

2017

# The importance of preventative care in oral health promotion

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BOSTON UNIVERSITY  
SCHOOL OF MEDICINE

Thesis

**THE IMPORTANCE OF PREVENTATIVE CARE IN ORAL HEALTH  
PROMOTION**

by

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B.A., Brooklyn College, 2013

Submitted in partial fulfillment of the  
requirements for the degree of  
Master of Science

2017

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## **ACKNOWLEDGMENTS**

To my family, advisors, my readers, editors, and close friends. Thank you! I am grateful for all of your support in my education, and in life.

# **THE IMPORTANCE OF PREVENTATIVE CARE IN ORAL HEALTH**

## **PROMOTION**

**MARK YABLOCHNIKOV**

### **ABSTRACT**

This thesis aims to examine the current state of oral health promotion with respect to fluoridation, the impact that the lack of dental care has financially on the patient and the overall health system and a discussion of alternative options that could help to improve the current state of oral health care.

While acknowledging research and official reports that indicate dental caries as the most prevalent preventable health condition in the lives of children, this thesis is a literature review studying the positive and negative effects of systemic and topical fluoride on both adults and children. Exploring differing perspectives of fluoridation's benefits and efficacy as a preventative oral health care measure, including community water fluoridation and topical fluoride application, this thesis will examine its effects on dental caries nationally and internationally. Although the prevalence of caries has decreased, to date, no systematic reviews have addressed adequately the disparities between incidence, severity, and recurrence of dental caries especially between children and adults. Likewise, substantial research has not yet adequately addressed the differences found in children that may make them more susceptible than adults to over fluoridation through a combination of systemic, topical fluoridation and water

consumption.

The literature review also includes the breakdown of costs and cost-effectiveness of dental care, including factors that increase cost, as well as suggestions to shift towards an emphasis on preventative care in attempt to reduce overall costs. Improving access to care especially to the underinsured is discussed. Furthermore, a review of the dental therapist occupation utilized successfully in other countries is discussed as this could be a viable solution for the shortage of dental professionals in areas with minimal access of care here in the United States. This in turn may reduce the number of disparities in oral health care, by reducing the severity of oral health disorders that result from an increased delay or neglect in treating the onset of dental caries from a preventative perspective. The primary measure of impact reported in several studies reviewed was the reduction in advanced care restorations, including surgery, needed with increased preventative care measures.

Evidence of the effectiveness of preventative oral health care including systemic and topical fluoridation implementation and city-specific school-wide initiatives to administer dental sealants for children covered by government-sponsored programs are growing. Moving forward towards a more prevention-based system with early detection and better access for all, these changes should help lead to increased oral health initiatives and improved oral and healthcare overall.

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## LIST OF ABBREVIATIONS

|           |   |
|-----------|---|
| ADA       | American Dental Association   |
| CDC       | Center for Disease Control and Prevention                               |
| CWF       | community water fluoridation  |
| d/D       | decayed   |
| deft/DMFT | decayed, missing or extracted, and filled (primary and permanent) teeth |
| GDP       | gross domestic product  |
| EPA       | Environmental Protection Agency   |
| ER        | Emergency Room  |
| HMO       | Health Maintenance Organizations  |
| I.Q.      | Intelligence quotient   |
| MFT       | mean missing/filled permanent teeth                                     |
| NADP      | National Association of Dental Plans                                    |
| RCT       | root canal treatment  |
| U.S.      | United States   |
| WHO       | World Health Organization   |

## INTRODUCTION

In 1956, anthropologist Horace Miner published a report, “Body Ritual Among The Nacirema” that purported to describe the culture, rituals, and habits, and “body attitudes” of an “indigenous” culture. Although Miner begins by describing their culture in mysterious and ambiguous terms, conceding that “little is known of their origin,” but that they “came from the east,” and were “living in the territory between the Canadian Creel, the Yaqui and Tarahumare of Mexico and the Carib and Arawak of the Antilles (Miner, 1956).” With this introduction, one may assume this demographic was a “tribal” group of Plains Native Amerindians, however, quickly Miner’s description betrays this suspicion, as he more blatantly describes a more familiar yet simultaneously more alienated culture. Describing the “household shrine” of the Nacirema in cleverly encoded veiled descriptions, the astute reader can quickly deduce he is talking about a modern Western medicine cabinet, and the “rituals” he describes as “self-worship,” are brushing one’s teeth and completing personal facial hygiene, that billions of Westerners, particularly Americans, are known to perform several times daily.

In this case, Horace Miner’s anthropological report turned out indeed to be a satirical reflection of our culture’s long-standing promotion of dental hygiene. Today, fewer Americans consistently visit their dentist as part of good oral health care- indeed, increasingly more have never visited a dentist at all due to lack of access and/or insurance- yet many dutifully purchase household mouth products including toothpaste,

tooth powders, mouthwash, and floss, and continue to practice home based dental hygiene habitually.

This thesis aims to examine the current state of oral health prevention with respect to fluoridation, the impact that the lack of dental care has financially on the patient and the overall health system while concluding with a discussion of alternative options that could improve the current state of oral health care. Research conducted to investigate reduction in dental caries based on demographic may lead improved oral health initiatives that would be based on prevention and early detection, including oral hygiene measures both at home and professionally.

### **Dental Caries**

Some of the prevalent oral diseases and adverse conditions many Americans are epidemically experiencing today include dental caries, periodontal disease, and oral cancer (2010, Benjamin). Additionally, research demonstrates that children often suffer, physically, and socially by the occurrence of dental caries and the deepening infections and decay they cause (Ramos, J., Pordeus, I. A., Ramos, Jorge, M. L., Marques, L. S., & Paiva, S. M., 2014):

The finding that older children have a greater chance of experiencing a negative impact on the quality of life seems to stem from the fact that older children have caries in more advanced stages of decay and also have a greater capacity to communicate with parents the effect of oral health conditions on their quality of life....Active and inactive

untreated severe carious lesions were associated with a negative impact on the quality of life of preschool children and their families. Traumatic dental injury was also associated with a poorer quality of life. Families with a higher income and younger children reported a better oral health-related quality of life (Ramos, J., Pordeus, I. A., Ramos J, M. L., Marques, L. S., & Paiva, S. M., 2014)

Dental caries or cavities are more commonly known as tooth decay. The natural acids in the mouth that dissolve food matter and aid in enzymatic digestion along with the saliva, are many of the same acids that, over time, destroy tooth enamel (Dawes, 2003). Indeed, this is why the time-tested recommendation to brush one's teeth after every single meal still persists today. As the enamel which protects the teeth begins to deteriorate under the caustic effect of the acids, tooth decay rapidly ensues. Children are most prevalently affected by dental caries and tooth decay, and many oral health and hygiene products are heavily marketed towards them (Rod, 2005). The number of caries is four times more prevalent than asthma rates in American children. The Center for Disease Control and Prevention (CDC) reports that children from 6-11 and young adults 12-19 years of age are the population most affected by dental caries (CDC, Dental Caries, n.d.).

Severe caries have been reported to detract from children's quality of life as they experience pain, discomfort, acute and chronic infections, and eating and sleep disruption as well as higher risk of hospitalization, high treatment costs and loss of school days with the consequently diminished ability to learn. Caries may affect a child's overall nutrition, growth and weight gain. Children of three years of age with nursing caries weighed about

1 kg less than control children because toothache and infection alter eating and sleeping habits, dietary intake and metabolic processes. Disturbed sleep has been shown to affect glucocorticoid production. In addition, there is suppression of hemoglobin from depressed erythrocyte production. Ninety per cent of pre-adolescents reported an impact related to oral health (Shielham, 2005; CDC, Dental Caries, n.d.).

Another very commonly prevalent condition of concern related to oral decay and dental caries is gingivitis. Gingivitis is categorized as a bacterial buildup of plaque on the teeth, tongue, and lining of the gums that over time acidifies and decreases gum tissue due to neglect of brushing teeth. The plaque and bacteria initially settles in the teeth, while the acidity of the deteriorating bacteria causes halitosis. If left untreated for a period of time, periodontal disease develops leading to gum sensitivity and bleeding, opening the pathways for systemic blood infection (Sayeed, 1978).

Periodontitis subsequently develops due to neglected tooth decay and gingivitis. Although periodontitis presents relatively mild symptoms such as gum bleeding, gum swelling, or even loose teeth, these problems indicate major tooth decay and poor overall oral health (Benjamin, 2010).

