



Role of Dental Professionals in Disaster Management: A Review

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[Review Article](#)

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ABSTRACT

Disasters are not confined to a particular part of the world; they can occur anywhere and at any time. Emergencies and disasters not only affect the health and well-being of people; frequently, a large number of people are dead, injured, or subjected to greater risk of epidemics. The fundamental aspects of Disaster Management include Disaster Response, Disaster preparedness, and disaster mitigation. Dentists are one of the important constituents of the health team, yet their role or utility has not been emphasized till date. The various activities carried out by Dentists for the purpose of Disaster Management include providing support to First responders, Disease surveillance, Forensic assistance, Triage duties, Definitive clinical treatments, Prescribing appropriate drugs, Vaccination programmes, Policymaking, etc. Forensic odontology also plays a major role in the identification of disaster victims with Dental Identification, DNA Identification, Palatoscopy, and Cheiloscopy. In the current scenario, Dental professionals have risen to the challenge in the fight against COVID -19 and have proved to be an invaluable resource in the pandemic response. Thus, in a developing country like India, where a disaster can fall at the strike of the clock, there is a need to harvest the services of the wide distribution of dental professionals practicing in the country.

Keywords: Disaster, Dentist, Forensic Odontology, Disaster Management, COVID-19.

Introduction

Disasters cause great harm to the existing infrastructure and threaten the future of sustainable development. Disasters are not confined to a particular part of the world; they can occur anywhere and at any time.¹



Emergencies and disasters not only affect the health and well-being of people; frequently, a large number of people are displaced, killed, injured, or subjected to greater risk of epidemics. Considerable economic harm is common and vulnerability to disaster is growing.²

Disasters are of two types: Natural and Man-made Disasters. Natural disasters include earthquakes, cyclones, floods, tidal waves, land slides, volcanic eruptions, tornadoes, fires, hurricanes, snowstorms, severe air pollution (smog), heat waves, famines, epidemics, etc. While Manmade disasters include building collapse, toxicological accidents (e.g. release of hazardous substances), nuclear accidents and warfare, etc. In the past decade, more than 2.6 billion people have become casualties of natural disasters, amongst which are flash floods, hurricanes, cyclones, earthquakes, and tsunamis, that have affected various countries over the 7 continents.³

Morlang⁴ was the first to discuss the potential roles of oral health care providers in both military and civilian disaster response support. Often, the roles of oral health care providers were thought to be of no importance and to be non-existent. However, it has been proven otherwise through the field of forensic dentistry or forensic odontology, which has played a vital role in the recovery of mass disaster or mass causality events, when the identification of victims could not be established by conventional means.

Over the past couple of years, the governments of countries like India and Nepal have brought a paradigm shift in the approach to disaster management. The approach has been translated into a national disaster framework and has been shared with all sub-divisional governments and administrations having a common scheme. The roles of traditional first responders shift in case of severe disaster events, particularly when the number of victims overflows the hospitals and clinics. In such situations, dentists and dental auxiliaries play a vital role in response to the disaster by a wide range of skill sets based on personal experience, training, and enthusiasm.⁵ For example, during the 9/11 disaster strike, an entire dental team which was assisted by the Disaster Mortuary Operational Response Team (DMORT), which is part of the National Disaster Medical Service (NDMS), played a relatively significant role in disaster response.³

Dentists are one of the important constituents of the health team, yet their role or utility has not been emphasized till date, especially in India. Oral healthcare personnel including dentists can be utilized successfully for the emergency medical response system in building the required partnerships, to identify and garner resources, and facilitating training, development of suitable policy, of a community or a society involving surveillance and evaluation.⁶

Fundamental Aspects of Disaster Management: A disaster can be defined as “any occurrence that cause damage, ecological disruption, loss of human life or sufficient to warrant an extraordinary response from outside the affected community or area”⁷ (Janssen JA, Lampiris LN). It is a serious disruption of the functioning widespread human, material, economic or environmental loss and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Disaster Management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular **preparedness, response, and recovery** in order to lessen the impact of disasters.⁸ (Quarantelli EL).

