

Occupational Hazards in Dentistry

Kommuri Sahithi Reddy^{1*} Dipak Sadhan Paul Majumder² Dolar Doshi³ Suhas Kulkarni⁴ B. Srikanth Reddy⁵ M. Padma Reddy⁶

¹Senior Lecturer, Department of Public Health Dentistry, Panineeya Institute of Dental Sciences and Research Centre, Hyderabad, India.

²Professor and Head, Department of Dentistry, Agartala Govt Medical College, Agartala, Tripura, India.

³Professor, Department of Public Health Dentistry, Panineeya Institute of Dental Sciences and Research Centre, Hyderabad, India.

⁴Professor and Head, Department of Public Health Dentistry, Panineeya Institute of Dental Sciences and Research Centre, Hyderabad, India.

⁵Reader, Department of Public Health Dentistry, Panineeya Institute of Dental Sciences and Research Centre, Hyderabad, India.

⁶Professor, Department of Public Health Dentistry, Panineeya Institute of Dental Sciences and Research Centre, Hyderabad, India.

ABSTRACT

Background: Dental professionals are predisposed to a number of occupational hazards. These include exposure to infections (including Human Immunodeficiency Virus and viral hepatitis); percutaneous exposure Incidents, dental materials, radiation, and noise; musculoskeletal disorders; psychological problems And dermatitis; respiratory disorders; and eye insults. Therefore, the aim of the paper is to increase the level of awareness of occupational hazards among the dental surgeons and also to provide information on the ways in which hazards can be reduced.

Keywords: Hazards, dentistry, health.

INTRODUCTION

Occupational hazards refer to a risk or danger as a consequence of the nature or working conditions of a particular job¹. Carrying out their professional work, dentists are exposed to a number of occupational hazards. These cause the appearance of various ailments, specific to the profession, which develop and intensify with years. In many cases they result in diseases and disease complexes, some of which are regarded as occupational illnesses².

Dentistry is known to be a demanding profession and a wide variety of deleterious work environmental factors are proved to affect the physical health of the dentists or even aggregate their pre-existing disorders³. occupational health hazards are not uncommon⁴, Even-though, Modern dentistry has been described as probably among the least hazardous of all occupations⁵. Likewise, many risks still challenge the status of this occupation. A

study by brooks SL et al⁶ reported that dentists, more frequently have worse health problems than other high risk medical professionals. The present scenario of dentistry in India is greater work hours, huge competition and fewer economic returns which had become an integral part of dental practice⁷ which led to dis-satisfied aspects such as their level of stress and limited amount of personal time⁸.

The reports of other countries on occupational hazards in dentistry are, the survey carried out in the United Kingdom and United States of America⁹ found that the most common manifestation of organic diseases included backache, haemorrhoids, chronic indigestion, and circulatory system diseases occurred among dentists. Similarly a study in Lithuanian dentists revealed that more than half of the dentists experienced work psychological complaints¹⁰. The occupational hazards found among dentists and other clinical dental workers are similar worldwide.

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*Correspondence Dr. Kommuri Sahithi Reddy.

Department of Public Health Dentistry, Panineeya Institute of Dental Sciences and Research Centre, Hyderabad, India.

Email: K_Sahithireddy@yahoo.com

The practice of dentistry exposes dental professionals to a variety of work-related hazards, they include: Working long hours at a high level of concentration, Working in a sedentary state, Working with anxious patients, Exposure to microbial aerosols generated by high-speed rotary hand pieces, Exposure to various chemicals used in clinical dental practice and Other hazards. These hazards can pose significant risks to dental practitioners⁹.

HISTORY¹¹

BERNADINO RAMAZZINI is referred as **father of occupational medicine** in 18th century published his systemic study of occupational diseases in a book entitled "**DE MORBIS ARTIFICUM DIATRIBE**" in the year **1713**. The book had **three principles** causing occupational hazards which he recognised they are as follows:

1. fixed working posture
2. A continuous repetitive motion
3. Psychological stress

These would now be referred to as repetitive "strain injuries". Hence, he recognised the role of occupation in the dynamics of health and diseases.

DEFINITION ¹¹⁻¹³

- Occupational hazard can be defined as a risk to a person usually arising out of employment.
- It can also refer to a work, material, substance, process, or situation that predisposes, or itself causes accidents or disease, at a work place.

