



Substance abuse and oral health: an overview

SADJ February 2014, Vol 69 no 1 p8 - p14

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ABSTRACT

Substance abuse is a worldwide phenomenon. It is on the increase in most countries and claims the lives of millions every year. Substance abuse may involve licit and illicit drugs, with licit substances claiming more lives than illicit drugs.

Illicit substance abuse is on the increase, especially with new drugs emerging on the world market every year. These new drugs appear faster than scientific studies can keep pace in determining their possible detrimental influences on health. Many abused drugs do have oral health complications. For this reason, it is important for dentists to have a thorough knowledge of the oral environment to be able to detect any abnormalities, regardless of what the underlying cause may be. Due to the nature of illicit substance abuse, reliable information and science is hard to come by.

This overview will focus on the direct consequences for oral health, whilst acknowledging that substance abuse may also have direct and indirect influences on general health.

INTRODUCTION

The World Health Organisation (WHO) defines substance abuse as the harmful or hazardous use of psycho-active substances, including the use of both illicit drugs and licit substances, such as tobacco and alcohol. According to the WHO, tobacco use remains the leading preventable cause of death in the world and must be included in any discussion on 'substance abuse', especially if seen to be practised by children.

'Drug abuse' and 'Substance abuse,' are used synonymously in literature, but this may create confusion. Most readers will associate drug abuse with illicit drug use, whereas substance abuse includes not only illicit drug use, but also licit drugs such as alcohol and tobacco. The term substance abuse will therefore be used in this paper to be more inclusive.

According to the United Nations 2013 Drug Report,¹ an increase has been found in the use and abuse of new psycho-active substances over the last few years. The new substances are not under current international control and it is therefore difficult to accurately assess their impact.¹ Although the use of substances under international control has remained largely stable over the last four years, illicit

ACRONYMS

HPV:	Human Papilloma Virus
LSD:	lysergic acid diethylamide
MDMA:	methylenedioxyamphetamine
OC:	oral cancer
OPC:	oropharyngeal cancer
PMD:	potentially malignant disorders
THC:	delta-9-terahydrocannabinol

abuse is still on the increase due to new compounds entering the market.¹

According to one definition, we use substances or drugs to undergo a mood change, or to change the way we feel.² If this was not the case, we would not repeat the use² and therefore have less risk for becoming addicted to, or abusing, the substance. The abuse of prescription drugs such as sedatives and tranquillizers is also high on the list of drug problems according to the United Nations Drug Report, with 60% of countries reporting them as amongst the top three substances abused.¹ Prescription drug abuse may be of particular concern for our profession. Dentists are exposed to a stressful work environment on a daily basis and have easy access to such drugs. Dental healthcare workers are not exempt from substance abuse and according to the American Dental Association 10%-15% of dentists in the USA will develop an alcohol/drug problem in their lifetime. The issue of drug abuse amongst oral healthcare workers is the focus of an upcoming paper in this Journal.

Substance abuse may have direct and indirect consequences. It has a negative influence on the immediate acquaintances and family of the user, as well as an increased financial burden on society largely due, amongst other factors, to health-related costs, crime, violence and an increased disease burden.^{1,4} Direct consequences of substance abuse include oral health complications,³ the focus of this overview. Another concern in South Africa has to be the high number of HIV positive people, many who may be injection drug users. Worldwide, 1.6 million people were injection drug users and living with HIV in 2011, down from almost three million in 2008.¹

Dentists and other oral healthcare workers will have to be vigilant in observing any oral symptoms and signs not in accordance with accepted parameters of oral health. In order to identify any abnormalities within the oral cavity, dentists should have a thorough knowledge of what constitutes normal oral health. This will become increasingly important in

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the face of new drugs flooding the market, before any research on associated health risks can be undertaken.¹ The role of the dentist and other oral healthcare workers, with regards to early detection, cannot be overestimated and we should all be aware of the oral health complications of substance abuse.

