# Caries Process and Prevention Strategies: Epidemiology

**Video Transcript**

Hello, and welcome to dentalcare.com's Cariology course that focuses on epidemiology. This is part one of a 10-part series entitled Caries Process and Prevention Strategies. Oral epidemiology is the area of public health that deals with the distribution and impact of oral disease on the human population. In this course, emphasis is placed on the relevance of epidemiology to clinical practice and information about prevalence, incidence, and trends of dental caries in the United States presented. The term DMF, or decayed, missing, and filled teeth is introduced, along with variations and limitations of the DMF index and an explanation of how to calculate DMF scores.

First, we wanted to go over a couple of clinical significant snapshots. These are questions that have come up with regard to epidemiology. First, what's the practical significance of the epidemiology of dental caries? As a dental practitioner, why should this interest me?

Well, information that reports the amount of any disease in a population is of tremendous importance in planning, funding, and delivery of health services so that enough healthcare professionals with the correct skill sets are trained, enough clinical centers are built, and that new and improved materials and clinical techniques are developed, to adequately research programs. Access to care is a critical issue for oral health. Many people in the United States are currently unable to receive the dental care that they need.

Having knowledge of this need for care helps health care planners create preventive programs to avoid disease in the first place. For example, water fluoridation, availability of low-sugar foods and beverages, and to ensure that enough dentists are produced to provide services, and that those services are adequately funded through private or public systems.

Another question would be what is the value of a dental index to me in dental practice? In this case, recording of a patient's health status is important, not only to plan any treatment currently needed, but also to assess a patient's changes in disease status and the response to treatment over time. The dental chart of cavities and restorations is similar to an index, and while it is not quantified numerically, it does allow comparisons over time.

As early caries lesions are reversible and typically should be treated not by restorative means, but by preventive needs such as fluoride agents and dietary modification. The methods of measurement and recording of the lesions is critically important. The DMF index does not differentiate between early and late-stage lesions. But new caries assessment indices having that capability, such as the ICDS, or International Caries Diagnosis and Assessment System, are being introduced into dental school curriculum.

Upon completion of this course, our expectations for the dental professional are that you should be able to discuss the need for epidemiologic studies, to be able to apply the results of oral epidemiology studies to clinical practice, to be familiar with the prevalence,

incidence, and trends of dental caries in the United States, to be able to describe the value of the DMF index in measuring oral disease, to be able to use the DMF index to measure the prevalence of dental caries, to understand the results of the NHANES surveys that are related to dental caries, to identify the factors that may or may not affect the DMF scores in adults, and, finally, to be able to calculate a DMFT, DMFS, or dmft, or dmfs index score from a patient's tooth charting.

Commonly known as tooth decay, dental caries is an oral disease in which the acids generated by oral bacteria cause damage to hard surface tooth structure. Although preventable, it's one of the most common chronic infectious diseases among American children and adults, and remains one of the most common diseases throughout the world, in spite of major improvements that have been made in the US dental healthcare system over the past few decades, particularly with regard to the percentage of cavities found in both children and adults. Some population groups continue to experience caries at higher rates than others. This is particularly true for populations with lower income and lower education, and also for some ethnic and racial groups.

Approximately 500 million dental visits occur each year in the United States and they come at hefty price. According to a 2020 update from the American Dental Association, dental spending reached a historic high in 2018 of $136 billion, or roughly 3.7% of total healthcare spending in the United States. The latest data show a slight recovery in the dental care economy in terms of overall dental spending, fueled by an uptick in utilization and spending among patients with private dental insurance.

Studies conducted in the field of oral epidemiology provide information on normal biological processes and on diseases of the oral cavity, identify populations at risk of oral disease or in need of specific care, and they compare original, environmental, social, and access similarities and differences in dental care between populations. Oral epidemiology also tests preventive interventions for controlling disease and evaluate the effectiveness in quality of interventions in oral health programs.

Now, to understand epidemiology, it's important to understand the definitions of the following terms. What is prevalence? Prevalence is the proportion of individuals with a disease, the number of cases in a population at a specific point in time. Incidence is a number or proportion of individuals in a population who experienced a disease during a specific time period. And trends are the changes or differences in the prevalence or incidence of disease with respect to time, occasion, or socioeconomics.