Many Americans are not able to receive preventative dental care due to lack of coverage thus the incidence of oral disease, specifically dental cavities are increasing in the average citizen. Cultural factors that influence collective diet choices, including coffee, alcohol and tobacco are detrimental to the teeth and mouth. For those who cannot afford the preventative oral care or do not have the best home hygiene and/or dietary

practices cavities may become more severe. Those that regularly see a dental professional may possibly avoid these issues while dental care costs are highly probably to be higher, on average, for Americans that do not see their dentist regularly.

### **Prevention of Poor Oral Conditions**

While it is true that various diseases and disorders of the mouth and throat caused by oral health neglect cause pain and disability for millions of Americans each year, there are progressive strides towards lowering incidence of tooth decay, periodontal disease, and oral cancers. The reports disseminated by the CDC indicate

“the baby boomer generation will be the first in which the majority will maintain their natural teeth over their entire lifetime, having benefited from water fluoridation and fluoride toothpastes.”

There is considerable data supporting the use of fluoridated water in the US as reported by the CDC (CDC, Fluoridation Statistics, n.d.) including recommendations for usage (CDC - U.S. Department of Health and Human Services, 2015) as well as resources for individuals to determine if and how much fluoride is used in drinking water in their community (CDC, My Water’s Fluoride, n.d.).

Additionally, there are tandem reports of fluoridation causing hyperactivity in the children of this generation (CDC, Dental Caries (Tooth Decay), 2016). Preventative measures such as oral sealants have also shown reports of decreased incidence of oral cavities and other unnatural damage. Despite local government’s heavy implementation of fluoride, more than 90% of adults, aged 20-64, have still experienced some form of

tooth decay or cavity, and tooth decay is still the most common disease in children of all backgrounds and even all dietary habits (CDC, 2016). In fact, several reports comparing vegans, vegetarians, and Standard American Diet eaters in various studies still show wide reaching incidences of tooth decay and cavities affecting 1 in 3 children indiscriminately, even in the “organic lifestyle” health-conscious demographics (Nagel, 2012). Studies also indicate that impoverished minority children and adolescents in both urban and rural environments who have less access to preventative treatments like dental sealants (unless provided in school-wide public school initiatives and other community endeavors) are more than “twice as likely to go untreated” (Mouradian, 2000).

### **Initiatives and Incentives That Exist**

Research has indicated implications of an overall benefit in America choice as a nation to invest in dental care programs that focus on preventative health, thus lowering the prices of dental health care that presently come at a very high cost (Patrick, D. L., Lee, R. S. Y., Nucci, M., Grembowski, D., Jolles, C. Z., & Milgrom, P., 2006). The need-based demand reported for more serious dental ailments due to neglect of preventative measures indicate the need for programs with more emphasis on prevention rather than drastic treatments (Mouradian, W. E., Wehr, E., & Crall, J. J., 2000).

Based on clinical evidence-based dentistry, another type of preventative program involves the use of pit and fissure sealants as an effective way to prevent and stop carious lesions on the occlusal surfaces of primary and permanent molars in children and adolescents (*Journal of Pediatric Dentistry*, 2016). Dental sealants are also used to

prevent decay for students attending schools in areas with low socioeconomic status, frequently at little or no cost to students. These school-based dental sealant programs are a cost-effective way to prevent cavities (Dye, 2010). The analysis further found that sealant prevalence among poor children is low; more than 60 percent of children, ages 6–11, had not received the preventive benefits of dental sealants. The percentage reduction in incidence and increment due to sealants was 68.5 percent at one year, 57.9 percent at two years, 40.1 percent at three years, and 25.8 percent at four years (Griffin, 2016).

State and local government- run preventive programs also play an important role in the oral health of communities. Water fluoridation programs have been long reported to have been a useful way to effectively strengthen teeth and prevent caries simply by everyday water consumption. Adding fluoride to the water makes teeth resistant to the bacteria that can cause tooth decay. To compensate for costs of fluoridating water, budget changes can affect how much care is needed in a given area (Abrams et al., 2014; Pizzo et al., 2007).

### **Benefits of Water Fluoridation**

The American Dental Association (ADA) lists five essential reasons supporting the use of fluoridated in water in communities. They cite that the benefits of fluoridation include effectiveness in preventing tooth decay, in protecting against cavities, in cost savings, and are natural, safe and effective. These proven benefits are attributed to the chemical makeup of fluoride, namely that it “is a naturally occurring compound that *can*

help prevent dental decay” (ADA, 2005).

Fluoridation of community water supplies entails adjustment of the existing naturally occurring fluoride levels in drinking water to an optimal fluoride level recommended by the U.S. Public Health Service (0.7 – 1.2 parts per million) for the prevention of dental decay. Based on data from 2002, approximately 170 million people (or over two-thirds of the population) in the United States are served by public water systems that are fluoridated. Studies conducted throughout the past 60 years have consistently indicated that fluoridation of community water supplies is safe and effective in preventing dental decay in both children and adults. It is the most efficient way to prevent one of the most common childhood diseases – tooth decay (5 times as common as asthma and 7 times as common as hay fever in 5- to 17-year-olds) (ADA, 2005).

It is important to make a distinction between systemic fluoridation and topical fluoridation. Systemic fluoridation is industrialized and wide reaching, often out of the individual citizen’s control, such as city wide water system fluoridation or grocery standardized salt fluoridation (just as processed foods are fortified and enriched with synthetic vitamins or table salt is enhanced with iodine or refined sugar is bleached, likewise salt is often fluoridated (Marthalar, 2013). Topical fluoridation is the individualized, home use based fluoridation as it is added to toothpastes and mouthwashes. Lastly, bi-annual cleanings often include topical fluoride treatment by the dentist for children under 12.

While statistical evidence does show that incidences and severity of dental caries

nationwide have decreased since the introduction of community water-system fluoridation, there is data that shows that during the same time period, other countries without systemic fluoridation have also decreased incidence of caries at much the same rate of decline (CDC Fluoridation Statistics (n.d.), Joury et al. 2017, Cooper et al. 2013).

### **Risks of Water Fluoridation**

One of the most widespread initiatives for preventative oral health care is fluoridation. Implemented for decades now, some studies have reported the negative long term effects of fluoride-- including disputed, foreign-based studies showing evidence of brain damage, reproductive health disorders, cancers, and hormone disruption/infertility (Feldscher, 2016). The fluoridation initiative was first proposed following the Department of Health's recommendations for 0.7-1.2 parts per million in 1962. This was undertaken with the goal of reducing the rising incidences of cavities. However, some reports indicate that other environmental triggers which might contribute to a negative effect were not considered. For example, there have been reports of a combined effect of fluoridation with the over calcification of American citizens through dairy use (Wang, 2007; Tang, 2008; Yiamoulannis, 1983). Why the concern over high fluoride levels? Because fluoride is not digestible in the human body and in high doses may lead to a build-up of metals in brain tissue and blood, possibly leading to systemic infections and adverse effect to teeth and bones (Chinoy, 2014). Tang et al. (2008) reported that the effects of high fluoridation on children, in fluorosis endemic areas, may negatively

impact brain development due to faster absorption in children than adults when all fluoridated sources (water, dental products, toothpaste) are taken into consideration. In fact, one study indicated a negative effect on intelligence quotient (I.Q.) levels (Tang, 2008). Thus, the reason so much emphasis and concern must be placed on fluoridation levels and standardization is the fact that, simply, children and adults absorb and metabolize fluoride differently (Coplan, M. J., Patch, S. C., Masters, R. D., & Bachman, M. S., 2007) . Research needs to be continuously performed to balance and standardize “safe” levels of community water fluoridation for all ages.

The evidence that excess fluoride intake causes dental fluorosis has been documented (Susheela, A. K. et al.1988). The excessive fluoride intake, to have a negative effect, must occur during the period of tooth formation, since the fluoride’s chemical makeup enables its influence and interaction with the activity of ameloblasts, especially during the late secretion or early maturation of enamel (Coplan, M. J., Patch, S. C., Masters, R. D., & Bachman, M. S., 2007). These cells lay down both the organic matrix and calcified tissue of dental enamel and assist with the maturation process prior to the emergence of the tooth into the mouth. Thus, while the period of susceptibility for an individual extends up to the time of formation of third permanent molar teeth, a priority is placed on the first 7 to 8 years of life (Osujip, O., Leake, J. L., Chipman, M. L., Nikiforuk, G., Locker, D., & Levine, N., 1988).

Some reports have indicated that recommendations from the 1960s are still the standard using water with fluoride levels up to 0.7-1.2 million parts per million.

