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ANIMATED ORAL HYGIENE INSTRUCTIONAL VIDEO EFFECT ON DENTAL IQ AND REPORTED HYGIENE BEHAVIOR MODIFICATION IN ACTIVE DUTY SERVICE MEMBERS

by

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ABSTRACT

Animated Oral Hygiene Instructional Video Effect on Dental IQ and Reported Hygiene Behavior Modification in Active Duty Service Members

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Dental emergencies due to caries in service members are largely preventable. Oral hygiene instruction in the DoD is not standardized and currently communicated via written instruction, the effectiveness of which is unknown.

An animated oral hygiene video paired with, and without, text message prompts will be tested against written instruction to measure any change in oral health knowledge, and self-reported oral hygiene behaviors.

Three groups will be created and a knowledge assessment will be performed. Control will receive written instruction only. Experimental Alpha will receive video alone; Bravo will receive video and a daily oral hygiene text message. All participants will complete the knowledge assessment again to compare to baseline.

Phase I of study which includes design, animated video, digital knowledge assessment, and text message logistics was completed. Phase II includes recruitment and survey distribution, and phase III will include analysis and publication to conclude the study in 2024.

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LIST OF ABBREVIATONS

ADA	AMERICAN DENTAL ASSOCIATION
BUMED	BUREAU OF MEDICINE
DOD	DEPARTMENT OF DEFENSE
HBM	HEALTH BELIEF MODEL
INST	INSTRUCTION
LOC	LOCUS OF CONTROL
NML&PDC	NAVY MEDICINE LEADERSHIP AND PROFESSIONAL DEVELOPMENT CENTER
OHI	ORAL HYGIENE INSTRUCTION
PI	PRINCIPLE INVESTIGATOR
QR	QUICK RESPONSE
SMS	SHORT MESSAGE SERVICE

CHAPTER 1: Introduction

The success of United States military operations is largely accredited to the ability to assess and deploy needed assets to an evolving situation quickly. This requires individual service members remain in a constant state of readiness including physical, medical, and dental readiness. A service member who experiences an unexpected dental emergency will not be able to continue to perform their job, which can jeopardize mission success. Dental caries is the underlying disease process responsible for many of the dental emergencies experienced by service members and is largely preventable provided proper oral hygiene is conducted on a routine basis.

Active-duty service members are required to have a dental exam annually where the member is classified one of three ways; dentally healthy, non-urgent care required, or as urgent care required that will likely result in a dental emergency in the next year if not treated. This classification system is designed to catch and treat oral disease in the clinical setting and prevent the member from deploying with a potentially debilitating oral condition. Despite these efforts, the incidence rate of dental emergencies in military personnel assigned to combat environments range from 111 to 437 per 1,000 personnel per year with a mean rate of 187.2, and of these cases, the number one most frequently observed diagnosis was dental caries.[18] This rate of dental emergencies has a significant impact on a deployed unit in terms of loss of manpower. In one study it was stated that a dental emergency can require three convoy vehicles with up to nine personnel for security in-theater for the sole purpose of medical evacuation.[4]

The current standard of care in US Navy dental treatment facilities recommends OHI be delivered through verbal instruction by a member of the dental team or by

providing the service member with written instruction, specifically BUMEDINST 6600.16A titled “How to Reduce Your Risk of Tooth Decay” which details the cause of tooth decay, brushing and flossing instruction, fluoride rinses, and benefits of chewing sugarless gum. However, this form of instruction does not provide a visual component to complement the verbal instruction nor does it provide any form of motivational messaging or encouragement to promote self-efficacy or prompt behavioral change in the way of increased oral self-care. Furthermore, there is not a standardized method for the delivery of OHI. It is largely left to the oral health care provider’s discretion.

Considering this current standard of care and lack of formal standardization in oral hygiene instruction, is not surprising that numerous studies have shown that the overall quality and quantity of oral hygiene fails to meet current recommendations as set by the American Dental Association and numerous other dental agencies around the world. One study investigated actual versus reported time spent on tooth brushing and discovered that while the self-reported time spent on brushing ranged from 134-148 seconds the actual mean time spent ranged from 72-83 seconds, only slightly more than half the recommended time of 2 minutes.[16] Research investigating the utilization of smartphone video “selfies” to monitor toothbrushing behaviors found that both the quality and quantity of brushing behavior was found to be inadequate. It was found that the time spent brushing was approximately 65 seconds, the angulation of the brush strokes was not in compliance with the recommended 45 degrees into the gum line known as the modified Bass technique, and several areas of the mouth were neglected altogether, most notably the lingual surfaces of the maxillary and mandibular anterior segments.[3,13,14]

To be effective, oral hygiene education must sufficiently address the appropriate time, frequency, and technique. Oral hygiene education in video format serves several advantages over verbal or written communication alone. Video allows you to present more information in a given amount of space and time, simplify complex concepts, demonstrate concepts that are in motion, and be more effective at keeping a patient's attention.[11] One study of teaching methods demonstrated that verbal instruction alone, visual instruction alone, and combined verbal and visual instruction all resulted in at least 70% recall at three hours. However, three days later, retention was 10% for verbal, and 20% for visual, versus 65% for combined verbal and visual instruction.[7] For these reasons, an animated video was chosen as the means of instruction for this study.

