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ASSESSMENT OF THE COMMON DENTAL NEEDS AND EVALUATION OF RATE OF ATTENDANCE POST EMERGENCY DENTAL MANAGEMENT AMONG THE HOMELESS POPULATION IN HOUSTON, TEXAS

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By

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DEDICATION

To my parents Malarvathine and Venguidesvarane, my sister Akila, my niece Thiya and my beloved brother Pebble.

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BDS, Pondicherry University, 2015

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Abstract:

Background: Dental care resources for the homeless population are scarce, underfunded and generally inadequate to meet their oral health needs. While poor oral health is clearly an added burden for people who struggle daily to survive under miserable living conditions, little is known about their views on dental health, their perceived needs and their attitudes towards dental care. The purpose of this study was to determine the most common oral health needs of homeless patients and to identify their participation in receiving comprehensive care.

Methods: The study was a cross sectional analysis where data were collected retrospectively using the records of patients who visited the dental clinic at Healthcare for Homeless for the first time from August 31st, 2017 to August 31st, 2018. Information on their chief complaint, pattern of visits, emergency management, smoking history and mental health history were recorded. Oral hygiene status and dental caries status were summarized using the Periodontal

Index and Decayed, Missing and Filled Teeth Index, respectively. Statistical analyses were conducted to estimate the common dental needs and their oral health status.

Results: The sample included 352 patients with a mean age of 43.2 (SD+- 17.6) with 38.6% women and 61.1% men. The majority of patients were African Americans (51.7%) followed by Caucasians (26.4%). About 49.4% were current smokers and 49% had diagnosed psychotic diseases. The most common dental need identified in this cohort was pain (38.1%) followed by routine care (23.6%). Other needs identified were cavities, broken teeth, missing teeth and cleaning. About 71% of the patients discontinued treatment after their initial visit. Analyzing the stages at which the treatment was discontinued, we found that 38% discontinued treatment with initial visit and 12% with emergency management. Univariate and multivariate analysis of treatment stages with continued participation resulted in a significant association with the patients receiving care at the outreach clinics and patients discontinuing treatment in between procedures. Further analyses were conducted to assess the association between periodontal health and the dental caries status and conducted t-test with 95% CI ($p<0.001$) which showed statistically significant associations between the two diseases. A linear regression model reported individuals who discontinued treatment had higher prevalence of dental caries. There were no significant associations for the predictors in periodontal assessment.

Conclusion: This study identifies and informs the oral health needs common to the homeless population. Identification of levels of detachment from comprehensive treatment is unique to this study. This could facilitate further research to identify the barriers and propose an intervention model to improve the oral health in the homeless community.

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BACKGROUND

How aware are we about oral health in the general population? Is it just a routine with which we start and end our day? If about 50% of the adult population with no financial barriers in the United States have untreated dental caries[1], how aware are individuals with limited or no resources about their oral health? To answer these questions, it is necessary to understand their dental needs and their participation in receiving comprehensive dental care.

Definitions:

Homelessness is a state of living with many contributing and interwoven causes such as poverty, mental illness, substance abuse, chronic illness, unemployment, low wages, family crisis and lack of affordable living[2]. The homeless community in the United States is one of the most diverse populations and continues to increase in number. The National Health Care for the Homeless Council recognizes more than one official definition of Homelessness. The health centers funded by the U.S Department of Health and Human services (HHS) defines an homeless person as "an individual who lacks housing (without regard to whether the individual is a member of a family), including an individual whose primary residence during the night is a supervised public or private facility (e.g., shelters) that provides temporary living accommodations, and an individual who is a resident in transitional housing[3]."

The World health Organization defines Oral health as "a state of being free from chronic mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease,

tooth decay, tooth loss and other diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking and psychosocial wellbeing[4]."

Literature Review

There have been few studies conducted specifically on oral health needs and access to dental care of the homeless, especially in Texas. Various studies conducted in different geographical locations have demonstrated dental insurance, ignorance, access to dental care and lack of awareness are the most commonly associated factors with reported lower utilization of dental care. Among these, access to health care has been recognized as one of the fundamental challenges faced by homeless populations in North America[5]. While a study conducted among Canadian homeless reported dental caries and oral hygiene to be the most common needs among these individuals, research on their attitudes on emergency and comprehensive dental care is less well known[6]

A review conducted by King et al. in 2003, reported that it is necessary to provide guidance for those interested in providing care to this select population as they are more transient and volatile in nature[14]. The Southwest border of the United States exhibits the highest level of transboundary exchange of populations compared to other national boundaries. The characteristics and experiences of homeless Hispanics and non-Hispanics on the southwest border differ despite both groups being homeless[7]. This shows the varying ethnicities within the homeless community and the national impact of globalization and migration. As heavily populated and highly diverse as Houston is, there are only three functional dental clinics catering primarily to the oral health of the homeless.

A study conducted to assess the oral microbiome in health and disease demonstrated the difference in bacteria associated in causing oral diseases. They found that the group of bacteria causing dental caries did not cause periodontal or other gum diseases[8]. Studies have revealed that bad oral hygiene can harbor a wide range of microbiomes in the oral cavity that may contribute to dental caries as well as periodontal diseases[9]. A study conducted on the homeless adolescents and young adults concluded that about 50% of the study population failed to maintain their oral hygiene due to various barriers[10]. A direct relation between the two common oral diseases namely dental caries and periodontal diseases, which share a common behavioral etiology have not been established.

Scope of the problem:

National statistics reported by the U.S Department of Housing and Development reveals more than 610,000 people experiencing homelessness in the United States at any given time. It reports an increased prevalence of homelessness among urban cities with California accounting for one-fourth of the nation's total homeless population followed by New York, Florida, Texas and Georgia[11]. In Texas, 12 out of every 10,000 people are homeless with Houston having an estimated 1614 unsheltered individuals and 2529 sheltered individuals for a total of 4143 homeless individuals counted in Harris, Fort Bend and Montgomery counties at any given night in 2016. While the count in 2017 was about 3605, the devastating effects of hurricane Harvey resulted in a steep rise in homelessness in Houston[11].

Dental care resources for this population are scarce, underfunded and generally inadequate to meet their oral health needs. While poor oral health is clearly an added burden

for people who struggle daily to survive under miserable living conditions, little is known about their views on dental health, their perceived needs and their attitudes towards dental care. According to the 2018 Community Homelessness Assessment, Local Education and Networking groups (CHALENG) reports, dental care has remained third among the top five unmet needs among veterans who are homeless since 1997[12]. Research on the oral health needs and awareness among the individuals who are homeless and interventional policies and strategies to help address the needs are limited and less studied, especially in Texas[13].

Public Health Significance

This study aims to serve as a tool to improve the oral health of the homeless population by assessing their dental and oral health needs and their attitude towards accessing free dental services offered in the community. This study could potentially help community dental clinics recognize the most common dental needs of the patients to improve and expand the dental services in those areas. Further studies on designing and formulating interventional programs to adhere to the dental treatment regimen may be facilitated with the help of the outcomes of this study. Assessing the oral health care needs and implementing interventional programs may help these individuals with better oral-health related quality of life within United States and globally[14].

Hypothesis, Research Question, Specific Aims or Objectives

Oral and dental health are rarely recognized as essential or mandatory healthcare when compared to general health, especially among the homeless. The most common reasons for

emergency dental treatments include situations such as intense and constant pain, injury to the jaw and the associated structures, fractures and infections with evident swelling[15].

The perceived attitude and behavior of these individuals regarding comprehensive dental care including prevention and maintenance is unknown and understudied. The objectives of the study are as follows:

Aim 1: To determine the most common dental needs and evaluate the oral health awareness among the Homeless population: "recognizing the most common complaints the individuals had when they sought dental care for the first time at the dental clinic for homeless".

Aim 2: To analyze the pattern of subsequent visits in this population and differences in individuals that went on to access routine care at the clinic in comparison to those who only utilized the clinic on an emergency basis.

Aim 3: To identify an association between the oral hygiene status and caries prevalence in the population.

METHODS

Study Design

The project was a cross sectional study identifying the different dental needs, pattern of continual dental care and the prevalence of disease status focusing on dental caries and oral hygiene among the homeless

Study Setting

In order to accomplish the aims of the study, we used real-time patient information collected at the dental clinic called "Healthcare for the Homeless". This caters to the oral health needs of the Homeless population and is located in the inner-city of Houston. The clinic is funded by the Community health department of Baylor college of Medicine and also by donations and grants from various church groups. The clinic runs from Monday through Friday from 8.00 am to 5.00 pm and averages up to 30 patients per day.