Recommended fluoride concentrations used at that time were used taking into account the way of life for that time period, yet in current times the average topical and systemic consumption of fluoride combined has risen (Palmer, C. et al., 2014). Fluoridated toothpaste, for instance, is reported to have about 1,000 parts per million of fluoride. This concentration, added to the levels in drinking water accumulating as one drinks throughout the day, quickly raise levels and may approach toxic levels for the average American adult on a daily basis (Cho, H. J., et al., 2014). Levels for children, who enjoy the sweetness of the toothpaste flavors, often swallow more toothpaste than adults (Paiva, 2002; Burt, 1992). Some reversal attempts were made in light of correlations between excess fluoridation and incidences of autism and ADHD in children (Lu et. al., 2000).

Fluoride exposure can lead to detrimental biochemical and functional changes in the developing human brain. Exposure may commence with fluoride in the maternal blood passing through the placenta to the fetus and continues during childhood from fluoride in food and drinking water (Sastry, M. G., Mohanty, S., Vyakaranam, S., Bhongir, A. V., & Rao, P. 2011). In the study Lu et al., a high-fluoride level in drinking water resulted in a greater intake of fluoride which was confirmed by higher urinary fluoride levels (Lu, Y., Sun, Z. R., Wu, L. N., Wang, X., Lu, W., & Liu, S. S. , 2000). Intelligence was, in turn, inversely related to the level of fluoride in both drinking water and urine in a study in China. No confounding factors such as population size or differences in social, educational, or economic background explained the relationship. The findings of this study support earlier studies in Mexico and China (Grimaldo, M. et

al, 1995; Xiang, Q. et al., 2003) and suggest that a relationship may exist between fluoride exposure and intelligence. Possible mechanisms for such a relationship have been suggested. The ability of fluoride to enter the brain is enhanced by its ability to form a lipid-soluble complex with aluminum. Aluminofluoride complexes are able to stimulate guanine nucleotide binding proteins (G proteins) and can produce pharmacological and toxicological effects in animal and human cells, tissues and organs. In the low-iodine area of Xinjiang, China, high-fluoride levels have also been associated with an impairment in intelligence in children, and may occur through the development of hypothyroidism or subclinical cretinism (Lu, Y. et al., 2000).

In 2015, federal health officials made the announcement that the amount of fluoride in drinking water will be significantly decreased for the first time since 1962 to a level almost half of the maximum, recommending only 0.7 milligrams of fluoride per liter of water instead of 0.7-1.2 milligrams per liter (Abrams, 2014; J Can Dent Assoc 2015;81:f16):

In 2006, the National Research Council undertook a comprehensive review of health effects of fluoride in drinking water. After a review of all available evidence, the committee considered three toxicity end points for which there were sufficient relevant data for assessing the adequacy of the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, allowing an adequate margin of safety (MCLG). MCLGs are non-enforceable public health goals (Carton, R. J., 2006). The clinical end points were severe enamel fluorosis,

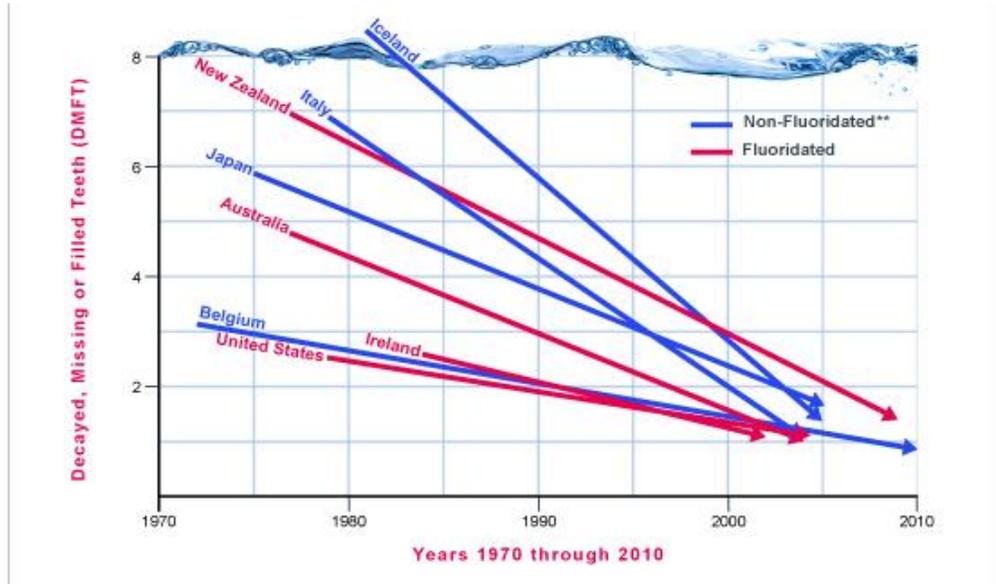
skeletal fluorosis, and bone fractures. This report concluded that the Environmental Protection Agency (EPA) standard level of fluoridation in this case was not adhered to, and the excess fluoridation is not protective of health because lifetime exposure at 4 mg/L of fluoride under certain circumstances could also weaken bone and increase the risk of fractures, especially among those who are prone to accumulate fluoride into their bones (e.g., people with renal disease) (Abrams, S. et al.2014):

A major advantage of community water fluoridation (CWF) over other fluoride vehicles is that people receive its benefits throughout the day without making a conscious effort to buy and use the product or visit the dental office for a topical fluoride application. Despite its merits, CWF may be one of the most scrutinized public health interventions. Early allegations included increased overall mortality and occurrence of Down syndrome in fluoridated communities. More recently, claims have focused on specific cancers, endocrine disorders, behavioral, cognitive and other neurological effects. Alleged adverse health claims have triggered governmental reviews. The National Research Council (NRC) in the U.S. reviewed the major adverse health claims of fluoride in 1993 and 2006 (Carton, R. J. (2006). The 1993 review found no adverse health effects associated with the ingestion of fluoride at the concentrations used for CWF (0.7-1.2 milligrams/liter (mg/L). The only unwanted effect at these levels, enamel fluorosis, was considered an aesthetic problem. The 2006 review focused on potential adverse effects of naturally occurring fluoride at 2–4 mg/L in drinking water, levels higher than that recommended for CWF. At these higher levels, the 2006 NRC review

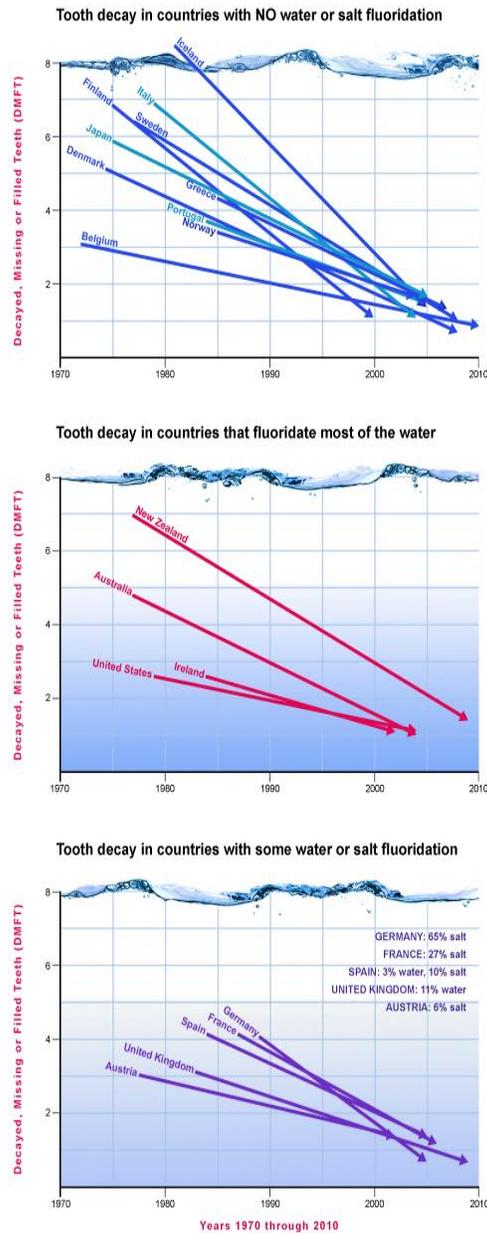
found substantial evidence only for an increased risk of severe enamel fluorosis (measured by pitting of the tooth enamel) as a health effect and recommended that the U.S. Environmental Protection Agency (EPA) review its drinking water standards in order to prevent this outcome (Abrams, S., Beltrán-Aguilar, E., Martínez-Mier, E. A., Kumar, J., Slade, G. D., & Gooch, B. 2014).

Overall, fluoridation and other preventative measures have reduced the incidence of dental caries since the discovery in the 1800s and more recently with guidelines proposed since 1962. In addition, it has been documented that other developed countries around the world have reported mixed results with some demonstrating decreased incidences of dental caries and decay without fluoridation or exceptional changes in toothpaste/toothbrush accessibility, along the same timeline as the United States reports water fluoridation implementation improved oral health (Pizzo, 2007).

