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Health, hygiene, and practical interventions, for people who are experiencing homelessness

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HEALTH, HYGIENE, AND PRACTICAL INTERVENTIONS, FOR PEOPLE WHO ARE EXPERIENCING HOMELESSNESS

by

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DEDICATION

I would like to dedicate this work to my father Victor Rollinger, and my late mother Barbara Rollinger, for supporting me through my many years of education.

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HEALTH, HYGIENE, AND PRACTICAL INTERVENTIONS, FOR PEOPLE WHO ARE EXPERIENCING HOMELESSNESS

LAURA ROLLINGER

ABSTRACT

Homelessness is a serious national and international issue, with significant implications for societal health. It is such a complicated and multifaceted issue to address, and it needs much more attention than it has currently. Alongside discussions on how to house homeless individuals, it is important to discuss how to help increase this populations overall health. The homeless population is one of the most medically at-risk patient populations. Existing research has shown that homeless individuals are at a higher risk for developing ill health and disease. They face numerous barriers to obtaining health care, and have many competing priorities. As a result, they are more likely to present to hospitals and clinics with advanced stages of disease that could have been prevented, or treated more easily earlier. Overall, the homeless population is at such a high risk of developing disease due to a variety of factors. Some of which are, their chronic exposure to the elements and other ill people, a lack of access to hygiene facilities or healthy food, and certain advantageous preventative resources. Past research has focused on interventions such as housing first over healthcare, and mobile clinical services, but they take a great deal of time and money to be fully realized. It is important to expand resources to include smaller, more feasible, preventative provisions for conditions that homeless individuals are more susceptible to such as skin cancer, tooth decay and loss, and others. More research into practical interventions, which can help improve the health

and hygiene of homeless population, will close a gap in the current medical literature. This thesis focuses on practical prevention efforts for the homeless in the form of, SPF 70 spray sunscreen, hard bristled toothbrushes, sugarless gum, body wipes, dry shampoo, hand sanitizer, and more. These scientifically backed interventions can be immediately incorporated into the resources that community healthcare centers, shelters, or any other related homeless care facilities, provide. These supplies should improve homeless individuals' health and quality of life while waiting for larger interventions such as housing, or free clinics, to be implemented. Importantly, these resources can help to bring an end to this current period in time in which homeless individuals are left to wait for any form of preventative or curative health care. As Ben Carson recently said, "Leaving [the] homeless unsheltered, unhealthy, and unsafe is a human tragedy and unacceptable."

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LIST OF ABBREVIATIONS

AIDS ..... Acquired Immune Deficiency Syndrome

BU ..... Boston University

CDC..... Centers for Disease Control

DNA ..... Deoxyribonucleic Acid

ER..... Emergency Room

ED ..... Emergency Department

HCV ..... Hepatitis C Virus

HIV..... Human Immunodeficiency Viruses

ICU ..... Intensive Care Unit

MRSA..... Methicillin- Resistant Staphylococcus Aureus

SPF .....Sun Protection Factor

TB..... Tuberculosis

UV .....Ultra Violet

INTRODUCTION

Background

Homelessness is a serious national and international issue, with significant implications for societal well-being; because it is such a complicated and multifaceted issue to address, it needs much more attention than it has currently. Before addressing how to better help individuals who are homeless, let us define what it means to be homeless. There are many variable definitions of homelessness, not everyone agrees, but the federal definition seems to be the most all-encompassing. For someone to be defined as homeless, they do not have a fixed, regular, or adequate residence in which to spend the night; or they have a residence which is public, or is a private place not designed for regular human habitation. This also includes those who are in emergency or transitional shelters, sharing someone else's housing, living in motels, hotels, abandoned buildings, trailers, cars, bus or train stations, parks, or sleeping on camping grounds for lack of alternative accommodations. Overall, people who are experiencing homelessness lack the resources or support network in which to obtain adequate permanent housing. [1]

As many as 13.5 million Americans have been homeless at some point in their lives; with approximately 2.3 to 3.5 million American's experience homelessness each year. [2, 3, 4, 5] On a single night in the United States, the most recent estimate quotes more than half a million, 553,000 people, experiencing homelessness. About two-thirds of the people, 65 percent, were in sheltered locations, and about one-third, 35 percent, were in unsheltered locations. This estimate demonstrates an increase, though a modest one of less than half a percent, in people experiencing homeless per night. This increase

continues to follow a trend of increasing numbers recorded for the past three years in a row. [6]

The majority of people without a home seem to be concentrated in the major cities on the West and East coasts of the United States. Addressing this homelessness is a particularly salient issue in California where almost half, 47 percent, of all unsheltered homeless people reside. To put this number in perspective it is about four times as high as California's share of the overall United States population. This number of unsheltered homeless people is also twice as large as expected given California's moderate temperatures, home prices, and poverty rates. Additionally, four of the top five cities with the highest rates of unsheltered homeless residents are in California. These cities include San Francisco, Los Angeles, Santa Rosa, and San Jose. [7] Los Angeles in particular holds 19 percent of the unsheltered population alone. California simply does not have enough shelter beds. There are six times as many adults living on the streets than there are available beds. This is the highest comparative rate in the country and needs to be addressed. [8]

Housing is a fundamental human need. [9] The newest national initiative to address this need employs the model of housing first. While affordable, accessible, and adequate housing is certainly a highly important, and large part of the solution, building and supplying housing takes years, if not significantly longer. As Ben Carson recently said, "Leaving [the] homeless unsheltered, unhealthy, and unsafe is a human tragedy and unacceptable." One way to more immediately and significantly improve the quality of life for these people, is to help address their medical issues.

Among the most at-risk members of our society, homeless individuals have the worst health. [10, 11] Additionally, homeless individuals are often the sickest members of the population in general, disproportionally suffering from an average of eight or nine active medical issues. [12] These medical issues lead to some of the highest rates of mortality, and a greatly reduced life expectancy from both chronic physical and mental issues. [13, 14, 15] Recent large-scale studies have shown the average age of death for a homeless man is 47, and for a homeless woman the average age of death is 43, compared to the general populations age of death which is 77 on average. [16, 17] Years of exposure to the outdoor elements, coupled with high rates of alcohol and drug addiction, mental illness, and more, contribute to the disproportionally high rates of morbidity and mortality in the homeless population. [18] The homeless population also self-reports a lower health-related quality of life, and increased hospital readmissions compared to the general public. [19, 20, 15]

Despite their health needs, access to and the use of health care services by homeless individuals is often difficult. Thus, they are more likely than the general population to forgo needed care. [11, 21] Homeless individuals face several significant barriers to using health services, especially preventative services. Competing priorities, are seen as the biggest barrier to addressing health care needs. Health services are seen, at least initially, as discretionary, as they compete with more immediate subsistence needs. These include the need for food, shelter, safety, employment, gaining welfare or social security, and finding child care. [22, 23] Other barriers include affordability, lack of trust in the health care system and providers, transportation issues, accessibility issues, and the feeling of being unwelcomed or stigmatized. [11, 15, 24, 25, 26, 27] As a result of these issues,

homeless individuals are more likely to present to the hospitals, especially in the emergency room (ER), with advanced stages of diseases that could have been prevented or treated more simply, and less expensively, earlier. ER's are a costly way to get health care, emergency care costs between two and five times the cost of primary care. [28, 29] Emergency departments (ED's) have become a "safety net" for socioeconomically vulnerable patients, like the homeless population. However, crowding the ED creates heavy workload burdens which can exceed its capacity, which leads to increasing waiting times and increased health care costs for everyone. [30, 31] It is important to note that, homeless people do not view their ER use as a choice, but rather view their use of emergency health care as a necessity. ER visits become a necessity to get their needs met, particularly for what they view as urgent medical issues and pain management. [29]

Adding to the aforementioned, homeless individual's hospital admissions cost on average 961 dollars more than housed individual's admissions. This value increases to 2559 dollars after adjusting for factors such as age, gender, and resource intensity weight (RIW). [32] RIW is a relative value measuring patients total resource use compared with average typical acute inpatients.[279] Hwang et al's. findings were similar to those found by Salit et al., in that study, length of stay was used to estimate costs, and the extra length of stay of homeless patients accounted for an excess of 2414 dollars each admission. [32, 249] Bharel et al. found that just 6,500 homeless people alone, ended up costing the health care system 16 million dollars a year. [129]

With almost 25 percent of homeless people in the United States reporting that they were a hospitalized within the last year, the costs of inpatient services for homeless

people can substantially impact the health care system. [32, 33] Improving care for high-need, high-cost patients, like homeless individuals, should be a high priority. They are among the 5 percent of patients who account for 50 percent of health care spending. [34] As Joynt et al states "High and increasing health care costs are arguably the single biggest threat to the long-term fiscal solvency of federal and state governments in the United States." [246] Overall, the poor access to preventative resources and regular healthcare for homeless individuals leads to significant health care costs for, and put a toll on, the public health system. [35, 36] Therefore, the health of the homeless is more than just a personal issue, it is a major issue for society, and highlights a great need to intercede and implement preventative tools in this vulnerable population.