Study Subjects

Participants in the study were individuals aged above 18 years and who sought care at the dental clinic at Healthcare for Homeless from August 31st, 2017 to August 31st, 2018. Besides the general rise in the homelessness, local and national surveys on their status reported that about 18% of the unsheltered homeless were on the street because of hurricane Harvey that hit the eastern coast of the United States on August 17, 2017 – September 2, 2017 and hence the time frame would be ideal for the study[16].

Sample Size Calculation:

Using the existing population of homelessness in the selected counties within and around urban Houston (4,143) and calculating the sample size for prevalence of dental needs in the population using a hypothesized percentage frequency of outcome factor of 50% and an absolute precision of 5% with confidence interval of 95%, a sample size of 352 individuals was selected to validate our findings in the given population.

(Formula used: Sample size ***n* = [DEFF*Np (1-p)]/ [(d^2/$Z^2_{1-\alpha/2}$*(N-1) +p*(1-p)]** where DEFF is the design effect of the sample, P is the anticipated % frequency, N is the total population size, d is the confidence limits as +/- percent of 100)

Data Collection

The data were collected retrospectively using medical and dental records of patients who visited the clinic for the first time from August 31st, 2017 to August 31st, 2018. Using a systematic random sampling method, every 3rd individual in the de-identified cohort was chosen to achieve a total sample size of 352 individuals who visited the clinic within the year. Caries status was recorded using the Decayed Missing Filled Teeth (DMFT) index and the oral hygiene status was calculated using the Periodontal Index (PI) to calculate the health of the supporting tissues.

Data Analysis:

Data analysis was done after the data was entered and verified from the existing de-identified patient records. Data entered was checked for outliers and coded for missing values. The research questions were analyzed using STATA15 software (College Station, Texas).

For Aim 1: Covariates like age, sex, ethnicity, past psychiatric conditions, smoking history were analyzed for median and frequency. Multiple statistical analyses were done with univariate descriptive analysis explaining the frequency and distribution of the various needs identified in relation to covariates like age, sex, ethnicity, past psychiatric condition and smoking history.

For Aim 2: To examine the research question, a descriptive analysis was conducted to identify the distribution of patterns of visits in the cohort. The clinic follows a step wise pattern in managing the high volume of patients visiting the clinic. We assessed each stage at which the patients discontinued treatment. The flow of events were: Patients visiting the clinic or patients visiting the outreach clinic (Beacon center outreach clinic) followed by visiting medical clinic to obtain thorough history, followed by either emergency management or first limited oral exam followed by second/third limited exam followed by full mouth examination followed by different dental procedures and ends with periodic oral exam for one year. Univariate analysis were conducted using chi square tests to compare the patients who discontinued treatment at the clinic with age, sex, ethnicity, past psychiatric history, smoking history, chief dental complaints, emergency management and the last clinical procedure underwent by the patients. A multivariate logistic regression analysis was constructed with the variables showing a univariable association (value <0.05) and the variables were tested for possible confounders to identify possible predictors for the lack of participation in comprehensive dental treatment by the homeless.

For Aim 3: Patients who had values for both the periodontal score and the caries scoring were included in this analysis. A total of 70 subjects were chosen and the Periodontal score and Decayed, Missing, filled teeth score were calculated. To check normality, a skewness and Kurtosis test were conducted and was plotted using histograms. On establishing normality, a two-sample t-test was conducted for variables with unequal variance to evaluate the hypothesis. The values of periodontal score were plotted against the DMFT score graphically to identify association between the two diseases. A linear regression model was constructed

for periodontal index and the caries index with age, sex, and ethnicity, chief dental complaint, smoking history and past psychiatric history as covariates. A multivariate logistic regression analysis was constructed with the variables showing a univariable association (value <0.05). The aim of this analysis was to determine if the association between dental caries status and periodontal health status was influenced by the aforementioned factors and to test for possible confounders.

Human Subjects, Animal Subjects, or Safety Considerations

Permission to review the medical and dental records was obtained from the University of Texas Health Science Center at Houston Institutional Review Board and the Committee of the Protection of Human Subjects by using de-identified patient information with a waiver for consent from the subjects (Appendix A). The Institutional Review Board of Healthcare for the Homeless clinic also granted permission to review records to obtain information (Appendix B)

RESULTS

A systematic random sampling was conducted on a total of 749 patients who visited the clinic in the chosen year. On choosing every third person in the sample, a total of 352 individuals were selected for the study. The analysis was conducted using STATA version 15. Sociodemographic characteristics of the study participants are presented in Table 1. The sample was predominantly composed of men (61.1%) and the age ranged from 18 to 83 years (mean=43.2). Most of the individuals were identified to be Black/African American (51.7%)

followed by White/Caucasians (26.4%). There were about 11.4% of individuals who were not wished to be identified. The smoking history reported about 49.4% to be of current smokers. The past diagnosed psychiatric history showed about 49.1% of which 15.9 % had at least one psychotic disease.

Table 1: Sociodemographic characteristics and distribution of individuals in the study

Variable	Description	N	Frequency *
Age (n=352)	18 to 34 years	66	18.75
	35 to 49 years	104	29.55
	50 to 64 years	135	38.35
	65 years and above	18	5.11
	Not available data	29	8.24
Sex	Male	215	61.08
	Female	136	38.64
	Transgender	1	0.28
Ethnicity	American Indian	3	0.85
	Asian	5	1.42
	Black/African American	182	51.70
	Hispanic	23	6.53
	Native Hawaiian	0	0
	White/Caucasian	93	26.42
	Mixed Race	6	1.42
	Not wished to be Identified	40	11.36
Smoking	Non smoker	53	15.06
	Current smoker	174	49.43
	Former smoker	40	11.36
	Other Forms of Tobacco	5	1.42

	Not available data	80	22.73
Past Psychiatric history	No disease	180	51.14
	At least one psychosis	56	15.91
	Two psychotic diseases	49	13.92
	Three psychotic diseases	34	9.66
	Four or more psychotic diseases	33	9.38

*Values as percentages

Results for Aim 1:

Among the distribution of common dental needs, pain was reported the most common condition (38.1%) followed by routine care (23.6%) and cavities or broken teeth (14.5%) (Figure 1). The mean Decayed, Missing and Filled score was 35.22 (SD =32.9). The mean for percentage having untreated dental caries was 6.8 (SD = 10.5), mean for percentage of teeth lost was 25.0 (SD = 29.9) and the mean for percentage of teeth filled was 3.4 (SD =10.8) which is listed in Table 2. To identify the distribution of the different needs among the various subgroups in the cohort, univariate analysis between the common dental needs and sex were constructed using chi square tests. To identify an association between the dental needs and age groups, a one- way ANOVA test was conducted and the p values are reported ($p<0.001$) (Table 3). Similarly, in Tables 3, 4 and 5, an association between the common dental needs and subgroups of ethnicity, smoking history and past psychiatric history were analyzed and the p values were reported. (P values: ethnicity=0.03, smoking history<0.001, past psychiatric history<0.001).

Figure 1: Distribution of the most common dental needs identified in the selected population