The fundamentals aspects of Disaster management consist of the three underlying steps:

- a. **Disaster response;**

- b. Disaster preparedness; and
- c. Disaster mitigation

These three aspects of disaster management correspond to different phases in the so-called "*Disaster cycle*".¹

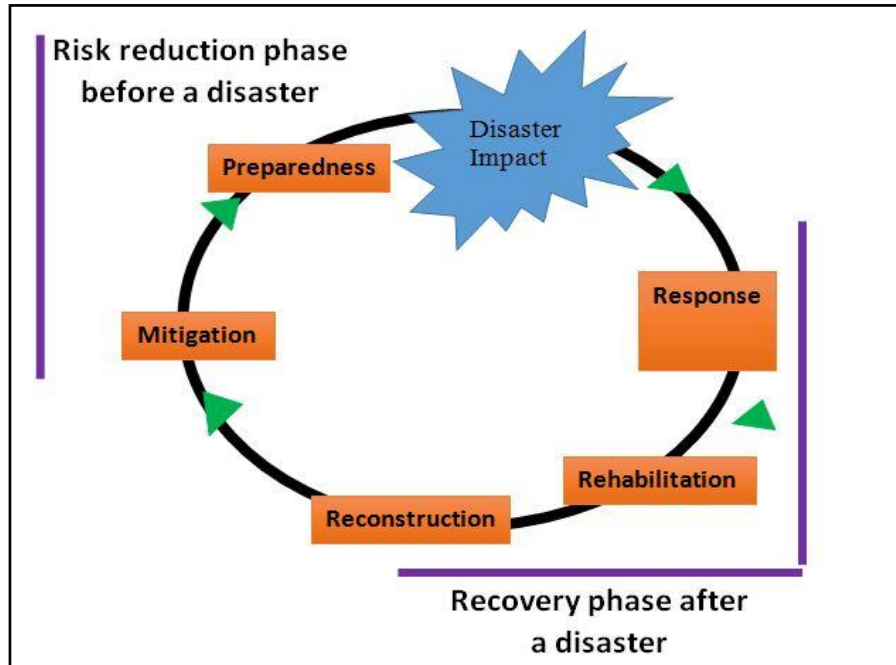


Figure 1: Management Sequence of Sudden Onset Disasters

In the decade 1990-2000, an average of about 4,344 people lost their lives and about 30 million people were affected by disasters every year. The loss in terms of private, community and public assets has been astronomical. At the global level, there has been considerable concern over natural disasters. Even as substantial scientific and material progress is made, the loss of lives and property due to disasters has not decreased. In fact, the human toll and economic losses have mounted. It was in this background that the United Nations General Assembly, in 1989, declared the decade 1990-2000 as the **International Decade for Natural Disaster Reduction** with the objective to reduce loss of lives and property and restrict socio-economic damage through concerted international action, especially in developing countries.¹

Role of Dental Professionals in Disaster Management: Dentists along with other health professionals can act as first responders well prepared to play an important role in response to catastrophic events as they are:

- Experts in infection control
- Trained and skilled in administering drugs by injection
- Skilled in placing sutures and controlling bleeding
- Able to participate in interdisciplinary professional groups; and
- Managing uncomfortable patients⁹

Thus, various roles carried out by Dental professionals during an emergency include

1. **Providing support to First responders:** Dental offices are equipped with potentially useful equipment and supplies and should be prepared to serve as **decentralized auxiliary hospitals** in



case the need arises. Further, dental offices, equipped with air and suction lines, x-ray equipment and sterilizing capability, can be used as self-contained alternate medical sites if hospitals are under attack or are unsafe because of widespread infection associated with biological weapons.^{10,11}