In addition to procedural knowledge, it is known that oral hygiene requires a significant commitment on the part of the patient to routinely carry out the prescribed techniques required to achieve and maintain a healthy oral environment. One study that monitored tooth brushing technique while the subjects were video recorded through a mirror, it was found that a significant number of participants failed to properly demonstrate proper technique despite having seemingly sufficient motivation, skill, and knowledge.[17] Five theories are most frequently associated with oral health summarized in the following table.[9]

Table 1: Summary of Health Behavior Theories

Model	Model Summary	Limitations
Health Belief Model (HBM)	Individuals with better information make better health decisions.	Information alone is usually not enough to change health behaviors.
Transtheoretical Model and Stages of Change	Individuals move along a predictable continuum of change, and each step has distinct characteristics.	No studies focusing on oral health. Questionable effectiveness of health programs based on this model.
Theory of Reasoned Action	The most important determinant of behavior is *the intention* and is based on 1. belief about what significant others think 2. personal motivation to comply with those significant people.	Extraneous factors such as fatigue or change in environment, may quickly change intentions and therefore change behavior outcomes.
Locus of Control (LOC)	An individual may have: 1: Internal LOC: Their actions determine their health status. 2: External LOC: Belief that others are in control of health decisions and health status. Sources may be God, fate, chance, or powerful others such as a dental professional.	LOC scales need to be tailored to measure specific conditions, however, it is predictive for children's dental health. Children with mothers who have an external LOC were at higher risk for developing caries.
Self-Efficacy	Based on the Social Cognitive Theory. Individuals do not learn or change behavior in a linear fashion. Changes are bidirectional and environment, information and behavior all affect one another. Individuals with high self-efficacy believe their actions will affect the outcome.	Very few. Self-efficacy has been an accurate predictor of oral health in both cross-sectional and longitudinal studies.

Self-efficacy is perceiving control over actions that will affect an outcome which differs from other theories in that it is domain-specific, as to say that a person can have high expectations that oral health is attainable through proper oral hygiene and professional care while simultaneously having low self-efficacy in other areas of health.[9] Given the effectiveness of the Self-Efficacy behavioral model on predicting behavioral change, an objective of this study is to include self-efficacious messaging into the instructional video with the hypothesis this form instruction will show statistically significant improvements in retention of the oral hygiene instruction as well as self-reported changes in hygiene behavior. The overall objective of this study is to investigate the utilization of an animated oral hygiene instructional video that provides a detailed instructional component of current brushing and flossing techniques in addition to a motivational component aimed to act as a catalyst for hygiene behavior change.

Although service members are required to receive a dental exam on an annual basis to screen for potential dental problems, the modality of how members receive oral hygiene instruction (OHI) is not standardized, and at present is typically provided verbally or having the patient read from an instruction sheet. It is also unknown if this current methodology of providing OHI is effective at increasing the service member's ability to conceptualize and retain the instruction. Furthermore, the current OHI modality does not provide any form of messaging to boost patient self-efficacy. The aim of this study is to test the hypothesis that the use of an animated oral hygiene instructional video tailored to the military service member will prove to be more effective at delivering OHI and will promote reported hygiene behavioral change when compared to the current standard of care.

CHAPTER 2: Materials and methods

Study subjects will be recruited from Primary Care Dentistry Department, Walter Reed National Military Medical Hospital, Bethesda, Maryland. Patients who are presenting for annual dental exams will be asked if they would like to volunteer to take part in a study which involves receiving one of three forms of Oral Hygiene Instruction and a questionnaire; one given before the OHI is administered and another after approximately two weeks.

Subjects will be given a study overview document, informed consent, and baseline dental knowledge questionnaire to be completed in the waiting room while they wait for the routine exam. The baseline knowledge questionnaire consists of 35 questions. 25 multiple choice dental knowledge-based questions were developed based on a standard BUMED instruction which describes the cause of dental caries, periodontal disease, and common risk factors. (Appendix B) Ten behavioral base questions were formulated with the aid of the Naval Postgraduate Dental School Psychology department to assess the subjects' confidence level with key elements of oral hygiene and willingness to increase hygiene practices. This portion of the questionnaire utilizes a Likert Scale where subjects will choose the level of agreement to a hygiene based behavioral statement on a linear scale from strongly disagree to strongly agree. (Appendix C)

Subjects will be assigned a study identification number and their phone number and email address will be collected. Subjects will be emailed a link to complete the baseline dental knowledge questionnaire via Max.gov survey tool. Subjects will be asked to complete the questionnaire while waiting to be seen for their dental exam. Subjects will be randomly assigned into one of three categories: control, experimental alpha, and

experimental bravo. 30 subjects will be recruited in each of three groups for a total of 90 subjects which provide adequate power for statistical analysis. After completing the questionnaire, subjects will have their routine dental exam carried out by various staff providers in the PCD department with the only difference being the form of OHI provided.