There is a significant gap in the current medical literature regarding the implementation of more quickly and easily achievable interventions, in order to help improve the health and hygiene of homeless population. Past studies have focused on interventions, such as housing first over healthcare, or free mobile health care services, but they take a great deal of time and money to be fully realized. It is important to expand resources to include smaller, more feasible, preventative provisions for conditions that homeless individuals are more susceptible to. These are ailments such as skin cancer, tooth decay and loss, and others will be discussed later. Additionally, homeless people lack free and safe access to the hygienic facilities they need in order to keep themselves clean. Without the capability to simply wash their hands, they are inherently more susceptible to contagious ailments. Overall, the homeless population is at such a high risk of developing disease due to a variety of factors. Some of which are, their chronic

exposure to the elements and other ill people, along with a lack of access to hygiene facilities, healthy food, and certain advantageous preventative resources.

This paper will have implications in providing this vulnerable, and most medically at-risk, population with interventions in order to help prevent the extra encumbrance of health problems. It will suggest research supported prevention efforts for homeless individuals in the form of, SPF 70 spray sunscreen, hard bristled toothbrushes, sugarless gum, body wipes, dry shampoo, and others discussed later. These scientifically backed practical interventions can be immediately incorporated into the resources that community healthcare centers, shelters, or any other related homeless care facilities, provide. They should improve homeless individuals' health and quality of life while these individuals wait for larger interventions such as housing, or free clinics, to be built. Moreover, for the general public, besides the inherent good in finding ways to help fellow humans who are suffering, these interventions can help to reduce the high public cost of treating homeless individuals with advanced stages of illness.

PUBLISHED STUDIES

The studies and interventions that are highlighted below, are believed to be able to help support and create immediate incremental positive changes in the lives of people who are experiencing homelessness, by leading to the reduction of the extra burden of ill health and disease.

1. Skin Cancer

Skin cancer is an ever-growing public health issue, which is especially increasing in countries with a light-skinned population. [37, 38] Skin cancer is the most commonly diagnosed cancer in the United States, but most cases are preventable. [39, 40] Most skin cancer is a result of DNA damage from sun exposure and its inherent ultraviolet radiation. This radiation causes several types of skin cancer based on the cells it effects. Cancer derived from the epidermal layer melanocytes leads to melanoma. Cancer derived from the basal layer, the lowest layer of the epidermis, keratinocytes gives rise to basal cell carcinoma. Squamous cell carcinoma also comes from keratinocytes in the epidermis, but these keratinocytes are in the layer directly above the basal layer. [37, 253] Melanoma is the deadliest form of skin cancer, and while it makes up only approximately 6 percent of skin cancers, it is responsible for 75 percent of skin cancer deaths. [40] Alarmingly, it has been found that melanoma incidences are increasing, and it was documented to be increasing by as much as 3 percent per year between 2006 and 2015. [41] Specifically, in older men, melanoma has a higher rate of increase; it has increased by 4.3 percent per year between 2002 and 2015. [41] To quickly highlight non-melanoma skin

cancer, more than 2.8 million new cases of basal cell carcinoma, and 1 million cases of squamous cell carcinoma are diagnosed annually in the United States. Those non-melanoma cancers alone end up costing the United States approximately 8.1 billion healthcare dollars each year. [42, 43]

Research has shown that there is a relationship between sunburns, also called erythema, and the skin cancers malignant melanoma and basal cell carcinoma. [44] Sunscreen increases the ultraviolet radiation dose required to stimulate erythema, and to measure sunscreen efficacy there is a sun protection factor number given on the products label. It has been shown that most people overestimate their protection level with most sunscreen, because they use less than the effective dose, which leads to less than the labeled sun protection factor. [45]

A recent study by Young et al shows that high sun protection factor sunscreen can protect against DNA damage in the skin. [46] This damage can be caused not only by natural sunlight but high doses of artificial sun-light. It is even protective when the sunscreen is used less than optimally, for instance when applying only one-third of the recommended thickness. [46] They found that DNA protection was dependent on sunscreen application thickness, and that DNA protection was shown under both acute and repeated artificial sunlight exposure, in addition to natural sunlight. Overall, the data suggests that sunscreen use is likely to reduce skin cancer incidence. [46]

Interestingly, another study, the Ou et al. study, showed a linear relationship between actual sun protection factor, and application density. [47] They also found that sunscreens with sun protective factor (SPF) of 70, or above, were able to provide

significant protection even at a low level of application, or if unevenly applied which is common in public practice. For SPF 70 sunscreen, when under applied, there still was enough protective factor (averaging an SPF of 19) which meets the minimum levels recommended to prevent skin photodamage and skin cancer. Ultimately, when using SPF 70 sunscreen that is broad spectrum, there is an extra margin of safety by providing enough protection however unevenly it is applied by the general public. [47] Adding to this, a large population-based study recently reported that use of sunscreens with SPF greater than or equal to 15 reduced the risk of melanoma by 30 percent. They further found that when women 40 to 75 years old used greater than SPF 15 sunscreen their decrease in melanoma was 18 percent. [48] This suggests that if people are able to successfully add SPF 15, or more thickly applied sunscreen all over their skin, there is a real significant decrease in melanoma. Another study from the University of Sydney focused on young adults. They found that people who are between 18 and 40 years old, who regularly use sunscreen, are 40 percent less likely to develop melanoma. [49] Therefore, no matter what age, sunscreen use has been found to reduce melanoma risk.

Williams et al. found that individuals experiencing homelessness spend large amounts of time outdoors; this finding is worrying when associated with Wilde, Jones, Lewis, and Hull's 2013 study, that homeless individuals often do not use sunscreen. [52, 54] These studies also agree with Joseph et al's report that over half, 52 percent, of individuals reported being in the sun often, yet only 21 percent reported the use of sunscreen. [39] There was a low use of sunscreen even though most individuals believed sun protection was important. They also found that they were less likely to believe that

they were at risk for skin cancer. This is alarming because skin cancer morbidity and mortality are higher in people of low socioeconomic status, thus should be a major health concern for the homeless population. [50, 51] In keeping with these findings, other studies have identified various skin cancers, and poor preventive practices, among this susceptible group. [51, 52, 53, 54] For example, Wilde and colleagues found during their screenings, 13 patients with cases of skin cancer out of the 62 homeless patients screened, as well as low use of sunscreen. [51, 52]

Skin cancer education and prevention, while important for everyone, is even more vital for the African American population. African American individuals' melanoma-specific mortality is higher than other races or ethnicities. [54, 56] Concordantly, Joseph et al. found that black homeless men were less likely to know, than other groups, that people with darker skin could get skin cancer and that sunscreen should be applied 15 to 30 minutes before sun exposure. [39] They also found that there was a lack of knowledge of practices that can prevent skin cancer, and the warning signs of skin cancers. Skin cancer education should be incorporated at all of the facilities that homeless individuals are most likely to visit. This will increase overall knowledge, promote skin cancer prevention practices, and decrease disparities. [51]

One intervention to help prevent skin cancer, and increase overall use of sunscreen, is to dispense sun screen in a continuous spray form. Traditional sun screen necessitates that people apply, and rub in, large amounts of white thick lotion to their skin, and have to reapply it later making it inconvenient and messy. "It can be hard to reapply lotion over and over again, and the tendency is not to do it," says Perry Robins,

president of the Skin Cancer Foundation and clinical professor at the New York University School of Medicine. Traditional sunscreen also can wear off more easily due to sweating and swimming, while spray sunscreens are usually waterproof. Additionally, continuous spray sunscreens coat the skin evenly with a clear mist, which does not have to be rubbed in. They are even more advantageous to help to cover hard to reach areas, and apply sunscreen without the need for anyone else's help, as you can easily use the spray bottle at any angle. [57]