The World Health Organization (WHO) has released several graphics and studies indicating evaluation of fluoridation efforts in 24 countries shows variable success suggesting that water fluoridation may be unnecessary (Figures 1 and 2). Belgium a country with similar tooth decay trends without water fluoridation should be evaluated further.



**Figure 1: World Health Organization Report on DMFT Trends in Fluoridated and Non-fluoridated Countries.** Shown is data from 1979 -2010 for 12 year olds number of Decayed, Missing & Filled Teeth (DMFT) in countries with fluoridated (red) and non-fluoridated countries (blue countries). Figure taken from World Health Organization Collaborating Centre for Education, Training, and Research in Oral Health, (n.d.).



**Figure 2: World Health Organization Report on Tooth Decay Trends in Fluoridated and Non-fluoridates Countries.** Shown is data from 1979 -2010 for 12 year olds number in countries with fluoridated (red) and non-fluoridated countries (blue countries). Figure taken from World Health Organization Collaborating Center for Education, Training, and Research in Oral Health, (n.d.).

**Table 1: DMFT (Decayed, Missing & Filled teeth) Status for 12 year olds by Country.** Tooth Decay data from: World Health Organization Collaborating Centre for Education, Training, and Research in Oral Health. Salt fluoridation data from Gotzfried F. (2006). Table amended from World Health Organization Collaborating Centre for Education, Training, and Research in Oral Health (n.d.)

| <u>Country</u>       | <u>DMFTs</u> | <u>Year</u> | <u>Status*</u>  |
|----------------------|--------------|-------------|---|
| <i>Denmark</i>       | 0.7          | 2008        | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation.     |
| <i>Germany</i>       | 0.7          | 2005        | <u>No</u> water fluoridation.<br>67% salt fluoridation.           |
| <i>England</i>       | 0.7          | 2009        | 11% water fluoridation.<br><u>No</u> salt fluoridation.           |
| <i>Netherlands*</i>  | 0.8          | 2002        | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation.     |
| <i>Switzerland**</i> | 0.82         | 2009        | <u>No</u> water fluoridation.<br>88% salt fluoridation.           |
| <i>Belgium</i>       | 0.9          | 2009-10     | <u>No</u> water fluoridation.<br>No salt fluoridation.            |
| <i>Sweden</i>        | 0.9          | 2008        | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation.     |
| <i>Australia</i>     | 1.0          | 2003-2004   | 80% water fluoridation.<br><u>No</u> salt fluoridation.           |
| <i>Austria</i>       | 1.0          | 2002        | <u>No</u> water fluoridation.<br>6% salt fluoridation.            |
| <i>Ireland</i>       | 1.1          | 2002        | 100% water fluoridation in study.<br><u>No</u> salt fluoridation. |

**Table 1 continued: DMFT (Decayed, Missing & Filled teeth) Status for 12 year olds by Country.** Tooth Decay data from: World Health Organization Collaborating Centre for Education, Training, and Research in Oral Health. Salt fluoridation data from Gotzfried F. (2006). Table amended from World Health Organization Collaborating Centre for Education, Training, and Research in Oral Health (n.d.)

|                      |      |           |   |
|----------------------|------|-----------|---|
| <i>Italy</i>         | 1.1  | 2004      | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation. |
| <i>United States</i> | 1.19 | 1999-2004 | 64% water fluoridation.<br><u>No</u> salt fluoridation.       |
| <i>Finland</i>       | 1.2  | 2006      | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation. |
| <i>France</i>        | 1.2  | 2006      | <u>No</u> water fluoridation.<br>65% salt fluoridation.       |
| <i>Spain</i>         | 1.3  | 2004      | 11% water fluoridation.<br>10% salt fluoridation.             |
| <i>Greece</i>        | 1.35 | 2005-06   | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation. |
| <i>Iceland</i>       | 1.4  | 2005      | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation. |
| <i>New Zealand</i>   | 1.4  | 2009      | 61% water fluoridation.<br>No salt fluoridation.              |
| <i>Japan</i>         | 1.7  | 2005      | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation. |
| <i>Norway</i>        | 1.7  | 2004      | <u>No</u> water fluoridation.<br><u>No</u> salt fluoridation. |

\* The Hague | \*\* Zurich

It is worth noting that scientists have not clarified the mechanism of action for fluoride in the decline in dental caries. It is a common belief that the wide distribution of fluoridated toothpastes may be key, but attempts to assess the role of fluoridated toothpastes have been able to attribute, at best, about 40-50% of the caries reduction to these fluoride products. This is not surprising, if one takes into account the fact that dental caries is not the result of fluoride deficiency (Aoba, 2002).

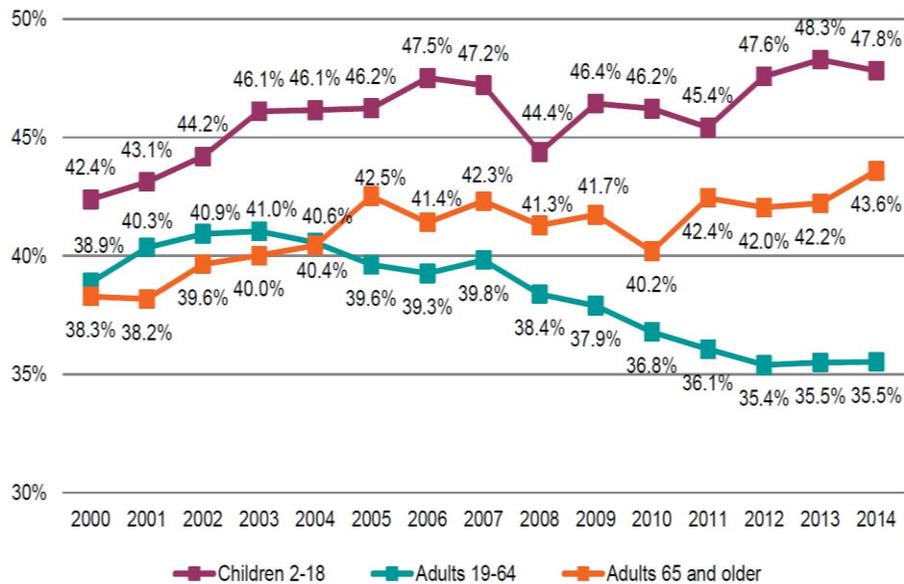
“In most European countries, where community water fluoridation has never been adopted, a substantial decline in caries prevalence has been reported in the last decades, with reductions in lifetime caries experience exceeding 75%.” (Aoba, 2002)

### **Disparities in Dental Health Care Access by Demographic**

Since the early 1960s, disparities in the prevalence and severity of periodontal disease based on education and income levels have been widely reported. The differences in education and income explain most if not all of the observed disparities in periodontal disease between Blacks and Whites (Borrell, 2012). An individual's socioeconomic position in society influences has been shown to not only health outcomes, health behaviors and healthcare access, but one's life experiences in general. There is an effort being made to minimize disparities in oral health by a number of incentive programs targeting disenfranchised and minority demographics for increased access. Additionally loan repayment programs through the military, public health corps and Veterans Administration have worked to improve access to care (American Dental Association (ADA), 2014).

It is important to also explore research pertaining to oral health care facilities, their expense and costs, their geographic locations of availability in relation to demographic distribution. For instance, which neighborhoods are adequately equipped and competently staffed dental practices available in? As well as the importance of exploring disparities in accessibility based on class, ethnic background, and socioeconomic status.

The health disparities surrounding access to proper dental care add another layer of complexity. Figure 3 shows the number of Americans visiting a dentist once a year between 2000-2014.



**Figure 3: Percent of Americans visiting a dentist once a year between 2000-2014.** For children and adults 65 and older, changes were significant throughout the course of the study. For middle-aged adults, changes were significant from 2003-2014. Changes were not significant for any age group from 2013-2014. Figure taken from the Health Policy Institute survey (2013).

The silent epidemic of oral diseases disproportionately affects disadvantaged communities, especially children, the elderly and racial/ethnic minority groups. Only one in five school-aged children from low-income families received dental sealants to prevent dental caries. Furthermore, 40% of Mexican American children aged 6–8 years have untreated tooth decay, compared with 25% of non-Hispanic White children.<sup>3</sup> More astonishing is the 87% of American Indian and Alaska Native children aged 6–14 years and 91% of the 15- to 19-year-olds who have a history of tooth decay (Benjamin, 2010).