The control group will receive a one-page written OHI, specifically the Bureau of Medicine Instruction 6600.16A "How to reduce your risk of tooth decay."

Experimental group alpha will be shown an animated OHI video which was built from the written instruction and contains the same information. A quick response code will be provided which allow subjects to view the video directly from their smart phone.

Experimental group bravo will be shown the same animated OHI video as group alpha, and additionally will receive a daily dental fun fact in the form of a text message for a period of two weeks. Text messaging will be carried out with the aid of an automated group text messaging service called DialMyCalls, which enables the principal investigator to send out a daily dental fun fact to the entire experimental group bravo simultaneously, and in an anonymous fashion without the recipients of the text messages being able to access the other participants identity or telephone number. Only the lead investigator will have access to add or delete telephone numbers of participants to the DialMyCalls program, and no information is stored by the program after the phone numbers are deleted from the program at the conclusion of this study. This methodology is utilized to maximize safeguarding subjects' identity and personal telephone numbers.

At the conclusion of the study, approximately 14 days after initial recruitment, all participants will again be emailed a link to the Max.gov questionnaire. Questionnaire data will be recorded utilizing Microsoft Excel spreadsheet, "master data sheet" (APPENDIX

H). The proportion of correct to incorrect answers from the baseline and post experimental questionnaire will be analyzed using the non-parametric Mann Whitney U test. All study subjects will be provided their individual questionnaire results upon request. Subject phone number will be removed from DialMyCalls, and no further text or email communication will be conducted.

CHAPTER 3: Results

The video production was carried out in three phases over a 12-month period. The first phase involved the creation of storyboard (APPENDIX E) which outlined the basic character animations, setting, and specific tooth brushing and flossing motions to be depicted in three dimensions. Phase two consisted of writing the script to ensure that the same quantity and quality of information was given as compared to the written instruction. Phase three involved the recruitment of the Naval Medicine Leadership & Professional Development Center (NML&PDC) Visual Informatics Department to animate the storyboard and provide voice talent.

Two- and three-dimensional animations in combination with motion graphics to display on-screen information was carried out using Adobe Character Animator, Illustrator, Audition, Premier, Photoshop, Capture, and Autodesk Maya software. Video creation and voice over acting was carried out over a four-month period. Afterwards the video was uploaded to YouTube after being approved by the NML&PDC Public Affairs Office. A quick reference (QR) code was assigned to the video to allow subjects the option to scan the QR code from any smart device.

Dental knowledge questionnaire was developed using the BUMEDINST 6600.16A. 25 multiple choice and true-false questions were formulated to assess the subjects' knowledge of the etiology of dental disease, factors that contribute to the disease, and knowledge of proper hygiene techniques. (APPENDIX B) Likert Scale was used to frame ten behavioral assessment questions which were developed to survey the subjects' understanding of the causative factors of oral disease, confidence in hygiene ability, and willingness to change or increase positive hygiene practices.

Both pre-experiment and post-experiment questionnaires will be administered to subjects using a unique link that is sent directly to the subjects' email from a secure survey tool (MAX.gov survey). This survey tool allows for the tracking of individual subjects' response to each question.

Correct answers from the multiple-choice portion of the questionnaire as well as the sum of the numerical responses to the behavioral questions were logged via a Microsoft Excel spreadsheet "master data sheet" (APPENDIX H). Baseline scores will be compared to post experimental scores using non-parametric Mann-Whitney U test.

Text messaging services will be carried out using a third-party provider (DialMyCalls.com). This service allows the principal investigator (PI) to enter the cell phone numbers of the subjects and send text messages to the entire experimental group simultaneously. Recipients will remain anonymous to other members who are also receiving the text message. All phone numbers are password protected and directly controlled by the PI. This service is protected by 256-bit SSL encryption.

CHAPTER 4: Discussion

It has been shown that an educational video allows for a greater quantity of information to be passed in a given amount of time and can act to simplify complex concepts.[7,11] An animated video was chosen for this study because dental hygiene instruction, specifically tooth brushing and flossing, is based on specific motions and angulations of the toothbrush, which is very difficult to explain in a written form as well as to capture with live action video with a real person. Historically live action dental education for dentists and dental hygienists is carried out on plastic models of teeth and gums. For the general population who are not educated in the anatomy and structural relationship between tooth and gingival tissue, it can be difficult to understand how to correctly brush and floss. For example, when asked to demonstrate flossing technique, many patients extend the floss between two teeth just below the contact point before it is removed. This incorrect technique may dislodge the large piece of food, however it does not address the plaque and calculus that reside on the tooth and root surface below the gum line which are primarily responsible for causing caries and periodontal disease. The use of an animated video allows for a clear demonstration of proper toothbrush movement and angulation, as well as, flossing technique in two and three dimensions without impediments such as the tongue, lips, and cheeks.