While no formal studies have been done currently, dermatologists report that their patients are more likely to use, and reapply the spray form of sunscreen. When their patients use this type of sunscreen, they are also more likely to cover all of their body, rather than just the easier to reach areas like their shoulders. So, the increased ease of use of spray sunscreen leads to more use of sunscreen, and more sunscreen coverage on patient's bodies. Overall, Dr. Martin A. Weinstock, chairman of the American Cancer Society's skin cancer advisory group, and professor of dermatology at Brown University, notes that "When you choose a sunscreen, choose one you like so you actually use it." [57]

Overall, to reduce skin cancer incidence there is a need to decrease the risk factors. For people who are homeless, there is a certain amount of risk that they cannot alter very easily, like their excess time being outside in the sun. Certain sun protective outwear like hats, sunglasses, or special clothing, are valid suggestions, but may not be readily available to homeless individuals. Suggesting that homeless individuals stay in the shade is also not effective, because ultra violet radiation can be reflected from the surrounding environment, especially from the ground. Ground covered by grass has a low

2 percent UV reflection, while concrete has approximately 10 percent, sand is up to 30 percent, and snow has an amazingly high 90 percent reflection of UV. [58] So, no matter what environment people live in, whether it has sand or snow, they are exposed to more UV radiation than they are aware of, even in the shade. Therefore, the seemingly most all-encompassing and cost-effective intervention for the public to endorse, and most effective in terms of timely prevention for the individual, would be to provide the homeless population sunscreen in a spray form with an SPF above 70.

2. Tooth Decay and Loss

Oral health specialists have been known to say, "the mouth is the window to general health," this is because the mouth is often the entry point of pathogens. These pathogens eventually enter the bloodstream and effect the rest of the body. The mouth contains more than 700 species of bacteria that can double in a few hours, if left undisturbed. As bacteria multiply, they form a biofilm, previously called plaque. Biofilm then becomes the major cause of periodontal disease. [59] Oral infections, specifically periodontitis, have been associated with many diseases such as diabetes, cardiovascular disease, respiratory infection, metabolic syndrome, and rheumatoid arthritis. Specifically, diabetes, cardiovascular disease, and HIV infection also make individuals more susceptible to infection, such as severe periodontal disease. Additionally, if people are missing even a few teeth, it increases the risk of systemic disease such as cardiovascular disease, diabetes, all-cause mortality, and metabolic syndrome. [55, 74, 99] Moreover, as people age, they naturally become more susceptible for developing both oral and systemic disease. [59] Poor oral health then often leads to pain, problems chewing, tooth

loss, speech problems, and both the reduced intake and enjoyment of food. [60, 61, 192] Consequently, it could be a modifiable determinant of malnutrition, because people may not be able to maintain an appropriate level of food intake, or because of the increased tendency to select softer foods, and avoid nutritious but harder to eat fresh vegetables and fruit. [273]

Besides physical health effects, there are negative effects to self-esteem, social relationships, and enjoyment of life. [192, 274] This leads to increased reports of poorer general health and more depressive symptoms. [99, 276, 277, 278] Yet another clinical importance of oral health is due to a relationship between poor oral hygiene and aspiration type of pneumonia specifically. [62, 61] This relationship results from poor oral hygiene increasing the volume and infectious nature of secretions from the mouth and throat. [61, 63]

In order to try to stave off the development of disease, regular dental visits have always been recommended. In fact, statistics show that receiving dental care is advantageous because it can help reduce medical costs by up to 2800 dollars per year. [64] In modern dental health practice, the major focus is on prevention. They focus on preventing caries, also known as cavities, and periodontal disease. It has been found in several studies that the accumulation of plaque leads to the development of both caries and periodontal disease. [65, 66] In recent years, there has been a reduction in the general population's incidence of caries and periodontal disease, which is believed to be due to a mix of multiple factors. These include procedures performed in dental offices, along with enhanced oral hygiene, the use of fluoride, and dietary changes. Though some studies

argue that care in the dentist's office accounts for only a small part of the decline in caries prevalence. [67, 68]

Completing regular oral hygiene practices can be difficult in the situation where a person becomes homeless. Besides irregular access to clean running water, the cost of a toothbrush and toothpaste has led them to be viewed more as luxuries rather than essentials. [69, 70] As a result of the low priority given to oral hygiene, research indicates that homeless people have poorer oral health and experience higher levels of dental caries and periodontal disease than the general population. [71, 72] In one study, they found that two thirds of homeless people had clinically significant dental problems. [4, 73] The prevalence and severity of oral disease in the homeless population paired with a lack of access to dental care is worrying. The situation becomes self-reinforcing, since major treatments are expensive, and the price is unrealistic for homeless individuals, therefore they postpone or avoid treatments which leads to even worse dental disease. Thus, the goal is to decrease oral health issues in the homeless population. If there are less people with dental disease, and if the severity of the disease declines, fewer and less expensive dental treatments will be needed. Also, if oral problems can be solved, or even better prevented, they will have an increased oral health-related quality of life. That might lead to more hope for re-entering society, establishing a job, and may be the motivation for starting to get independent of other health risking behaviors, like using cigarettes or illegal drugs.

Dental care for the homeless is mostly limited to emergency visits, and used for relief of pain. [75] In one study, 45 percent had pain or infection as a result of untreated

dental issues. [76] The number of dental issue related ER visits nearly doubled from 2000 to 2010. [30] The cost of treating patients with dental conditions at ER's ranged from 867 million dollars to 2.1 billion dollars over that same period. [260] Most dental issue related ED visits are for nontraumatic conditions, that could have been successfully treated in a regular dental office setting. [261] These non-traumatic patients only receive palliative care, through pain relief/analgesics or antibiotics, rather than dental procedures in the ER. [31, 259] Thus, going to the ER for dental issues only helps temporarily, but it does not fully address the problem.

More than half of homeless individuals studied reported not to have seen a dentist in more than ten years. [70] These figures are not surprising as it is hard for individuals who are homeless to sustain continuity of care, to attend appointments made in advance, or to just keep participating in oral health beneficial activities. [70] Prevention appointments alone usually require a mailing address to send reminders to, and a consistent phone number in which to reach the patient, both of which can be difficult for homeless people to gain and maintain. There are some mobile clinics, dental fairs, and community resources that are available for homeless people to get some basic dental care but the demand significantly outweighs the availability. [75] Additionally, specialists like surgeons are often not involved in the free or reduced cost dental clinics, so more complicated or involved dental care is even harder to gain.

Even if they do not attend regular dental visits, most people will practice oral health care by brushing their teeth. The removal of dental plaque by hand plays an important role in oral health maintenance through the prevention of caries and

periodontal disease. [66, 77, 96] In fact, the frequency of teeth brushing showed an inverse association with risk of oral cancer. [80] Several studies also suggest that tooth brushing twice or more daily is protective. [78, 79, 80, 81] In accordance with this, Ledder et al. found that there is a significant, ($p < 0.01$), distinction between brushed and un-brushed surfaces when measuring for the removal of simulated plaque. [66] Ledder also found that new toothbrushes removed significantly, ($p < 0.05$), more plaque and controlled gingivitis, more than worn brushes. [66] Besides cleaning ability, worn toothbrushes have been reported to harbor potential oral pathogens including *Streptococcus mutans*, which leads to further tooth decay. [66, 82] In addition to not being worn, studies show that subjects cleaned significantly better with medium and hard bristled brushes than with a soft-bristled brush. Therefore, brush filaments must have a degree of stiffness in order to effectively dislodge plaque deposits. [83, 84] Interestingly, Kumar et al. found that the mean tooth surface loss measured was significantly higher with the use of soft toothbrushes, when compared to medium and hard bristled toothbrushes. These findings are similar to findings by Teche et al., and Dyer et al. [254, 255] Together all these studies suggest that using a hard-bristled toothbrush is the most beneficial for overall cleaning and tooth health maintenance.