In order to measure oral diseases, epidemiologists use what is called an index, which is a standard method of rating a disease in which there is a graduated numerical scale with values corresponding to specific criteria. Types of measurement scales for indices include: nominal, which simply names the conditions, ordinal, which lists conditions in order of severity, interval or ratio, which establishes a mathematical relationship between the data, irreversible, which measure cumulative conditions that cannot be reversed, such as we find with dental erosion, or reversible, which measures conditions that can be reversed, such as is found with gingivitis.

An index is only valuable if the information it reports is, number one, valid. An index must be designed to measure the aspect of disease that it's intended to measure in corresponded clinical stages of a disease. It has to be reliable. An index should be reproducible, repeatable, and should provide consistent measurement at any given time under a variety of conditions. It has to be clear, simple, and objective. An index should have clearly stated, unambiguous criteria with mutually exclusive categories and should be simple enough for an examiner to memorize and score using that criteria. The index has to be quantifiable. The index must present data that can be numerically analyzed and treated. Group status should be expressed by distribution, mean, median, or other typical statistical measures, and it has to be sensitive. An index should identify small, yet significant shifts in the condition studied. Finally, the

index has to be acceptable. The use of the index should not be unnecessarily painful, time-demanding, or demeaning to the subjects. Here we would like you to view a short video by Dr. Edward Lo regarding the important characteristics of a valid index with reference to a disease such as dental caries.

The most important characteristic of a valid index can be used to measure disease such as dental caries is that the index have to reflect actual disease situation. For example, if the index indicated that there's disease, it should be reflected in the actual disease level, which can be measured by what we call [ghost-ended]. Okay, so in this situation, you should be referred on historiological findings, okay, this [inaudible] enamel caries should appear on the historiological observations that the caries stages is still within the enamel. Okay. And the- the patient [inaudible] does require, okay, the study should be reliable, okay, or reproducible. This means that, okay, different, okay, examiners, okay, or the same examiners observation able to arrive at the same, okay, uh, recording. Okay. And then it needs to have very clear, okay, criteria, okay, so that the people understand, okay, what the, uh, index codes mean. Okay, so all these are basic, okay, characteristics or requirements of a valid index.

Next, we will discuss the DMF index. Decayed, missing, or filled, or DMF index, has been used for almost 90 years and is well-established of the key measure of caries experience in dental epidemiology. The DMF index is applied to the permanent dentition and is expressed as the total number of teeth or surfaces that are decayed, D, missing, M, or filled, F, in an individual. When the index is applied to teeth of the permanent dentition, specifically, it is called the DMFT index, and scores per individual could range from 0 to 28 or 32, depending on whether the third molars are included in the scoring. When the indexes apply only to two surfaces, which is five per posterior tooth and four for anterior tooth, of the permanent dentition, it is called the DMFS index, and scores per individual could range from 0 to 128 or 148, depending on whether the third molars are included in the scoring.

When written in lower case letters, a dmf index is a variation that is applied to the primary dentition. The caries experience for a child is expressed as the total number of teeth or surfaces that are decayed, again, d, only small d this time, missing, m, or filled, f, all in lower case. The dmft index expresses the number of affected teeth in the primary dentition, with scores ranging from 0 to 20 for children. Again, when written in lower case, the dmfs index expresses the number of affected surfaces in the primary dentition. Again, five per posterior tooth and four per anterior tooth, with a score range of 0 to 88 surfaces. Because of the difficulty in distinguishing between teeth extracted due to caries in those that have naturally exfoliated, missing teeth may be ignored according to some of the protocols. In this case, it is called the DF index.

Calculating DMFT. The teeth that are not counted are unerupted teeth, congenitally missing teeth, or supernumerary teeth. Supernumerary is a condition where people have more than the standard number of teeth. And then also not counted are teeth removed for reasons other than dental caries, and primary teeth retained in the permanent dentition. Counting the third molars is optional. When a carious lesion or both carious lesion and a restoration are present, the tooth is recorded as a capital D. When a tooth has been extracted due to caries, it is reported as an M. When a permanent or temporary filling is present or when a filling is defected but not decayed, that is counted as an F. Teeth restored for reasons other than caries are not counted as an F.