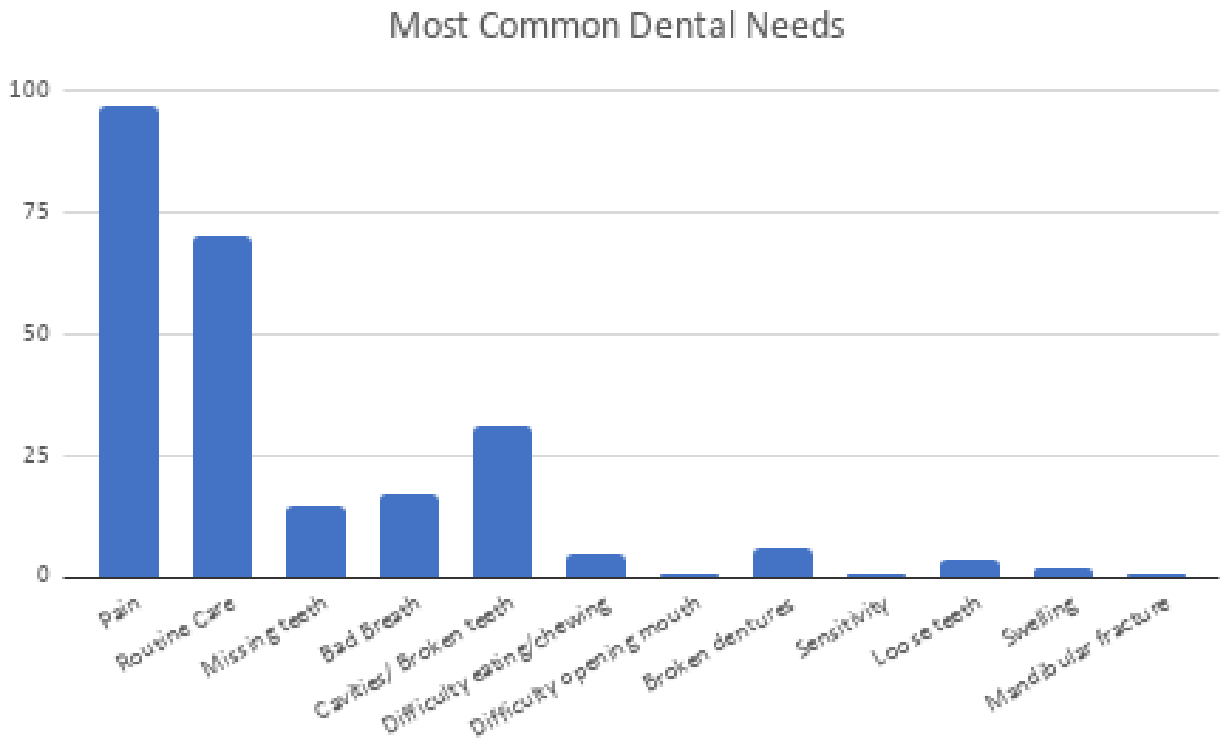


Table 2: Dental caries status of the individuals in the study. The Mean and Standard deviation of the missing, filled and decayed teeth shows the following results for the 352 patients included in the studied. The mean for untreated dental caries is 6.8, for teeth lost is 25.0 and for filled or restored teeth is 3.4

Variable	Mean (n=352)	Standard deviation
Percentage of patients with untreated dental caries	6.83	10.54
Percentage of patients with teeth lost	24.99	29.85
Percentage of patients with filled teeth	3.42	10.81
Total caries distribution in the population	35.22	32.86

Table 3: Percentage distribution of the dental needs identified in relation to age and sex of the individuals in the study with reported P-Values. Univariate analysis such as one –way ANOVA was conducted to identify the association of age in the distribution of the dental needs and was significantly associated ($p<0.001$). Similarly an association between sex and the dental needs using chi square tests yielded no significant association.

Most common dental needs identified	Age* N=352					Sex* N=352		
	18-34**	35-49**	50-64**	>=65**	NA	Male	Female	Other
Pain	9.7	12.8	13.6	1.4	0.6	19.9	17.9	0.3
Routine care	3.7	5.4	6.5	0.6	7.4	17.9	5.7	0
Missing Teeth	0	2.0	4.3	2.0	0	5.4	2.8	0
Bad Breath/Cleaning	0.9	2.6	4.0	0	0	5.7	1.7	0
Cavities/Broken teeth	0.3	4.8	5.11	0.6	0.3	7.1	7.4	0
Difficulty eating/chewing	0.3	0.6	1.1	0.6	0	2.0	0.6	0
Difficulty opening mouth	0.3	0	0	0	0	0	0.3	0
Broken Dentures	0	0.3	2.0	0	0	0.9	1.4	0
Sensitivity	0	0.3	0.9	0	0	0.9	0.3	0
Loose Teeth	0.3	0.3	0.6	0	0	0.9	0.3	0
Swelling	0	0.3	0.3	0	0	0.3	0.3	0
Mandibular fracture	0	0.3	0	0	0	0.3	0	0
Total Patients	18.8	29.6	38.4	5.1	8.2	61.1	38.6	0.3
Reported p value (<0.05)	***P <0.001***							

*Values as percentages; **Values as years; NA: no data available

Table 4: Percentage distribution of the dental needs identified in relation to ethnicity of the individuals in the study with reported P-Values showing significant association between the ethnic groups and the different dental needs.

Most common dental needs identified	Ethnicity (%) N=352						
	American Indian	Asian	Black	Hispanic	White	Mixed race	Not available
Pain	0.6	0.6	20.7	4.0	10.5	0.3	1.4
Routine care	0	0.3	8.8	1.1	4.0	1.1	8.5
Missing Teeth	0	0	5.4	0	2.6	0	0
Bad Breath/Cleaning	0	0.3	5.1	0.3	1.7	0	0
Cavities/Broken teeth	0.3	0	7.1	0.9	5.1	0.3	0.9
Difficulty eating/chewing	0	0.3	0.9	0	1.1	0	0.3
Difficulty opening mouth	0	0	0	0	0.3	0	0
Broken Dentures	0	0	1.4	0.3	0.6	0	0
Sensitivity	0	0	0.9	0	0.3	0	0
Loose Teeth	0	0	0.9	0	0.3	0	0
Swelling	0	0	0.3	0	0	0	0.3
Mandibular fracture	0	0	0.3	0	0	0	0
Total Patients	0.9	1.4	51.7	6.5	26.4	1.7	11.4
Reported p value (<0.05)	***P=0.003***						

*Values as percentages

Table 5: Percentage distribution of the dental needs identified in relation to the smoking history of the individuals in the study with reported P-Values showing significant association between smoking history and the common needs. It is also identified that patients who are current smokers reported for pain more than other complaints.

Most common dental needs identified	Smoking History* N=352				
	Non smoker	Current smoker	Former smoker	Other forms of tobacco	NA
Pain	5.7	21.3	5.7	0	5.4
Routine care	1.1	7.4	0.9	0.3	14.0
Missing Teeth	0.9	6.3	0.6	0	0.6
Bad Breath/Cleaning	2.2	3.1	1.4	0	0.6
Cavities/Broken teeth	3.7	7.1	2.0	0.9	0.9
Difficulty eating/chewing	0.6	0.9	0.6	0.3	0.3
Difficulty opening mouth	0	0.3	0	0	0
Broken Dentures	0.3	1.4	0	0	0.6
Sensitivity	0.3	0.6	0	0	0.3
Loose Teeth	0.3	0.9	0	0	0
Swelling	0	0	0.3	0	0.3
Mandibular fracture	0	0.3	0	0	0
Total Patients	15.1	49.4	11.4	1.4	22.7
Reported p value (<0.05)			***P<0.001***		

*Values in percentage; NA: no data available

Table 6: Percentage distribution of the dental needs identified in relation to the past psychiatric history of the individuals in the study with reported P-Values showing significant association between the past psychiatric history and the common dental needs. It is also identified that patients with at least one type of psychoses reported to the dental clinic for pain, whereas patients with no diseases reported for routine care.

Most common dental needs identified	Past Psychiatric History* N=352				
	No disease	At least one type of psychosis	Two types of psychosis	Three types of psychosis	Four or more types of psychosis
Pain	17.1	8.8	4.6	4.0	3.7
Routine care	19.3	1.4	0.9	1.1	0.9
Missing Teeth	4.3	1.1	0.9	1.4	0.6
Bad Breath/Cleaning	2.9	0.6	2.0	1.1	0.9
Cavities/Broken teeth	4.3	3.1	3.4	1.4	2.3
Difficulty eating/chewing	1.4	0.3	0.6	0	0.3
Difficulty opening mouth	0	0	0.3	0	0
Broken Dentures	0.9	0.3	0.3	0.3	0.6
Sensitivity	0.6	0	0.3	0.3	0
Loose Teeth	0.3	0	0.9	0	0
Swelling	0.3	0.3	0	0	0
Mandibular fracture	0	0	0	0	0.3
Total Patients	51.1	15.9	13.92	9.7	22.7
Reported p value (<0.05)			***P<0.001***		

*Values in percentage

Results for Aim 2:

In order to assess the pattern of visit, the workflow at the dental clinic for a patient who visits for the first time needs to be illustrated. The flowchart in figure 2 illustrates the normal pattern of workflow at the dental clinic in Healthcare for the Homeless[30]. To analyze the general pattern of attendance we categorized the patients into three broad categories: 26.7% of the patients were currently continuing treatment, 2.3% of the patients completed their treatment in the given year and almost 250 patients (71.0%) discontinued their treatments.