2b. Dentifrice

The use of a dentifrice, also known as toothpaste, in western societies is considered by most people to be an essential part of oral hygiene; and it has been recommended by the American Dental Association. Intriguingly, this is despite several studies that have found that brushing without dentifrice removes a significant amount of

plaque and other studies that show that using a normal and routine type of dentifrice does not lead to a greater plaque removal than brushing without dentifrice. [66, 85, 86, 87, 88, 89] In yet another study, Jayakumar et al. found that using dentifrice reduced plaque by 57 percent, but without using dentifrice there was a 66 percent reduction in plaque. [90] This 9 percent difference was found to be statistically significant. They suggest this difference could be a result of the dentifrice allowing for sliding, which may not allow the bristles to reach the tooth surface effectively. [85, 90] Overall, they concluded that dentifrice does not enhance plaque removal, and may actually lessen the effect of tooth brushing. [90] They do admit that there is some chemical plaque inhibition with dentifrice, but it is most likely from the detergents in the mixture. [90, 91] However, there are also reports about the harmful effects of the detergents, and the abrasives contained in the toothpaste can cause injuries to dental hard and soft tissues. Many studies demonstrate that tooth brushing with dentifrice is a factor in gingival recession and both tooth abrasion and wear. [89, 90, 92, 93, 94, 95, 97] The abrasion of the teeth occurs most commonly by breaking down the collagen matrix. Further, Kumar et al. found that abrasion was increased when toothpaste was used in conjunction with a soft bristled toothbrush. [89] They hypothesized that this was because soft toothbrushes have bristles with more flexibility, and therefore have more contact with tooth surface leading to more surface loss. Also, because the soft toothbrushes retain more toothpaste they cause more abrasion. To lend more support to their findings they also found that brushing with water caused very little abrasion when compared to a group which brushed using dentifrices. Similar findings were also reported by Tellefsen et al. [89, 98, 256]

If individuals are most concerned about cleaning their teeth, dentifrice is not needed, and may potentially be harmful because of the tooth abrasion. Some people may still opt to use it for the reduction of odor, and the feeling of freshness after use. Van der Sluijs et al. study also supports that use of a dentifrice is likely to be preferred, but it is not essential for cleaning. [100] Overall, everyone should be encouraged to brush their teeth daily with a hard-bristled brush, even if it is without water. It has been found that dry brushing is just as effective as brushing with a prewetted brush. [100] Ansari et al. also concluded that there was no significant difference between wet and dry brushing, in its capacity to remove plaque. They indicate that dry brushing could be an acceptable technique. [101] They further go on to suggest that water actually makes the bristles bend, and leads them to become ineffective more quickly. Even the finest nylon bristles are shown to lose their firmness, by up to 27 percent, when fully water saturated; therefore, the toothbrush becomes softer and less effective at cleaning than if it was applied dry. [101] For practicality, the first intervention that seems most helpful, is to maintain a constant supply of new hard bristled toothbrushes to distribute.

2c. Xylitol

There is one other intervention that can be suggested to help prevent caries and tooth loss. Xylitol and other sugar substitutes have been studied extensively. Xylitol has been used as a safe all-natural sugar substitute in foods for more than 30 years. [102, 103] It has been proven to have antibacterial effects specific for *S. mutans*, by compromising its metabolism and colonization. [104, 105] As stated before, this is the strain of Streptococcus that significantly contributes to tooth decay; so, inhibiting these bacteria would be helpful

in preventing tooth decay. Also, after a person chews xylitol gum there is a significant increase in the pH of the saliva in the mouth. [102] This is because xylitol reduces lactic acid production in plaque, and promotes an ecological shift, resulting in a less hospitable environment for the caries causing microorganisms. This is in comparison to what happens when sugar-filled gum is chewed. The sugar leads to a rapid fall in mouth pH, which ultimately leads to an increase in saliva microorganisms, and promotes caries. [102] Adding to this, bacteria in the plaque also produce acids which degrade the teeth, and the local reduction in tooth surface contributes further to caries development. [106] One other benefit was seen in more recent studies, Kumar et al. found that xylitol has a plaque reducing effect by attracting, and essentially starving, the harmful mouth microorganisms. [102] This action allows the mouth to re-mineralize any damage done to the teeth more rapidly, because there is less interruption. Then when teeth are mineralized, they are inherently more protected against the production of caries. [102]

Additionally, Scheinin et al. found in their study of xylitol that if you can substitute a person's entire sugar intake with xylitol, it can lead to dramatic caries reduction, essentially leading to no new caries which was seen in the group testing xylitol. [107] This is impractical in practice for most people, and could potentially lead to digestive distress, so replacing all sugar is not a suggested tactic. [105, 107] Next researchers completed controlled studies which demonstrated that several exposures daily to high content xylitol chewing gums, or other xylitol candies with a high content of xylitol, when holding the rest of the diet the same, significantly inhibited caries prevalence and incidence. This effect is not only due to the increase in salivary flow and saliva buffers

inherent when chewing sugar free gum. This is shown by another controlled study that included gum of high content sorbitol alone, and gum with other sugar substitutes in combination with xylitol, in which they demonstrated a xylitol dose-response efficacy. So simply changing the sugar substitute, which also increases saliva and buffers in the mouth, did not have the same effect as xylitol. [105, 108] The reason that gum with xylitol has been focused on in so many studies, is because gum has a mechanical cleaning action on its own, which pairs well with stimulating the production of more saliva, leading to further anti-cariogenic benefits inherently. [102, 109] Lastly, to prove xylitol's safety and benefits, studies have been done giving mothers xylitol gum to chew daily postpartum. It was found that their three-month-old infants experienced delayed colonization by *S. mutans*, and dramatically lower levels of caries at both five and seven years old. This occurred even though the mothers stopped chewing the gum when their children were a little over a year old. [105, 110] This result has been confirmed in many other subsequent studies. [105, 111] This demonstrates the primary prevention of caries by preventing mother to child transmission of the major pathogens leading to caries. Thus, it can be concluded that xylitol helps with both the primary, and secondary prevention of tooth decay. [105] Therefore, the second intervention suggested would be to provide a regular supply of sugar free (xylitol) gum.

3. Lack of Access to Hygiene Facilities

People experiencing homelessness experience significant barriers to completing self-care and personal hygiene practices. There is insufficient access to free sanitation facilities among people experiencing homelessness worldwide. In the U.S. specifically,

the availability of free public toilets has significantly decreased in the last decade, which consequently reduces opportunities for homeless people to practice good hygiene. [112] Good personal hygiene is known to reduce risk of disease and improve mental health, but access to sanitation facilities and hygiene behaviors among homeless individuals has not been the focus of much attention. [112, 113, 114, 115, 116, 117] Only a few studies mention the availability of water, sinks, showers, toilets, or laundry facilities. While many studies cover high-income countries like North America and Europe, one might assume that these services are always available in shelter facilities. Shockingly, some studies did not find that to be true. One study found that water in U.S. shelters was sometimes cut off, and for handicapped residents, bathrooms and showers were not wheelchair accessible. [118, 119] As a result of these conditions, some shelter residents have given up on using the shelters bathroom, and one resident in particular was quoted stating they had not been able to take a shower in three months due to accessibility and safety issues. [118, 119] When mentioning safety issues, people may also feel uncomfortable and unsafe using the public bathing facilities, even if they are made available. [112, 120, 121] Besides feeling unsafe, because of a lack of funding and staff, shelters and other facilities may not have the most cleanly and disinfected facilities. [112, 122] Another recent study, though it was not based in the United States, found that there were water shortages, unhealthy water quality, dirty toilets, and lack of working laundry facilities in shelters. [119, 123] Moreover, for people who are homeless and engage in risky behaviors like heavy drinking, injection drug use, and just sleeping outdoors, they have a higher chance of reduced hygiene practices. Shelters will even often deny entry to individuals who appear to be under the influence of drugs or

alcohol, which can result in even less access to hygiene facilities among people with a substance use disorder. [112]

Reduced hygiene in homeless individuals combined with overcrowding, even in high-income countries, has been associated with the spread of a variety of communicable and non-communicable diseases. Infrequent showers and the laundering of clothes and blankets has been associated with increased risk of outer surface parasite (ectoparasite) infestation, like body and head lice, fleas, and scabies. In addition to causing discomfort, body lice can transmit infections such as Bartonella, Rickettsia, and Yersinia. Infections with these species can lead to long term negative health consequences, such as developing painful arthritis. [112, 124, 125] Reduced hygiene is also a risk factor for developing skin infections, the most notable being methicillin-resistant *Staphylococcus aureus* (MRSA). MRSA is transmitted in crowded environments through close contact, and homeless individuals experience elevated incidence of MRSA due to contact transmission within sanitation facilities, crowded living conditions, or from contaminated intravenous drug use materials. [112, 126, 127, 128] Infections like MRSA can then quickly become severe if people do not have access to regular healthcare. This leads to more severe and expensive types of treatment needed and delivered in emergency departments, where many people experiencing homelessness receive their only medical care. [112, 129, 130] These individuals also frequently require continued care in the ICU due to the advanced or life-threatening state their health issues have become. [35, 36]