CLASSIFICATION

These hazards can be grouped into¹¹:

- 1) Physical
- 2) Chemical
- 3) Biological
- 4) mechanical
- 5) social aspects

Handbook of Occupational Hazards and Controls for Dental Workers by government of Alberta in year 2011 classified occupational hazards into¹⁴

- 1) Biological

- 2) Chemical
- 3) Physical
- 4) Psychological

Babaji P et al stated that dentists during during clinical practice exposed to variety of work related hazards. These occupational hazards can be classified into five types¹⁵:

- 1) Physical
- 2) Chemical
- 3) Biological
- 4) Psychological
- 5) Musculoskeletal disorders

PHYSICAL HAZARD ¹⁵

The dentists are at risk of physical injuries during many dental procedures. Physical hazards includes

Poor illumination:

Causes- eye pain, eye strain, headache and eye fatigue

Excessive brightness

Causes- discomfort and visual fatigue

The study¹⁶ done in Norway reported that public health dentists complained 13% of eye problems. An investigation done on Flemish dentists in Belgium revealed a similar problem that 52% had vision problems ²², eye injuries among dentist may be as high as 10%²³. The study in Australia suggested continuing but low prevalence of eye injuries amongst dental students and assistants¹⁷.

Prevention of poor illumination and excessive brightness-

- Sufficient and suitable lighting
- Natural or artificial is advised

The study done in UK revealed that the Use of eye protection by dentists was found to be as low as 57% when using laboratory cutting machines²⁴.

EXPOSURE TO SOUND ^{25, 26}Air driven, high speed hand pieces operating from 3900 to 12,500 Hz and electric engines are main contributing factors towards sound pollution.

Hearing loss, acoustic stress and impaired power of concentration first affect the individual who are regularly exposed to frequencies above 3000 Hz, therefore Use of high speed compressors and suction ultrasonic scaler.

Causes- temporary and permanent hearing loss

Prevention

- Personal protection by using ear plugs and muffs which reduce high intensity sounds by 30 to 35 dB.
- The noise levels of modern dental equipment have now generally fallen below 85 Db, the widely used benchmark standard, below which the risk of hearing loss is believed to be minimal and negligible

An investigation done on Flemish dentists in Belgium revealed that 20% of dentist had auditory problems²².

Kadanakuppe S et al ²⁷ (2011) done a study in dental practical classes, the acoustic environment is characterized by high noise levels in relation to other teaching areas, due to the exaggerated noise produced by some of these devices and use of dental equipment by many users at the same time.

FernandesJCS et al²⁸ (2005) measured and analysed the noise levels in the learning- teaching activities at the Dental School of the University of Porto (Portugal). The study Results revealed that the noise levels registered vary between 60 and 99 dB(A) and are similar to the data of other international studies. The results recorded differences in sound levels when the equipment was merely turned on and during cutting operations. Differences between brand new and used equipment were also noted. It appears that hearing damage risk may be lesser amongst dentists who use brand new equipment.

Radiation 29, 30

Dental personnel are exposed to both ionizing and non-ionizing type of radiations

Non- ionising radiation injury - Exposure to Dental Curing Light and Lasers

Causes- conjunctivitis and keratitis

Prevention

- Protective eye wear during usage

Ionising radiation injury - Exposure to radiation

Causes- acute erythema, dermatitis, chronic skin cancer, bone marrow suppression, damaged to eye including cornea. Radiation effects are cumulative and this damage is totally painless yet life threatening. Ionising radiation is a well established risk factor for cancer. The study conducted among Canadian dentists reported that occupational doses of ionizing radiation among dentists and dental workers have decreased markedly since 1950s³¹.

Prevention

- Lead gloves and lead apron.

The risk from ionising and non-ionising radiation appears to have been effectively reduced by most dentists in a study done in Thailand³².

