral health. Walsh and Heckman (1985) reported that patients using dental floss had decreased bleeding on probing (BOP)[35]. Graves et al. (1989) found that tooth brushing reduced interproximal bleeding by 35% but the use of dental floss further decreased bleeding by 67%[36]. Lang et al (1995) examined 319 individuals and found that those subjects who exhibited acceptable flossing ability had less plaque and calculus, shallower pocket depths, and less attachment loss than those with unacceptable flossing skill; in regression analyses, brushing thoroughness, flossing ability and frequency, and dental visit frequency were predictors of lower levels of plaque, gingivitis, and calculus[37]. Barendregt et al (2002) determined that flossing as the sole form of oral hygiene was effective in preventing the development of gingival inflammation and reducing the level of dental plaque[38]. Lewis et al, (2004) longitudinally examined 55 adults with gingivitis or slight chronic periodontitis, and found at 12 weeks that plaque scores and bleeding were reduced in the group randomized to flossing as compared to a group that used a toothpick-holder[39]. Crocombe et al, 2012, obtaining data from the National Survey of Adult Oral Health 2004–06, found that regular interdental cleaning was associated with better oral hygiene outcomes (lower levels of dental plaque and gingivitis); however, there was no significant association between regular interdental cleaning and clinical attachment loss[40], suggesting potentially that non-behavioral factors (i.e., host predisposition) may have a greater influence on CAL.

6) How Are Systematic Reviews and Meta- Analyses a Source of Controversy?

Recent findings from meta-analyses and systematic reviews have raised questions as to the effectiveness of flossing[1–4]. In a meta- analysis- by Sambunjak et al. (2011) the authors reported some evidence from 12 studies that flossing in addition to tooth brushing reduces gingivitis compared to tooth brushing alone. They determined that “there is weak, very unreliable evidence from 10 studies that flossing plus tooth brushing may be associated with a small reduction in plaque at 1 and 3 months”[1].

In a more recent consensus report drawing off meta-reviews and systematic reviews, Chapple et al, 2015, asked : **“**Does daily interproximal cleaning in addition to tooth brushing reduce gingival inflammation and does it also reduce interproximal plaque levels compared to tooth brushing alone?”[13] The authors found that there is “very inconsistent/weak evidence

for an adjunctive effect of interproximal cleaning to brushing, either due to a lack of efficacy (flossing) or a lack of evidence from appropriate clinical investigations"[13]. Interestingly, they found limited evidence that IDB use (or other interproximal cleaning) reduced gingival inflammation. The reasons for this, according to Chapple et al, 2015, may be related to the limitations of the gingival indices used, the variability of outcome measures used (i.e., gingival inflammation vs. plaque) or the variability of study designs[13]. As stated earlier, to this list we would also add not having a measure of oral hygiene skills[7].

Further, in the report by Chapple et al, 2015, no RCTs were identified which assessed whether individual sites without attachment loss and no signs of gingival inflammation (healthy sites) would benefit from daily interproximal plaque control[13]. Thus, it is unknown whether effective flossing (in sites initially too small to use IDBs) can help maintain healthy and tight gingival margins around teeth—that is, maintain a first line of defense against PD.

7) Do Multi-Level Influences of PD Add Complexity to Longitudinal Studies?

Other host and environmental factors may influence the progression on PD over time. Such factors include genetic predisposition, personal level factors (diet, smoking status home care, medical conditions) the access to and use of oral health care services, and, more recently, even epigenetic factors[41]. Collecting accurate data on such variables can be an important consideration for longitudinal studies. Given the advent of electronic medical records, large-scale, multi-site naturalistic databases could be used to collect and analyze findings to strengthen the evidence base—provided that variables are consistently defined, measured and updated on regular and ongoing basis.

8) Flossing vs. the Use of IDB—do we Know all we Need to Know Yet?