For proper and thorough hygiene most people shower frequently. It has been found that around sixty five percent of Americans shower daily. The number is even

higher in Australia, over eighty percent. Interestingly though, in China about half of people report bathing only twice a week. The amount of showering per week seems to be a function of societal norms, and not about health per say. Showering daily could even potentially harm health. [131] Washing and scrubbing, especially with hot water, removes the oil and "good bacteria" which are normal and healthy to have on the skin surface. This is an even more prominent effect when people wash with antibacterial soaps. Antibacterial soaps disrupt the skin microbiota, which can foster the proliferation of bacteria that is even more resistant to antibacterial agents. Additionally, the human immune system has a need for some level of stimulation by normal organisms, dirt, and environmental elements. The immune system needs this to produce antibodies and immune memory cells. So, if someone is showering or taking a bath too often, the immune system might be negatively affected, which can allow infections and allergies to develop. This is one reason some pediatricians and dermatologists advise against daily baths, especially for kids. [131] So much bathing can also lead the skin to become dry, itchy, and irritated. Dry skin can lead to skin cracking, which allows bacteria and allergenic material to breach the bodies first line of defense, the skin. Lastly, a few people are starting to suggest that the water used for bathing may be contaminated with harmful chemicals, metals, pesticides and other unhealthy substances that have made their way into the water system. This contamination could lead to problems in the future, but no studies have been done about this issue at this point in time. [131]

None of the above reasons may be compelling enough to change people's minds about showering daily. Besides the health implications, bathing daily wastes a lot of soap

and more importantly water, unnecessarily. Experts suggest that showering a few times a week is plenty unless there is an unusual amount of dirt on the skin. They also say that showers lasting three to four minutes, with a focus on the areas that become the sweatiest, like groin and armpits, can be enough. [131] Homeless individuals lack of access to bathing facilities, even to use only as much as just suggested, this indicates a need for some type of intervention. The intervention suggested is to provide body/skin wipes for the time between bathing sessions. These wipes can help individuals to maintain a cleaner appearance which can reduce the stigmas associated with homelessness, and could potentially lead to receiving more services, gaining employment, and ultimately obtaining housing.

Odio et al. conducted four studies to demonstrate that disposable baby wipes were gentler on the skin, that the use of a cotton washcloth and water. [132] They consider wipes to be the "gold standard" for skin mildness. This is because they observed that wipes minimally disrupt the skin barrier, and therefore can be used on intact or irritated/compromised skin. [132] Wipes also have the ability to leave the skin soft and better moisturized. [133, 134, 135, 136] These studies are relevant for adults because they used adult skin for several of their clinical assessments, especially when the study called for wipes used on irritated skin. When skin was wiped more forcefully, wipes showed a statistically significant advantage in gentleness. In fact, when wiping multiple times with a washcloth and water, there was a detectible disruption in the skin barrier, unlike the wipes. If you were further to add soap and water to the washcloth, it was found to be even more aggressive in the disruption of the skin barrier. Tentative evidence shows that a

high frequency of soap and water use is associated with an increased risk of skin damage. [136, 137, 138, 139] Then if you further pair the soap and water with towel drying afterwards, there is another disruptive and thinning effect on the skin barrier. Lastly, it was found that the daily recurring use of wipes did not affect the skin repair process in irritated skin, but the use of washcloths and water caused a marked delay in skin repair. [132]

There is another complementary report by Lavender et al. that discussed the findings from one of the largest clinical trials on baby wipes versus using only water and cotton wool. They found there was no difference in skin hydration, skin pH, redness, trans-epidermal water loss, or microbes on the skin, between the two. [140] This is for those who may be concerned that wipes could cause skin dermatitis. Wipes ingredients have changed a lot over the last decade, and those associated with dermatitis are likely older formulations with non-optimal or non-allergy screened ingredients. [140]

In the past, soap and water have been used for hygiene, but recently it has been mostly replaced by disposable wipes. [141, 142, 143] Besides using wipes for children, many wet wipes are used in the hospital or nursing home setting for patients that are bedridden, and therefore cannot get up to shower. Veje et al. reports that cleaning with wipes was found to be for health reasons, social propriety, and just for pleasure. [136, 143, 144, 145] These cleanings are also viewed as necessary to improve the quality of patients' lives, and to maintain their social acceptance and overall well-being. [133, 144, 146, 147] They further consider personal hygiene a basic need. [148] This finding is supported by Veje et al, which found that their participants said that the type of bath was less important, than the overall need to be washed. [136] There seems to be a social stigma attached to uncleanliness and

odor in Western society, so there is the expectation that everyone bathes. [146] This explains why some participants in the studies expressed that they felt ashamed and disgusting because they felt odorous, if they did not wash every day. [136] If it is a basic need and expectation that people bathe, and we help people who are bedridden to do this, providing homeless people some type of supplies in order to maintain their hygiene is the kind and just thing to do

Participants in the Veje et al. study additionally discussed that wet wipes are a fast and easy type of bath, which can be less burdensome if someone has pain or an illness, so it is considered to be convenient. [136] Another important advantage to wipes is that they promote independence, as patients could wash themselves despite disabilities. Furthermore, the use of wipes seems more cost effective, and saves time compared to using washcloths, soap, and water, then having to wash the cloths. [136, 137, 149, 144, 150, 151] Additional studies found more positive feelings towards the use of non-conventional water bathing techniques. Some studies found that the people felt clean using the wipes, and would trade their soap and water for wet wipes. [133, 136, 141, 143, 152] Other people were found to prefer the wipes, and would even prefer to exchange washing with soap and water with wipes on a permanent basis. [133, 114, 143, 150, 152]

3b. Dry Shampoo

Another intervention to help with the lack of access to regular bathing is to provide dry shampoo. Human hair can be entirely unwashed, as it probably was for many generations in the distant past. Eventually a stable state of sebum distribution will be reached on the head and hair, but the interim state is not necessarily compatible with

modern sensibilities. [153] There is the other extreme where people wash their hair every day, or multiple times per day. This practice can strip hair of its natural oils, (sebum). Some sebum is healthy for us to have because it protects the scalp skin, and softens hair. [154] If maintaining healthy hair is of value, experts suggest using dry shampoo to extend the interval between traditional washes. They also indicate that dry shampoo allows a person to calibrate their hygiene and stay clean without losing their hairs natural oils, which keeps their hair looking healthy. [155]

Dry shampoo, despite its name, does not really cleanse the hair. It is made to soak up excess dirt and natural oils from the hair, and it then can be brushed out of the hair. It disguises the dirt and oil, making the hair look cleaner, and it leaves a nice fragrance, so a person can extend the time between when they are able to shower and wash their hair with regular shampoo. [155] It is a temporary solution, but it can be used a few times a week, if needed. This is particularly useful for people who have busy lives, and it allows the hair to feel fresh within minutes. [155]

Interestingly there is not much scientific research about dry shampoos long-term use and effects, but it in general has been around and safely used for many years. In fact, dry shampoo was developed prior to modern liquid shampoo. It was developed for a time when running water was not available in all homes. There is one additional modern benefit to dry shampoo use, using dry shampoo can help to extend the life of added hair color. This is because hair dyes fade with each wash with water. [156] Using dry shampoo is becoming very popular with many people, it is now seen as a normal practice. Beauty industry experts suggest that waterless beauty products, like dry shampoo, will be shown

to make an even bigger impact in 2019, after rising steadily over the past three years. [157] The global dry shampoo market was valued at about three billion dollars in 2016, and it is expected to reach over five billion dollars by 2025. Most people say they use dry shampoo for three main reasons, water conservation, convenience/time conservation, and a sense of cleanliness. [158] All of these things align with the obstacles that homeless people face: their lack of water access and competing priorities for time, but wanting to be able to feel a sense of cleanliness. Hair, even though it is technically dead, has a fundamental importance and significance in people's lives. If hair becomes visibly dirty or disheveled, people can feel a loss of self-esteem, social standing, and can lose opportunities like employment opportunities. [153] So, having opportunities to use products like dry shampoo, can have a substantial impact on people's lives.

