



NAVAL MEDICAL RESEARCH UNIT SAN ANTONIO

THE BURDEN OF DENTAL EMERGENCIES, ORAL-MAXILLOFACIAL, AND CRANIO-MAXILLOFACIAL INJURIES IN U.S. MILITARY PERSONNEL

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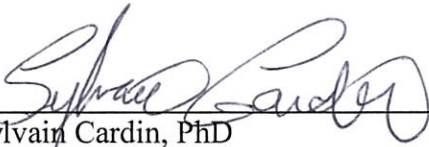
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ABBREVIATIONS

CMF	Cranio-maxillofacial
DE	Dental Emergencies
DoD	Department of Defense
DODTR	Department of Defense Trauma Registry
DRC	Dental Readiness Classification
ICD	International Statistical Classification of Diseases and Health Problems
IDC	Independent Duty Corpsmen
IMR	Individual Medical Readiness
OIF	Operation Iraqi Freedom
OMF	Oral-maxillofacial
OND	Operation New Dawn
PHA	Periodic Health Assessment
PPY	Personnel Per Year
SG	Surgeon General
s.d.	Standard Deviation
TSCOHS	Tri-service Center for Oral Health Studies
CONUS	Continental United States
OCONUS	Outside the Continental United States

EXECUTIVE SUMMARY

Background: High numbers of dental emergencies (DE) in military service members (approximately 15% per annum) prompted the inclusion of Dental Readiness as one of six conditions that determine service members' Individual Medical Readiness (IMR). Additionally, even with the advances in body armor and helmet design, Cranio- and Oral-maxillofacial (CMF, OMF) injuries continue to occur in hostile environments.

Objectives: The objectives of this report are (1) to provide a comprehensive review of the incidence of DE and CMF/OMF injuries in U.S. military personnel deployed in multiple environments, and (2) to compare the rates of DE and CMF/OMF injuries occurring in the twentieth century with the rates observed in the early twenty-first century.

Methods: Published and unpublished studies, as well as military reports of DE, OMF and CMF injuries occurring in U.S. military personnel were evaluated. Study publication dates included 1955 to 2017, with data collection periods from 1941 through 2014.

Results: Three reports, 17 published manuscripts, and two unpublished studies of DE (a total of 31 DE rates were described, as five publications reported rates for multiple samples) and 13 studies of OMF-CMF injuries were reviewed. Overall, the reported annual DE rates varied widely among U.S. military personnel between 1966 and 2012, ranging from 26 to 324 (mean 152.2) DE per 1,000 personnel per year (PPY). The average annual incidence of DE for personnel in hostile environments was 125.1 per 1,000 PPY. Thirteen studies reported rates of OMF-CMF injuries from 1941 to 2014. The overall mean OMF injury rate in Operation Enduring Freedom (OEF) was 2.8 per 1,000 PPY, while the mean rate during Operation Iraqi Freedom (OIF)/Operation New Dawn (OND) was 3.2 per 1,000 PPY. A mean of 22.3 CMF injuries per 1,000 PPY was calculated from two reports during OIF.

Conclusions: The percentage of DE and OMF casualties that can be expected in hostile environments is approximately 12%. Using the most recent data since 2000, the mean DE rate was 118.2 per 1,000 PPY and the OMF rate was 3.0 per 1,000 PPY. Continued research is required to provide improved diagnostic and treatment capabilities for DE and enhanced protection of the cranio-maxillofacial area. More importantly, quality data are necessary (1) to enable the accurate prediction of DE, CMF, and OMF casualties to insure that adequate levels are sufficient for mission success, and (2) to ensure that all outcome variables are available to measure policy success or failure.

INTRODUCTION

Vice Admiral Forrest Faison, the Surgeon General (SG) of the United States Navy, stated on March 9, 2016 before the Subcommittee on Defense of the House Committee on Appropriations, that one of the major goals of the Navy Medicine enterprise is to “support the Navy-Marine Corps mandate to be where it matters, when it matters and ready to respond in time of crisis”. The SG further went on to clarify this statement by describing Navy Medicine as an agile, rapidly deployable health system, “capable of providing life-saving and health sustaining specialized capabilities to the warfighters in all domains and locations”.¹ However, predicting future wars, their geographic locations, and their corresponding medical requirements remains elusive. As such, an important focus of Navy Medicine is to provide sufficient preventive care aimed at being responsive to potential operational requirements and maintaining a “medically ready” force.