Oral health complications in substance abuse

There is a wide range of substances which may be abused, from licit products, like alcohol and tobacco, to illicit drugs such as marijuana, ecstasy, cocaine, heroin and to prescription drugs, for example tranquilizers and sedatives.⁵ Oral health complications from substance abuse can therefore be varied and complex and may be ascribed to chronic physical, rather than acute physical, harm inflicted by the substance. This is in accordance with the scale of harm by drug abuse, developed by Nutt *et al.*⁴

Although there is a perception that substance abusers are mainly poorly educated people from low socio-economic backgrounds, this is not true and addicts (users), often are in higher income groups leading otherwise normal lives.⁶

Seen against the tragedy of 211 000 illicit drug -related deaths in 2011, reported by UN World Drug Report,¹ and involving mostly young people, the prevention of severe problems by early detection is clearly a high priority. However, we should be realistic in terms of illicit versus licit substance abuse and the impact each has on health. This is best illustrated by the deaths of 443 000 people per year in the U.S.A. from tobacco-related disease between 2000-2004⁷ and 440 000 from alcohol-related disease between 2006-2010.⁸ Seen against this background, tobacco and alcohol must be targeted as the number one substance abuse problem. In a paper on the harm caused by misuse of drugs, Nutt *et al.* included five licit drugs, namely alcohol, tobacco, khat, solvents and alkyl nitrates.⁴ The fact is that alcohol and tobacco cause more harm than any of the other psychoactive drugs.⁴

There is however another substance which is addictive to the same degree as illicit addictive drugs, is used on a daily basis by almost all people and has dire consequences for general and oral health. This substance is sugar.⁹ All dentists are well aware of the direct negative effects of foods high in sugar on the oral cavity. What is less well known is the major effect obesity has on oral health and it is now accepted that high sugar intake is the main cause of obesity.⁹ This is further reason for all dental healthcare workers to be aware of all forms of addiction and resulting abuse, of both licit and illicit substances. This paper cannot cover the extensive and fascinating issue of sugar addiction and its effects on oral health in any detail, but perhaps it is material for a future review.

This overview will be limited to the oral health complications seen with abuse of licit substances (tobacco, alcohol and anabolic steroids) and illicit substances (cocaine, cannabis, opiates, hallucinogens). These may be roughly classified into the following categories:¹⁰

- stimulants ('uppers': including cocaine, crack, tobacco)
- depressants ('downers'/sedatives): including alcohol, inhalants, barbiturates, benzodiazepines
- hallucinogens (psychedelics): including LSD (lysergic acid diethylamide), ecstasy (3,4 methylenedioxymethamphetamine, MDMA), marijuana
- analgesics: including opioids such as morphine and codeine

Any oral sign or symptoms which cannot be logically explained by the patient's medical history, (including systemic medications), nor by the dental history, or any oral diseases present, should be treated with circumspection and a certain degree of suspicion that substance abuse may be associated.

LICIT SUBSTANCE ABUSE

Tobacco and alcohol

Nicotine is regarded as a substance of abuse and may affect the brain in a manner similar to the effects of more serious drugs like heroin and cocaine.⁶ Besides being the major risk for potentially malignant disorders (PMD) and oral cancer (OC), smoking is an independent risk factor for periodontitis, with periodontitis in turn being an independent risk factor for PMD and head and neck squamous cell carcinoma.¹¹⁻¹³

Oral healthcare workers will have to ensure that they are up to date on all the possible interactions of substance abuse and oral health, as it is becoming evident that the interplay between risk factors and oral/general health is a complex subject.

An important aspect of smokers to be aware of, is that the fact that they may show fewer signs of inflammation, gingivitis and periodontitis, which may therefore be missed during a routine oral examination not including periodontal probing.

The WHO classifies alcohol abuse under substance abuse and records it as responsible for almost 4% of all deaths worldwide (6.2% of all deaths in males and 1.1% of females.) More importantly, it causes 9% of all deaths between ages 15-29^{14,15} Young people in this age group are also vulnerable to illicit drug use which may be masked by simultaneous alcohol abuse. Although alcohol is responsible for only half the number of deaths related to the use of tobacco, drinking problems contribute almost 5% to the global burden of disease, the same level as for tobacco.^{14,15} Worldwide, alcohol is the third most important risk factor for disease and disability, but in middle-income countries such as South Africa it poses the greatest risk.¹⁵ In the United Kingdom, alcohol and tobacco abuse account for 90% of all substance abuse deaths.⁴ South Africa falls into the highest category of consumption according to the WHO, with the adult per year consumption of 15-25 litres of alcohol in 2003, (included is an estimate of unrecorded consumption from home brewing).^{15,16} If this is seen against the background of 65.2% of the South African population being lifetime abstainers, then it is clear that the high per capita intake is achieved in only the remaining 35%.¹⁵