2. **Disease Surveillance:** Bioterrorism attacks and pandemics often have relatively indistinguishable beginnings and end with unpredictable effects on a population. Such surveillance (observation) would note if there is an influx of people seeking medical attention with non-traumatic conditions and flu-like or possibly neurological or paralytic symptoms. A wide distribution of dental offices in nearly every community makes them less vulnerable to complete elimination in a catastrophic disaster.¹²
3. **Providing Forensic assistance:** Dental identifications have always played a key role in victim identification during natural and manmade disaster situations and in particular mass casualties normally associated with aviation disasters. At the onset of disaster, various teams of dentists can be established to start collecting antemortem data based on the list of missing persons. Once these records have been compiled, forensic odontologists can begin comparisons between remains and antemortem records.¹³
4. **Triage duties:** Triage is derived from the French, meaning to sort out, and can be applied to various situations ranging from everyday triage of emergency department patients to large-scale disasters. This assistance allows physicians to provide definitive care for patients requiring urgent treatment. Dental offices could serve as triage centres if needed. A major earthquake struck China on May 12, 2008. Of the 4,582 patients, 408 (8.9%) sustained a total of 482 facial injuries. The dental team participated in triage in the field, in medical patrol service at support sites in many areas including dental offices, and as additional staff members in the hospitals.¹⁴
5. **Providing definitive clinical treatments:** They are especially experienced in treating dentoalveolar injuries and facial fractures. A team of Oral and maxillofacial surgeons is capable of administering anaesthetic and surgical services to patients with many types of injuries. Dentists have training and experience in many areas that may be a part of casualty care in mass casualty events. Oral and maxillofacial (OMFS) practitioners are qualified trauma surgeons who can provide first aid, including endotracheal intubation and cardiopulmonary resuscitation.¹⁵
6. **Prescribing appropriate drugs:** Physicians, nurses, and pharmacists may not be able to effectively prescribe or dispense the appropriate drug necessary in the critical time required. Dentists can be called on to prescribe and dispense the appropriate drugs required as determined by the physicians and public health officials managing the disease outbreak. The dentist also can monitor patients for adverse reactions and side effects and refer patients to physicians for treatment, if necessary.^{6,16}
7. **Vaccination programmes:** Dentists can participate in mass vaccination programs with a minimum of additional training and may be a critical factor in the success of urgent programs. Dental offices can be used as immunization sites to minimize the concentration of potentially infected persons. To limit the spread of infectious agents, whether, from a natural pandemic, a deliberate bioterrorism attack, or contamination as a result of a local event, rapid immunization of great numbers of individuals may be required in a short amount of time. Physicians and nurses may be unable to implement such a program in the critical time frame required.^{16,17}
8. **Policy making:** Dentists who specialize in the field of Public Health if involved in Policy making can prove very vital to the Government for the emergency medical response system in the development of suitable policy for the purpose of Disaster Management in the country.⁶

Role of Forensic Odontology in Disaster Management: Today forensic odontology is considered as a specialized and reliable method of identification of the deceased, particularly in multiple fatality incidents.



Mass disasters may be caused by natural events such as severe flooding, earthquake, or volcanic eruption. It may also be caused by human activities such as mishaps involving mass transport by land, sea, or air; other causes include war, boundary disputes, ethnic or religious conflict. In severe burn situations and/or following severe disintegration, visual recognition of facial features and fingerprints is often impossible due to extensive soft tissue destruction; this situation often necessitates the use of hard (calcified) tissue such as human dentition and jawbones for human identification likewise persons who have been diseased for some time prior to discovery and those found in water also present unpleasant and difficult visual identification.¹⁸

Dental identification plays a key role in natural and manmade disasters especially in mass casualties associated with aviation disasters. In case of mass disasters, the principal aim of the investigation is to establish the identity of the victims. The post-mortem procedure for identification includes the location of the bodies and photography at the scene of the accident, post-mortem dental examination using dental charting, photography, radiographs, study models, and biological specimens were taken for DNA analysis, and then these records are compared with antemortem records available. When it is difficult to identify a person according to fingerprints or dental records, palatine rugae or lip prints may be an alternative method of identification.^{18,19}

The reliable methods of Human identification with the use of Forensic Odontology include:

- 1) Dental Identification
- 2) DNA Identification
- 3) Palatoscopy
- 4) Cheiloscopy

1) Dental Identification

Dental identification of a person is based on unique individual characteristics of the dentition and dental restorations, relative resistance of the mineralized dental tissues, and dental restoration to changes resulting from decomposition and harsh environmental extremes such as conditions of temperature and violent physical forces.

Dental identification is common in the establishment of the identity of recovered human remains. The establishment of dental identification requires the collection of dental information from the recovered remains. Once this information has been completed, a comparison of this information is made with dental information of the missing or suspected individual collected from the dentist's record.

There are many methods of dental identification as given by ABFO (American Board of Forensic Odontology) Identification Guidelines like collection and preservation of dental records using visual examination, radiographs, photographs, study models. Some other methods used are post-mortem dental profiling, preservation of jaw and tooth fragments, labelled dentures, removable orthodontic braces, scanning electron microscopy with and without energy dispersive X-ray analysis (SEM-EDX), and jaw resection.¹⁹

Sources for Antemortem Data

The variety of resources agencies and individuals that might provide assistance in locating records include:

- Local agencies like hospitals, other health care facilities, dental hospitals, health care providers, Employer Dental Insurance.
- State agencies, they contact to local agencies for dental records.