3c. Hand Sanitizer

One last intervention, to help with the lack of access to washing facilities especially, is to provide hand sanitizer. Hands are the primary carriers of bacterial disease. [159] Hand hygiene is known to be a healthy and crucial measure that reduces infectious disease transmission. [160] In fact, interventions that improve a community's hand hygiene has been shown to reduce infectious disease rates. [161, 162] Failure to perform appropriate hand hygiene has been acknowledged as a significant contributor to outbreaks. [163] One of the main reasons people fail to comply with hand hygiene is irritated skin. Irritated or dry skin is also more challenging to disinfect, all of which leads to increased infection transmission. [164]

Traditionally, hand washing with soap and water has been the predominant means that people clean their hands with to prevent illness. Soaps are detergent based products which remove dirt and other organic materials from the hands, along with some transient flora, but have only a small amount of antimicrobial action. [163] Transient flora includes the bacterial growth that is not normally on a person's hands. The transient flora is considered contamination on the hands, and is most often associated with infections. Studies show there is typically a larger effect for reducing gastrointestinal illnesses than respiratory illnesses with hand hygiene. [162, 165, 166, 167, 168] Meta-analyses estimate that handwashing can reduce diarrheal episodes an average of 31 percent, and respiratory illness approximately 21 percent. [1, 169] Despite the proven effectiveness of handwashing, it is hard to encourage in populations that do not have regular access to soap and clean water. Considering the difficulties that certain individuals face, like individuals who are experiencing homelessness, an alternative means of cleansing the hands needs to be recommended. The most promising alternative to traditional hand washing at the moment is utilizing hand sanitizer.

Hand sanitizer has several benefits compared to washing with soap and water. First, it does not require water, it also requires less time to effectively clean, and it does not require the hands to be dried. [169, 170] CDC guidelines for hand hygiene recommend alcohol-based sanitizers for routine decontamination of hands, except in cases that the hands are visibly soiled. [163, 257] Some studies have shown that hand sanitizer is at least as effectual at reducing bacteria and viruses as washing with soap and water. [161, 169, 171] Other studies suggest that hand sanitizer is even better at reducing the number of bacteria

on hands, then the use of typical liquid soap. [159] This method of hand cleansing removes and destroys transient microorganisms but also reduces the resident (normal) flora on a person's hands. [163] One relevant study demonstrated the reduction in bacteria by showing a group of children at school given hand sanitizer has 23 percent less respiratory infections, and 30 percent fewer antibiotic prescriptions compared to the control group not given hand sanitizer. Interestingly, the children given only soap and water had a 21 percent higher risk of respiratory infections than the hand sanitizer group, and the children given hand sanitizer had the fewest sick days out of all of the groups. [278]

The formulation of the hand sanitizer makes a difference in people's usage. Whether the sanitizer is in the form of a gel, foam, or liquid, its sensory properties moderate acceptability. Greenaway et al. found that the gel and foam formats were more desired than the liquid. The key properties that influence this opinion include: fast absorption, soft/moisturized hand feel, not being sticky, feeling clean, and low smell. Between gel and foam sanitizer, foam was found to provide the combined benefits of a liquid and a gel, which may lead to the greatest hand hygiene compliance. [164] The study also found that participants mentioned past issues of having sticky residues left on their hands after sanitizer use, which may still be influencing people's usage behavior today. Besides the formulation of the sanitizer, location of the dispensers makes a difference. The Cure et al. study found that the accessibility and visibility of dispensers has an impact on hand hygiene practices. [247] The more accessible and visible, the more people are apt to use them. It would then be advantageous for hand sanitizer dispensers to be put in highly visible areas which homeless individuals frequent. It will reinforce the

importance of the use of sanitizer, and provide a source of more sanitizer than can be contained in the small personal bottles. Along with wall dispensers, small bottles of hand sanitizer, the kind that attach onto the outside of bags or backpacks should be given out. Therefore, the sanitizer becomes more visible and accessible wherever a person goes, especially when they encounter a lack of hand washing facilities.

4. Food Insecurity/Malnutrition

In a developed and prosperous nation, like the United States, it can be surprising that hunger is still an issue. Curtis et al. found in their research that malnutrition was common among shelter clients. [119, 172] Another New York study found that approximately one third of homeless shelter clients had obtained less than two thirds of the recommended number of calories during the previous 24 hours. [15] In the 1996 National Survey of Homeless Assistance Providers and Clients, 19 percent reported they went one or more days in the previous week without anything to eat, and 40 percent went a whole day in the previous month without anything to eat. Less than half of the persons interviewed reported eating the recommended three times a day. [15] Even though food insecurity is not universal among homeless individuals, they are much more likely to experience food insecurity compared to housed individuals. [173, 174, 175] Potential reasons for the higher food insecurity among homeless adults include the inability to purchase food, not having access to cooking and food storage facilities, and being unable to get foods that meet their dietary needs. [176, 175, 177, 178, 179] These obstacles to eating a healthy diet can then lead to the development of unhealthy habits and preferences, such as preferring cheap, fatty, sugary, low quality, or high calorie food to be satiated even when

healthier alternatives may be available. [3, 180] Fruits and vegetables contain various nutrients, and numerous studies have shown greater intake is associated with better health outcomes. [181, 182] Thus, when it was found that greater food insecurity was associated with poorer dietary intake, including macro and micro nutrients, it is not unexpected that people with food insecurity will have poorer physical and mental health outcomes. [183, 184]

Individuals who are experiencing food insufficiency typically assign lower priority to health care in favor of directing available resources toward more basic needs, like obtaining food. [4, 21, 22] Therefore, food insecurity was found to be associated with impaired access to medical care and prescription medications. [4] This is also unfortunate because food insecurity has been significantly linked to negative physical health outcomes, including obesity, hypertension, and diabetes. [179, 185, 186] It has also been significantly associated with negative mental health outcomes, including depression and post-traumatic stress disorder (PTSD). [184, 186, 187, 188, 189] Food insecurity in the homeless population has further been associated with more psychiatric hospitalizations, and overall higher rates of both ER visits and medical hospitalizations, compared to the rates of homeless individuals who are food secure. [4, 179] These findings may not be surprising, since Hernandez et al. found that food insecurity can be a trigger that lowers a person's ability to withstand emotional distress, and therefore contributes to increased negative health incidences. [179] Moreover, Williams et al, found that despite the high level of physical activity homeless individuals obtain, the majority of homeless individuals were either overweight or obese. This is extra troubling given the increasing evidence that

associates obesity with cancer, so efforts must be made to provide nutritious meals to individuals who are experiencing homelessness. [54]

As a result of its ties to mental and physical wellbeing, provision of adequate food services to the poor and homeless should be a public health priority. [4] Studies have shown that it is important to understand the food likes and dislikes of the local homeless population in order to try to provide nutritious, familiar, and comforting foods. [190] Culturally appropriate foods, and the portability of those foods, are also important factors to consider when making food available to homeless adults. [179] Bowen et al. found that the odds of food insecurity were reduced by 8 percent for each 100 dollar increase in monthly income. [191, 248] Most people would not advocate giving out hundreds of dollars to each homeless person in order to reduce food insecurity, so the suggested intervention is to provide a variety of fruit, vegetable, and other nutritious food options at locations that homeless individuals frequent. For example, fruit, in dried or juice form, can be provided easily at services designed to support the homeless. This could be offered in shelters, soup kitchens, food pantries, and any other common service or meeting area. This intervention could further be delivered via peers recruited within homelessness services, who could more comfortably ask about how other people experiencing homelessness obtain food, and when and how they eat. They then could advise others about better and worse food choices, even when the selection may be limited. [9] Homeless adults have been found to be more likely to make healthy choices if their self-efficacy is increased through encouragement by a peer. [180] This peer advisory structure could allow for many such

health improving interventions in a successful and cost-effective way, with high potential benefits.