Recently, the EFP, citing a lack of evidence, did not endorse flossing to prevent dental caries and gingivitis; instead, they advocated the use of interdental brushes (IDBs), citing greater current evidence[14]. We question whether endorsing IDB use, at the almost complete expense of flossing, may be premature. We addressed this topic in relation to dental caries previously with a focus on the low quality of the studies, lack of a measure of oral hygiene skill and self-reported data[7]. Further, studies comparing flossing with IDB use tended to exclude teeth/interproximal sites that were too narrow for appropriate IDB cleaning (i.e., more appropriate for flossing) which further stacks the deck for more favorable results for IDB use. Granted, flossing is technically difficult; however, these studies may indicate that, in general, participants found IDBs easier to use and thus used them more regularly than those in the flossing group (who were given minimal or no instruction on effective flossing).

9) How can an Objective Measure of Tooth Brushing and Flossing Help Clarify This Topic?

We are establishing the reliability and validity of a new provider-observed measure, the oral hygiene skills mastery (OHSIM)[7]. The OHSIM measures central components of tooth brushing and flossing skills. Once provisionally established to be reliable and valid measure, OHSIM can be added to future studies on the topic of flossing to add methodological rigor. Interestingly, in preliminary analyses (n=67) tooth brushing skill is highly correlated with flossing skill (using Pearson correlation, rho=0.46, $p<0.001$; Vernon et al, unpublished data)—suggesting that tooth brushing skill may be a critical confounding variable in studies of

interproximal cleaning. Or, what if flossing, directly or indirectly, enhances tooth brushing skill over time—could that yield powerful long-term effects? Even a small effect over a long period of time could make a substantial difference in oral health.

10) How can SMART studies help us gain clarity on the utility of flossing?

Sequential Multiple assignment randomized trails (SMART) employ Adaptive Treatment Strategies (ATS) and allow researchers the opportunity to individualize treatment based on how people respond clinically to a series of pre-defined treatment options; thus, subjects are randomized to different interventions at multiple points in the study [15].In essence, SMART studies allow for multiple RCTs to be conducted at the intra-individual level and within the confines of a singular study. For example, a primary tailoring variable (e.g., type and level of oral hygiene care) can be modified using ATS if there is a lack of a clinical response by a pre-defined time period[15, 16]. OHSIM could be used in SMART studies to potentially yield more valid and reliable findings regarding flossing. In addition to SMART design implementation, future such studies could also employ digital technologies that help to monitor patient behaviors such as tooth brushing (e.g., “smart” tooth brushes)[42, 43] to measure frequency and duration of time spent brushing. By combining SMART design and current technological innovations, researchers will better be able to address traditional data biases inherent to self-reported information.

Conclusion

In sum, the current state of evidence for flossing effectiveness as it pertains to PD is weak and underdeveloped. PD is a complex disorder with many factors contributing to it. Understanding the relative clinical value of flossing/interdental cleaning will require a thorough, nuanced, well designed[44] and methodologically valid approach. Finally, interpreting the currently available “evidence” in all its forms (i.e., varying type of studies, different study designs and varying measures used) is not well delineated[11]. In other words, this is a complicated research question. How best to communicate this complexity in a simple manner to the lay public may also be yet another question in search of an answer. Given the importance of prevention in oral health promotion, we have developed a set of plain language guidelines that providers may consider to promote patients’ effective cleaning between their teeth. These suggestions (See Tables 1, 2 and 3) are based upon the development of OHSIM, existing health behavior change theory and previously published work on oral health coaching by our group [45, 46].

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Abbreviations

AAP	American Academy of Periodontology
ADA	American Dental Association

ATS	Adaptive Treatment Strategies
BGI	Biofilm–Gingival Interface
BOP	bleeding on probing
CDC/AAP	the Centers for Disease Control with the American Academy of Periodontology
CAL	clinical attachment loss
CR	Cochran Reviews
EFP	European Federation of Periodontology
FDA	Food and Drug Administration
IDB	inter-dental cleaning devices, inter-dental brushes
NYT	New York Times
OHSIM	Oral Hygiene Skills Mastery
PD	periodontal diseases
RTC	randomized clinical trials
SMART	Sequential Multiple Assignment Randomized Trials

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Table 1

Suggested Plain Language Approach for Providers to Communicate with Patients on How to Clean Between Teeth to Help Prevent Gingivitis and Possibly PD:

1 The American Dental Association (ADA) recommends "brushing twice a day and cleaning between teeth with floss (or another interdental cleaner) once a day" [6] This is a simple yet important statement, thus, further detail may be helpful to some providers.