Dentists have a major role to play in detection of alcohol abuse, especially amongst young people where intervention is still possible. Oral cancer remains the biggest oral health risk in these patients and a daily consumption of 50g (approximately four drinks) or more of alcohol will increase the risk for OC two to nine fold.^{15,17-19} Alcohol being such an important risk factor for oral cancer is often overlooked by oral healthcare workers and the public remains largely ignorant of this fact.²⁰ It is, however, an important issue and should be addressed by the dental profession in South Africa as an overall strategy in improving the health of our patients.

If tobacco and alcohol are used in conjunction then the effect is multiplicative, with one study reporting a 50-fold increased risk for OC in combination heavy smokers and drinkers.^{17,18} Even mild coincidental use of tobacco and alcohol will increase the risk for OC 5-fold.¹⁸ Alcohol is carcinogenic through its metabolite acetaldehyde^{17,18,21} and dentists

have an obligation to inform their patients about this. I believe the dental profession should take responsibility for OC by commitment to the overall WHO strategy which aims to lower the worldwide burden of disease from alcohol abuse. Although all forms of alcohol may cause OC, drinkers of spirits are at higher risk and in South Africa - this constitutes 16% of consumers of alcohol.^{15,16} Alcohol and tobacco abuse will also decrease the levels of salivary Immunoglobulin-A (s-IGA).²² Coupled with a decreased salivary flow and the negative interference with the protective glycoprotein production seen with alcohol abuse, this may be the mechanism which results in oral infections, periodontal disease and a general state of inflammation of the oral mucosa.^{22,23} In one study of alcohol abusers, oral lesions were mostly unimportant but in 15.2% of patients, further investigation was indicated, i.e. red lesions, white lesions, pigmented lesions, lichen planus and inflamed uvula. Ten percent of patients had suspicious lesions.²⁴ Dentists should be on the lookout for the general appearance of red, atrophic type oral mucosa, coupled with general signs of alcohol abuse in patients.⁶

Smokeless tobacco is a major risk for PMD and OC, especially if used in conjunction with other carcinogenic substances.^{21,25} The abuse of smokeless tobacco in all its different forms remains an ever increasing problem and in South Africa, with its strict anti-smoking laws, may become a bigger challenge in future.

Anabolic Steroids

Anabolic steroid is the general term used for synthetic derivatives of the male sex hormone testosterone. The correct term is 'anabolic-androgenic steroids', but the abbreviated 'anabolic steroids' is most often used.²⁶ The popularity of these lies in the fact that they promote muscle growth, (anabolic effect) and will enhance male sexual traits (androgenic effect). Athletes and body builders are the people most likely to abuse this substance, but school pupils may also be abusers of anabolic steroids to enhance their performance at sport. In the U.S.A. anabolic steroid abuse reached a peak in 2000, but has since been on the decline with 2.1% of grade 12 pupils reporting lifetime exposure in a 2013 survey.²⁶

There is a paucity of scientific evidence on the oral effects of anabolic steroid abuse, but most are likely to be secondary to kidney impairment, liver damage, weakened immune system and cardiovascular damage by drugs.^{26,27} Pointers of abuse in adolescents may be stunted growth, due to premature completion of skeletal growth and signs of accelerated puberty.²⁷ Although anabolic steroids are not in themselves addictive as are other illicit drugs, the abuse patterns do indicate some form of addiction.^{26,27}

Although there is a lack of clear evidence of oral health complications with anabolic steroid abuse in humans, hypertrophy of the masseter muscle has been reported.²⁸ Animal research has shown malocclusion and spacing of teeth, due to growth in the jaw, but not in the dentition,²⁹ cranio-facial abnormalities with maxillary overgrowth³⁰ and mandibular lengthening and increase in height.³¹ From this research, conclusions are drawn that human adolescents may show similar changes when taking these drugs and dentists should be on the lookout for developing discrepancies in antero-posterior jaw relationships, as well as morphological changes in cranio-facial formation.³⁰