Dental emergencies (DE) are an increasing burden at civilian emergency departments. Allareddy et al. reported that approximately 1% (4,049,361) of all emergency department visits in the U.S were for treatment of dental conditions for the years 2008-2010.² Similarly, Verma and Chambers reported that approximately 1% of all emergency department presentations at a general hospital in Australia were due to dental causes, with abscesses and toothaches accounting for 66% of the dental complaints.³ Emergency departments and dental practices are readily available to treat dental emergencies (DE) occurring in civilians. However, for military personnel who are serving in remote or hostile environments, DE can create negative outcomes related to mission success and the often dangerous logistical requirements to transport personnel to treatment facilities.

Rudimentary dental classification guidelines have been used by military Dental Officers since World War I.⁴ However, the need to standardize and implement guidelines by way of Department of Defense (DoD) instruction was required to aggressively prioritize pre-deployment care, and thereby attempt to decrease the number of DE experienced during deployment. A DoD instruction was in effect from 1984 that used Class 1 (needs no treatment), Class 2 (treatment needs not predicted to cause a DE with one year), Class 3 (dental condition that increases the likelihood that a DE will occur within 1 year), Class 4 (dental status unknown or last known greater than one year) as guidelines for clinicians.⁵ The initial guidelines were broad. Therefore,

each U.S. service crafted their own specific guidelines, with the Navy Dental Corps implementing theirs in 1996,⁶ followed by a revision in 2002.⁷ The 2002 guidelines increased the classification requirements for Sailors and Marines to become worldwide deployable.

The risk of DE increases with the severity and number of unmet dental needs. The Tri-service Center for Oral Health Studies (TSCOHS) conducted an investigation that confirmed the observation that unmet dental needs increases the risk of DE. Military personnel from recruit training through the first four years of service (1994-1998) were followed and a nine-fold increase in the DE risk of Class 3 was observed compared to Class 1 (DoD) personnel. The study reported an eight-fold increase of risk in U.S. Army personnel; a seven-fold increase in U.S. Navy personnel; a 15-fold increase in U.S. Air Force personnel; and a 17-fold increase in U.S. Marine Corps personnel.⁸

In order to facilitate the assessment of a service members' medical readiness across all U.S. military services and to highlight their preventive care needs, the DoD Individual Medical Readiness (IMR) system was implemented in 2006⁹ and later updated in 2014.¹⁰ The IMR classifies service members as either fully medically ready, partially medically ready, indeterminate, or not medically ready using six elements to reach this determination: (1) Periodic Health Assessment, (2) No Deployment Limiting Conditions, (3) Medical Readiness Laboratory Studies, (4) Individual Medical Equipment, (5) Immunization status, and (6) Dental Readiness. Failure in any of the aforementioned elements results in a service member being classified as "not medically ready." Section 5.4.7 of the IMR instruction identifies the minimal medical readiness goal as 75% fully medically ready, i.e., not deficient in any of the six categories.⁹

The dental readiness portion of IMR requires service members to complete annual periodic dental examinations to assess their current oral health status and their potential to develop DE within the next 12 months. Clinical guidelines that determine classification are also included in the IMR. The overall assessment of the patients' conditions are simplified into four general categories or classifications referred to as Dental Readiness Classifications (DRCs):

- DRC 1 signifies service members that have a current dental examination and do not require dental treatment or reevaluation for 12 months.

- Service members designated as DRC 2 have a current dental examination, but require non-urgent dental treatment or reevaluation for oral conditions that are unlikely to result in DE within 12 months.
- DRC 3 represents service members that have a current dental examination, but require urgent or emergent dental treatment. These patients are not considered to be worldwide-deployable.
- Service members who are DRC 4 are overdue for an annual examination.

Being classified as DRC 1 or 2 signals unit commanders that the service member is dentally “ready” to be deployed worldwide, whereas DRC’s 3 or 4 highlight a significant potential for operational disruption due to DE, and therefore designates the service member as not deployable.