### **Disparities in Accessibility**

Accessibility as it pertains to geographic location is often linked with socioeconomic status and education level as well. In parts of the United States, especially in urban areas, there is a shortage of dentists in poor areas that lack adequately funded and professionally staffed dental schools and facilities (Sun, 2010). To remedy this, there is a movement in some areas on the state and federal level to allow mid-level providers (non-dentists, therapists and hygienists) to provide treatment to disadvantaged patients. This may involve either a) expanding the duties currently legally performed by hygienists or b) creating a new type of dental auxiliaries called dental therapists. These individuals would be licensed to perform some less complex dental procedures such as simple fillings and baby tooth extractions. Services provided by a dental therapist would cost less than going to the dentist (Sun, 2010).

Lack of accessibility to dental care is a problem that significantly diminishes

preventive care. As mentioned above, there are programs that exist to address the shortage of dentists in certain types of areas. When newly graduated dentists work in areas with less access to care, their student loans are pardoned through the assistance of loan forgiveness programs (ADA, 2014). For example, a young dentist graduating from dental school with \$200,000 in outstanding student loans, might feel motivated to work in a remote, underserved area of Alaska or an inner-city slum for three years knowing that his/her outstanding loans will be forgiven. The purpose of this type of program is to increase access to care (ADA, 2014).

Lower socioeconomic areas or populations, similar to the ones mentioned above, are less aware of the ramifications of poor oral health barred in their systematic marginalization from the correct information regarding oral health (Holden, 1993). In addition to visiting a dentist, oral health can be improved by educating both children and adults concerning home care as well as the importance of gaining confidence in a dental health provider with whom they may develop a close and informative relationship. Dental students and practitioners often visit school children in an attempt to remedy the lack of education on oral health (Seale, 2003). These programs are able to have an impact by decreasing the overall extent of caries, and instilling a lifelong understanding of the importance of oral health. They are also an opportunity to identify children in need of urgent dental treatment.

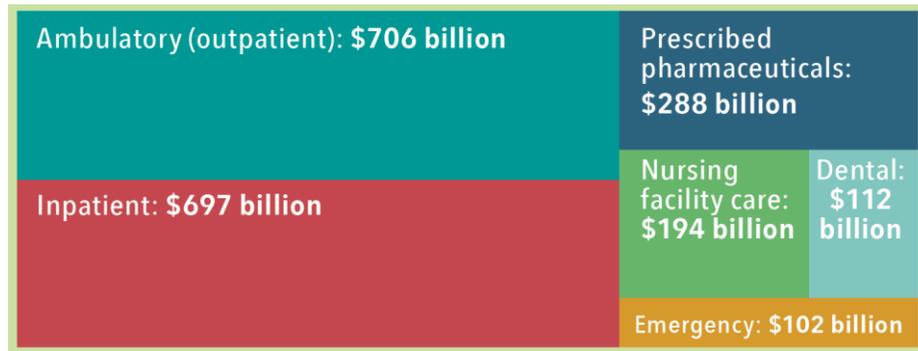
## **Links to Systemic Medical Problems**

In some cases, systemic medical issues including serious bloodstream infections, can result from what once started as a simple cavity (Li, 2000): “As previously discussed, oral infections and dental procedures can cause transient bacteremia. The microorganisms that gain entrance to the blood and circulate throughout the body are usually eliminated... within minutes and as a rule lead to no other clinical symptoms than possibly a slight increase in body temperature. However, if the microorganisms find favorable conditions, they may settle at a given site and, after a certain time lag, start to multiply. ...Soluble antigen may enter the bloodstream, react with circulating specific antibody, and form a macromolecular complex. These immunocomplexes may give rise to a variety of acute and chronic inflammatory reactions at the sites of deposition” (Li, 2000).

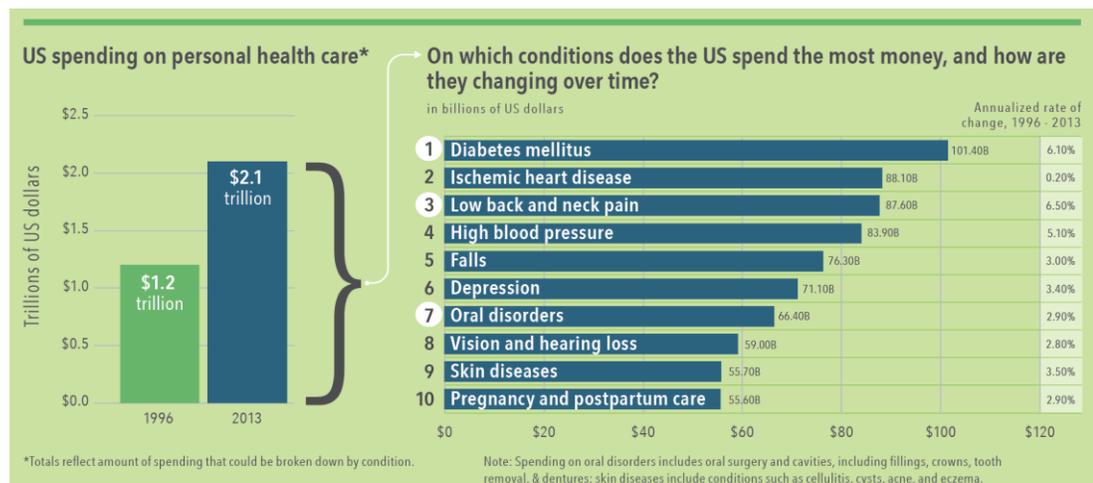
## **COST OF DENTAL CARE**

### **Routine Dental Care**

For many Americans with dental insurance, a visit to the dentist may occur once or twice a year. This means recommended cleanings, x-rays, and checkups happen regularly enough for most dental issues to be detected early as well as prevented. Dental health recommendations are implemented because early detection can prevent further decay and neglected decay can exacerbate into more severe problems. For example, if a patient develops a small cavity a month after their first dental visit, the next time they visit, they are scheduled for an x-ray, with which the dentist will be able to detect and properly treat it with a filling rather cost-effectively, before it having escalated to a more severe problem requiring a root canal, crown, or more extensive extraction. Even more serious issues such as gingivitis, prior to it progressing from its earlier stages, can be caught and monitored long before it develops further. Finally, regular visits allow dentists to educate their patients regularly and thoroughly in good oral hygiene, further helping them maintain good oral health. However, what becomes of those citizens who can't afford or are not qualified for medical benefits extending to dental services? Even most Medicaid programs do not provide coverage for dental treatments, and many Americans simply cannot afford regular dental checkups (Figures 4 and 5).



**Figure 4: 2013 Health Care Spending in the United States by Type.** Data indicating the financial cost per year for outpatient, inpatient, nursing, emergency and dental services. Figure taken from Dielman *et al.* (2013).



**Figure 5: 2013 Health Care Spending in the United States by Disease.** Data indicating that oral diseases are the 7<sup>th</sup> largest expenditure of the US health care costs. Figure taken from Figure taken from Dielman *et al.* (2013).

Many without access to care or education may remain ignorant of potential treatment options due to early detection minimizing pain and cost to the patient Cavities

may progress to serious issues of infection and/or nerve damage, when not detected and eradicated early (Caulfield, 2000). For example, the crown of a tooth with serious decay may be past the point of saving, and instead of a simple filling, serious-- and costly-- surgical restoration (including a new crown) may be required. As will be discussed, the costs associated with more serious dental procedures can be far greater than those for simple remedies-- a crown to repair and strengthen a damaged tooth, for instance-- or other forms of major treatment.

Before elaborating on who has or does not have medical coverage for dental plans, or the correlative relationship between access to dental care and an individual's actual oral health, it is imperative to first define some terms. Correlations show causal relationship between inability to afford dental care services and higher incidence of dental caries, as well as correlations between inability to afford care and higher expenses for more complex dental treatment. Lack of access, attendance, or adherence to treatment at the onset of the problem has lasting implications. So what constitutes as a reasonable standard of oral health the average citizen should aspire to? The World Health Organization defines oral health as

“a state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal (gum) disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity” (WHO, n.d).

## **Description of Costs**

Due to lack of accessibility to preventative care America's most disadvantaged (low-income, disabled, etc.) consumers often seek care in hospital emergency rooms. The care provided in the ER is more expensive than a regular visit to the dentist. In fact, most emergency rooms are not staffed with dental professionals and most of them do not alleviate the problem. They simply treat the symptoms to temporarily relieve pain using Medicaid resources without a positive outcome.