ILLICIT SUBSTANCE ABUSE

Depending on the method of intake, illicit drugs may cause direct damage to oral tissues when smoked or ingested, or there may be indirect damage through an interference

with the physiology of the oral cavity. The effect on brain function will also lead to oral health complications through poor plaque control, risky behaviour patterns and general carelessness.^{3,32} Substance abusers will tend to have a low self-esteem and dental care will be low on their list of priorities.⁶ This may lead to a general neglect of oral status and the addict may end up seeking emergency dental care only. It should be noted that there is a paucity of scientific evidence on harm done by illicit drugs. This is compounded by the rapid development of new drugs which have not yet been tested for any potential harmful effects.⁴

Cocaine (benzoylmethylecgonine)

Cocaine is a psycho-active alkaloid derived from the coca plant (*Erythroxylon coca*). Currently cocaine is either smoked, (crack and base forms), or snorted/ingested (cocaine salts), the most popular way, with intravenous injection not widely used.³³ Snorting and applying it orally, usually to the gingiva, will lead to oral health complications.³

In the Netherlands it has been found that two distinct groups use cocaine, young and trendy people, who use it as part of nightlife experiences and homeless older people.³³ In the United Kingdom there are approximately one million regular users of cocaine.³⁴ In South Africa, we will probably have a similar practice amongst young and trendy people, with the high cost keeping it out of reach of the jobless poor. Cocaine can be measurable in the saliva for up to eight hours after use, which suggests that saliva could be used instead of urine for testing.³³

Oral health complications from cocaine abuse may present as perforation of the nasal septum and palate, bruxism from grinding teeth due to the increased dopamine effect and erosion of enamel to a glassy appearance due to the pH lowering effect.³³ If the cocaine is rubbed on the gingiva (this method is used to check the purity and as a topical anaesthetic) gingival recession may result, probably due to the vasoconstrictive properties of the drug.^{33,34} This has been seen mostly on the anterior maxillary teeth, which recover spontaneously within eighteen months on cessation of the habit.³⁴

More than 50% of people who snort cocaine have periodic nose bleeds and chronic sinusitis, whilst nasal septum perforation has been found in up to 5% of users.³³⁻³⁵ Some researchers feel there is probably an under-reporting of these complications, due to the careless attitude of users and their often low socio-economic status, where oral health needs are of low priority.³⁶

There is however a very serious side-effect of cocaine use that dentists should be aware of as it may lead to death in the dental surgery. This is due to its sympathomimetic effect, which will increase the oxygen demand by the heart, while at the same time lessening the supply by constricting the coronary arteries.³³ Myocardial infarction has become extremely common in chronic cocaine users. Those with pre-existing atherosclerotic coronary artery disease are at even higher risk.^{37,38} This fact is of major importance to dental practitioners, especially those who perform surgical procedures in their dental rooms, which will create an increased stress situation for the patient. There is only one sure way of predicting a potential complication such as this and that is obtaining a thorough and truthful history of any substance abuse from the patient. Once that is obtained, the patient may be sent for a thorough medical evaluation before any surgical procedures are embarked upon.

Opiates

Drugs in this category include morphine, heroin (diamorphine), hydromorphone, and methadone, amongst others. The opiates used to be regarded as synonymous with narcotics, but in the USA the term 'narcotics' is now reserved for any prohibited drug.

Opiates act on the central nervous system where it will have a sedative or analgesic effect.⁶ Heroin, a semi-synthetic opiate, is probably the most well-known drug in the world. In the USA, heroin is a major drug of abuse. Heroin is prepared from the poppy (*Papaver somniferum*), first as morphine and then through acetylation to its final form, diacetylmorphine.⁶

Heroin is either injected, (sub-cutaneous or intravenous), or ingested orally or nasally. Heroin addicts suffer from an increase in caries and periodontal disease. This is mainly ascribed to neglect of their own health, coupled with increased consumption of sweets and anxiousness about visiting the dentist.⁶ In a recent study it was found that only 7.5% of heroin addicts visited their dentists regularly, but 52% visited one at least once per year.³⁹ Oral health complications were also found with a higher frequency in those addicts who had a lower level of education, were older jobless people and had used heroin for longer periods of time.³⁹ One could speculate that non-heroin users with the same profile would also have more oral health complications. It seems that most oral health complications seen in heroin addicts can be ascribed to their lifestyle and provided they adhere to regular dental visits and good plaque control habits, their oral health will be good.^{6,39}