Even with DoD directives, DE occurring intra-operationally continue to pose a threat to the military mission because emergency dental conditions take military personnel away from their assigned place of duty. Seeking care for DE in hostile environments can pose significant danger and potential casualties to the patient, as well as to those required to escort the patient to a dental clinic. According to a 2012 report, military personnel experiencing a DE can require up to nine personnel and a convoy of three vehicles to evacuate the military personnel to receive necessary care.¹¹ Intra-theater transportation, lost duty days and the potential need for backup personnel are also costly. According to a 2013 study, the cost to treat DE in deployed U.S. Army personnel was \$21.4 million between July 1, 2009 and June 30, 2010, and \$21.9 million between July 1, 2010 and June 30, 2011.¹²

Opportunities exist to optimize dental care and its impact on the dental health, wellness, and readiness of the U.S. military personnel. Past world conflicts have shown that the U.S. military requires an active analytical and research footprint in order to overcome previously identified operational obstacles and to avoid future challenges through innovation. Wing Commander G.D. Mahoney of the Australian Defense Force theorized that the first step in improving operational dental care is to define the fundamental problem of operational dentistry, the expected dental casualty rate of a given conflict. Dental morbidity remains an estimate which is dependent on previously recorded data and confounded by the inability to directly compare one conflict to another. Inaccurate as this estimate remains, dental morbidity statistics

paint a picture of the logistical requirements for military strategists and planners. The second step is the education of unit commanders and key stakeholders concerning dental casualty rates and their effect on combat effectiveness or work performance. The third step is the use of dental casualty rates to determine the merit and capacity required of dental support. Lastly, the most appropriate and effective methods to render dental treatment intra-operationally should be determined.¹³

Among the general population, the prevalence of dental caries and periodontal diseases for adolescents (aged 12 to 19) and adults (aged 20 to 64) have decreased since the late twentieth century.¹⁴ However, a reduction of DE commensurate with oral disease might not be expected in military populations, since incoming recruits have large numbers of unmet dental needs. According to the 2008 DoD Recruit Oral Health Survey, which included findings from an oral health survey of DoD recruits at the time of entry into nine military training sites from December 2007 to November 2008, 4.2% of the recruits were classified as DRC 1, 43.4% were DRC 2 and 52.4% were DRC 3 and therefore not deployable.¹⁵ More troubling was the observation that the percentage of DRC 3 recruits increased from 47.5% in 2000 to 52.4% in 2008. Even with the decline in dental caries, restorative treatment needs were one of the leading causes for 2008 DoD recruits being classified as DRC 3.

Oral-maxillofacial (OMF) and cranio-maxillofacial (CMF) injuries occurring during conflict are often life threatening. Decreases in thoracic injuries during combat have been observed due in part to improvements in body armor. However, few studies have been undertaken to describe the incidence of OMF and CMF injuries in military personnel.

The objectives of this report are (1) to provide a comprehensive review of studies describing the incidence of DE, CMF injuries, and OMF injuries in U.S military personnel serving in combat environments, during stabilization operations, during deployments, during training exercises, and while in garrison, and (2) to compare the rate of DE and CMF/OMF injuries occurring in the late twentieth century with the rate observed in the early twenty-first century.

METHODS

PubMed, a freely searchable database provided by US National Library of Medicine of the National Institutes of Health, was used to make multiple queries of published literature related to DE, CMF and OMF injuries occurring in U.S. military personnel.

Multiple synonyms for DE have been used by authors, therefore, the search strategy used ‘dental emergency’, ‘disease non-battle injury’ and ‘dental casualty’ as key words. No restrictions were placed on year of publication. Additionally, military reports referenced in two previous review articles were included.^{16,17} Finally, unpublished studies undertaken by the authors were also included in the review. The collection of the data for the unpublished studies was approved by the Naval Medical Research Unit San Antonio Institutional Review Board in compliance with all applicable federal regulations governing the protection of human subjects. (NAMRU-SA.2011.0003 “Evaluation of the Incidence and Treatment Required for Dental Emergencies Occurring in Deployed Military Personnel”.)

Identification of publications describing OMF and CMF injuries in U.S. military personnel was also performed using PubMed. The search strategy include key words ‘cranio-maxillofacial injuries’, ‘oral-maxillofacial injuries’, and ‘dentofacial injuries’. No restriction was placed on year of publication. Military reports describing OMF and CMF injuries were also identified for inclusion in this review.

Only studies which reported the rates of DE, OMF and CMF injuries (or studies where rates could be calculated) in U.S. military personnel were included. Rates were categorized by type of deployed environment (1) Combat, which included Stabilization Operations, Peacekeeping deployments, (2) Deployments, which included deployments on naval vessels, Marine deployments, Field exercises, and Army deployments, and (3) Garrison, which included studies where the sample consisted of Recruits or other military personnel while in garrison.

The incidence of DE, OMF injuries, and CMF injuries reported in these studies were considered to determine if trends could be observed. Descriptive statistics were calculated as mean and standard deviation (s.d.). Means were compared using Student’s t-test and one-way ANOVA with correction for multiple comparisons. Comparison of trends over time were performed using analysis of covariance. Significance was set at $p < 0.05$. Analysis was completed using SAS Version 9.4.