Following are the recommendations for safety of the practitioner ^{33, 34}

Buying of standard radiographic equipment, which rigidly follows the National Council on Radiation Protection and Measurements (**NCRP**) and ISI recommendations .Well-collimated and filtered beam of at least 1.5 mm of aluminium filtration, should be available. Special conch shell designs are recommended for the X-ray departments. During construction use a special barium plaster, which absorbs the scattered radiation. Lead aprons should be routinely used for all patients, and for all children special thyroid shield should be used. Use of fast films, i.e. Ekta (E) speed to lower exposure time's .Dental surgeons must use a film badge service provided by the **Baba Atomic Research Centre** (BARC), Mumbai for personnel monitoring. Justification of radiographic examination:

- a. Operator should leave the room or take a position behind a suitable barrier or wall during exposure of the film.
- b. Walls must be of sufficient density or thickness.
- c. The operator should stand at least 6 feet from the patient, at an angle of 90° to 135° to the central ray of the X-ray beam.

d. Films should never be held in place by the operator (use film holding instruments).

e. The radiographic tube should never be stabilized by the operator or patient during the exposure.

To ensure the above, advice to use film badges. These badges contain a piece of sensitive film or radiosensitive crystal by which the quantity of radiation exposure or dose can be determined. The instrument used to measure radiation dose is known as **dosimeter**.

Exposure to cuts from sharp medical instrument

Includes – needle prick injuries and injuries from sharp objects and spicules of bone and teeth

Needle cut injuries are also known as precutaneous injuries; they are most efficient method of transmitting blood-borne infections.

- Fasunloro A and Owatade FJ in 2004¹³ done a survey on occupational hazards among clinical dental staff in Nigeria reported that 1-15% of surgical procedures like suturing cause's needle stick injuries and cuts from sharp objects.
- A study done in United States reports that more than 800,000 needle stick injuries occur each year inspite of continuing education and efforts to prevent them³⁵. Also, the studies in United kingdom²³ and Thailand ³² also revealed that precutaneous injuries are mostly due to needle prick.
- A survey in South Africa only 14% of dentists reported needlestick injuries ³⁶.
- The two studies in Australia from brisbane and sydney revealed that 72% of dental students indicated injury from sharps objects during their training³⁷.
- 70% of the injuries occurred during administration of the local anesthesia³⁸.

Prevention: Safe working procedures and wearing of double gloves. National and international guidelines, such as the Needle stick Safety Act in 2001 were developed to help minimize the risk of blood borne pathogen exposure to health care workers including dental settings^{39,40}.

AEROSOLS ⁴¹⁻⁴³ Aerosols is Defined as particles less than 50 micrometers in diameter. These are ejected from operating site and suspended in the air and are airborne infection in dentistry. Therefore, Aerosols are contaminated with bacteria and blood.

Procedures Shown To Produce Airborne Bacterial Contamination⁴⁴

Ultrasonic and sonic scalers - Shown to be the greatest source of airborne contamination. The use of a high volume evacuator will reduce airborne contamination by greater than 95%.

- ✓ Air polishing - Bacterial counts show that airborne contamination is nearly equal to ultrasonic scalers. Commercially available suction/barrier devices will reduce airborne contamination by greater than 95%.
- ✓ Air-water syringe - Bacterial counts indicate that airborne contamination is slightly less than ultrasonic scalers. High volume evacuator will reduce airborne bacteria by nearly 99%.
- ✓ Tooth preparation with an air turbine hand piece - Minimal airborne contamination if a rubber dam is used.

Azari RM et al ⁴⁵ (2008) conducted a study on Occupational risk of dental personnel to microbial airborne contamination and reported increased prevalence of respiratory infections. Therefore, study concludes that there are no standards for acceptable levels of indoor air contamination with pathogenic microorganisms and since pathogenic *Streptococcus haemolyticus* and opportunistic *Staphylococcus* species were found in some areas of the dental school, the need for management of possible risk of infective hazards is recognized.

Chemical Hazards ⁴²

Dentists are exposed to many various types of chemicals that are hazardous while providing care. They include beryllium, silica, powdered natural rubber latex (NRL), formaldehyde and most dangerous mercury.

Silica: Inhalation of dust containing free silica or silicon dioxide in ceramic laboratories leads to silicosis

Beryllium: Some of the dental alloys contain beryllium and if it inhaled while working on items such as dental crowns, bridges, and partial denture framework, they can cause chronic beryllium disease (CBD). As per Occupational Safety and Health Administration (OSHA) specification, employees cannot be exposed to more than 2 microorganisms of beryllium per cubic Meter of air for an 8 hour time weighted average

Formaldehyde¹: is one of the chemical agents routinely used in the clinical set up mainly for disinfection of operatory area. Liquid and vapour forms of formaldehyde may cause severe abdominal pain, nausea, vomiting and eye irritation.