Morphine, which is a natural opiate, suppresses the immune system. This may well be the mechanism how opiate dependent patients become susceptible to periodontal disease.⁶

A more generalised problem with opioids is that it is the mainstay of pain control in many countries, including South Africa. It is especially the use in mild to moderate pain which can be important for dentists, as this is often what we have to deal with. Codeine is regarded as a reference opioid for mild to moderate pain.⁴⁰

Tramadol is an opioid freely available in South Africa and many other countries. It is very effective and popular worldwide for moderate pain relief.⁴⁰ Dentists should always beware against prescribing too many such pain killers for oral pain. It would be far better to seek a solution by resolving the cause of the pain. There is always the danger that patients may get "hooked" on pain killers and so start an addiction to more serious opioids. Tilidine is a potent opioid which is available in South Africa and can be taken orally with a quick onset of effect. It is used in the control of moderate to severe dental pain and again the prescribing dentists should be cautious in its prescription, especially for those patients who request it by name. Patients who ask for potent opioid analgesics by name could have an underlying drug abuse problem and as a profession we should always be reserved about providing such prescriptions. Prescription fraud involving these drugs have been reported and there is every reason to believe that similar fraud could be prevalent in South Africa.⁴⁰ Dry mouth is a side effect of Tilidine as it is for many other drugs and if xerostomia is seen in younger people without a clear explanation, it should be viewed with suspicion.

Hallucinogens

Of the hallucinogens, LSD (Lysergic acid diethylamide), Methamphetamine and methylenedioxymethamphetamine (MDMA)^{3,4} are the best known. Of the three, dentists are more likely to encounter patients on MDMA (Ecstasy), and Methamphetamine ("Tik") than LSD.⁴¹ 'Tik' is a serious problem in South Africa and will be described separately in this paper. Ecstasy is the classic drug of 'rave' parties when dancing to 'techno' music was very popular at one stage.⁴² It has to be borne in mind that MDMA is often used in conjunction with alcohol and other drugs.^{43,44} This may complicate the appearance of oral symptoms and lesions. There is a misperception amongst young people that Ecstasy is a relative harmless drug, but its use may lead to acute toxic episodes with resultant death. In the period 1996-2002, 202 people died from indulging in Ecstasy in Wales and England. More than 70% of the victims were between 15-29 years.⁴¹ Dentists have an important role in preventing such tragic deaths by supplying drug education via pamphlets in their rooms.

There seems to be a definite relationship between Ecstasy and dry mouth and bruxism.⁴³ The xerostomia may last for 24-48 hours after taking the drug and in one study, up to 74% of users reported thirst.⁴⁴ Most then drink carbonated soft drinks, which in turn will promote dental caries.⁴³

Bruxism was found in 40% of a sample after 24, and in 28.6% after 48 hours in a study involving 428 Ecstasy users.⁴⁴ Many develop increased attrition of the teeth.⁴³

Marijuana (Cannabis)

Marijuana is one of three of the products of the *Cannabis sativa* plant and is also the most widely used, the other two being hash and hashoil.⁴⁵ Marijuana is usually smoked and contains cannabinoids of which some are psycho-active.⁴⁶ The main cannabinoid causing euphoria in addicts, is delta-9-tetrahydrocannabinol (THC).⁶ There is conflicting evidence as to whether marijuana smoking will cause OC.^{21,47} Until such time as there is clarity on this issue, dentists should nevertheless view marijuana use as a potential promoter of OC.

In a longitudinal study spanning 32 years, Thomson *et al.* found marijuana smoking to be an independent risk factor for periodontal disease, with high frequency users showing a prevalence of periodontitis seven times that of non-users.⁴⁸

Cannabis abuse may also lead to gingival enlargement not dissimilar to that seen with phenytoin use.⁴⁹ Cannabis will also cause xerostomia and frequent users may become susceptible to caries and periodontal disease, due to a chronic dry mouth effect.^{45,50,51} Cannabis use may also cause stomatitis with leukoedema of the buccal mucosa and hyperkeratosis.^{50,51} A higher oral carriage of *Candida albicans* has been found in cannabis users although they do not show a higher prevalence of candidiasis.⁵²

One of the most shocking developments in oral disease over the last few years has been the dramatic increase in Human Papilloma Virus (HPV)¹⁶ - associated oropharyngeal cancers (OPC) in young people.^{53,54} Marijuana use plays a significant role in HPV-16 associated OPC.⁵³ Marijuana smoking is associated with an increased rate of infection on exposure to the Human Papilloma Virus type-16, it promotes persistence of the infection and also lowers anti-tumour immunity.⁵³ With the dramatic increase of these cancers in young people, dentists must be aware of the important associations and educate young people about this danger.