RESULTS

Dental Emergencies

Three military reports, 17 published studies, and two unpublished investigations describing DE in U.S. military personnel were included in this report. Overall, 31 rates were reported in the studies reviewed, with five studies reporting rates for multiple years and/or multiple sites. Study publication dates ranged from 1967 to 2014, with data collection periods from 1966 through 2012. The main characteristics and number of DE and DE rates of the studies are shown in Table 1. Six studies (one study included in both deployed and combat categories) described the incidence of DE during deployments and field/training exercises (i.e., Deployed during Vietnam era, Marine deployments, submarine deployments, Europe, [Fort Stewart, Fort Hood, Fort Ord], and Fort Drum); five studies (six rates reported) described the incidence while personnel were in garrison (i.e., Laflamme Dental Clinic (two samples reported), Fort Knox, Fort Leonard Wood, and other non-specified CONUS locations [two rates reported]); and 12 studies (19 rates) described the incidence of DE during combat or peacekeeping operations (i.e., Vietnam [four rates], Saudi Arabia [three rates], Iraq [five rates], Afghanistan [three rates], Kuwait, Egypt, and Bosnia [two rates]).

The most commonly reported dental statistic for previous conflicts and operations was the annual DE rate. The reported DE rates for the military personnel ranged from 26 per 1,000 PPY among U.S. Navy personnel on submarines¹⁸ to 324 per 1,000 PPY among deployed U.S. Army personnel within CONUS in 1981-1982.¹⁹ Description of studies conducted in each military service is described below, with Figure 1 illustrating the means of the three categories of environments in which studies were conducted.

The reported rate of DE among **U.S. Navy and Marine** personnel during combat, deployments, or in garrison ranged from 26 to 210 DE per 1,000 PPY (mean 120.5 s.d. 70.4). In Vietnam, Ludwick reported a DE rate of 210 per 1,000 PPY during a three-month deployment in 1969 among U.S. Navy and Marines, a DE rate of 157 during a six-month deployment in 1970, and a rate of 240 per 1,000 PPY in a control deployed sample of Sailors and Marines.²⁰ Based on data collected across multiple dental clinics located OCONUS and in CONUS (Okinawa, Japan; Iwakuni, Japan; Camp Lejeune, North Carolina; or Kaneohe Bay, Hawaii), a mean DE rate of 57 per 1,000 PPY was reported between 1989 and 1990 among U.S. Marines.²¹ In Kuwait, Deutsch reported a DE rate of 149 per 1,000 PPY among U.S. Marines between 1990

and 1991²², while Christopher (2008) reported a rate of 50 DE per 1,000 PPY for five of the seven clinics in Iraq during 2006.²³ A much lower rate was observed in U.S. Navy personnel on submarines where Deutsch reported a DE rate of 26 per 1,000 PPY between 1997 and 2000. International Statistical Classification of Diseases and Health Problems (ICD) codes documented by Independent Duty Corpsmen (IDC) during deployments were used to identify DE, with the etiology identified by dental record review.¹⁸ A review of Navy and Marine Corps personnel dental records that covered a period from 1997 to 2004 revealed a rate of 131 DE per 1,000 PPY.²⁴ Additionally, in unpublished data of Marines in Iraq during 2007-2009, 3,656 DE were documented by Dental Officers in Iraq using a computerized data entry form. Using denominator data from the Defense Manpower Data Center, a rate of DE at 77 per 1,000 PPY was observed over a 20 month period. Using the same methodology, a total of 431 DE (rate of 108 per 1,000 PPY) were documented for Marines in Afghanistan for five months during 2009.

Two reports of DE in **U.S. Air Force** personnel in Southwest Asia have been reported (range 137 – 153 DE per 1,000 PPY; mean 145.0, s.d. 8.0). Dunn reported a rate of 137 DE per 1,000 PPY in the Sultanate of Oman during a 6-month deployment, between March and September 2002.²⁵ Additionally, Dunn et al. evaluated unscheduled visits for oral-facial problems at two expeditionary support facilities in Iraq between January and September 2003. The authors reported a rate of 153 DE per 1,000 PPY at Prince Sultan Air Base, Kingdom of Saudi Arabia, and a rate of 145 DE per 1,000 PPY at the Baghdad Airport facility.²⁶