There has also been a large (31%) increase in Medicaid patients in the ER because a large number of providers have stopped accepting Medicaid (Taubman, 2014). In 2009, there were 10 million fewer Americans receiving dental coverage because the cost of dental insurance increased by 7% over that decade. More than 44% of dental costs are paid out-of-pocket by consumers, compared to just 10% of costs to a physician. For instance, when emergency rooms are used, state healthcare systems are the ones that end up paying extremely high costs (\$31 million in NY in 2010) when consumers and Medicaid are unable (Taubman, 2014).

According to the Pew Charitable Trusts, states need to invest in improving access to preventive care (Koppleman, 2016). This would in turn reduce hospital visits, strengthen oral health, and reduce their costs. In 2009, more than half of children that have Medicaid did not receive dental care, including routine exams. The problem with access is that there is a shortage of dentists in many areas of the U.S. and that many dentists do not accept Medicaid.

## **People That Get Preventative Care**

People that are afforded access to adequate preventative care, on average, pay approximately \$300 per year for dental care. This twice-a-year treatment includes periodic examination by a general dentist, prophylaxis, and topical fluoride application. The average adult premium for dental insurance consists of a \$225-\$285 monthly in addition to a copay for the dental work done (Probasco, 2015). If individuals do not have dental insurance (from their employer or purchased individually) they are responsible for paying the total cost of the dental service out of pocket. Thus, receiving preventative care (from a hygienist or other provider), these individuals have a reduced chance of more costly dental problems (that need to be treated by a dentist). This can be explained by considering the average hourly cost of a dentist that is more than for a hygienist (Probasco, 2015).

To illustrate this idea to further conceptualize costs and comparative treatment rates, consider treatment options for a typical patient. If a patient has regular checkups and caries are found at the level where they can be restored with direct restorations (amalgams or composites), the cost of dental treatment and time spent with the dentist would be much less than if a patient skips checkups that include cleanings by a hygienist and then requires dental treatment when the only solution is extraction or root canal treatment (RCT) & crown. Unfortunately, many patients that cannot afford quality dental treatment and who do not regularly see a hygienist, opt for extraction because it is more affordable. Unfortunately, as with many industries the financial availability is a key

player in one's ability to maintain healthy living.

### **People That Do Not Get Preventative Care**

According to the National Association of Dental Plans (NADP), 114 million Americans do not have dental coverage (Adler, N. E., Cutler, D. M., Jonathan, J. E., Galea, S., Glymour, M., Koh, H. K., & Satcher, D., 2016). Without coverage, data shows that individuals do not receive preventative care. People that do not get preventative care initially save approximately \$150 per visit (as they don't pay for checkups) but later could pay closer to, or more than, \$1000 for more serious treatment (Dorsey, 2014). Serious treatment, for example, can include multi-surface fillings, full crown restorations, and root canal treatments. Also, due to the link of oral health to systemic health, the cost of general care also increases when dental care is inadequate. Oral diseases have been linked to systemic diseases such as, adverse pregnancy outcomes, cardiovascular diseases, and diabetes (Sampaio-Maia, 2016).

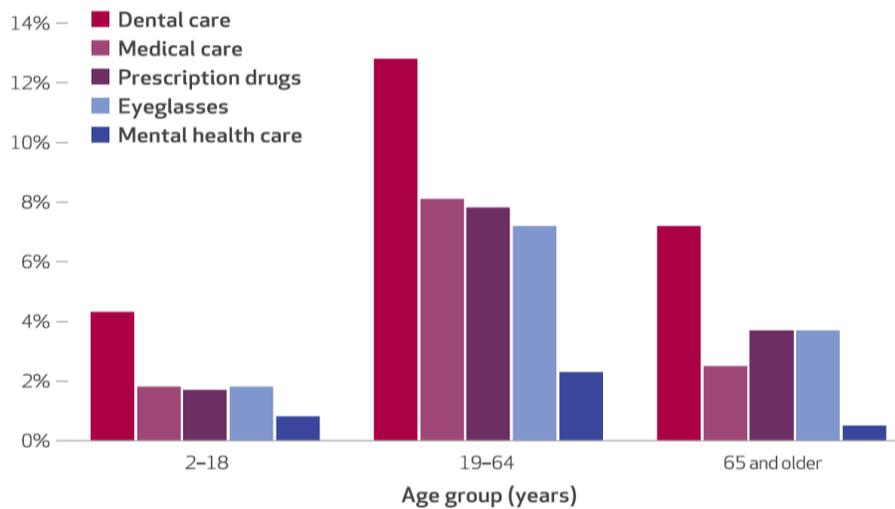
### **Description of People That Don't Get Preventative Care**

According to a 10-year study published in the *Journal Frontiers in Public Health*, researchers analyzed data collected from nearly 650,000 middle-aged and older adults. Although the number of people who received care increased during that time, in 2008, 23% - 43% of Americans did not receive preventative dental care and gaps continued to exist among racial groups (Preidt, 2013). Based on this report, there is evidence of a percentage of patients that require relatively complicated, expensive procedures, but

could have sometimes avoided them by receiving proper preventive care.

Middle class individuals that have health insurance through their jobs are not always covered for dental check-ups, however, they generally have the funds to pay for them out of pocket. Lower income individuals are less likely to have adequate insurance through an employer, and may rely on government programs such as Medicaid. These two groups will both be discussed with their particular circumstances in mind.

As shown in the Figure 6 below, more people do not get dental services due to cost, than any other health care services. This holds true for children, adults, and seniors.



**Figure 6: Financial Barriers to Health Care.** More people do not get dental services due to cost, than any other health care services. Figure taken from Center for Disease Control and Prevention - National Health Interview Survey (n.d.).

## **Dental Insurance Plans in Existing Healthcare System**

There are many different health insurance plans in the U.S. As per the Affordable Care Act, everyone should be insured. People can get these plans from their employers, from the government, or they can purchase another form of private insurance that better suits their needs. Even though oral health should not be separate from healthcare, in general, it is not included under the coverage of most insurance plans. Adults in the U.S. are not required by law to obtain dental insurance, like they are medical. Children, on the other hand, are supposed to have dental coverage but according to dental hygiene commentary on the ACA, this has not been carried out as planned by the time the ACA became law (Discepolo, K., & Kaplan, A. S., 2011).

According to the NADP, 64% of Americans have dental benefit (WHO, Dental Benefits Basics, n.d.). The cost of dental care depends on the individual and their particular situation. Along with the cost, coverage also varies from person to person. Many Americans rely on the group insurance plan bought by their employer to compensate for the cost of going to the doctor but they soon realize that going to the doctor is not the same as going to the dentist. Those without dental benefits are forced to pay out of pocket or purchase separate dental insurance in order to maintain their oral health. Evidence suggests that the correlation between oral and systemic health is considerable but health policy does not reflect this. When it comes to the benefits provided by insurance programs, dental benefits are usually not included along with the medical (Hollister, 1993).

The dental delivery system in the United States has its faults. At its foundation, dentistry and medicine were established as distinct practices. This results in oral health being treated differently by both the medical system and by public insurance programs. However, by recent evidence demonstrating a correlation between systemic and oral health diseases, the separation of the two is no longer well-founded.

Help, in the form of new insight, perception, and suggestion, can be found by looking outside of the United States. There are nations that have systems with better outcomes and come at a lower cost (see Figure 1) (World Health Organization Collaborating Centre for Education, Training, and Research in Oral Health, n.d.). Although countries differ in size, population, and the manner in which oral healthcare is funded, standards like diversity and democracy allow for an equal basis for comparison. A possible solution to what the U.S. encounters is offered by looking at a country such as Israel. Israel has a universal healthcare system set around four health maintenance organizations (HMOs). On average, people in Israel live longer, healthier lives than the population in the U.S. It also spends about 10% less of its gross domestic product (GDP) on healthcare expenses (Sax, P., 2005). Per person, they spend about a fourth of what the U.S. does.

The cost of dental healthcare, although also treated differently in Israel's system, is lower per capita than in the U.S. (Sax, P., 2005). Although dental benefits are not included in Israel's basic health plans, they come at a significantly lower cost than they

do in the United States. Compared to \$685 - \$1,624 in dental expenditures per patient per year in the U.S., Israel spends a portion of what the United States does. The cost of dental care in Israel can be summed up as follows: Health Fund clinics offer one free checkup, and most private clinics do too, for \$41-\$55 USD. It costs approximately the same amount for a filling at private practice, whereas, for a root canal treatment, the cost is between \$200 and \$825 USD. On average, this is about half the cost of treatment in the U.S. In the U.S., it costs approximately \$86 for a single surface filling, and up to \$606 for a multi surface filling. A root canal treatment costs between \$511 and \$1274, and the cost of a crown is from \$309 to \$1450 (Israel's Dental Care Options, 2016; Ramon, T., Grinshpoon, A. Z., Zusman, S. P., & Weizman, A., 2003).