An animated hygiene video is also beneficial to large training commands where tens of thousands of young recruits from various backgrounds and education levels start their military careers. Recruits can view the animated hygiene video in large groups which efficiently provides standardized education while lessening the burden on the dental clinic

staff. Animated format might also appeal more to the majority of recruits, who are under the age of 30.

Compared to phone calls or email, text messaging has been shown to be one of the most reliable and preferred forms of communication. One study reported that 99% of text messages are opened by the recipient, and 90% are read within three minutes.[21] Leveraging text messaging as a means of behavioral intervention to increase oral hygiene behaviors has not be studied, however there is a body of literature that supports other health related behavioral interventions. These studies indicate that text messages are shown to have a small but positive effect on health behaviors.[21] In our study, instead of using instructive text messages to remind or encourage the subjects to brush or floss their teeth, we intentionally chose to use friendly and non-invasive dental "fun" facts. It is thought that this form of gentle nudging will act as a cue to promote healthier hygiene behaviors. If this form of intervention is successful in promoting desired hygiene behaviors over the course of a two-week period, it is believed this could also help to form sustainable hygiene habits for the subject resulting in better health outcomes.

The small sample size of 30 subjects per group is a limitation of this study, however it will provide enough statistical power to indicate whether further research is warranted. All subjects will be recruited from the NML&PDC Primary Care Dental Department which provides dental services to the service members who currently work in the hospital. The large majority of these patients are highly educated and work in the medical field as healthcare providers, nurses, and medical technicians. Oftentimes, they already have a higher level of baseline dental knowledge than service members who do not work in the healthcare industry. Another limitation of this study is that the behavioral assessment is

self-reported and in part subjective in nature. It does not measure quantifiable behavioral change. Therefore, this study is unable to definitively conclude if long term hygiene change is achievable though an animated hygiene video with or without the addition of short-term text message interventions. This may be an area of study for future research projects.

CHAPTER 5: Conclusions

This study is awaiting the final approval of the NML&PDC Institutional Review Board. The first phase including, study design, video production, text messaging logistics, and knowledge assessment was completed in this multi-year project. Phase 2 includes recruitment and survey distribution and will be conducted from Mid-2021 to Mid-2023. Phase 3 includes analysis and publication and will be performed during the second half of the 2023. The results of the study may serve as the basis for how hygiene instruction is delivered throughout the DoD.

APPENDIX A

BUMEDINST 6600.16A
23 Aug 2010

HOW TO REDUCE YOUR RISK OF TOOTH DECAY

Tooth decay ("dental caries") is a complex disease process, caused by bacteria, and mediated by other important factors. Nearly everyone has the bacterium (mutans streptococci) that causes tooth decay. The two primary factors that influence the ability of these bacteria to cause tooth decay are diet and exposure to fluoride. There are some important things you can do to reduce the ability of these bacteria to cause cavities:

1. **Reduce the number of times per day that you eat refined carbohydrates ("sugars").** People who have more than three to five exposures to sugars per day tend to develop a greater number of cavities. What are exposures? They are "eating occasions" separated by at least 20 minutes. For example, a bowl of Frosted Flakes at 0900, followed immediately by a handful of M&Ms is considered *one* exposure; a bowl of Frosted Flakes at 0900, followed by the M&Ms at 0920 or 0930 is considered *two* exposures. Why 20 minutes? Because, whenever you eat, the bacteria in your mouth eat too; they metabolize refined carbohydrate to acid, and it takes about 20 minutes for the acid to clear from your mouth. The more frequently this acid is produced, the more likely it becomes that you will develop tooth decay. So, don't keep soda (there are 12 teaspoons of sugar per can) or coffee with sugar on your desk and sip on it throughout the day – this provides the bacteria with a continual supply of sugar!

   Sweets aren't the only foods that promote acid formation and tooth decay. Many foods that people generally consider "healthy" – fruit juices, sports drinks, and dried fruit (like raisins) – contain high levels of refined carbohydrates. So do snack foods such as potato chips, pretzels, and crackers (even saltines). Diet sodas, although they contain artificial sweeteners, can be harmful because they contain phosphoric acid. On the other hand, fresh fruits and many cheeses do not promote tooth decay. You cannot and should not eliminate all carbohydrate from your daily diet. Instead, try to reduce your number of between meal snacks and limit your refined carbohydrate intake to mealtimes.

2. **Brush your teeth three times a day with fluoride toothpaste.** Fluoride helps make your teeth more resistant to the decay process. Whenever possible, brush immediately after meals and snacks. This removes food particles and helps clear the bacterial acids more quickly. Incidentally, contrary to popular belief, rinsing with water after meals has very little effect on bacterial acids, although it may help clear food debris. For maximum benefit, your teeth need frequent exposure to fluoride – brush for at least 2 minutes, three times each day. Always use a soft toothbrush and floss your teeth at least once each day.