The reported DE rates among **U.S. Army soldiers** in combat and stabilization operations, field exercises and in garrison ranged from 65 to 324 per 1,000 PPY (mean 171.1, s.d. 74.8). In one of the earliest reports on DE, Hutchins reported the incidence of DE among deployed U.S. Army soldiers in Vietnam during 1966 as 65 per 1,000 PPY in one unit and 99 DE per 1,000 PPY in another unit (locations not specified).²⁷ Three studies evaluated DE during peacekeeping or stabilization operations. When U.S. Army soldiers were deployed to Egypt in March 1982, Teweles and King reported a DE rate of 160 per 1,000 PPY²⁸ and two studies examined the DE rate among deployed U.S. soldiers in Bosnia. Chaffin evaluated DE in Stabilization Force (SFOR) 7 in Bosnia in 2000 and reported an incidence of 156 per 1,000 PPY.²⁹ Similarly, Moss observed an incidence of 170 DE per 1,000 PPY between September 2000 and March 2001 for SFOR 8 in Bosnia.³⁰

Simecek et al. reported estimated annual DE rates among **U.S. Army soldiers** deployed to Iraq and Afghanistan or Kuwait between 2009 and 2012. During OIF, rates observed were 116 DE per 1,000 PPY in 2009, 144 in 2010, and 113 in 2011. For OEF, the overall annual DE rates were 81 per 1,000 PPY in 2011 and 86 in 2012.³¹

In deployed or simulated combat situations, Parker et al. reported a DE rate of 234 per 1,000 PPY during a 117-day field exercise held in several locations (Fort Stewart, Fort Hood, and Fort Ord) from October 1980 to April 1981.³² In another study, Payne reported a DE rate of 167 per 1,000 PPY during a 39-day field exercise conducted in Fort Drum.³³ During a 10-day military exercise conducted in 1982 in Western Europe (Carbine Fortress), King reported a DE rate of 259 per 1,000 PPY.³⁴

Grover evaluated recruits at Fort Leonard Wood in 1980 and observed a DE rate of 259 per 1,000 PPY,³⁵ while Keller evaluated personnel in North Carolina and observed rates of 324 and 272 DE per 1,000 PPY in 1981-2 and 1983-4,¹⁹ respectively. An annual incidence of 153 DE per 1,000 PPY (830 DE during 12 months in 1985-1986) was calculated from a report by McClave and Brokaw who evaluated DE during 12 months in 1985-1986 at Fort Knox.³⁶ Another study examined the baseline DE rate among U.S. service members in garrison. Among the soldiers in garrison (i.e., Brigade Combat Team) within the Continental U.S., the estimated DE rate in 2011 was 221 per 1,000 PPY.³⁷

One-way ANOVA was conducted to test for any significant differences in the average rate of Dental Emergencies between US Navy and Marine Corps, Army, and Air Force. A p-value of .0726 was calculated and in conclusion, no significant differences in average dental emergency rates were found between the different military branches.

Differences between the three categories of DE (Combat, Deployments, Garrison) were evaluated using ANOVA. No difference between environments was observed (p=.09).

Lastly, differences among the three branches were compared for each category of DE. A one way ANOVA was conducted to detect differences in the rate of Combat DE among branches. No significant differences were found (p=.66). A T-test was used to compare Deployment DE between Army and Navy and no significant difference was found (p=.23). Comparisons could not be made for differences in Garrison DE among the branches due to insufficient data (N=1 for Navy). Analysis of Covariance (ANCOVA) was used to detect whether trends in combat related dental emergencies differed over time between the study period

from 1966-1999 and the study period from 2000-2012. Figure 2 presents the results graphically of the trends in dental emergency rates with a time x study period interaction. Although the slopes for dental emergency rates appear to be different for the two periods, the interaction term was not found to be significant ($p = 0.1625$).

Oral-Maxillofacial Injuries

There are relatively few studies that have reported the incidence of OMF injuries in wars and conflicts, and even fewer studies that have included rates of OMF injuries. In one of the earliest studies that described OMF injury rates among the U.S. military personnel, Jeffcott reported that the rates of non-battle OMF injury in the continental U.S. during World War II (1941 – 1945) ranged from 0.6 to 1.2 per 1,000 PPY, with a slightly wider range of 0 and 3 per 1,000 PPY outside continental U.S.³⁸ Katz et al. described the incidence of dentofacial injuries (i.e., injuries to the teeth, jaws, intraoral soft tissues, perioral soft tissues, and facial bones) among active duty U.S. Army soldiers, across 16 Army posts, during a nine-month surveillance period in 1975. The annual incidence of dentofacial injuries was 3.8 per 1,000 PPY.³⁹