Natural Rubber Latex (NRL) ⁴⁶⁻⁵³: Latex gloves (dusted with cornstarch powder) form an efficient barrier against most pathogens. Unfortunately most of the professionals are allergic to latex content of gloves. The powder in latex gloves itself is not the allergen. It only provides binding sites for latex protein, and aids in carrying the protein into the skin. It has also been reported that airborne powder particles can cause asthmatic allergic reactions or even anaphylaxis. Dental personnel should also note that latex is present in other personnel protective equipments like masks, eyewear, and clinical gowns.

Clinical symptoms of latex allergies include: urticaria, conjunctivitis accompanied by lacrimation and swelling of eyelids, mucous rhinitis, bronchial asthma and anaphylactic reaction.

Prevention

Most allergic reactions can be managed by self medication, prescribed medication. Sufferers from latex allergy are advised to work in latex free environment and use vinyl, nitrile or 4H gloves.

It is estimated that 2.8-17% of the employees of health service are allergic to latex⁵¹. 8.8% of dentists were found to be allergic⁵². The frequency of occupational related dermatosis varied from 21% to 43% depending on the prevailing material used in the various specialties.⁵⁰

Dental Products - such as acrylics, resins and polymer materials used in restorative dentistry represent a major advance in dentistry; but these products may act as allergens in part of the

population.^{54, 55} therefore, dental personnel should be familiar with the major signs and symptoms of allergic reactions, including anaphylaxis. Dentistry uses variety of different polymer materials. The setting of restorative materials and adhesives is initiated chemically by mixing two components or by visible light. In both cases, polymerization is incomplete and monomers not reacted are released. These free monomers may cause a wide range of adverse health effects such as irritation to skin, eyes or mucous membranes, allergic dermatitis, asthma and parasesthesia in the fingers. Additionally, disturbances of the central nervous system such as headache, pain in the extremities, nausea, loss of appetite, fatigue, sleep disturbances, irritability, loss of memory, and changes in blood parameters may also be noted.⁵⁷ The Asthma Due to Acrylate Compounds Allergic respiratory problem due to dental materials is also an important occupational hazard.⁵⁸

NITROUS OXIDE^{60, 61} The National Institute for Occupational Safety and Health (NIOSH) in 1994 issued a warning to hundreds of thousands of medical, dental professionals who work with nitrous oxide (N₂O). The Institute warns that even with preventive measures such as scavenging systems in place these workers may be at risk for serious health effects due to their exposure. N₂O commonly called as laughing gas, is an anesthetic agent used in operating rooms. Workers are exposed to N₂O while administering the anesthetic gas to patients. To protect workers from the health risks associated with N₂O, operating rooms are often equipped with scavenging systems that vent unused and exhaled gas away from the work area. If used in high concentrations during anesthetic administration, it may cause increased absorption and thereby liver and kidney damage with **neuralgic disease and congenital abnormalities.**

XYLENE⁶²⁻⁶⁴

In dentistry, xylene is used in histological laboratories for tissue processing, staining and cover slipping and also in endodontic retreatment as a guttapercha solvent. Exposure to xylene can occur via inhalation, ingestion, eye or skin contact. It is primarily metabolized in the liver by oxidation of a methyl group and conjugation with glycine to yield methyl hippuric acid, which is excreted in the

No	Type of musculoskeletal disorders	Symptoms
1)	Neck and shoulder disorders	
a)	Myofascial pain disorder	Pain and tenderness in the neck, shoulder and arm muscles. Painful trigger points upon touch.
b)	Cervical Spondylosis	Intermittent / chronic neck and shoulder pain or stiffness, headache, hand and arm pain, numbness, tingling and clumsiness
c)	Thoracic Outlet Syndrome:	Pain in the shoulder, arm or hand, numbness, tingling of fingers, muscle weakness / fatigue, cold arm or hand.
d)	Rotatory Cuff Tendinitis / Tears.	Pain and stiffness in the shoulder associated with backward and upward arm movements. Weakness of rotator cuff muscles
2)	Hand and Wrist Disorders:	
a)	DeQuervain's Disease	Pain in thumb and wrist area when grasping, pinching, twisting.
b)	Carpel Tunnel Syndrome:	Hand or finger numbness, pain, tingling, burning, clumsiness. Eventual muscle weakness and atrophy. Symptoms often worse with increased activity.
c)	Guyon's Syndrome	Symptoms begin with a feeling of <u>pins and needles</u> in the ring and little