When calculating DMFS, remember there are five surfaces on the posterior: the facial, lingual, mesial, distal, and occlusal surfaces, there are four surfaces on the anterior teeth: facial, lingual, mesial, and distal. The list of teeth not counted is the same as for DMFT calculations, and listing D, M, and F, is also done in a similar way. When a carious lesion or both a carious lesion and a restoration are present, the surface is listed as D. When a tooth has been extracted due to caries, it's listed as M. When a permanent filling is present

or when a filling is defected but not decayed, the surface is counted as an F. Surfaces restored for reasons other than caries are not counted as an F. The total count is 128 or 148 surfaces.

Calculating in lower case: dmft and dmfs, for dmft, the teeth not counted are unerupted and congenitally missing teeth, as well as supernumerary teeth. The rules for recording d, m, and f are the same as for dmft. The count total here is 20 teeth. For dmfs, the teeth not counted are the same as for dmft. As with dmfs, there are five surfaces on the posterior teeth and four surfaces on the anterior teeth. The total count is 88 surfaces.

While DMF indices can provide powerful data in perspectives on dental caries, they also have some limitations. For one, researchers have noted a significant amount of interobserver bias and variability. Other criticisms include that the values did not provide any indication as to the number of teeth at risk or data that's useful in estimated treatment needs. But the indices give equal weight to missing, untreated decay, or well-restored teeth, but the indices do not account for teeth lost for reasons other than decay, such as periodontal disease, and that they do not account for sealed teeth since sealants and other cosmetic restorations did not exist in the 1930s, when these methods were originally devised.

The NHANES, or National Health and Nutrition Examination Survey, is a series of surveys conducted in the United States that began in the 1960s to examine the oral and nutritional status of a large representative population. A paper published in 2007 described the trends in oral health status based on data collected from people ages 2 years and over, from 1988 to 1994, and then again, 1999 to 2004. More recent papers reported on the information from 2005 to 2008, and then from 2011 to 2012 surveys. The most recent updated on the status of oral health in the United States is available online, from the CDC's National Center for Health Statistics Oral Health and Dental Health, which was updated in 2018. The information collected in this update focuses on caries, dental history, tooth retention, edentulism, or tooth loss, and other related areas. It's clear from the most recent NHANES surveys that for some... er, that for most Americans, oral health has improved since the 1980s. What follows are some of the most significant findings of the most recent survey.

According to the most recent data, the prevalence of caries among children ages 2 to 5 actually decreased from 28% during 1999 to 2004, to 23% during 2011 to 2016. Since 1999 to 2004, prevalence decreased by 8 percentage points, to 33% upon Mexican American and poor children, by 7 percentage points to 30% among poor and near-poor combined children, and by 6 percentage points to 24% and 18% among male and non-Hispanic white children, respectively. Clearly, progress is being made as these data indicate that the overall prevalence of caries for two to five-year-olds in the most recent data set is around 75.8%.

According to the CDC, during 2011 to 2014, 13.7% of children age 2 to 8 had untreated dental caries in their primary teeth or their baby teeth. The proportion of children with untreated dental caries in their primary teeth increased with age. 10.9% among children age 2 to 5, and 17.4% among children age 6 to 8. A larger proportion of Hispanic are 19.4%, and non-Hispanic Black children, 19.3%, had untreated dental caries in primary teeth, compared with Hispanic white children, which was 9.5%. During 2011 to 2014, 13.3% of children and adolescents age 6 to 19 years had untreated dental caries in their permanent teeth. The percentage of children and adolescence with untreated dental caries increased with age. 6.1% among those age 6 to 11 years, 14.5% among those 12 to 15 years, and 22.6% among those age 16 to 19 years.

Overall, the data for 2015-2016 indicate, and for 2015 to 2016, the prevalence of dental-dental caries, both untreated and treated, was 45.8%, and untreated caries was 13% among youth age 2 to 19 years. The prevalence was lost in youth age 2 to 5 years, compared with those age 6 to 11 and 12 to 19 for total, which was 21.4%, 50.5%, and 53.8%, and untreated caries, 8.8%, 15.3%, and 13.4% for the three age groups mentioned. Hispanic youth had the

highest prevalence of total caries. Non-Hispanic Black youth had the highest prevalence of untreated caries. For both total and untreated caries, prevalence decreased as family income level increased. Untreated caries prevalence increased from 2011 to 2012, 16.1%, to 2013 to 2014, which was 18%, and then decreased in 2015 to 2016, to 13.0%.