- Federal agencies include the Federal Bureau of Investigation (FBI), National Crime Information Center (NCIC), family/friends/co-workers, public aid insurance administrator, Employer dental insurance carrier, prior military service, prior judicial detention in-country, State or federal institutions, Prior hospitalization (e.g chest films, skull films), oral surgeons in the area, veterans administration hospitals, any previous areas of residence, Chiropractice X-rays, if evidence of ortho treatment, orthodontists in the area, Comparison of antemortem and post-mortem data.

If the dental records of the patients are not available, then the other method of identification is by using DNA technology.²⁰

2) DNA Identification

Human identification is one of the major fields of study and research in forensic science because it deals with the human body and aims at establishing human identity. Several proper and specific individual characteristics may be used in human identification. Among the identification methods, fingerprint examination, dental identification, etc are the most used ones. But in cases where nothing else is possible, then DNA technology is being used for the identification. Various methods for DNA Identification are:

- I. DNA Identification Methods through
 - a. RFLP Method
 - b. Polymerase Chain Reaction Method (PCR)
- II. Human Identification using DNA
- III. Teeth as a genetic source [19]

I. DNA Identification: It is carried out using the following two methods:

a. RFLP (Restriction Fragment Length Polymorphisms) Method: RFLP method is a DNA typing method that was first described and most commonly employed by many crime labs initially, is known as Restriction Fragment Length Polymorphisms (RFLP) analysis.

b. Polymerase Chain Reaction (PCR) Method: It is a method of copying or “amplifying” a particular segment of DNA. A few strands or a single strand of DNA can be used to reproduce millions of copies of target DNA fragments. Kary Mullis was awarded the Nobel Prize in 1993 for the discovery of the PCR process. PCR amplification is a sample preparation technique, which enables further testing to detect various polymorphisms. PCR testing is sensitive, quicker, less labour intensive, and less tedious than RFLP testing. It is also used for degraded specimens because only a few copies of relatively short segments need to remain intact. However, PCR testing is susceptible to inhibition and the potential for cross-contamination.

II. Human Identification Using DNA

Genetic material can be obtained from several biological sources such as body fluids (blood and saliva), soft tissues (muscles and viscera), and mineralized tissues (bones and teeth). When dealing with living suspects in parenthood tests (father, mother, and son), genetic material is preferably obtained from either blood (leukocyte) or buccal mucosa. In a recent death case blood, viscera and soft tissue are the first materials choice, but as time goes by those sources become inappropriate, leading to mineral tissues sources: bones and teeth. Bones are an important source to obtain genetic material. Traditional identification methods would not give such good results. DNA analysis from bones and teeth would also guide anthropologic studies to identify population migration origin in ancient times.

III. Teeth as Genetic Material Source

Teeth also are a good source to obtain genetic material. This is true mainly because of their great tissue resistance (enamel, dentin, cementum and pulp) against external injuries.

Malaver et al. in 2003 extracted DNA obtained from dentin and cementum that had been buried for at least 5 years. Dental pulp is protected by tooth structures and therefore can present better conditions than other soft tissue for DNA extraction. *Lessing et al.* in 1995 showed that pulp can be a source of DNA in teeth that had been kept or obtained in different conditions such as teeth that had been extracted when the person was alive and after death and kept at room temperature for respectively 12 and 6 months. Amelogenin can be also studied from dental material that had been through adverse situations.^{19,20,21}

Sometimes the DNA identification is not possible, so palatoscopy and cheiloscopy are some other methods used for identification.²²

3) Palatoscopy

Anatomists always have shown interest in the evolutionary development of the folds of tissue found in the roof of the human mouth—the palatine rugae. *Winslow* (1732) seems to /have been the first to describe them, and the earliest illustration of them probably is by *Santorini* (1775). Palatal rugae, also called plicae palatinae transversae and rugae palatina, refer to the ridges on the anterior part of the palatal mucosa, each side of the median palatal raphe, and behind the incisive papilla.²²

When traffic accidents, acts of terrorism, war or mass disasters occur in which it is difficult to identify a person according to fingerprints or dental records, palatine rugae may be an alternative method of identification.²³ The palatine rugae are permanent and unique to each person and can establish identity through discrimination (via casts, tracings, or digitized rugae patterns). Palatal rugoscopy was first proposed in 1932, by a Spanish investigator named *Trobo Hermosa*.