3)	Back Disorders:	
a)	Herniated Spinal Disc	Back and leg numbness, tingling, pain, weakness. Worsens with coughing, sneezing, sitting, driving, bending forward
b)	Lower back pain:	Pain, Stiffness in lower spine and surrounding tissues
c)	Sciatica	Pain from lower back or hip radiating to the buttocks and legs. Leg weakness, numbness, or tingling. Possible causes are prolapsed intervertebral disc pressuring the sciatic nerve; worsened with prolonged sitting or excessive bending / lifting.

urine. Smaller amounts are eliminated unchanged in the exhaled air. There is a low potential for accumulation

Effects: Dizziness, headache, mental confusion from inhalation of vapour. **Acute:** Eye and mucous membrane irritation from vapour and liquid forms.

Chronic: If xylene contains benzene as an impurity, repeated breathing of vapour for a long period may cause leukemia.

PREVENTIVE MEASURES

- Substitution
- Local exhaust ventilation
- Proper protective equipment

Mercury ⁶⁵⁻⁷⁰:

By definition, an amalgam is a mixture of uncharged metal powders in elemental form that is mixed with liquid mercury to form an emulsion that hardens with time.

Prevention: Use of precapsulated alloys, Good ventilation, Excess and spilled mercury should be collected in fixer containing break resistant bottles. Mercury caused the formation of "neurofibrillar tangles," which are one of the two diagnostic markers for Alzheimer's disease. In February, 1998, a group of the world's top mercury researchers announced that mercury from amalgam fillings can

permanently damage the brain, kidneys, and immune system of children.^{69, 70}

Biological Hazards ⁷¹⁻⁷⁷ are constituted by infectious agents of human origin and include viruses, bacteria and fungi. Therefore it is greatest concern to the dental professional. They are HIV, HBV, HCV and Mycobacterium tuberculosis. A dentist can become infected either directly or indirectly.

Prevention from contamination and cross-infection can be done by effective sterilization of instruments using autoclave before and after use.

Legnani et al ⁷² made an assessment of the aerosol contamination resulting from dental procedures. Air contamination was measured by means of the Surface Air System method and the "plate" method (Air Microbial Index). It was proved that during working hours the average air bacterial load increased over three times, and the air load levels were 1.5 times (aerobic bacteria) and 2 times (anaerobes) greater as compared to the initial load.

In the study done in United Kingdom^{73,74}, the carrier rate of HBV in the general population is 0.5%, while dentists have a carrier rate of approximately 1.6%. Several of the common viral agents that can cause hepatitis.

Musculoskeletal disorder ⁷⁸

Musculoskeletal disorders are common health problems reported among dentists. Therefore, it has been reported that young and less experienced dentists experience more musculoskeletal disorders compared to older and experienced one. Common musculoskeletal problems are, **low back pain, shoulder pain, headache, hand and wrist pain.** Low back pain is more prevalent than other types. The cause of musculoskeletal problem is due to, repeated unidirectional twisting of the trunks, working in one position, prolonged static periods and operators flexibility.

Prevention of Neck, Shoulder and Back Disorders

Ergonomic recommendations for minimizing the risks of back injuries focus on improving working posture and equipment design. These include:

- 1) **Change Posture** - Alternate between sitting and standing to reduce postural fatigue and maximize postural variety, which helps to reduce static muscle fatigue.
- 2) **Use Support** - When sitting or standing, don't lean forwards or stoop in an unsupported posture for prolonged periods. If you are sitting, sit up straight or recline slightly in a chair with good back support, and use a good footrest if necessary. If you are standing for prolonged periods try to find something to help you lean against.
- 3) **Safe reaching** - Avoid having to reach awkwardly to equipment and work close to the patient. Keep the items used most frequently within a distance of about 20 inches (50 cm). Use assistants to help move equipment into this zone.
- 4) **Normal arm posture** - Keep elbows and upper arms close to the body and don't raise and tense the shoulders when working. Also, ensure that hand postures are not deviated because this could lead to wrist problems.
- 5) **Use Comfortable Equipment** - Use equipment that isn't too heavy, that can be used without awkward upper body posture, and that feels comfortable to use. Ergonomically designed equipment helps to minimize stresses on the upper extremities and the back.
- 6) **Manage Time** - Avoid long appointments where possible, or intersperse these with frequent