Additionally, the review identified three published studies that described oral-facial injuries among U.S. Army soldiers deployed to Iraq and Afghanistan/Kuwait during different periods of time. In these studies, oral-facial injury was defined as any injury to hard and soft tissues of the oral cavity, maxillofacial areas, and/or the adjacent and associated structures. Specifically, Mitchener et al. described oral-facial injuries that required medical evacuation from OIF/OEF. Between January 2003 and December 2004, Mitchener et al. reported an annual oral-facial injury rate of 1.1 and 2.1 per 1,000 PPY for OIF and OEF,⁴⁰ respectively. In another study by Mitchener and Hauret who evaluated data collected between January and December 2005, the incidence of oral-facial injuries was 1.3 per 1,000 PPY in Iraq and 2.2 per 1,000 PPY in Afghanistan.⁴¹ During a 12-month deployment in 2006, the incidence of oral-facial injuries was 1.0 per 1,000 PPY in Iraq and 1.1 per 1,000 PPY in Afghanistan.

Mitchener and Canham-Chervak described the incidence of oral-maxillofacial wounds and oral-maxillofacial fractures for the U.S. Army soldiers seeking inpatient or outpatient care in fixed U.S. military medical facilities worldwide or non-DoD facilities for one or more injuries of the oral-facial region.⁴² Between 2000 and 2005, the authors reported range of rates of 1.2 – 1.3

and 12.0 – 12.7 per 1000 PPY for oral-maxillofacial fracture and oral-facial wounds, respectively.

Using data collected by the Department of Defense Trauma Registry (DODTR) Chan et al. reported the number of cranio-maxillofacial (CMF) injuries suffered by U.S. service members in Iraq and Afghanistan from 2001 to 2011 that required medical evacuation out of theater.⁴³ Injuries to the eyes, nose, ear, head, jaws, neck, cranial nerves, and oral cavity were included in their study. A total of 4,036 CMF injuries were described, however, the authors did not calculate the incidence of the injuries over this ten-year span. Using data from the Defense Manpower Data Center, annual rates of CMF injuries in Iraq and Afghanistan were calculated. An annual rate of 21.5 CMF injuries per 1,000 PPY was observed in Iraq, while a rate of 23.1 CMF injuries per 1,000 PPY was calculated for U.S. service members wounded in Afghanistan.

In the most recent report, Mitchener et al. used data from the DODTR to describe the incidence of OMF injuries among U.S. military personnel deployed to OEF and OIF/OND, between October 2001 and June 2014.⁴⁴ OMF injuries were defined as “hard and soft tissues of the oral cavity, maxillofacial area, and/or the adjacent and associated structures such as the orbital floor (formed in part by the maxilla) and parts of the neck closest to the mandible.” Rates were presented by services (Air Force, Army, Marines, and Navy). The overall OMF injury rate in OEF ranged from 1.1 to 5.0 per 1,000 PPY (mean-2.8 per 1,000 PPY). The highest OMF rate in OEF was seen among Marines (0.6 – 9.4 per 1,000 PPY). The rates for the Army ranged from 1.1 to 4.9 per 1,000 PPY, 0 to 3.3 per 1,000 PPY for the Navy, and 0 to 3.4 per 1,000 PPY for the Air Force. In OIF/OND, from March 2003 to December 2011, the overall CMF injury rate in OIF/OND ranged from 0.7 to 8.9 per 1,000 PPY (mean-3.2 per 1,000 PPY). The highest OMF rate in OIF/OND was reported for the Marines, ranging from 0.9 to 42.7 per 1,000 PPY. The injury rates in OIF/OND for the Army ranged from 0.7 to 8.7 per 1,000 PPY, for the Navy from 0.4 to 19.2 per 1,000 PPY, and for the Air Force from 0.2 to 1.1 per 1,000 PPY.

DISCUSSION

DE rates vary by the guidelines used to determine patient dental classification, the definition of DE used by the authors, the methods used to collect DE data, and the population studied. Submariners do not deploy with a dentist on board. Submariners are, therefore, required

to have the highest level of dental readiness, and were seen to have the lowest DE rate of 26 per 1,000 PPY.¹⁸ In contrast, military personnel preparing for deployment, especially for first deployments, frequently deploy with unmet dental needs that result in DE, and the dental treatment provided has a probability of post-operative sequelae. Resultant high rates, such as the 221 DE per 1,000 PPY observed in CONUS personnel, are observed.³⁷ The great diversity in rates can be visualized in Figure 1, where the three studies of deployed Navy and Marine Corps personnel had a range of 26-240 DE per 1,000 per year, which resulted in a standard deviation of 115.6.