What percentage of adults had dental caries in their permanent teeth? Well, people age 20 to 64 were included in this group. Overall, decreasing caries was seen in American adults, with coronal caries dropping from 95% in 1988 to 1994, to 92% in 1998 to 2004. And the largest decline being seen in the 20 to 34-year age group. In the 2011-12 update for the same age group, caries decreased further, to 91%. As the most recent CDC report notes, approximately 91% of US adults age 20 to 64 had dental caries in permanent teeth in 2011-12. Dental caries among adults age 35 to 64 was higher, 94 to 97%, compared with adults age 20 to 34, which was 82%. Prevalence of caries among adults age 20 to 64 was lower for Hispanic, 85%, non-Hispanic Black, 86%, and non-Hispanic Asian, 85% adults, compared with non-Hispanic white adults, which is 94%. During 2011-12, about 27% of adults age 20 to 64 had untreated tooth decay in permanent teeth.

Little difference was seen in the prevalence of untreated dental caries between the age groups examined. The prevalence of untreated dental caries was nearly twice as high for non-Hispanic Black adults, which was 42%, compared with non-Hispanic white, or 22%, and Asian, 17% of adults. Untreated tooth decay was lower among non-Hispanic white and Asian adults compared with Hispanic adults, which was 36%.

When considering older adults, in 2011 to 12, nearly all US adults age 65 and over are 96% with any permanent teeth had dental caries. The prevalence of dental caries was similar among those age 65 to 74, and those age 75 and older, caries prevalence was lower for non-Hispanic Black are 91%, and Hispanic, 86% of adults, compared with non-Hispanic white adults. Approximately 19% of adults age 65 and over had untreated caries in 2011 to 2012. No difference was seen in untreated dental caries prevalence between those age 65 to 74 and those age 75 and over. Untreated tooth decay was significantly higher for non-Hispanic Black adults, which was 41%, compared with Hispanic, 27%, non-Hispanic white at 16%, and non-Hispanic Asian, 27% of adults. Older non-Hispanic Asian and Hispanic adults were more likely to have untreated dental caries, compared with older non-Hispanic white adults.

The report further noted, similar to 1999 to 2004, about 1 in 4 adults age 20 to 64 years of age, and 1 in 6 older adults age 65 years or older had untreated tooth decay in 2011 to 2016.

One interesting finding in the NHANES studies related to DMFT and DMFS scores in adults was that there was no significant differences based on poverty levels, as was found in children. Also, while there were some differences in DMF scores based on race, they were not as significant as those seen in children. Finally, there was also a difference in DMFT and DMFS scores between the genders. Women demonstrate higher scores compared to men of the same age, but this is not because women are more susceptible to dental caries. It's more likely due to the fact that women seek dental care more frequently than men, and women experience earlier tooth eruption patterns. However, recent papers and peer-reviewed journals examined the gender differences, and some suggested several possibilities include hereditary component for caries susceptibility carried on the X chromosome.

In 2016, the Health Policy Institute of the American Dental Association, or the ADA, made available oral health fact sheets for every US state. These data can be accessed via the- the following ADA link, and may be of interest to both dental health professionals and their patients.

In conclusions, we can say that dental caries is a serious public health issue, and collecting data on its prevalence, incidence, and trends is important in oral epidemiology. The DMF index is a standard method for assessing dental caries experience in populations. While linear increases in caries with age in both children and adults indicate that caries affects individuals

throughout life, longitudinal surveys indicate a decline in dental caries experience over the past two decades, yet dental caries remain a prevalent oral disease among children and adults.

Let's conclude this section by discussing how this information can help you in your practice. First, fully understanding epidemiological information will help you clearly identify evidence-based and scientifically-based supported interventions for making decisions regarding your patients at-home care and reductions of caries risks. Second, epidemiological information, when communicated at the level of the patient can be a powerful tool in driving compliance and overall adherence to your at-home oral care recommendations. Describing how caries are accurately measured can instill trust and confidence in patients and can be far more powerful than simply instructing patients to brush their teeth more often. Thank you very much.