To further asses the 250 patients for the levels at which they discontinued treatment during the different stages of the procedures, we constructed a flowchart in Figure 3. About 33.5% (n=118) discontinued during the course of their various dental procedures. While 27.8% (n=98) discontinued at their initial dental screening at the Beacon outreach program which is conducted once every month, 15.6% (n=55) patients failed to continue treatment after their first limited oral examination. About 10.8% (n=38) patients discontinued treatment after an emergency appointment. To illustrate the different types of emergency services provided at the clinic, a distribution graph showing the treatment types are elucidated in the Figure 4. The clinic visits distribution pattern among men and women exhibited equal levels of discontinuity in most categories for both the sexes. However, the male population showed significant differences in continuing treatment after the Beacon outreach screening and the first limited oral examination when compared to the females. (Figure 5)

To further assess whether demographics, smoking history, past psychiatric history, the last treatment underwent by the patients, the most common dental needs and the emergency management of patients were associated with discontinuing their treatment, we conducted

univariate and bivariate analyses. The univariate analyses using chi square tests showed significant associations between ethnicity ($p<0.001$) and last procedure underwent by the patients ($P<0.001$) with their discontinuity to treatments. Selecting these factors, a bivariate analysis was conducted using logistic regression. The model had a favorable p value ($p<0.001$) indicating a good association with the outcome variable. The results showed that the beacon outreach screenings (OR: 8.95, SE: 6.76, P=0.004 and CI: 2.03 and 39.37) and discontinuity in between the course of dental procedures (OR. 0.25, SE: 0.11, P= 0.001 and CI: 0.11 and 0.58) to be significantly associated with greater odds of discontinuing a comprehensive treatment (Table 7). In the regression model, all the subgroups under ethnicity and the other subgroups in the last treatment underwent by the patients were not significantly associated with discontinuing a comprehensive treatment.

Figure 2: Flowchart of the regular sequence of treatment management at the dental clinic at the Healthcare for the Homeless in Houston, Texas

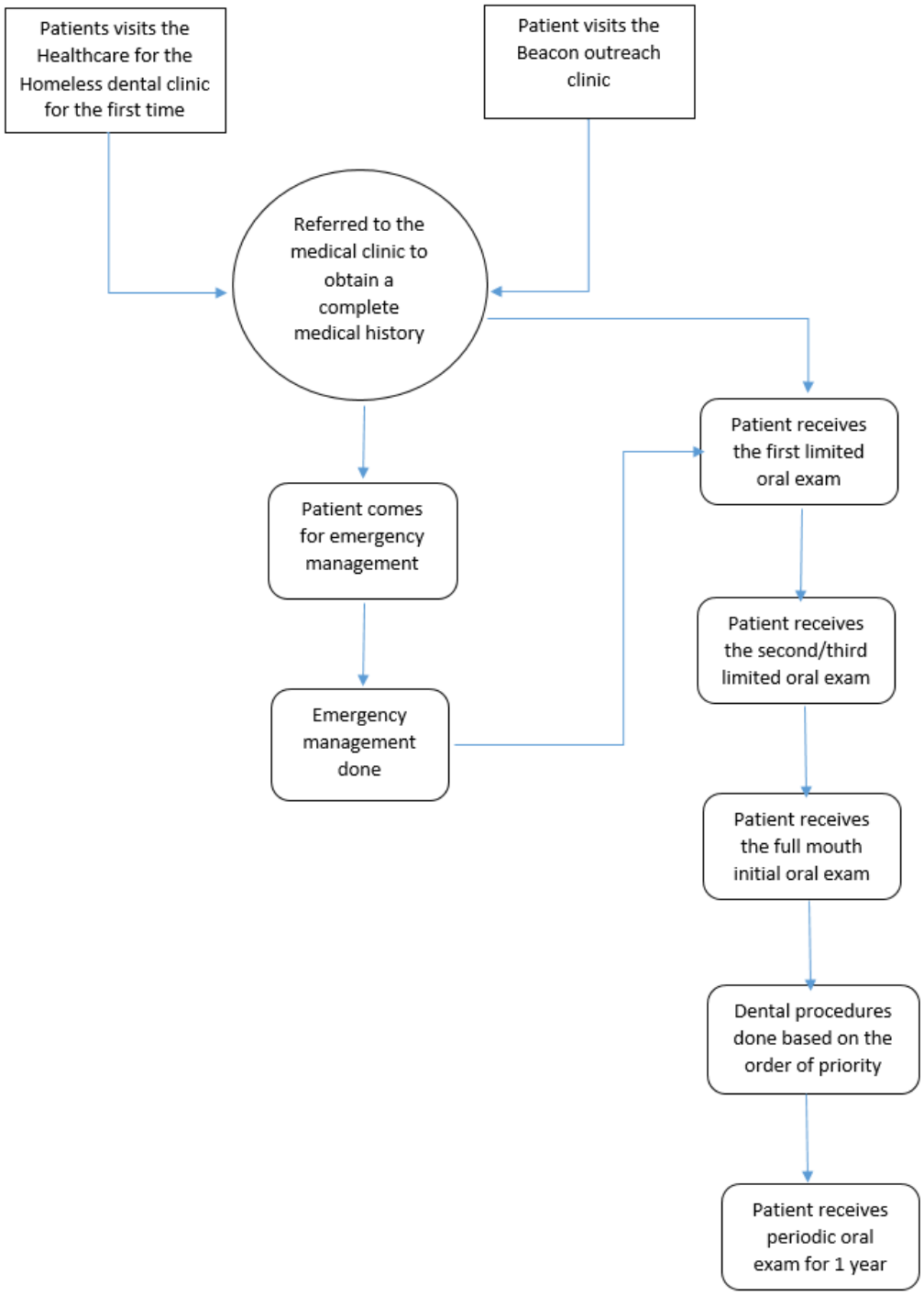


Figure 3: Flowchart depicting the stages at which the patients discontinued treatment during the selected year 2017-2018. The number of patients (N) who discontinued at each stage is also included.

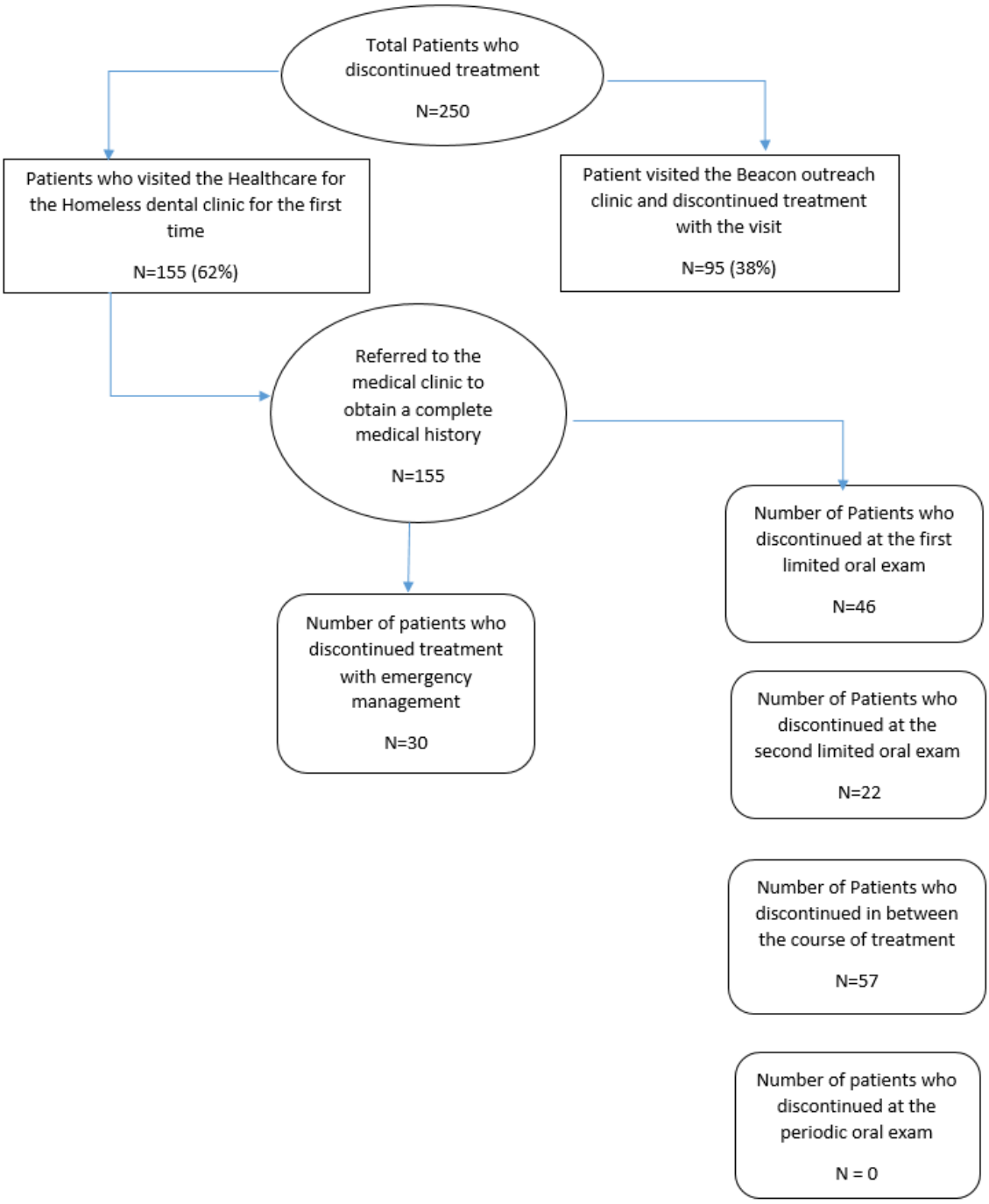


Figure 4: Distributional graph reporting the different types of emergency management that were carried out on individuals seeking emergency care at the dental clinic.