A military force that is well trained and equipped may not be as effective if the medical and dental readiness of the fighting force is not at an optimal level. Dental readiness is an important part of mobilization and has a direct effect on the capability of a deployed force to accomplish its assigned mission. DE can significantly reduce a deployed force's ability to accomplish its mission. As stated above, one case of DE can require "three convoy vehicles with up to nine personnel for security in-theater for the sole purpose of medical evacuation." Additionally, dental issues account for a substantial percentage of all medical visits. Ten percent of all visits to MTF's in Bosnia in 1997 were due to dental causes.⁴⁵ Similarly, Murray et al. reported that close to 20% of soldiers in a brigade had dental issues and sought care at a dental treatment facility while deployed.⁴⁶ In a recent study, Gunepin et al. reported that DE accounted for 16% of the total medical evacuations among French soldiers, deployed to Mali during the Operation Serval.⁴⁷

Documenting DE, as it relates to combat effectiveness, is important in understanding what occurs with the oral health of soldiers during deployments. Even with policy changes and a vigorous evaluation of dental readiness, DE will not be eliminated during a deployment. A study of DE states that up to 70% of DE are not preventable, even when urgent care is completed.⁴⁸ Even though the rate of DE in DRC 2 personnel is much lower than for DRC 3 personnel, a much larger percentage of personnel are classified DRC 2 than DRC 3, so the contribution of DRC 2-classified personnel to total DE numbers is relatively large. A literature review by Mahoney and Coombs concluded that a well-prepared, dentally fit force can expect 150 to 200 dental casualties per 1,000 PPY.¹⁷ The authors further stated that with a less dentally fit force, the DE rates would be higher. A diminished fighting force, as a result of DE, can negatively impact a unit's ability to efficiently complete its military mission. The accuracy of this statement

has not been adequately examined, but reports from OIF and OEF indicate that the rate of DE in combat settings continues to range between 10-15% PPY. However, a recent report described the severity of oral-facial problems occurring in U.S. Navy and Marine Corps personnel deployed to Iraq between March 2008 and February 2009. The annual incidence of documented DE ranged from 1.5 (severe [e.g., anatomic space infections and necrotizing ulcerative gingivitis]) to 11.1 per 1,000 PPY (moderately severe [e.g., periodontal abscess and irreversible pulpitis]).⁴⁹ Even though the observed rates of DE are high, only 1.3% of the total DE observed were deemed severe or moderately severe.

In a 2005 study, Richardson reported that U.K. soldiers supporting Operation Telic in Iraq who were Dental Fitness Category 3 before deployment had three times the risk of a DE when compared to other dental fitness categories before deployment.⁵⁰ Furthermore, in a recent study, U.S. Army Reserve personnel had a higher risk of DE than U.S. active duty in both theaters (i.e., Iraq and Afghanistan). In Iraq, U.S. Army Reservists had a 17% increased risk compared to U.S. Army active duty, and in Afghanistan, U.S. Army National Guard and U.S. Army Reserve personnel had over 50% increased risk of DE compared to U.S. Army active duty personnel.⁵¹

Even though a decrease in the rates of DE since the 2000 might be perceived from Figure 2, comparison of the trends between the two periods of time (before 2000 and after) yields no significant difference ($p=0.16$). The rate of injuries to the head and neck area appear to have remained steady or increased slightly over time. (Table 2) However, there were relatively few studies of CMF injuries, in general, and few studies of OMF injuries prior to OEF and OIF which reached a definitive conclusion. Studies of rates of OMF and CMF injuries have not received the same level of attention as studies of DE. This may be due to dental investigators not being comfortable looking at primarily medical data.

Advances in technology should be leveraged to perform research that will develop more sensitive methods to predict DE. Quality data concerning the incidence of DE, CMF, and OMF injuries is required for planners to insure that redundancy of capability is taken into account due to these types of casualties. CMF and OMF data are routinely collected using a standardized methodology by the DoD Joint Trauma Registry. However, quality DE data is not collected in a standardized manner across the military medical enterprise. These data are of vital importance,

not only to provide the information necessary for deployment planning, but also furnish a valid means by which to evaluate the efficacy and effectiveness of policies, such as the IMR.