3. **Use a fluoride mouth rinse at bedtime.** While you're asleep, your salivary flow diminishes, leaving your teeth less protected from bacterial acids. This is the most beneficial time of day to expose your teeth to fluoride. So, just before you go to bed, after you've brushed and flossed, rinse with a 0.05% sodium fluoride rinse (Act® and Fluoriguard® are examples – available in supermarkets, drug stores, etc.), and then don't have anything else to eat or drink. This gives your teeth a "boost" of fluoride protection.

4. **Chew sugarless gum.** Chewing sugarless gum increases your salivary flow, which helps to neutralize and clear bacterial acids. If you chew gum, use a sugarless gum such as Trident®, Extra®, or Carefree® since the bacteria in your mouth generally cannot metabolize "non-sugar" sweeteners.

Enclosure (7)

APPENDIX B

Please select the best answer to the following questions.

1: Dental Caries (Cavities) is considered a:
a) Fungal infection
b) Bacterial infection
c) Viral infection
d) Not an infectious disease
e) I don't know

2: Fluoride is added to drinking water and tooth paste because:
a) It makes your teeth more resistant to acid attack.
b) It kills harmful microorganisms that cause decay.
c) It decreases the amount of saliva in your mouth.
d) It acts as a lubricant so food is less likely to stick to your teeth.
e) I don't know.

3: Harmful microorganisms that cause tooth decay are present in our mouths at all times. Proper oral hygiene and diet help prevent these microbes from causing irreversible tooth decay.
a) True
b) False
c) I don't know

4: Cavity causing microorganisms contribute to tooth decay by consuming _____ in food and beverages and excrete _____, which demineralize tooth structure leading to tooth decay.
a) Protein, acids
b) Sugars, protein
c) Fats, sugars
d) Sugars, acids
e) I don't know

5: Dental professionals recommend daily flossing to help prevent tooth decay and gum disease. Flossing works by:
a) Removing food and plaque from between the teeth.
b) Altering the physical environment of the gum tissues below the level of the teeth.
c) Stimulates the gum tissue between teeth to help prevent inflammation, which contributes to gum disease.
d) All answers are correct.
e) I don't know

6: Snacks that are low in carbohydrates are less likely to cause dental cavities.
a) True
b) False
c) I don't know

7: Stimulating saliva flow protects your teeth.
a) True
b) False

c) I don't know

8: Microorganisms that cause dental cavities can be spread from mother to child through contact with the mother's saliva by sharing food or kissing.
a) True
b) False
c) I don't know

9: Dry mouth, a side effect of many medications and chronic diseases, is a factor in developing dental cavities.
a) True
b) False
c) I don't know

10: Carbonated beverages that do not contain sugar (like Diet Coke) have no effect on teeth.
a) True
b) False
c) I don't know

11: Which of the following does not cause dental cavities?
a) Table sugar
b) Fruit juice
c) Yogurt
d) Corn syrup
e) I don't know

12: Dental cavities usually grow beneath the surface of the teeth before becoming a hole on the surface.
a) True
b) False
c) I don't know

13: Which of the following practices most increases your risk of getting dental cavities?
a) Slowly sipping from a sugary soft drink all afternoon
b) Drinking a sugary soft drink at a meal
c) Both practices are equally risky
d) I don't know

14: Drinking tap water containing _____ may protect your teeth from getting dental cavities.
a) Fluoride
b) Iron
c) Vitamin C
d) Vitamin D
e) I don't know

15: Tooth brushing reduces dental cavities by breaking up plaque above the gum line.
a) True
b) False
c) I don't know

16: Gum disease may be more severe in people with poor nutrition.

a) True
b) False
c) I don't know

17: Smokeless tobacco has no effect on gum disease or dental cavities.
a) True
b) False
c) I don't know

18: Smoking may lead to oral cancer but not gum disease.
a) True
b) False
c) I don't know

19: If you develop periodontal disease you will also have tooth decay. The causative microorganisms are the same.
a) True
b) False
c) I don't know

20: If flossing makes your gums bleed, you should not floss.
a) True
b) False
c) I don't know

21: Flossing controls gum disease by breaking up plaque below the gum line.
a) True
b) False
c) I don't know

22: Tooth brushing with more force is a good practice because it leaves the teeth cleaner.
a) True
b) False
c) I don't know

23: Stress may contribute to dental disease and mouth sores.
a) True
b) False
c) I don't know

24: Proper tooth brushing consists of back and forth, and up and down motions of the bristles on the teeth.
a) True
b) False
c) I don't know

25: Chewing sugar free gum is a good way to clear food particles and stimulate saliva production which helps protect against cavities.
a) True
b) False
c) I don't know

APPENDIX C

Please select your level of agreement to each of the 10 statements below:

At this current point in time:	**Strongly Disagree**	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly Agree**
I have the ability to prevent cavities with my oral hygiene practices.	0	1	2	3	4
I have the ability to prevent gum disease and with my current oral hygiene practices.	0	1	2	3	4
I am confident that I know what causes dental cavities.	0	1	2	3	4
I am confident that I know how to prevent dental cavities.	0	1	2	3	4
I am confident that I know what causes gingivitis and periodontal disease.	0	1	2	3	4
I am confident that I know how to prevent gingivitis and periodontal disease.	0	1	2	3	4
I am confident that I know the technique and frequency of proper tooth brushing.	0	1	2	3	4
I am confident that I know the technique and frequency of proper flossing.	0	1	2	3	4
I plan to increase the duration and or frequency of tooth brushing.	0	1	2	3	4
I plan to increase the duration and or frequency of flossing.	0	1	2	3	4

At conclusion of experimental trial:

1. If you received oral hygiene video, please provide feedback (effectiveness, instructional quality, content, method of instruction, etc.)

_____
_____
_____
_____
_____
_____
_____

2. If you received oral hygiene video with text messages, please provide feedback (effectiveness, instructional quality, content, method of instruction, etc.)

_____
_____
_____
_____
_____
_____
_____

APPENDIX D

1. The average amount of money left by the tooth fairy in 1950 was 25 cents. In 1988 it was $1.00, the going rate now is $2.00.
2. The earliest dentist known by name is Hesi-Re. He lived in Egypt over 5,000 years ago.
3. George Washington never had wooden teeth. His dentures were made from gold, hippopotamus tusk, elephant ivory and human teeth.
4. In 1986, the winner of the National Spelling Bee won by spelling ODONTALGIA (which means toothache)
5. The average American spends 38.5 total days brushing their teeth over a lifetime.
6. People who drink 3 or more glasses of soda each day have 62% more tooth decay, fillings and tooth loss than others. Put down the pop and sports drinks and pick up some nice fresh water instead.
7. Tooth enamel is the hardest substance in the human body. However, we do not recommend that you use your pearly whites to open bottle caps!
8. If you don’t floss, you miss cleaning 40% of your tooth surfaces. Make sure you brush and floss twice a day!
9. If you're right handed, you will chew your food on your right side. If you're left handed, you will tend to chew your food on your left side.
10. Every year, kids in North America spend close to half a million dollars on chewing gum.
11. More people use blue toothbrushes than red ones.
12. Like fingerprints, everyone's tongue print is different

13. The average woman smiles 62 times a day. The average man smiles about 8 times a day.
14. Kids laugh around 400 times a day, adults just 15 times a day.
15. Giraffes only have bottom teeth.
16. Just like finger prints, tooth prints are unique to each individual.
17. The average person only brushes for 45 to 70 seconds a day, the recommended amount of time is 2-3 minutes.
18. 78% of Americans have had at least 1 cavity by age 17.
19. 1882 was the year commercial floss was first manufactured.
20. The most valuable tooth belonged to Sir Isaac Newton. In 1816 one of his teeth was sold in London for $3,633, or in today's terms $35,700. The tooth was set in a ring!
21. More than 300 types of bacteria make up dental plaque.
22. Dogs have 42 teeth, cats have 30 teeth, pigs have 44 teeth, and an armadillo has 104 teeth.
23. A snail's mouth is no larger than the head of a pin, but it can have over 25,000 teeth!
24. The elephant grinds its molars and grows new ones. This happens six times in a lifetime! An elephant's molar is about 7 inches square and can weigh over 6 pounds
25. The Blue Whale is the largest mammal on earth, but it eats only tiny shrimp because it has no teeth.
26. The Crocodile Bird flies into the open mouth of a crocodile and cleans the crocodile's teeth!
27. There are 10-12 teaspoons of sugar in a single can of soda.

28. Mosquitos have twice as many teeth as humans. The average adult human has 32 teeth.
29. The average human produces 25,000 quarts of saliva in their lifetime — enough to fill two swimming pools.
30. The number one chronic child disease is tooth decay; it's 5 times more common than asthma and 7 times more common than hay fever.
31. Although teeth and bones look the same color and are hard, teeth aren't bones.

APPENDIX E

Looks good, but there are a few things we should discuss

StoryboardThat

- Dental Professional reviews findings of dental exam and starts conversation.

APPENDIX F

APPENDIX G

Front desk staff: The success of United States military operations is largely accredited to the ability to assess and deploy needed assets to quickly respond to an evolving situation. This requires individual service members to remain in a constant state of readiness including physical, medical, and dental readiness. A service member who experiences an unexpected dental emergency will not be able to continue to perform their job, which can jeopardize mission success.

Service member: Hello, I'm here for my dental exam.

Front desk staff: Hi, Sure we can help with that.

Dentist: Overall things are looking pretty good, but there are some areas of concern.

Service member: Yeah, I thought there might be some issues, and I do have some questions.

Service member: So, I know dental problems run in my family. Did I inherit weak teeth from my relatives?