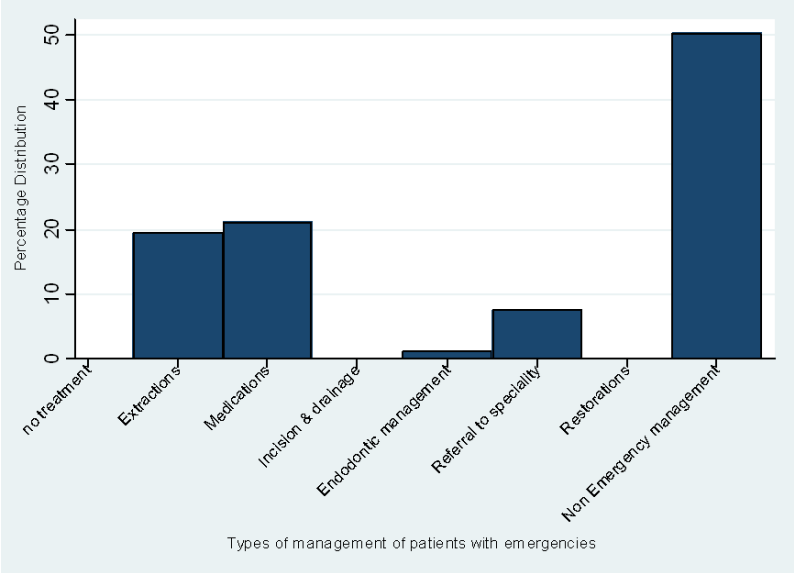


Figure 5: A comparative analysis on the clinic visit patterns between men and women who received care in the given year.

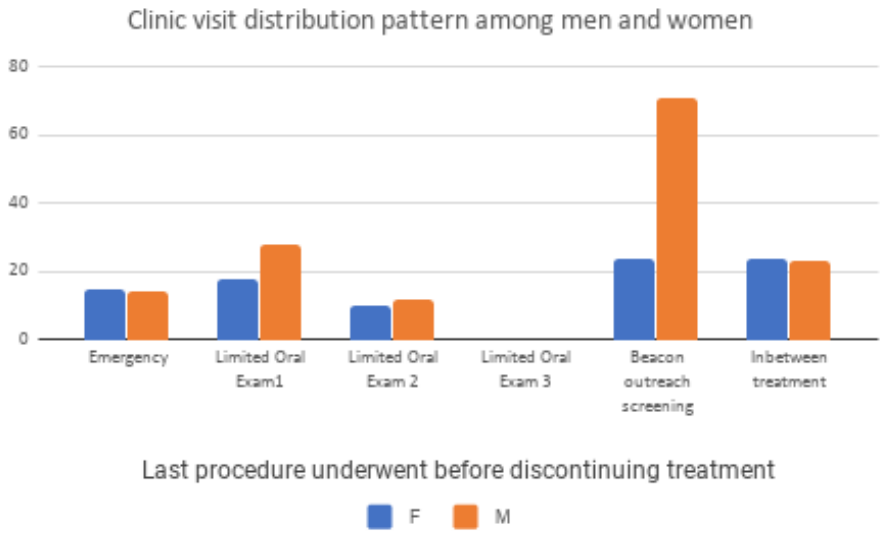


Table 7: Results from the logistic regression model created after testing for the sociodemographic and other factors. The table shows the odds ratio and the confidence interval of the subgroups that had associations with the patients discontinuing treatment at the clinic. Of all the covariates that were tested only the patients who discontinued after beacon outreach screening and patients who discontinued during dental procedures had greater odds of discontinuing a comprehensive dental treatment.

Independent Variables	**Odds Ratio[1]**	**SE**	**z**	**p**	**95% CI**	
Last procedure underwent:						
Beacon outreach	8.95	6.76	2.90	0.004	2.03	39.37
In between procedures	0.25	0.11	-3.32	0.001	0.11	0.58
Log likelihood = -161.5, $p<0.001$, R^2= 0.21						

[1]adujusted for other variables in the table

Results for Aim 3:

To analyze this research question, we isolated patients from the sample data to include patients who had both periodontal health history and dental caries status history. A sample of 70 patients were included and checked for normality. Skewness/kurtosis yielded significant results for normality for both the periodontal score (P=0.006) and the total decayed, filled and missing teeth score (p=0.008). Based on the central limit theorem, we can establish that the two variables are normally distributed. The variables were also plotted for periodontal score

and decayed, missing and filled teeth score in a histogram for establishing normality of the data sample (Figure 6 & 7).

Figure 6: Normality distribution of the periodontal scores plotted in a histogram

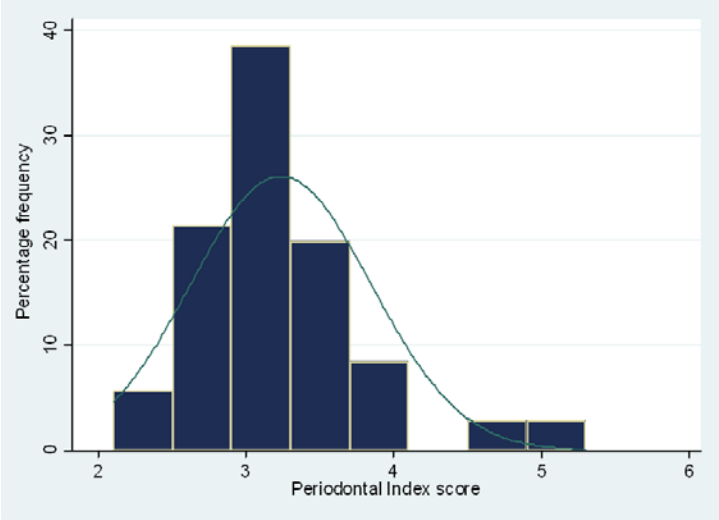
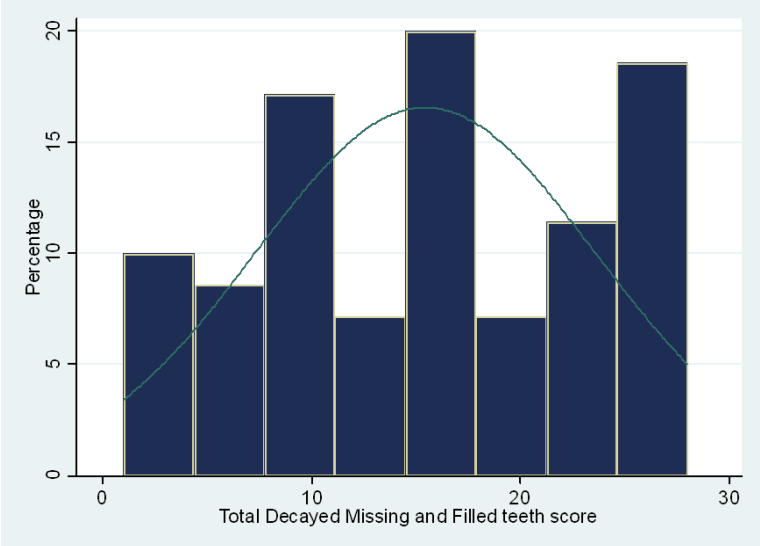


Figure 7: Normality distribution of the Decayed, Missing and Filled score in a histogram.