2 Ideally, your **dentist or dental hygienist c**an help select a type of floss or interdental cleaning aid that works for your oral health needs and does the best job to clean between your teeth.

3 "Cleaning between the teeth" can be done in a variety of ways:

- **a.** **Flossing is one option**. Floss can reach between teeth with tight contacts and may help prevent gingivitis in these areas. Gingivitis (swollen gums) can "open the door" to more serious conditions—that is, it is necessary but not sufficient to cause PD
  - **i.** Proper flossing can be challenging. Allow yourself approximately 1–2 months to *"just learn the basics"* on your own teeth. Focus initially on optimal technique[12]. You can choose from different types of floss (and even powered flossing and interdental cleaning devices, see 3b).
  - **ii.** Initially, it may be best to look in the mirror and use "floss holders" (easier to learn a new skill with) to clean between teeth you can see easily (anterior teeth). After learning to floss well and without hurting your gums (pain resulting from the force of floss not being directed towards and against the tooth), begin to add teeth to your daily regimen that are less easy to see (posterior teeth).
  - **iii.** Work towards developing a daily habit of flossing (or cleaning between teeth in some manner). Focus first on flossing with a good technique [12]—even if it's only a few teeth each day, as this can help you feel more confident and may help reinforce a routine and long-term habit. Floss more teeth as you learn to develop the skill better. Consider flossing "top teeth" one day and "bottom teeth" the next day. In time, flossing can become more simple and easy.
  - **iv.** Ask your dentist or dental hygienist for feedback on how you are doing. Also ask if there are some teeth that may be more important for you to floss than others[7]. Focus more on those teeth.
  - **v.** Initial bleeding gum tissue (not due to trauma) can be normal in sites previously not cleaned well. This should subside in about 1–2 weeks of proper daily interproximal cleaning (provided there is no residual calculus).
- **b.** **ICDs are another option:** Many people avoid flossing or find it too difficult—and there are other options to clean between your teeth.
  - **i.** There are many types of **ICDs**[6]. They should be able to fit easily to clean between your teeth without hurting your gum tissue.
  - **ii.** For example, there are various sizes (smaller to larger headed) interdental cleaning brushes, toothpick holders, wooden plaque removers, and irrigation and/or mechanical electric cleaning devises (water and air flossers, and others). What type of device is best for you will depend on the size of the space between your teeth (i.e., 3-dimensional architecture of your gingival embrasure).
  - **iii.** Posterior teeth can be the most important to clean (due to the large surface area) and also the most difficult (harder to reach and unable to see in a mirror).
  - **iv.** You may need to experiment with different types of cleaning aids. If you have questions or difficulty, ask your oral health provider for suggestions.
- **c.** **Creative use of your toothbrush.** In teeth with spaces between them (i.e., a "gap" between teeth or teeth next to a missing tooth), a manual or power brush can clean the "sides of the teeth" (i.e. that does not face the tongue or the check). It is important to clean *all* sides of your teeth.
  - **i.** If flossing or interdental cleaning aids do not work for you, you may consider purchasing an **electric or powered spin brush** (oscillating rotating power brush)[13]. Hold the brush so it cleans where the tooth meets the gum tissue. Angle the head of the toothbrush so it cleans the space where two teeth touch: aiming it at both sides of the "V" shaped space between all your teeth. Be sure to brush both the check side and the tongue side of the tooth where it meets to gum tissue. Overall cleaning (plaque removal) is important.