It should be noted following the earlier discussion of preventative measures such as water fluoridation that Israel used this technique for decades. In 2001 it became mandatory for larger cities but in 2014, due to research was ended, however overturned in 2015 by the Ministry of Health since evidence was clear of its benefits. Additionally studies also indicated that fluorine added to water was metabolized to a compound the same as naturally occurring fluoride and was no risk environmentally (State of Israel Ministry of Health, n.d.).

### **Non-linear Costs**

Delaying a dental visit is likely to not only increase the cost of care but also increase a patient's chances of developing serious dental issues. (ADA Health Policy Institute Survey, 2013). The costs of simple versus more complex dental procedures are therefore non-linear. Now, sometimes these complex treatments are necessary. But it is the simple filling that would have been caught had the patient seen a dentist regularly that is necessary to improve care and decrease cost.

## **DISCUSSION: POTENTIAL SOLUTIONS**

Costs for the dentist are considerable and contribute to the high cost of dental care in the U.S. due to cost of a dental education and in some states (CA and NY) the need to complete a dental residency. Dentists can practice as a general dentist or go on to specialize in a number of different fields such as, endodontics, orthodontics, prosthodontics, or pediatric dentistry. Costs also factored in include office, instrument and equipment costs, personnel costs and cost of dental materials used in restoration. These costs, however, don't necessarily equate to what insurances pay to reimburse practitioners for their work. All of this has a direct influence on the type of industry that dentistry is in the U.S. and why it is so costly.

### **Dental Therapy**

Due to many factors including the lack of oral health prevention and education, access to dental care and financial constraints, there needs to be alternative treatment options for those in need in vulnerable and underserved in areas where disparities are apparent.

Dental Therapy is an emerging, complimentary service system in tandem with traditional dentistry that is increasingly practiced internationally for minor procedures. Practiced mostly for treatment for children in government-sponsored programs in over 53 counties, it is only allowed by state law in two states – Alaska and Minnesota (Friedman,

2011). A dental therapist is a mid-level provider similar to the physician assistant which assists doctors. Dental therapists serve to provide much of the preventive care and minor restorations such as fillings, sealants and fluoride topical treatment. In light of this market and demographic need, more states may implement laws approving dental therapy as an insurance-covered option. Dental therapy differs from traditional dentistry in many ways; as does the role of a dental hygienist, yet hygienist/therapists often perform the same tasks as a traditional dentist. Further discourse needs to be held concerning the distinct services that each can provide. Although, for some time it has been perceived that “dental hygiene has long been a para-dental occupation, subordinate to dentistry,” dental hygiene practices are increasingly becoming more favorable to traditional dentistry, thus creating more competition that health providers and insurers are increasingly at conflict about (Adams, 2004). Despite the competition, it is imperative that providers (i.e. hygienists, dentists, dental therapists) become more educated and informed about the other, as research shows dentists have less knowledge of the actual extent of training and professional merit of the dental-hygienist who, by the way, is recently expanding training requirements so that dental hygienists are certified to do more duties overlapping those of a dentist (Ross, 2007; Rowbatham, 2009). Due to “social trends like the decline in dental caries,” it becomes less necessary for patients to need the higher cost treatments and can instead visit dental hygienists who may be less extensively trained than professional dentists, but are also less expensive even for more mundane maintenance procedures (Adams, 2004).

Such an approach has the potential to release resources at a practice level and also increase the capacity to care for those who currently don't access services, thereby reducing the efficiency, cost-effectiveness and equity of NHS service provision (Cumella, S., Ransford, N., Lyons, J., & Burnham, H., 2000). Hygienists and dental therapists also adopt a more preventive approach, when compared to many general dentists, as their clinical training focuses on prevention rather than surgical intervention. However, although intuitive, using a less expensive resource to undertake a clinical task may not always result in a cost-saving. Less experienced staff may take more time to reach a diagnosis and see fewer patients per session. They may also use more consumables or over-refer. A further substantive barrier to using hygienists and dental therapist as a front-line clinician is the social and professional acceptability of the model for patients and general dental practitioner. Although the literature would suggest that the use of hygienists and dental therapists are accepted by the majority of the population (Macey 2016) they are not fully supported by the ADA (ADA Statement on Accrediting Dental Therapy Education Programs, 2015). Recently CODA – the Commission of Dental Accreditation has set forth guidelines for dental therapy accreditation and would be awarded on a state by state case (ADA-CODA, 2016).

Overseas, particularly in the United Kingdom, Wales, Scotland, and New Zealand, dental therapy is increasingly becoming a legitimate dental health care primary provider alternative (Nash, 2008; Nash, 2014; Ross, 2007), in the United States, the battle is still waging just for the mere recognition of dental therapy as a more widely available

option for citizens (Eisenberg, et. al., 1993; Licari, et. al., 2014). As yet, most of the literature concerning significant acknowledgement or accolades for dental therapists in the United States concerns the work of therapists in treating Alaskan Native children, implementing the updated training standards and requisites for their increased merit and credibility, following the “New Zealand Model” (Nash2004; Nash et al., 2005, Mathu-Muju et al., 2015):

The training curriculum for New Zealand dental therapists consists of two academic years, both of which are 32 weeks in duration, with a total of 2400 curriculum clock hours. Approximately 760 hours of the curriculum are spent in the clinical setting treating children. Upon graduation, individuals enter the School Dental Service and must serve for 1 year with another school dental therapist (Nash, 2004; Nash et al., 2005). Nash continues to describe how the children of New Zealand showed significant improvement related to the implementation of dental hygienists in the school nursing program, crediting the dental therapists as a whole for the increased attention that has proven preventative of further damage and preventing caries in the children who regularly attended the school dental program. Although the indices of decayed, missing or extracted, and filled (primary and permanent) teeth (deft/DMFT) of the children of New Zealand and the United States is roughly comparable, there are differences in the components of these epidemiological measures. A 2003 report indicate that 53% of New Zealand’s children of 5 years of age are caries free, and the cohort has a mean rate of extracted/filled primary teeth (eft) of 1.8. At ages 12–13 years, 42% of children are free

of caries, with a mean missing/filled permanent teeth (MFT) of 1.6. These data are interesting in that the decayed (d/D) components are not included, because these data are collected at the end of each school year and represent children enrolled in the School Dental Service whose decayed teeth, at that time, have either been restored or extracted, or have exfoliated. This means that essentially all of the school children in New Zealand are free of untreated caries at the end of an academic year (Nash, 2005).

Following this model, there is hope the same standard and utilization of staff hygienists would yield the same collective improvement for the Alaskan Native communities studied. It is also suggested that since the New Zealand school nurse dental hygienist model in the United States is much more conceivable now that the New Zealand effect has so successfully spread to other countries overseas and now has the legitimacy to have inspired its own curriculum as a standard for implementation in the United States:

A curriculum to develop dental therapists, more recently designated “pediatric oral health therapists,” exists and has been documented to be effective in multiple countries throughout the world (Nash, D. A., 2005). It is the traditional curriculum of the New Zealand school dental nurse/therapist. The curriculum for a pediatric oral health therapist would be comparable to the 2-year (associate’s degree) curriculum for preparing dental hygienists. The primary difference would be the focus of the training: the hygienist’s focus would be periodontal disease, particularly in the adult; the therapist’s focus would be dental caries, specifically in the child. Evidence suggests the performance

skills required to restore children's teeth are no more complex than those skills typically taught to dental hygienists in a 2-year curriculum (Nash, 2005).

Implementations such as these are inspiring in that they testify to the spreading validity of the dental therapy division of oral health care providers and services. Particularly for children, it is perhaps more beneficial for them to be regularly attended by a school nurse staff member, a familiar, friendly face that will regularly check their oral health progress throughout the school year, able to detect early any issues that can be easily, quickly, and less expensively corrected before worsening into a dramatic condition requiring surgery or more intensive invasive measures that require a more formal, unfamiliar, perhaps even scary visit (for the child) to a traditional dentist (AlSarheed, 2011).

### **Additional Society Factors Affecting Oral Health**

Another societal and environmental variable currently affecting oral health rates and contributing to epidemic rates of oral disease is processed foods. Furthermore, billions of dollars are spent on marketing and advertising these dangerous factory foods, when the same billions are not spent to fund studies to prove the detrimental effects of these chemicals, or even spent on marketing to widely disseminate the messages and advisements for Americans to stop consuming such harmful products (Graff, 2012).