In table 8, the mean of the periodontal score and Decayed, missing and filled teeth score with the breakdown of the mean of decayed, missing and filled scores individually for the dataset are reported. The distribution pattern of the periodontal score among men and women is shown to be equal within the score range of 2-4 and with men having scores greater than 5 (Scores scaled from 2 to 7). (Figure 8). The distribution pattern of the Decayed, Missing and Filled teeth score among and women illustrated in Figure 8 shows women with more score between 1 to 10 while men scored higher between 11 to 25. Both sexes show equal scores between 26 and 28. (Figure 9)

Table: 8 Summary statistics of the periodontal health status and dental caries status of the individuals selected in our study (N-=70)

Variable	Mean	Standard deviation	Minimum Score	Maximum score
Periodontal health: **(N=70)**				
Periodontal Index score	3.23	0.61	2.1	5.3
Dental Caries Status: (N=70)				
Total caries distribution in the population	15.44	8.13	1	28
Decayed teeth score	3.44	3.33	0	12
Missing teeth score	9.67	8.48	0	28
Filled teeth score	2.37	3.94	0	25

Figure 8: Comparative distribution of periodontal score between men and women in the selected sample (Scaled from 2 to 7)

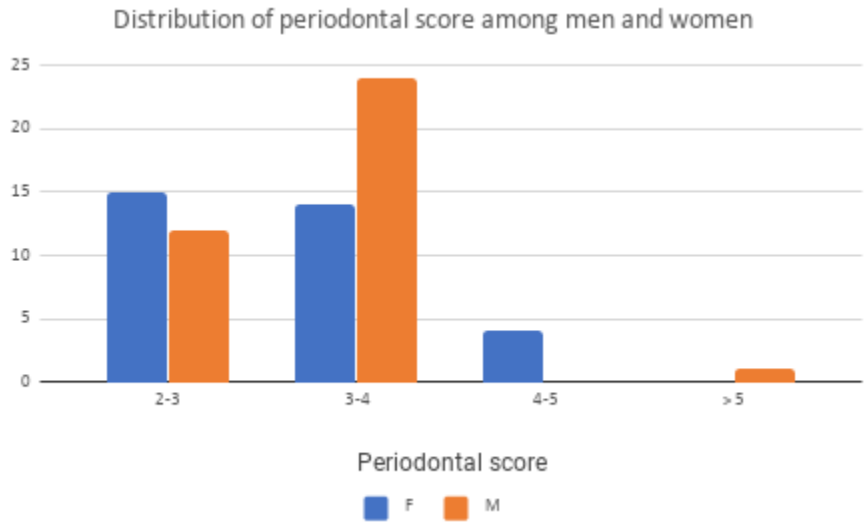
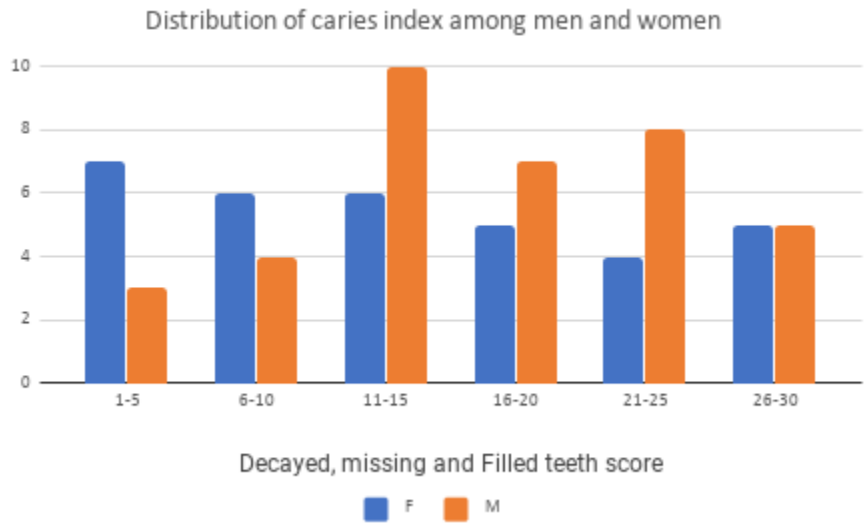


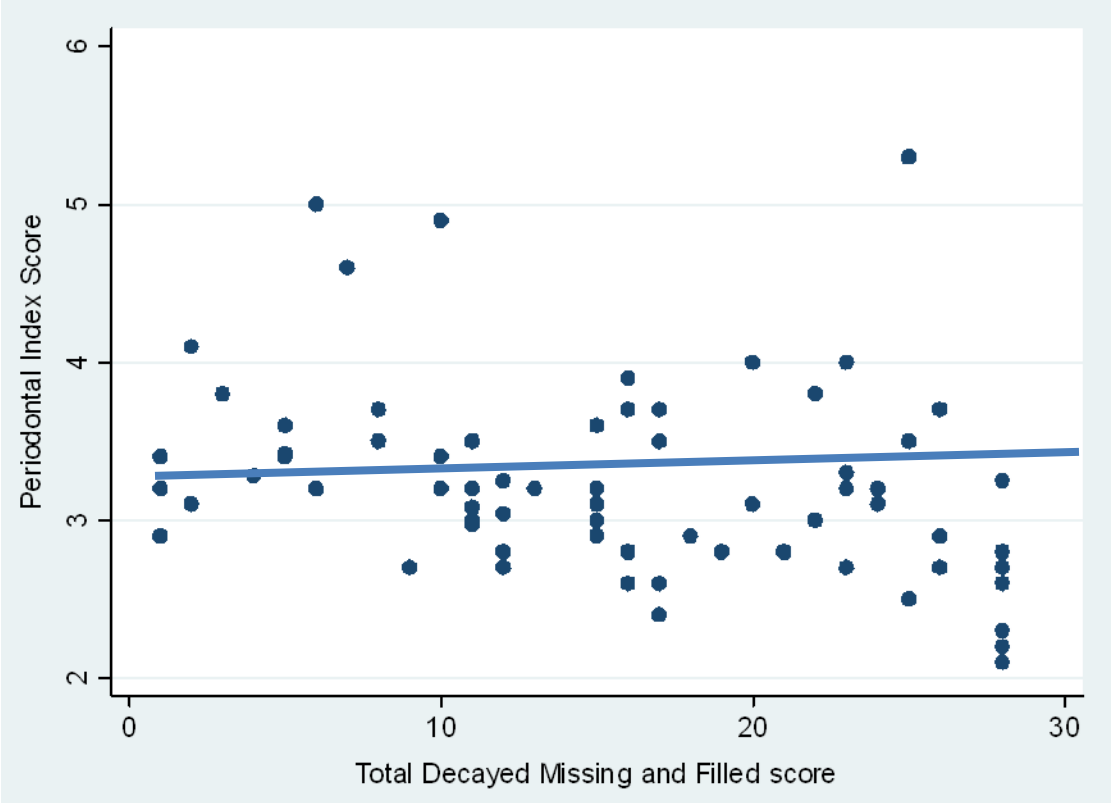
Figure 9: Comparative distribution of dental caries status between men and women in the selected sample (Scaled from 1 to 28)



To identify an association between the periodontal health status and the dental caries status in the given population we conducted a two-sample t-test with unequal variance. Based on the

hypothesis testing, we rejected the null hypothesis with a p value <0.001 and found that the two diseases were associated (t= -12.53, 95% CI: -14.15, -10.36). We further plotted the graph with the total Decayed, Missing and Filled teeth score at the x-axis and the periodontal score at the y-axis. The results showed a straight-line distribution exhibiting no association between the two variables (Figure 10).

Figure 10: Graphical representation of the association of the two diseases status namely, periodontal health and dental caries status plotted in a scatterplot.



We further conducted univariate and bivariate analysis for the two conditions to check for confounders in the association. Considering the dental caries status as the outcome and

periodontal status as the exposure we conducted univariate analysis for the outcome variable. There were no statistically significant associations between the dental caries status and the explanatory variables. However, the univariate analysis showed that clinic visit patterns and last treatment underwent by the patients before discontinuing treatment were associated with caries status. A multivariate regression analysis showed a slope coefficient of -6.15 which showed that the patients who discontinued treatment had a significant association with a decrease in the dental caries health (p=0.01). After stratifying for confounders, the regression model did not show a significant association between dental caries status and periodontal health status. (p=0.1). The R^2 value reports 0.21 which explains about 21% variance in the relationship (Table 9).

Table 9: Results from the regression analysis of the different covariates with the dental caries status of individuals selected for the study. The periodontal health was not significantly associated with the dental caries status of the individuals.