Figure 2: Palatoscopy

Recording of Palatal Rugae: Alginate impression of the maxillary arch should be made. Rugae pattern was recorded by adding additional silicone over impression material as it has high tear strength and better accuracy, optimum pressure was applied to make an impression of the upper dental arch for all the subjects and the impressions were then poured with Type 3 dental stone. The palatal rugae patterns were highlighted by black lead pencil on the cast and were then analyzed. The other method of identification is by using computer techniques. For this purpose, special software was designed called Palatal rugae comparison Software (PRCS version 2.0).²²

Clinical Significance of Palatoscopy

- I. Variation of rugae pattern in different ethnic groups:** There seems to be a significant association between rugae forms and ethnicity *Kashima* compared the palatine rugae and the shape of the hard palate in Japanese and Indian children. They found the following: Japanese children had more primary rugae than did Indian children, but both groups had the same number of transverse palatine rugae. *Aparna Paliwal et al.* (2010) compared the palatal rugae patterns in two different populations in India (Madhya Pradesh and Kerala). The results showed that the straight rugae pattern on the right side of the palate in the males was found to be significantly predominant in the Madhya Pradesh population, whereas the wavy shape was predominant in Keralites; however rugae patterns on the right side of the palate in female subjects exhibited no significant difference.^{22,24}
- II. Forensic identification:** The establishment of a person's identity can be a difficult task in cases of traffic accidents or acts of terrorism or mass disaster situations. The application of palatal rugae patterns for personal identification was suggested by Allen in 1889. Although teeth are more durable than other parts of the body, identification via dental records also may prove to be inconclusive, because the dental treatment might have been performed between the creation of a dental record and the person's death. The anatomical position of the rugae inside the mouth—surrounded by cheeks, lips, tongue, buccal pad of fat, teeth, and bone—keeps them well-protected from trauma and high temperatures. Thus, they can be used reliably as a reference landmark during forensic identification.^{22,24}
- III. Burn cases:** *Muthusubramanian et al.* in 2005 did a study to examine the extent of palatine rugae preservation for use as an identification tool in burn victims and cadavers. Patients with third-degree were examined within 72 hours after their accident. The study results showed that among the subjects with third-degree burns, 93 percent of the palatine rugae were normal. They concluded that the palatine rugae could be used as a reference landmark during forensic identification of an individual.²⁵ Similar studies have been carried out to assess the application of dental methods of identification to human burn victims in mass disasters.²⁶
- 4) Cheiloscopy:** Lip prints are similar to fingerprints, palm prints, and footprints in that, individual characteristics are used for identification. Labial mucosa a part of oral mucosa is not smooth like buccal mucosa or soft palate. It has many elevations and depressions forming a characteristic pattern called "lip prints". According to *Sivapathasundharam B et al*, 2001 cheiloscopy is the examination of the lip prints. *Vahanwala SP* in 2000 defined cheiloscopy as a forensic investigation technique that deals with the identification of humans based on lip traces.²²

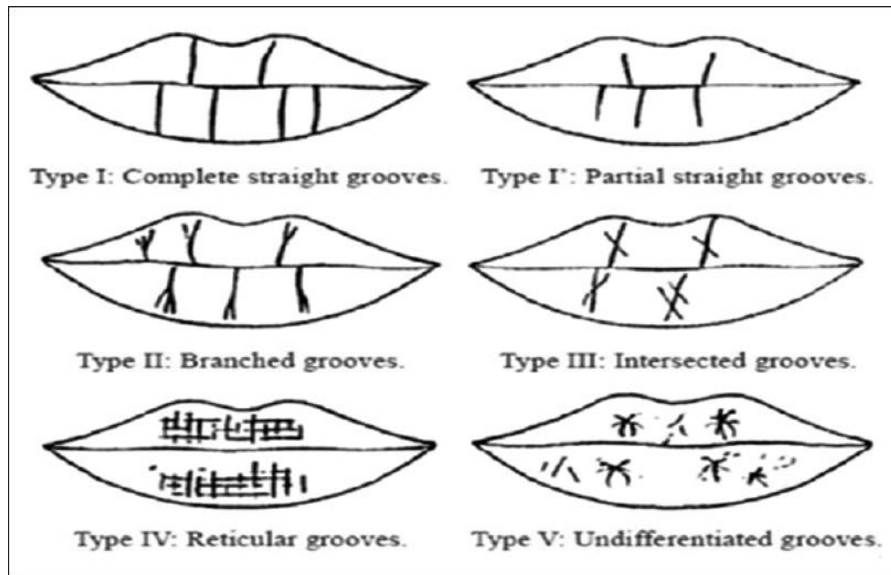


Figure 3: Cheiloscopy

Methods of recording lip prints

Cheiloscopy is applicable mostly in identifying the living since lip prints are usually left at crime scenes and can provide a direct link to the suspect. Lip prints can be recorded on a non-porous flat surface such as a mirror, they can be photographed, enlarged and overlay tracings can be made of the grooves. If the photograph is used directly with no medium and tracing is made then the correct lighting is required. Lipsticks can be applied to the lips and then the lips are photographed. Images are observed through a magnifying glass and traced onto cellophane.²⁷