5. Foot Problems

Foot issues are common among homeless persons, but are often overlooked and inadequately treated. [193, 194, 195, 196] Up to two thirds of homeless individuals report a foot related health concern, but only one quarter visit a healthcare provider. This could be a result of embarrassment at the poor condition of their feet, shoes, or socks, that 63 percent of homeless people cited had deterred them from seeking care. [196, 197] Of those people that receive care, one-fifth require more follow-ups due to the severity of their conditions. [196] Being on one's feet all day, along with a lack of enough clean and dry socks, or access to properly fitting shoes, all increase the risk of problems, or make existing problems worse. [9] As Dr. Hwang notes; "Disorders such as onychomycosis, tinea pedis, corns and callouses, and immersion foot are usually the result of inadequate footwear, prolonged exposure to moisture, long periods of walking and standing, and repetitive minor trauma." [193, 195, 201] Walking is the primary, or sometimes only, mode of transportation for numerous homeless people. One study found that 74 percent of homeless individuals were on their feet 5 hours or more each day. [198] Another study found that homeless individuals walked a median of 5 miles per day. [196, 197] These practices can lead to foot pain. In fact, one study found that more than 50 percent of the homeless people studied had foot pain, with 12 percent reporting to be in constant pain. [196, 198] They also can lead to an increased risk of injuries and repetitive trauma. Without proper care and rest, the trauma and fractures sustained often lead to foot deformities. [199,

[200] Conditions such as frostbite, gangrene, and trench foot, also occur due to lack of shelter and prolonged exposure to moist and cold environments. [195, 199] Immersion/trench foot was observed in 5 percent of people studied. This may be a result of the 13 percent of people who reported that they could not really tell if their feet were dry or wet. [194, 196]

Foot infections were also highly prevalent among the study population and regularly led to hospitalization for limb or life-threatening infections. [3, 125, 195] Prevalence of pitted keratolysis, a bacterial skin infection of the feet, was 20 percent and nail onychomycosis was reported at 15 percent. [196] Cellulitis, a skin infection, was also found in several studies. [199, 196, 202] Foot pathologies related to chronic diseases such as diabetes were also identified, and led to further complications. [196] Arnaud et al. found that 41 percent of homeless individuals with diabetes had difficulty walking, 42 percent had loss of foot sensitivity, 43 percent had permanent reduced mobility, and 17 percent had to have a lower limb amputation. [196, 258]

Lack of access to clean socks and properly fitting shoes can cause and worsen existing foot problems. [195, 196] Homeless individuals have been found to be more likely than their housed neighbors to have improperly-fitting shoes. [203, 204] Macnee et al. found that 33 percent of homeless individuals who presented at a foot screening clinic did not have shoes that fit. [204] Schwarzkopf et al. found that 43 percent of homeless men had a shoe size mismatch of greater than 1 size, and 17 percent had a shoe size mismatch of greater than 1.5 sizes. [203] Another study found that only 61 percent of homeless participants changed to a clean pair of socks daily. [196, 198] These individuals may simply not have the resources to change their socks every day, or to maintain good foot hygiene.

Supplies like clean water, soap, towels, nail clippers, and files are needed. [197] One study found that only 68 percent of homeless individuals had access to clean water, 70 percent to soap, 56 percent to a towel, 44 percent to a nail clipper, and 31 percent to a nail file. Medical providers should ensure that individuals have access to these essential foot care items. Also, ensure they have clean socks and properly fitting shoes, which could lead to a reduction in foot problems, and overall improved mobility. [196]

The above findings highlight the need for evidence-based interventions to improve foot health in the homeless population. [196] The only current interventional study found was for diabetic individuals with ulcers. They were treated with wound care, antibiotics, and analgesics, for about a year. [198, 205] They also importantly received protective footwear. Eighty six percent of participants had significant improvements. Some even had completely resolved issues. This suggest that a multifactorial interventional approach can be effective. [196] Thus, suggested interventions include having foot care professionals come to properly size people for shoes. Or, to train volunteers on how to properly size people for shoes. Then, to provide properly fitting shoes, and at the same time provide a supply of clean socks. Also, to inform people that they should try to take off their shoes and socks at night, to allow time for drying, and to wear flip flops in public showers to prevent tinea pedis. This would also be a great time to have foot care and cleansing supplies available, and medical providers to come look at and address foot health concerns.

6. Infectious Disease

People who are homeless are at risk of contracting multiple infectious diseases like Hepatitis A, B, and C, HIV/AIDS, TB, and more. This is due in part to less robust immune systems, poor nutrition, poor hygiene, sleeping outdoors, IV drug use, sex for survival, and overcrowded conditions. Combining this with the multiple barriers many homeless people face in getting healthcare to treat their conditions, makes avoiding infectious diseases in this population challenging. [17] It was found that one out of every five vulnerable individuals who attended a Health Care for the Homeless clinic was found to have an infectious or communicable disease. [73, 206] Injection drug use further dramatically increases the risk of certain diseases like HIV, viral hepatitis C, and skin and soft tissue infections. [207, 208, 209, 210, 211, 212, 213] Torres et al.'s 1990 study found over half of their homeless subjects reported active drug use. [119, 245] Studies also indicate that the prevalence of HIV among the homeless is up to as much as two-thirds, with some subgroups, like young Hispanic or Black individuals, having much higher infection levels. [206, 214] With all of this together, it is not surprising that more homeless people die of AIDS, than any other HIV-infected population. [215]

Harm reduction organizations focus on reducing the adverse effects of substance use, including overdose, addiction, and infectious disease. In the spirit of harm reduction, one way to significantly reduce infection would be to intervene and provide clean supplies to IV drug users. The first way to do this would be to advocate for a Needle Exchange Program. Sharing drug injecting equipment for the administration of intravenous drugs is common, and has been implicated in the transmission of blood borne

viruses like HIV or Hepatitis C. [216, 250, 252] Syringe services programs, that provide sterile syringes and equipment, have noticeably reduced HIV and HCV transmission among people who use drugs. [34, 169, 213, 217, 218] People who inject drugs represent approximately 9 percent of new HIV diagnoses despite being only an estimated 0.3 percent of the population in the U.S. [219, 220] Between 2010 and 2014, reported Hepatitis C infection increased by 158 percent, attributed in large part to the rise in injection of heroin and other opioids. [221, 199, 222, 223] Increasing access to sterile syringes has been proven as an effective strategy to reduce transmission of HIV, and many other blood-borne pathogens. [224] Having locations where people can obtain clean syringes allows for the opportunity to introduce people to other needed services such as medical care, disease testing, or connecting them to social services.

There are some reported difficulties related to the location of such exchanges. [225] Some people are against exchanges being in their city, and for the patrons there is reduced utilization if the exchange is too close to a police station. There is also reduced, or less regular, utilization if the locations are perceived to be too far away. One way to expand services, and reach a wide range of users, would be to implement a mobile needle exchange program. [225] To date, all of these needle exchange programs rely on grants and donations to fund the purchase of syringes. This limits the number of syringes that can be purchased and distributed, despite a recent increase in the number of people participating in syringe exchanges. [225] Also, if there is not police cooperation, even clean needles can be confiscated under drug paraphernalia laws, and people can potentially be arrested.

Recent studies show, there is an increase in syringe sharing when people have been arrested before for possessing needles. [225, 226]

6b. Non-needle Supplies

As a result of legal restrictions, and some negative public opinions regarding needle exchanges, another intervention to consider is to offer non-needle supplies. The self-reported sharing of drug paraphernalia is high, no matter the setting or population studied. Several studies have concluded that up to 84 percent of intravenous drug users report sharing drug cookers, filters, and water. [216, 227] The evidence relating to the risk of transmission associated with sharing injecting paraphernalia is limited. [216, 228] Even so, the theoretical risks of transmission through this route have been recognized for over a decade. [229] Several studies have highlighted numerous opportunities for cross contamination to occur when individuals share drug preparation equipment other than needles. [230, 231, 232, 233] For example, it has been shown that isolated Hepatitis C Virus RNA can be isolated from equipment including spoons used as drug cookers, filters, and water samples. [11, 216] This is particularly concerning because the sharing of cookers, filters and water, is reported to be much more common than the sharing of needles. [216]

6c. SPOT Programs

Another intervention that could potentially be even less controversial than providing supplies, is to implement a SPOT program. SPOT stands for a Supportive Place for Observation and Treatment. [262] This is a program that helps to combat fatal overdoses in people misusing drugs. This type of service is urgently needed because the United States is in the midst of an ever-increasingly fatal opioid crisis. In fact, overdosing

on drugs is the leading cause of accidental death in the United States. [263] Since the year 2000, the crisis has taken more than half a million lives. [263, 264] There also has been a documented tripling in overdose mortality rates per year in the U.S. between 1999 and 2014. [265] This growing overdose crisis is only further straining the already over-taxed health care system and in turn the economy. [213] One example of this shows that ED visits involving prescribed drug misuse have risen more than 100 percent, along with illicit drug use increasing by more than 33 percent, between 2004 and 2011. [213, 266] Overall, the economic burden of opioid use has been estimated to be as much as 500 billion, as recently as 2015. [213, 267] This is even more relevant to homeless individuals because people who are experiencing homelessness have been disproportionally affected by the opioid crisis. The Niagara Point-in-Time Count recently identified that 36 percent of homeless individuals polled reported an addiction, this is even more than the 34 percent who reported a medical condition. [9, 15] Another related study indicates that homeless adults had a drug related overall death rate up to 17 times higher than the general population. [268]