Independent Variables	**Coefficient**	**SE**	**t**	**p**	**95% CI**	
Clinical Visit Pattern						
Patients who discontinued treatment	-6.15	2.3	-2.66	0.01	-10.77	-1.53
Periodontal health status	-2.58	1.5	-1.67	0.101	-5.67	0.52
F[7,62] = 3.67, p=0.002 R^2= 0.21						

DISCUSSION

The United States Interagency council reported that the number of homeless in Texas makes up to 4% of the country's entire homeless population where Texas represents 6% of the countries' total population [17, 24]. This study represented a sample of the urban homeless population of the highly populated counties in Houston, Texas. The sociodemographic results in the study reported 61% males in the population and 52% of the individuals with African American ethnicity which is similar to the national statistics which represents 70% of the homeless population to be male and about 40% of the African American population to be homeless[18, 24]. The study participants were also analyzed based on their mental status and we found that about 49% of the patients had at least one type of psychoses which was similar to the studies conducted in Ethiopia (41%) and Hong Kong (56%) on the mental health of the homeless population [17, 32].

While we analyzed different aspects of the oral health needs, we found that the study shows similar results on the most common dental need as oral or dental pain. The study results are comparable to a study conducted by Conte et al, which reported over half the population had oral facial pain among homeless adults in Newark, New Jersey[34]. However, the distribution of dental needs highly depends on various sociodemographic and geographical factors. A study on the homeless population in Hong Kong reported widely prevalent periodontal disease followed by dental pain[31]. Whereas a study conducted in a cohort of homeless population in Scotland reported dental caries and edentulousnes or missing teeth as their most commonly identified dental needs[19]. This shows the varying trends in dental needs among different

populations and the importance of identifying them to design and execute individualized and customized intervention programs based on their specific needs. This study also reports the dental needs based on the chief complaint that the patient had when they first visited the dental clinic unlike self-reported oral or dental needs by which most studies were constructed. The use of chief complaint as the patient's self-reported primary reason could be used as a measure of their immediate or more recent oral and dental needs. We found that 42% of the smokers in the population visited the dental clinic for pain. A previous study on smoking and dental pain in homeless veterans revealed a significant association between current smokers with increased dental pain experience which is similar to the results from our study[25].

The second part of this study reveals the stages at which most patients discontinued treatment. About 71% of the patients who visited the dental clinic in the study year discontinued their treatment of which 125 patients came only for the first time. While there are many studies on the homeless population that reflect the oral health needs and the individuals' knowledge in dental treatment, this is the first study in literature that recognizes the pattern or the stages at which they stopped or discontinued their dental treatment. The clinic at which the study was carried at had a systematic approach in handling the high volume of homeless patients seeking dental care. While 34 % of the patients followed all the initial examination appointments but discontinued visits in between the dental treatments, about 26% of the patients discontinued treatment with their first visit. The 28% of the patients who undergo dental screenings at the Beacon outreach program were found to have discontinued treatment after the first visit. Previous studies have reported that there were high rates of acute healthcare use in the form of emergencies or inpatient admissions among the homeless population[26]

However, our study recognized individuals' participation beyond emergency management, as only 11% of the patients discontinued treatment after their emergency visit. These findings warrant a deeper understanding of their patterns of dental visit and receiving a comprehensive care. The inadequacy in dental and oral health literacy may contribute to the lack of participation after their initial screenings at the outreach centers. Studies on dental health of homeless on Toronto, Canada reported a lack of dental literacy to be one of the main contributing factors for their lack of participation[6]. Even though the dental services required by this population was extensive, their adherence to the treatments was highly compromised.

The third part of the study concentrated on studying an association between dental caries and gum or periodontal health. Studies on children have recognized improper brushing techniques and lack of oral hygiene to be one of the major factors contributing to dental caries[28]. In adults, presence of visible plaque followed by tooth brushing frequency were found to be associated with dental caries[29]. However, these factors are also highly associated with periodontal diseases like gingivitis and periodontitis. Although previous studies have reported the association of plaque with dental caries and periodontal diseases, no investigation on the correlation of these two diseases have been conducted[33]. To test if these two diseases were associated, we compared the periodontal health with the dental caries status. We found the two diseases were associated, whereas discontinuing dental treatment showed significant associations in the prevalence of dental caries among this population. Further research is required to find a definitive association between the two health conditions. Studies on homeless adults have reported social barriers such as inability to afford a toothbrush as well as lack of a

place to practicing daily oral care as one of the major reasons for not being able to maintain adequate oral hygiene [27, 32].

CONCLUSION

The findings in the study adequately explains the common dental needs the homeless population have while seeking dental care. The findings that are unique to the study are recognizing the levels of the lack of participation by the homeless individuals in receiving a comprehensive dental treatment when the services are offered free of cost. The study also successfully identifies the association between periodontal diseases and caries disease having common behavioral etiology.

Strength and limitations of the study:

The sample size is the major strength of the study. Appropriate assessments were made possible because of the good number of patients in the study. The use of chief complaint and clinical data warrants a uniform assessment of the findings as all this information are recorded by dental health providers and not self-reported needs. Identifying the stages of discontinuity has never been reported in literature for individuals in this community. This research will be first in the literature to identify and assess those levels in finding an association with discontinuing treatment for comprehensive care. The use of mental health history is very essential to the population and this study included mental health and smoking health in all assessments to identify for confounders or associations.

Although the study produced significant findings in the oral health of the individuals who are homeless, the assessment was affected by some limitations. Firstly, the participants were

gathered from the more urban areas of Houston city which allowed greater access to this group of participants, but perhaps did not allow for the collection of information from the more rural population, which may have its own unique barriers to dental treatment. Secondly, as our analysis rely on cross-sectional data, it's harder to establish causality between the variables. Thirdly, we chose patients who had both periodontal health records and dental caries recording to assess the third aim. The periodontal health assessment is not included in the initial exams, since the patients discontinued treatment during the examinations they did not proceed to periodontal assessments. Hence we included the patients with both the caries and periodontal health assessment available. The variables though it was normally distributed, there could be possible bias in the data as the recordings are done by different dental health care providers such as a dentist for the Caries assessment and dental hygienist for the periodontal assessment. Since the assessments were made only using the clinical manifestation of the diseases, a deeper understanding can be facilitated by expanding the research and utilizing questionnaires to self-report their hygiene and eating habits to better understand the correlation. To improve their adherence to a comprehensive dental treatment, further research can be facilitated by using self-reported questionnaires to address the barriers in obtaining a complete treatment.

The study will successfully help in researchers and public health workers to implement further action to help address the dental needs of the urban homeless population. This study could help the community dental clinics to identify the stages of their lack of participation to design implementations and interventions to address the discontinuity in obtaining comprehensive dental care. Further research like identifying the specific barriers using questionnaires and designing interventions to address these barriers could lead a future

direction to the study to provide best oral health care to the homeless individuals. Having completed dental treatment and better oral health has provided a lot of success stories during my interaction while working with these individuals. This shows that research on their needs and addressing them could not only promote oral health and prevent dental diseases, it could significantly improve their quality of life.

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APPENDICES

Appendix A: IRB permission from UT Health Science Center at Houston

UTHealth
The University of Texas
Health Science Center at Houston

Committee for the Protection of Human Subjects
6410 Fannin Street, Suite 1100
Houston, Texas 77030

Dr. Heera Govindarajan Venguidesvarane
UT-H - SPH - Master of Public Health (Epidemiology)

December 26, 2018

HSC-SPH-18-1104 - *"ASSESSMENT OF THE COMMON DENTAL NEEDS AND EVALUATION OF RATE OF ATTENDANCE POST EMERGENCY DENTAL MANAGEMENT AMONG THE HOMELESS POPULATION IN HOUSTON, TEXAS"*

The above named project is determined to qualify for exempt status according to 45 CFR 46.101(b)

CATEGORY #4 *: Research, involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified directly or through identifiers linked to the subjects.*

CHANGES: Should you choose to make any changes to the protocol that would involve the inclusion of human subjects or identified data from humans, please submit the change via iRIS to the Committee for the Protection of Human Subjects for review.

INFORMED CONSENT DETERMINATION:
Waiver of Consent Granted

HEALTH INSURANCE PORTABILITY and ACCOUNTABILITY ACT (HIPAA):
Waiver for Retrospective Chart Review granted:
Information to be accessed: dental records
PHI to be retained: none

STUDY CLOSURES: Upon completion of your project, submission of a study closure report is required. The study closure report should be submitted once all data has been collected and analyzed.

Should you have any questions, please contact the Office of Research Support Committees at 713-500-7943.