Dentist: No, not at all! You have control over many of the risk factors that contribute to oral diseases such as cavities and gingivitis. Also, with advancements in dentistry, we now have better methods and materials to keep your smile healthy and beautiful for a lifetime.

Service member: So how do I know if there are problems with my teeth or gums? If they do not hurt then they must be fine, right?

Dentist: We get that question a lot around here. We use x-rays, bright lights, and magnification

to catch small problems and fix them. If you start to have pain or notice changes in your mouth it is best to come in and get it checked out early. Don't put it off.

Service member: Ok so what can I do to prevent these issues?

Dentist: Glad you asked! Let's review the basics.

Dentist: Ok so the bacteria found in our mouths eat sugars from foods and sugar containing drinks. They convert these sugars into acids, which melt away the outer surface of teeth. Over time this process is repeated and results in a hole in the tooth- this is known as a cavity. The tooth will need a filling in order to prevent further breakdown, pain, and eventually even death of the tooth.

Roughly 20 minutes is required for our bodies to neutralize these harmful acids from the mouth after eating food/beverages with sugars or fermentable carbohydrates. These are found in more than just sweets and candy, but also most fruits, potatoes, corn products, bread, pasta, rice, cereal, and even chips and pretzels. Keep in mind that beverages that contain artificial sweeteners, for example a diet soda, can still harm tooth enamel due to the high levels of acid. There are some foods that have a protective effect against cavities such as milk, cheese, and yogurt.

We know that people that have more than 3-5 exposures per day to sugars tend to get more cavities. The goal is to MINIMIZE the number of these exposures, NOT totally avoid them.

Service member: So, I don't have to totally change my diet to avoid cavities?

Dentist: No, just eat your meals over a short period of time and limit snacking. For example, don't slowly sip on sugary drink over the course of several hours. This could be 5-6 sugar exposures from one soda!

Dentist: That brings me to fluoride. Fluoride, can be found in everyday tap water, toothpaste, and many dental mouth rinses. It works to re-mineralize or strengthen the outer surface of the tooth. One easy step to ensure you are getting adequate fluoride is to be brush your teeth with a fluoride containing tooth paste.

Service Member: Interesting stuff doc! I thought you were just going to tell me I need to brush and floss more.

Dentist: Not necessarily more but we can help you improve your technique. Let's review the basics. Ok: So, brushing should last for 2 minutes, consisting of 30 seconds per quadrant of the mouth. You should brush in the morning after breakfast and again before you go to bed. Preferably 3 times per day if you have had any dental cavities within the past 3 years.

Use a SOFT bristled tooth brush at an angle pointed toward the gum tissues and brush in GENTLE circular motion. Brushing alone is not enough to prevent tooth decay and gum disease, flossing must also be performed.

Dentist: It is very important that the floss is extended BELOW the surface of the gums. In most cases if you correctly floss a site you will actually be able to see chalky white plaque or food particles on the floss when it is removed. Don't worry if there is a little bleeding or pain when you first start. This is a sign that the gums are infected, and this should clear up

in about week or two of daily flossing. Interproximal brushes, floss picks, and pressurized water flosser are all good adjuncts to daily flossing routine.

Dentist: We need to floss daily because the bacteria that causes gum disease is *different* than the cavity causing bacteria, but similar to cavity causing bacteria in that it is *considered infectious* and is easily *transmittable*. These bacteria can cause gum disease, bad breath, and in some cases bone loss which over time can lead to early tooth loss. Smoking, vaping, or chewing also contribute to gum disease and early tooth loss and significantly increase the risk for developing mouth, throat, and lung cancers.

Dentist: Don't worry we are here to help you along the way. You can prevent most dental problems with 10 minutes of dental hygiene a day - and save yourself a lot of costly and time-consuming dental procedures over the years.

Service member: Hey Doc this was really good, thank you for explaining all this to me!

APPENDIX H

Count		Subject Phone #	Email Address	Group (1,2,3)	PreT K- 1	PreT K- 2	PreT K- 3	PreT K- 4	PreT K- 5	PreT K- 6	PreT K- 7	PreT K- 8	PreT K- 9	PreT K- 10	PreT K- 11	PreT K- 12	PreT K- 13	PreT K- 14	PreT K- 15	PreT K- 16	PreT K- 17	PreT K- 18	PreT K- 19	PreT K- 20	PreT K- 21	PreT K- 22	PreT K- 23	PreT K- 24	PreT K- 25	Pre-test # Correct	PreT B-1	PreT B-2	PreT B-3	PreT B-4	PreT B-5	PreT B-6	PreT B-7	PreT B-8	PreT B-9	PreT B- 10	Oral Hygiene Behavior Total
1	*EXAMPLE*	*#########*	*test@gmail .com*	*3*	*1*	*1*	*0*	*1*	*1*	*1*	*1*	*0*	*1*	*0*	*1*	*1*	*0*	*1*	*1*	*0*	*1*	*0*	*1*	*0*	*0*	*1*	*1*	*1*	*0*	*15*	*3*	*3*	*3*	*2*	*3*	*4*	*4*	*5*	*1*	*2*	*27*
2	2102			2																									0											0
3	2103			2																									0											0
4	2104			2																									0											0
5	2105			2																									0											0
6	2106			1																									0											0
7	2107			3																									0											0
8	2108			2																									0											0
9	2109			3																									0											0
10	2110			1																									0											0
11	2111			1																									0											0
12	2112			3																									0											0
13	2113			1																									0											0
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30	2130			3																									0											0
31	2131			2																									0											0
32	2132			1																									0											0
33	2133			2																									0											0