The main focus of SPOT is harm reduction through monitoring the vitals of people who have already injected drugs and are at risk of overdosing. This is not a place where people are allowed to take illegal drugs, but a place to medically monitor those people who already have taken them. If there are signs of an overdose, medical providers can rapidly intervene with naloxone, an opioid reversal agent, and supplemental oxygen. [269] This then reduces the harm that people could come to when by themselves, on the street, sedated, and at risk of overdosing. Overall, the program aims to reduce the

alarming number of fatal opioid overdoses. Also, they can engage individuals, who are at high health risk by using drugs, in the healthcare system. This allows for treatment, and importantly trust to develop, which gives providers the opportunity to pass on information about safety practices, and other services to help treat those who are addicted. This program has been successfully established in Boston, in partner with Boston Healthcare for the Homeless. It has helped to engage and care for an often hard to reach, and high risk, population. [262] Additionally, for the community, it has been shown to reduce the number of over sedated people in public by a significant 28 percent. [262]

DISCUSSION

The importance of tangible goods has long been recognized as "non-cash" income, for instance the value of housing provided by the government. If people lack a good that is required for their health and well-being, one of the simplest responses is to provide it for free. This approach underpins many governmental and non-governmental programs which regularly devote substantial resources to distributing goods to people in need. [234, 235, 236, 237] Providing people with free goods complements other efforts to promote health and wellbeing, such as providing healthcare services, and receiving a basic income. [234, 238, 239, 240] The receipt of free tangible goods also frees up some of the limited income or resources that people would otherwise spend in obtaining those goods. This additional income may result in improved health because it allows access to goods that can improve health, such as safe shelter, healthy foods, clean water, and essential medicines. [234] For example, a related study that included poor households, in a location where diarrheal illness is a large public health concern monitored families that received either bleach, hand washing supplies, or flocculant-disinfectant (which is a disinfectant powder used to clean water). This study concluded that receiving any of the free goods, along with a presentation about the importance of hygiene and water contamination, reduced the daily prevalence of hygiene-related diarrhea in participant families. [241] This is just one study that demonstrates how a free tangible good can improve the health of a community. [234]

Moreover, if poverty is defined partially as being unable to afford tangible goods and services, then examining the impact of free good provision on health, describes the

effect of poverty reduction on health. [242] Then this information can be considered alongside studies of other interventions aimed at reducing poverty, such as a basic income. [239, 240] Being able to have certain tangible goods can further be understood as fulfilling a basic human right, such as the right to housing, or the right to have healthy food and clean water. [243] Then providing such goods could also be seen as helping to achieve social justice, having positive impacts on both the individuals and their communities. [234]

A potential concern is that giving out free goods is not a suitable idea because people will not use them, or may sell them. One study that addresses this concern involved women with young children in Uganda, who were provided with free long-lasting treated mosquito nets. [244] Seventy-three percent of women who received the free nets were unwilling to accept the premium price they were offered in order to part with the nets, even one of their nets. Thus, most people who were given free mosquito nets were unlikely to resell them, and used them for their intended preventative health purpose. [234, 244]

This paper addresses ways to improve the overall health of homeless individuals and concludes that providing needed supplies to intervene and prevent health issues, or the worsening of existing health conditions, may be the best way. This idea is echoed by a journal article that said, “Any attempt to address the health care needs of the homeless must take into consideration their unmet needs [such as] food, clothing, shelter, and bathroom facilities.” [22]

Overall, individuals who are experiencing homelessness experience a variety of complex medical conditions that are only compounded by limitations, usually not self-imposed, in their ability to properly care for themselves. [34] While their needs are broad and multidimensional, there are some common health problems that homeless individuals face including higher instances of skin cancer, caries, tooth loss, infections, and more. Most homeless people have at least one, and often several, chronic diseases, yet often our health systems are focused on the episodic treatment of chief complaints at a given moment in time. [9]

In this thesis it was found that the most practical and scientifically backed interventions to help are: sunscreen that is in a spray form with an SPF above 70, hard-bristled toothbrushes, xylitol gum, body/wet wipes, dry shampoo, hand sanitizer, healthy and nutritious foods, properly fitting shoes, clean socks, needle exchanges, and/or non-needle supplies such as filters. These supplies can improve the health of individuals and ultimately the community. The supplies may also reduce long term suffering for many people, and may reduce public health costs. The most often recommended strategy for cost containment is to focus resources on the small proportion of patients who account for the vast majority of health care spending. [246] This concept of targeted intervention is part of our recommendations.

To implement these changes, we suggest including peers in the distribution of supplies, information, and awareness, at least in the beginning. These peers could be currently homeless people, low income individuals, or people that have been able to make their way out of prior homelessness. We suggest this because developing positive

relationships is one facilitator to homeless individuals getting healthcare. This may be easier with peers, because there is some mistrust in health care providers and possibly the whole healthcare system, which is a barrier. If people develop these positive relationships, this increases the chances that homeless people will seek further care in the future. It also discourages the view that health care is just "big business" and its' providers are only financially motivated. [270, 271, 272]

Additionally, the distribution of services and supplies should meet these individuals where they already are, co-locating them where people already congregate. This means setting up at locations frequented by the homeless population in order to help the most people, some of which may not actively see out help if it is out of the way or inconvenient. These places may be food pantries, methadone clinics, shelters, walk in healthcare clinics, bus stations, or any local gathering spot. Co-locating services and making them easily accessible also helps reduce time and travel constraints, so those are no longer barriers to receiving needed healthcare. Additionally, this strategy may prove to use the often-limited resources efficiently.

The limitations of this thesis include that we did not gather significant data on how receptive homeless individuals are to these specific interventions, or formally discuss with them, and document, what supplies they would prefer to use. Overall, the homeless population is an underserved but medically complicated population, so it is not surprising that little research has gone into studying immediate interventions to help these individuals. Involving the homeless population in further research studies will be important for ensuring that all members of our society receive the quality and quantity of

care they deserve. In the end, it is important to emphasize the need to combine the health effects of food, housing, services, and practical interventions, in order to best help improve the lives and health of people who are experiencing homelessness.

LIST OF JOURNAL ABBREVIATIONS

AADE in Practice	American Association of Diabetes Educators in Practice
Acta Odontol Scand.	Acta Odontologica Scandinavica
AIDS Behav	AIDS and Behavior
Ann Intern Med	Annals of Internal Medicine
Australas J Dermatol	Australasian Journal of Dermatology
BMC Geriatrics	BioMed Central Geriatrics
BMC Pediatrics	BioMed Central Pediatrics
BMC Public Health	BioMed Central Public Health
BMJ	British Medical Journal
Curr. Opin. Microbiol	Current Opinion in Microbiology
Dent Clin North Am	Dental Clinics of North America Journal
Eur Arch Psy Clin Neurosci.	European Archives of Psychiatry and Clinical Neuroscience
Int Dent J.	International Dental Journal
Int J Dent Hygiene	International Journal of Dental Hygiene
J Am Dent Assoc.	Journal of the American Dental Association
JAMA	JAMA: The Journal of the American Medical Association
J Am Acad Dermatol	Journal of the American Academy of Dermatology
J Acquir Immune Defic Syn.	Journal of Acquired Immune Deficiency Syndromes
J Am Podiatr Med Assoc	Journal of the American Podiatric Medical Association
J Clin Oncol	Journal of Clinical Oncology
J Dent Res.	Journal of Dental Research

J Dent (Shiraz)	Journal of Dentistry Shiraz University Medical Sciences
J Foot Ankle Surg.	The Journal of Foot & Ankle Surgery
J Periodontol	Journal of Periodontology
J Viral Hepat	Journal of Viral Hepatitis
Photochem Photobiol Sci	Photochemical and Photobiological Sciences
Prog Biophys Mol Biol	Progress in Biophysics & Molecular Biology
Subst Use Misuse	Substance Use & Misuse

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