Appendix B: IRB permission from Healthcare for the Homeless dental clinic

Healthcare for the Homeless Houston
health, hope and dignity

Healthcare for the Homeless – Houston
1934 Caroline St.
Houston, TX 77002
713-286-6124
www.homeless-healthcare.org

PERMISSION TO CONDUCT STUDIES WITH HUMAN SUBJECTS

Status: approved
Review date: 1/30/2019
Approval Period: 1 year
Signature of Review Committee Chair: [illegible]

Review Committee: Marie McCants, Julia Rivas, Carlie Brown, Frances Ebell, Joseph Benson

Title of Project: "Assessment of the common dental needs and evaluation of rate of attendance post emergency dental management among the homeless population in Houston, Texas"

Submission Date: 1/15/2019

Name of Principal Investigator, contact information, and school affiliation (if any):
Heera Govindarajan Venguidesvarane,
7900 Cambridge Street, Apartment 16-1H,
Houston, Texas 77054,
Phone number: (832)708-9840
Graduate student at The University of Texas School of Public Health at Houston

Name(s) of Co-Investigators: Dr. Ezinne Ogbureke, Dr. James Hixson, Dr. Craig Hanis

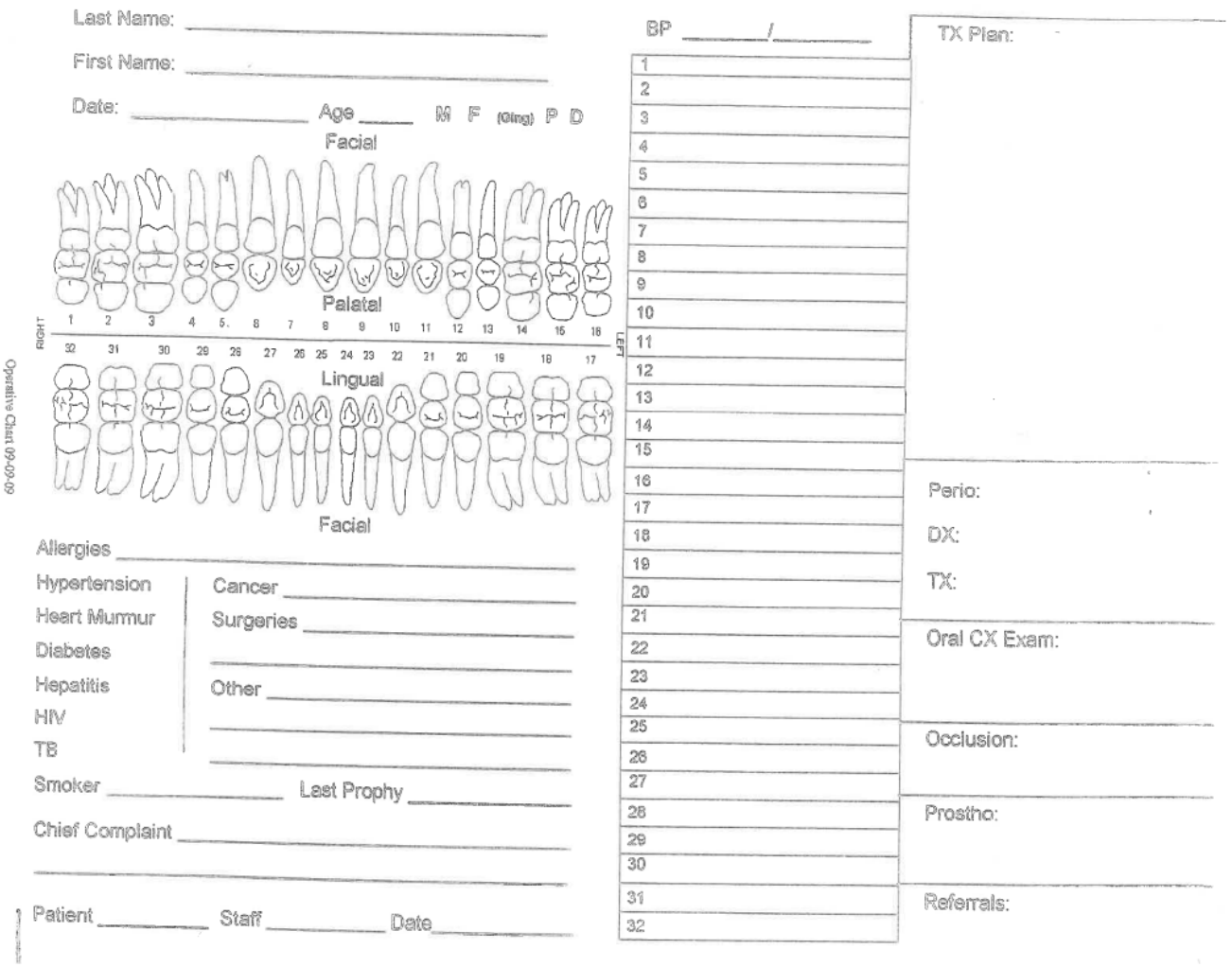
Research proposed for which HHH-affiliated site/program? HHH Dental Clinic at Caroline Street.

Summary of Project (100 words or less)

Oral and dental health are rarely recognized as an essential or mandatory healthcare when compared to general health, especially among the homeless population. The most common reasons for emergency dental treatments include emergency situations such as intense and constant pain, injury to the jaw and the associated structures, fractures and infections with evident swelling. The perceived attitude and behavior of these individuals regarding comprehensive dental care including prevention and maintenance is unknown and understudied. The objectives of the study are as follows:

Aim 1: To determine the most common dental needs and evaluate the oral health awareness among the Homeless population: "recognizing the most common complaints the individuals had when they sought dental care for the first time at the dental clinic for homeless".
Aim 2: To analyze the pattern of subsequent visits in this population and differences in individuals that went on to access routine care at the clinic in comparison to those who only utilized the clinic on emergency basis.
Aim 3: To identify an association between the oral hygiene status and caries prevalence in the population.

APPENDIX C: OPERATIONAL CHARTS AND ORAL EXAMINATION FORM



Last Name: _____

First Name: _____

Date: _____ Age ____ M F (Ging) P D

Facial

Palatal

RIGHT 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 LEFT

32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17

Lingual

Facial

Operative Chart 09-09-09

Allergies _____

Hypertension
Heart Murmur
Diabetes
Hepatitis
HIV
TB

Cancer _____
Surgeries _____
_____
Other _____
_____
_____

Smoker _____ Last Prophy _____

Chief Complaint _____

_____

Patient _____ Staff _____ Date _____

BP _____/_____

1
2
3
4
5
6
7
8
9
10
11
12
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14
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32

TX Plan:

Perio:

DX:

TX:

Oral CX Exam:

Occlusion:

Prostho:

Referrals:

Dental Limited Oral Exam Form (LOE)

Is this an LOE 1 LOE 2

Date:

Patient Name:

Date of Birth:

Where is the pain:	UR	Upper Ant.	UL
	LR	Lower Ant.	LL
How long has the pain been present?		More than 48 hours/	** Less than 48 hours
Describe the pain:	**Sharp	Dull	
	**Shooting	Achy	
	**Constant	Intermittent	

**Sensitive to hot? ----------	Yes	No
Sensitive to cold? ----------	Yes	No
Sensitive to sweets? ----------	Yes	No
Sensitive to biting/chewing? ----------	Yes	No
**Swelling present? ----------	Yes	No
**Pus present? ----------	Yes	No
**Bleeding present? ----------	Yes	No
**Trismus present? ---------- *(unable to open mouth completely)*	Yes	No
**Fever present? ----------	Yes	No

Is patient taking antibiotics and/or pain medicine? ---------- Yes No

If yes, what are they taking: _____

_____

Check quadrant(s) which are missing teeth *not including 3rd molars*

UR	UL
LR	LL

Name of RDA taking x-rays: _____

Appendix D: Decayed, Missing and Filled teeth scoring criteria

Calculation of the Index	
Individual DMFT:	Total D+M+F = DMF
Group Average:	Total DMF / Total number of the subjects examined
Percentage needing care	Total number of decayed tooth / Total number examined
Percentage of tooth lost:	Total number of missing teeth / Total number examined
Percentage of filled teeth:	Total number of filled teeth / Total DMFT

Appendix E: Periodontal Index scoring criteria

Score	Criteria
0	Absence of inflammation
1	Mild to moderate inflammatory gingival changes not extending all around the tooth
2	Mild to moderately severe gingivitis extending all around the tooth
3	Severe gingivitis, characterized by marked redness, tendency to bleed and ulcerate
4	Gingival crevice in any of the measured areas extending apical to the CEJ but no more than 3 mm
5	Gingival crevice in any of the measured areas of the tooth 3-6mm apical to the CEJ
6	Gingival crevice in any of the measured areas more than 6 mm apical to the CEJ

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