Table 2

Practical Suggestions for Oral Health Providers on how to Help Increase Compliance for Patients to Clean Daily Between Their Teeth: Applying Behavioral Health Theory

Main point: Merely *giving information* alone (i.e., "telling" a person to floss or clean between their teeth) is unlikely to change a person's behavior[47].

1 Using a Health Theory-Informed Approach while communicating with patients about flossing behavior may yield greater compliance and patient success. For example, one well utilized, empirically validated model called the ***Information-Motivation-Behavioral Skills*** **(IMB)** model [48] helps identify critical areas of patient need in conjunction with modifying or performing new health behaviors.

2 Using **IMB,** providers should focus on addressing each of the following 3 areas:

a. **Information**: For example, use a mirror to show the patient areas of teeth with gingivitis (redness, infection and/or edema). Explain in simple language how plaque can cause this and what might be future complications of these conditions if plaque is not removed. Compare and contrast healthier sites within a patient's mouth with unhealthy sites (or use photographs) to illustrate what healthy gum tissue should look like. Explain that cleaning all sides of the tooth (where the tooth meets the gum) will promote healthy gum tissue. Reinforce ongoing, regular professional cleaning and exams. *Ask* the patient if they would like specific home care tips on how to help make their gums healthier. It is also important to address any misinformation that patients may have about gingivitis, periodontitis, flossing or interdental cleaning.

b. **Motivation:** Assess how important it is for your patient to have healthier teeth and gums. You could try using a Likert scale from 1 (very low) to 10 (very high) to determine "where they are" [45, 47, 49]. Some people are more motivated towards positive outcomes than by scare tactics (i.e., stressing negative outcomes). Ask the patient which type of messages they prefer hearing and which will be most helpful to them. Such preferences should be noted and acted upon. Be authentic, project hope and confidence that better oral health is possible for the patient (and, as a provider, believe this within yourself) provided that they desire it and take action. Encourage even small steps towards greater oral health. One's context or environment can be important: encourage the patient to obtain support from family or friends, if appropriate.

c. **Behavioral Skills:** Assess your patient's baseline level of oral health skills and record results. Show—in an interactive, hands-on manner—specific ways that they can improve their technique (i.e. brushing, flossing or using an IDB/ICD). Be sure to observe the patient actually performing the suggestion; give positive feedback on areas of strength and constructive feedback on specifics on how to improve further. Help the patient set realistic and measurable goals—even if it may seem to be a minor step to you, as a provider. Personalize your messaging to all patients' level of understanding and personality type. Tailor your message to the most important things that can be done to improve the patient's overall oral health. Be patient, enthusiastic and positive. Showing your patients how you value prevention will be communicated non-verbally to your patients.

Adapted from Vernon and Howard, 2015[46]

Table 3

Additional Pointers for Oral Health Providers on Encouraging Oral Hygiene Behavior Change:

1	Develop rapport and establish a real human connection with your patient (aka, use good "bedside manner"); express concern and be empathetic. Also, believe in yourself that improvement (however small) is possible.
2	Be respectful and ask questions (about IMB elements) in a non-judgmental way.
3	Be conversational and use simple, concrete language. Be genuinely enthusiastic; help promote a patient's self-efficacy and/or self-empowerment. Have fun as you do this.
4	Individualize your suggestions for specific teeth, sites or conditions in your patient's mouth. Simplify and prioritize your suggestions
5	Use a coaching stance; work *alongside* the patient—avoid "telling"[47]—or "giving advice as an authority", as this may be perceived as not listening and/or not connecting with the patient.
6	Communicate effectively; explain yourself; check in with the patient to assess their level of comprehension; ask for feedback on how you are doing or how you could be more helpful to them.
7	If you encounter resistance, use a motivational Interviewing (MI) approach (for details see Ramseier and Suvan, 2010[47]). Check in and ask if this is helpful or if you could continue next time. Acknowledge and respect their frustration and or point of view. Ask questions to understand the patient better. Meet them "where they are" and gradually move forward.
8	Identify and troubleshoot potential challenges (logistic, motivational or otherwise) that may impede forward progress.

Adapted from Vernon and Howard, 2015 [46]