Methamphetamine ('Tik')

Methamphetamine acts on the central nervous system in a manner similar to amphetamine, but the effects are stronger and last longer.⁵⁵ 'Tik' is the street-name given to methamphetamine in South Africa. 'Tik' is a highly addictive substance⁵⁶ and is widely abused in South Africa, especially in the Western Cape. One of the reasons it is so widely abused is that it can be manufactured easily and cheaply.⁵⁵ 'Tik' can be ingested orally, nasally (snorted), by intravenous injection and by smoking. Smoking is one of the most popular ways of abusing 'Tik'.⁵⁵

In North America 'Tik' is responsible for what is known as 'Meth Mouth', which presents as extensive rampant caries, usually starting on the buccal surfaces of teeth. Much of the evidence for 'Meth Mouth' is anecdotal but it is widely accepted due to many reports on its features.⁵⁶

One recent pilot study reported on the oral health complications of methamphetamine and confirmed much of what is known about 'Meth Mouth', even though the study involved a small number of subjects.⁵⁶ A further complicating factor found in this study was the high percentage of methamphetamine abusers who simultaneously were abusing other substances (14% tobacco, 82% marijuana, 60% cocaine and 66% alcohol).⁵⁶ This is a widely seen feature with substance abuse and makes the profiling of oral health complications of specific substances very difficult.

Additional oral health complications found amongst methamphetamine users include xerostomia, a higher DMFS rate and a higher rate of bruxism than in non-users.⁵⁶

Methamphetamine users also have less buffering capacity and a lower resting pH of the saliva, which, coupled with higher plaque scores, are all underlying causes of the extensive caries seen in 'Meth Mouth'.⁵⁶ 'Tik' users also report a higher than normal intake of sweet carbonated drinks, in response to the xerostomia, and this will further fuel the caries process in these abusers.^{55,56}

Dentists should be on the lookout for unexplained extensive caries, especially if it affects mostly the buccal surfaces and be aware that this could be an indicator of 'Tik' abuse. A good caries prevention plan, which should include plaque control and dental education, should be part of the overall strategy of treating 'Tik' abusers. More research is needed on the effect of 'Tik', involving large numbers of abusers and especially in the young, so that more effective strategies can be put in place to prevent the irreversible dental damage seen in 'Tik' abusers.

CONCLUSIONS

Oral health complications in substance abuse are not clear-cut. Many complications reported in literature, are based on single case reports and lack scientific evidence of cause and effect. Therefore one has to be careful in drawing too many conclusions from such reports. One can speculate about why this is so, but the illegal nature of illicit substance use and abuse must surely be a hindrance to obtaining reliable information from substance abusers. As clinicians we have all been exposed to the difficulty in obtaining reliable information regarding licit substance abuse involving tobacco and alcohol. It is that much more difficult when dealing with illicit substance abuse.

I believe that dental health care workers should have a very detailed knowledge about the oral cavity in health and disease. This will equip them to identify any abnormality of the oral cavity and to then pursue the underlying causes in an intelligent manner through a process of elimination. Such a systematic approach may reach a point where a certain degree of suspicion may point in the direction of substance abuse. When reaching such a degree of suspicion about potential substance abuse, we should consult with our medical colleagues regarding appropriate counselling and testing of the patient.

Ultimately dental healthcare workers should become involved, not only in the routine dental treatment of substance abusers, but in the prevention strategies and the education of the public through campaigns on the dangers such substances may hold for their oral and general health. In the long run this will benefit our profession and will add value to our standing within the healthcare community. More research is needed in South Africa on substance abuse and oral health, especially concerning illicit substances such as 'Tik' which is widely abused in our country.

Declaration: No conflict of interest declared.

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