short rest breaks in which you change posture and relax the upper extremities

Wazzan al et al⁸¹ in their study, reported that only 37% of those suffering back and neck pain sought medical treatment and concluded that these symptoms among dental personnel are not severe enough to ask for medications.

Visser and Straker ⁸² also showed the dentist experienced significantly greater levels of lower back discomfort than dental assistants.

Onycholysis and nail pitting are of occupational dermatitis of manicurists and people whose jobs relate to vibrating machines but have not been mentioned in dentistry. Here we report a unique case of this object. A 29-year-old right-handed female dentist who had been carrying out endodontics for 5 years, was visited in Qaem dermatology clinic with complaint of nail deformity. There was not any evidence of dermatologic disease and allergy in her medical history. Clinical examination revealed onycholysis in internal angle of right thumbnail and pitting in the ipsilateral index finger, with 6 months duration. Besides, nail bed biopsy ruled out other differential diagnosis of dermatologic disease with nail manifestations. She reported exacerbation of the condition with longer occupation time and relative improvement in vacations.

The possibility of occupational onycholysis with a none-allergic aetiology was considered. Improvement was noted when she stopped her career. This is the first report of occupational onycholysis due to dentistry.⁸³

Psychological Hazards ⁸³ Dentists encounter numerous sources of professional stress, anxiety, and depression, beginning in dental clinic.

Stress can be defined as the biological reaction to any adverse internal or external stimulus physical, mental or emotional that tends to disturb the organism's homeostasis

Meslach and Jackson⁸⁴ (1986) define burn out as: "A syndrome of emotional exhaustion, depersonalization and reduced personal accomplishment that can occur among individuals who do people work of some kind. Burn out may

lead to depression, so early recognition of the symptom is important.

Humphris et al⁸⁵ reported that general dentists and Oral surgeons had the highest levels of burnout and that orthodontists had the lowest levels of burnout.

Anxiety Disorders⁸⁴ are chronic and relentless and can grow progressively worse if not treated. Two common and potentially overlapping anxiety disorders are panic disorder and generalized anxiety disorder, or GAD.

Good communication between the doctor and the patient has a positive influence upon a stricter observance of the doctor's recommendations by the patient. The course of doctor patient relations significantly reflects patient's health action and result of treatment⁸⁶

Prevention

The goal of coping with stress is to offset the negative effects of stress by using appropriate coping strategies. Coping can be done by, participating in activities that make to feel better, going to movies or participating in religious, social or other activities. Stress management workshops focusing on stress relievers may include deep breathing exercises; progressive effective relaxation of areas of the body; listening to audiotapes of oral instructions on how to relax; meditation.

Legal Hazards⁵⁰

In every country there are relevant statutes and regulations which apply to the practice of dentistry. The contravention of any of these may warrant that legal actions be brought against a dental practitioner particularly in developed countries where the citizens appear more aware of their rights. To help assure a safe work environment in dental treatment, the hazard awareness and prevention of legal risks should be made known to all clinical workers of the dental hospital.

Recommendations

Dentist has to upgrade their existing knowledge by participating in continuing dental education, regular workshops and seminars on occupational hazards should be organized for all clinical dental staff

periodically to update their knowledge and, hopefully, influence their work practices. Precaution has to be taken while practicing to prevent occupational hazards. Dental clinic design has to be made with, sufficient lighting, ventilation, engineering control measure and equipped with appropriate personal protective. More effort should be made by management officials to educate the staff about the importance of Hepatitis B vaccination. All staff members should also be alerted to the danger of chronic mercurial poisoning and its prevention.

CONCLUSION

Occupational health hazards are present in every profession. Dentists are one such professional group. In spite of these hazards we cannot refrain from providing care and serving community. Sufficient knowledge and adequate information regarding occupational hazards and its prevention will contribute in providing quality care to patients without any doubt.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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