Despite the growing problem of childhood obesity, most food commercials directed at children promote what nutritionists call "low-nutrient, calorie-dense"

products, or what the lay public terms “junk food.” More specifically, the majority of food advertisements viewed by children are for products high in fat, sugar, or sodium. In contrast, genuinely healthy foods that should be a part of a regular diet are almost never advertised to children. The food brands most heavily advertised on television are also featured prominently online. In addition to banner-style advertising, websites include so-called advergames that engage children in entertaining activities while immersing them in a product-related environment. Emerging research shows that such interactive techniques wield powerful influence by diminishing children’s conscious awareness of marketing techniques while penetrating the subconscious with positive brand associations (Graff, 2012).

Laden with non-nutritional refined bleached sugar, many processed foods are directly responsible for cavities, which lead to eventual systemic infections if untreated. The high acidity of the sugar in processed foods weakens the teeth, and even a single bowl of cereal can yield up to 150% of the recommended daily value for sugar (Schwartz, 2008):

According to the 2005 Dietary Guidelines for Americans

“Small amounts of sugars added to nutrient-dense foods, such as breakfast cereal... may increase a person’s intake of such foods by enhancing the palatability of these products, thus improving nutrient intake without contributing excessive calories.” (Department of Health & Human Services, 2005)

The finding that children’s and non-children’s cereals contained a substantial percentage

of the recommended allowances of added sugar seems inconsistent with the characterization of added sugar in cereals as a small amount. When evaluated against the nutrition standards for competitive foods sold in schools outlined by the Alliance for a Healthier Generation (11), only 34% of children's cereals could be considered in full compliance, compared to 56% of non-children's cereals (Schwartz, 2008).

Studies show that modified foods contribute directly to inflammation (including of the gums), kidney and liver failure, sepsis of the blood, chronic yeast and candida infections, and various reproductive and urinary tract diseases and disorders, in addition to the aforementioned tooth and bone deterioration (Kantovitz, 2006). Because processed foods have high sugar content and behavior modified drug substances like F&D 6 or Yellow 5 or Blue Lake 4, processed foods can alternately flood the brain with rage-inducing impulses as well as excess dopamine, giving a false and addictive feeling of bliss and relaxation, thus compelling the individual to crave more even when not physically hungry (Volkow, 2011). With the mind chemically and hormonally deceived into craving more sugary processed foods even when not hungry, this easily leads to obesity due to overeating, and tooth decay due to excess acid breaking down the tooth enamel and excess fluoridation aiding in softening the tooth itself:

Diets high in sugar (for example, added sugar) have been associated with various health problems, such as dental caries, dyslipidemias, obesity, bone loss and fractures and poor diet quality. Added sugar is defined as sugar that is eaten separately at the table or used as an ingredient in processed or prepared foods, such as cakes and cookies, soft

drinks and ice cream. This term helps consumers to identify food and beverages that mostly provide energy but are poor sources of micronutrients. In addition, sweetened drinks (fruitades, fruit drinks, soft drinks, etc.) constitute the primary source of added sugar on children's daily diet. Furthermore, soft drinks pose a risk of dental caries because of their high sugar content and enamel erosion due to their acidity. When sugar intake exceeds 15 to 20 kilograms per person per year, such intake is directly associated with increasing caries prevalence. In addition, people with early tooth loss clearly showed a deviation from preferred foods, as well as a deficiency of certain vitamins and microelements. This may be because people who cannot chew or bite comfortably are less likely to consume high-fibre foods such as bread, fruit and vegetables, thereby risking reducing their intake of essential nutrients (Kantovitz, 2006).

With a diet high in processed junk foods and sugar, it is more difficult for your body as a whole and your mouth specifically to resist infection that causes tooth decay, gum disease, and deep septic cavity infections (Kantovitz, 2006). Gum disease, not treated at first detection and rapidly exacerbated by nutrient deficiency, is the leading cause of tooth loss in adults and the reason worldwide older adults have full sets of teeth missing from their mouths.

Medical experts now generally agree that the key to good oral health in and of themselves is preventative. It is always recommended to brush and floss twice a day along with drinking lots of water (preferably specifying fluoride-free water). Also of high importance is placed on eating a diet rich in whole grains, fruits, veggies, and lean

sources of protein found in vegetarian diets in peas, beans, lentils, legumes, and nuts, and in standard diets recommending skinless chicken or fish (that is not deep fried). Most urgently recommended dietary changes that help ensure healthy teeth and a healthy life in general is limiting daily intake of processed foods, choosing snacking alternatives like fruit, nuts, or cheese and honey to indulge a meal and a bit of natural sweetener. In addition, it is advised that, when food is eaten slowly and deliberately at a table or floor setting, it neutralizes the body with the right posture, and the increased time lapse produces more saliva which washes food thoroughly down the throat (instead of food that often gets lumped in the crevices behind teeth, between teeth, and between the cheek and jawbone or even under the tongue), eventually decaying and rotting, creating fermentation acid in the mouth and around the teeth.

There are inherent difficulties for the United States to establish an oral health care system that effectively treats all patients, incorporates professional preventative measures, and compensates providers accordingly for their work. Certainly, an ideal system does not exist, but studies often show that there are numerous aspects of health care in other nations that are successful and that we, as a country, need to do a much better job. The difficulty lies in providing care that would satisfy and be affordable to all. The spectrum of patients is entirely spread out across the United States in different types of regions and with vast differences in economic access. Preventative care has the potential to improve the dental health for Americans across the nation, and across the economic spectrum, which, as has been discussed, can dramatically lower the cost of the

dental healthcare system. Together with this, strategies for improving oral health through awareness programs can also improve public health, thus lowering costs further. As previously noted, the long-term harm caused by inadequate dental care has shown to result in high healthcare costs. The results can manifest themselves as serious systemic conditions that could potentially lead to bankruptcy over medical bills or, worse yet, death from a severe disease. Additionally, chronic diseases are the root cause of the billions of dollars that the United States pays in annual health care costs.

With an abundance of comparative evidence showing increased quality of life and dental care benefits in other societies, it is responsible and astute of the discerning researcher and policy maker to understand that disparities between dental care access and overall population incidences of oral decay and/or disease exist. Rather than merely claiming the benefits and improvements of fluoridation and other preventative measures, it is imperative for researchers to consider variables in accessibility per demographic, and incidence rates per age group, when comparing different subcultures not only in differing parts of the United States with different levels of dental access, but also in countries around the world with the resources and development to implement formal nationwide healthcare coverage plans similar to the standards of the West, including the United Kingdom and other parts of Europe.

## CONCLUSION

Overall, in future research and initiative suggestions, variables to be seriously considered in any comparative analysis of dental/oral health promotion include availability of clean drinking water, fluoridated and/or unfluoridated water, availability of food sources and traditional diet staples as well as the regional lifestyle habits. It is imperative for experts to consider many variables when accurately determining the most influential factors contributing to oral health disorders. Just as was discussed with fluoridation efforts, the scientific evidence yielded that based on the chemical compounds, fluoride is effective against arresting spreading of tooth decay due to the relationship between the chemical structure of fluoride and the acid in the mouth. However, care must be taken to continually re-evaluate current systems, such as water fluoridation, as changing time and societal issues dictate constant change as reported in Israel's fluoridation policies and in countries like Belgium that have caries rates similar to the US without fluoridation. Thus, more research and discernment is required on the part of policy makers and researchers to fully examine and consider the full long range effects and efficacy of a proposed initiative. Fluoridation measures have been proven in various international reports to have been effective in combating acid-based tooth decay and caries, however, simultaneously, the introduction of health issues by the fluoride must be considered as new studies are reported.

Other factors that must be seriously considered when discussing effective

preventative oral health measures is the nature of disparities and discrepancies in dental health accessibility, and the availability of differing options for treatment from varying dental health professionals. It is important to study endeavors to normalize the acceptance of dental therapists and viable dentist alternatives for less expensive treatments. It is also important to analyze demographic factors that make dental healthcare inaccessible for some minorities and those of lower socioeconomic status. Finally, it is also imperative to be cognizant and carefully observe developmental differences between populations such as adults and children promoting treatments such dental sealants and/or fluoridation.

Although America may have substantial capital as a nation, the prioritization and allocation of the funds in budget decisions does not always address oral health initiatives. Investing in preventative measures and educating citizens on improved oral hygiene and oral health to cause awareness and early detection of oral problems would benefit the nation as a whole financially. Overall, placing an emphasis on preventative measures, whether home-based oral hygiene maintenance or routine dental visits with a dentist, dental therapist, or hygienist, as well as societal factors such diet, Americans collectively must continue to work to reduce the incidence and severity of dental caries and improve both oral and overall health.

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