In recent years, lipsticks that do not leave any visible trace after contact with surfaces such as glass, clothing, cutlery, or cigarette butts have been developed. These lip paints are characterized by their permanence and are therefore referred to as “persistent lip prints”. Although invisible, these lip prints can be lifted using materials such as aluminium powder and magnetic powder.²⁸

Emergency Preparedness Curricula Proposed for Dental Schools

The current increased threats of terrorism clearly support the need to incorporate terrorism preparedness and response material into the curricula for every health professions school. The program consists of three levels of courses of increasing clinical complexity:

- (1) Core Disaster Life Support (CDLS),
- (2) Basic Disaster Life Support (BDLS), and
- (3) Advanced Disaster Life Support (ADLS).

These programs can also be incorporated into the post-graduate training curriculum.

An integrated fourth-year course in catastrophe preparedness can also be developed for dental students. This type, of course, is already implemented in the dental curricula of New York University as a Senior Level Course. A program called the ‘National Disaster Life Support (NDLS) training program can also be developed to better prepare health care professionals and emergency response personnel for mass casualty events.¹⁹

Role of dental curriculum

The role of dental curriculum should be highlighted, as dental schools should train all students in a core set of competencies of mass disaster and bioterrorism. In June 2002, the American Dental Association held a meeting in order to identify the specific areas in which the dental profession could provide emergency assistance and to prepare dentists adequately. Dentists and their dental auxiliaries can augment the existing medical professionals in responding to declared medical emergencies.²⁹

Role of Dentists in the Ongoing Covid-19 Pandemic

The emergence of the highly infectious novel Coronavirus SARS-CoV-2 has led to a global COVID-19 pandemic. Since the outbreak of COVID-19, worldwide healthcare systems have been severely challenged. The rapid and explosive surge of positive cases has significantly increased the demand for medical care. Though dentists and physicians have different scopes of practice, their trainings share many similarities. Dental professionals, with their knowledge of basic human science and sterile surgical techniques, are an invaluable resource in the COVID-19 pandemic response. It is commendable that many dentists have risen to the challenge in the fight against COVID-19.



Figure 4: Dental clinicians were trained to conduct swab procedure using swab booths for COVID – 19 screening tests (Photo credit: National Dental Centre, Singapore)

Licensed dentists are eligible to administer COVID-19 diagnostic tests such as nasopharyngeal and oropharyngeal swabs. Dentists can also assist their medical counterparts in the inpatient setting. Such duties include patient triage, monitoring vital signs, administering oxygen and injectables, writing prescriptions and immunization programmes. Dentists are capable of administering local anesthesia and suturing for emergency procedures. In addition, oral surgeons and dental anesthesiologists are competent in performing intubation, deep sedation, and general anaesthesia services.³⁰



Digitalized healthcare services can be implemented with a qualified team of dentists being available online to provide reliable oral healthcare solutions in an accessible, affordable and appropriate manner. In India, such efforts have been made by Oral healthcare online apps like toothsi and Denta Mitra.^{31,32} Oral healthcare professionals can also engage in voluntary service for residents in community housing to promote good oral health.³⁰

Dental practice will be considerably changed in the post-COVID-19 era. There is a greater need to have refresher courses for practicing dentists on new infection control strategies. Moreover, the curriculum in dental schools should be expanded to include competencies in pandemic and disaster relief. In addition, voluntary medical work should be made a part of the community dentistry curriculum.^{33,34} Therefore the contribution of dentists stands above and beyond dental practice in this pandemic situation and shall be appreciated by future generations.

Conclusion: When disaster threatens, it becomes imperative on the part of the healthcare providers' forever preparedness. Although the first responders are primarily looked upon in case of any disaster response; if called upon, dentists can be a source of vital support in medical surge events. The role of dentists in disaster management does not hold any clear-cut boundaries as such. Dentists along with other health professionals can act as first responders well prepared to play an important role in response to various natural as well as man-made disasters. Thus, in a developing country like India, where a disaster can fall at the strike of the clock, there is a need to harvest the services of the wide distribution of dental professionals practicing in the country.

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