REFERENCES

1. Alcouffe F. Improvement of oral hygiene habits: a psychological approach. 2-year data. J Clin Periodontol 1988;15(10):617-20.

2. Astroth DB, Cross-Poline GN, Stach DJ, Tilliss TS, Annan SD. The transtheoretical model: an approach to behavioral change. J Dent Hyg 2002;76(4):286-95.

3. Ausenda F, Jeong N, Arsenault P, et al. The Effect of the Bass Intrasulcular Toothbrushing Technique on the Reduction of Gingival Inflammation: A Randomized Clinical Trial. J Evid Based Dent Pract 2019;19(2):106-14.

4. Brauner MK, Jackson T, Gayton E. Medical Readiness of the Reserve Component. Rand Health Q 2012;2(2):7.

5. Calley KH, Rogo E, Miller DL, Hess G, Eisenhauer L. A proposed client self-care commitment model. J Dent Hyg 2000;74(1):24-35.

6. Croffoot C, Krust Bray K, Black MA, Koerber A. Evaluating the effects of coaching to improve motivational interviewing skills of dental hygiene students. J Dent Hyg 2010;84(2):57-64.

7. Dwyer FM. Strategies for Improving Visual Learning. 1978; Learning Services 1-20.

8. Gillam DG, Yusuf H. Brief Motivational Interviewing in Dental Practice. Dent J (Basel) 2019;7(2).

9. Hollister MC, Anema MG. Health behavior models and oral health: a review. J Dent Hyg 2004;78(3):6.

10. Horowitz LG. Dental patient education: self-care to healthy human development. Patient Educ Couns 1990;15(1):65-71.

11. Hurtubise L, Martin B, Gilliland A, Mahan J. To play or not to play: leveraging video in medical education. J Grad Med Educ 2013;5(1):13-8.

12. Kumar PS, Doshi D, Kulkarni S, et al. Effect of motivation on oral hygiene and caries status among young adults in Hyderabad City. Indian J Dent Res 2019;30(1):15-20.

13. Madan Kumar PD, Mohandoss AA, Walls T, Rooban T, Vernon LT. Using smartphone video "selfies" to monitor change in toothbrushing behavior after a brief intervention: A pilot study. Indian J Dent Res 2016;27(3):268-77.

14. NICE. Oral health promotion: general dental practice. 2015.

15. Ostberg AL, Abrahamsson KH. Oral health locus of control in a Swedish adolescent population. Acta Odontol Scand 2013;71(1):249-55.

16. Saxer UP, Barbakow J, Yankell SL. New studies on estimated and actual toothbrushing times and dentifrice use. J Clin Dent 1998;9(2):49-51.

17. Schlueter N, Klimek J, Saleschke G, Ganss C. Adoption of a toothbrushing technique: a controlled, randomised clinical trial. Clin Oral Investig 2010;14(1):99-106.

18. Simecek JW, Colthirst P, Wojcik BE, et al. The incidence of dental disease nonbattle injuries in deployed U.S. Army personnel. Mil Med 2014;179(6):666-73.

19. Singh A. Oral health knowledge, attitude and practice among NCC Navy Cadets and their correlation with oral hygiene in south India. Oral Health Prev Dent 2009;7(4):363-7.

20. Sniehotta FF, Araujo Soares V, Dombrowski SU. Randomized controlled trial of a one-minute intervention changing oral self-care behavior. J Dent Res 2007;86(7):641-5.

21. Suffoletto B. Text Message Behavioral Interventions: From Here to Where? Curr Opin Psychol 2016;9:16-21.

22. Thavarajah R, Kumar M, Mohandoss AA, Vernon LT. Drilling Deeper into tooth brushing skills: Is proactive interference an under-recognized factor in oral hygiene behavior change? Curr Oral Health Rep 2015;2(3):123-28.

23. Tillis TS, Stach DJ, Cross-Poline GN, et al. The transtheoretical model applied to an oral self-care behavioral change: development and testing of instruments for stages of change and decisional balance. J Dent Hyg 2003;77(1):16-25.

24. Williams KB, Gadbury-Amyot CC, Bray KK, Manne D, Collins P. Oral health-related quality of life: a model for dental hygiene. J Dent Hyg 1998;72(2):19-26.