The implementation of the electronic health record provides a unique opportunity to capture DE data. CMF and OMF data are documented using ICD diagnostic and treatment codes, however, this is not the case for dental information. The assessment and refinement of dental classification diagnostic criteria require valid outcome data since classification guidelines are defined by the probability of the occurrence of a DE within 12 months. Even though dental diagnostic codes are available, only treatment codes are utilized, which limits the evaluation of the causes of DE (e.g., A new restoration is placed [code D2160-3 surface dental amalgam] either because there is a new caries lesion or because the existing restoration has fractured; the cause is not specified). New caries can be assessed pre-deployment, but predicting restoration fracture is more difficult. In either case, a diagnostic code and a treatment code, would provide more complete information by which to refine the dental classification diagnostic criteria.

This review reveals that the burden of DE and OMF injuries to commanders approximates 12% of all troops deployed to hostile environments. Using the most recent data since 2000 (13 rates reported for combat environments), the mean DE rate was 118.2 per 1,000 PPY and the mean OMF rate was 3.0 per 1,000 PPY (11.8% DE, 0.3% OMF). However, the data have a great variability due to non-standardized methodologies used. Computerized data entry and policy that defines readiness have greatly enhanced the probability of a decrease in DE in the near future. Tracking of CMF/OMF data is performed using standardized methodologies and across services by the DODTR. Similar standardization and collection of DE data are necessary.

TABLE 1.

Number and rate of dental emergencies (DE) by study period, military service, location, definition of dental emergency, and method of data collection.

Author(s)	Study Period	Military Service	Environment Location	Method of Data Collection (Type Study; Data Source)	Number of DE	DE Rate (No. of DE /1,000 personnel per year)
Hutchins	1966	U.S. Army	Vietnam	Unknown	-	65 99
Ludwick	1969 1970 1970	U.S. Navy and Marines	Vietnam Vietnam Non-Vietnam	Prospective	3,370 2,398 3,057	210 157 240
Parker	1980 –1981	U.S. Army	Simulated Combat (Fort Stewart, Fort Hood, Fort Ord)	Prospective	182	234
Payne	1981	U.S. Army	Simulated Combat (Fort Drum)	Prospective	438	167
Teweles and King	1982	U.S. Army	Egypt	Prospective	39	160
Grover	1980	U.S. Army (Recruits)	Fort Leonard Wood	Prospective	1,294	259
King	1982	U.S. military	Europe (Carbine Fortress)	Prospective	355	259
Keller	1981 –1982 1983 –1984	U.S. military	North Carolina (Laflamme Dental Clinic)	Prospective	2,587 2,150	324 272
McClave	1985-1986	U.S. Army	Fort Knox	Retrospective	830	153

TABLE 1 CONT.

Number and rate of dental emergencies (DE) by study period, military service, location, definition of dental emergency, and method of data collection.

Author(s)	Study Period	Military Service	Environment Location	Method of Data Collection (Type Study; Data Source)	Number of DE	DE Rate (No. of DE /1,000 personnel per year)
Rodden	1989 –1990	U.S. Marines	Deployed, or in field exercise	Prospective	890	57 (deployed)
Deutsch	1990 –1991	U.S. Marines	Kuwait	Retrospective	4,776	149
Chaffin	2000	U.S. Army	Bosnia	Retrospective	211	156
Moss	2000 –2001	U.S. Army	Bosnia	Retrospective	269	170
Dunn	2002	U.S. Air Force	Sultanate of Oman	Retrospective	135	137
Dunn et al.	2003	U.S. Air Force	Saudi Arabia Iraq	Retrospective	759 106	153 145
Simecek	2007- 2009	U.S. Marines	Iraq	Prospective	3,656	77
Simecek	2009	U.S. Marines	Afghanistan	Prospective	431	108

Author(s)	Study Period	Military Service	Environment Location	Method of Data Collection (Type Study; Data Source)	Number of DE	DE Rate (No. of DE /1,000 personnel per year)
Christopher	2005 –2006	U.S. Marines	Iraq	Prospective	1,576	50
Deutsch	1997 –2000	U.S. Navy	Submarine	Retrospective	55,435	26
Simecek	2003-2006	U.S. Marines	Iraq	Retrospective	262	131
Colthirst et al.	2011	U.S. Army	Continental U.S.	Prospective	255	221
Simecek et al.	2009 –2011 2010 –2012	U.S. Army	Iraq, Kuwait or Afghanistan	Prospective	27,838 (OIF/OND) 12,188 (OEF)	OIF/OND: 116 (Year 2009) 144 (Year 2010) 113 (Year 2011) OEF: 81 (Year 2011) 86 (Year 2012)

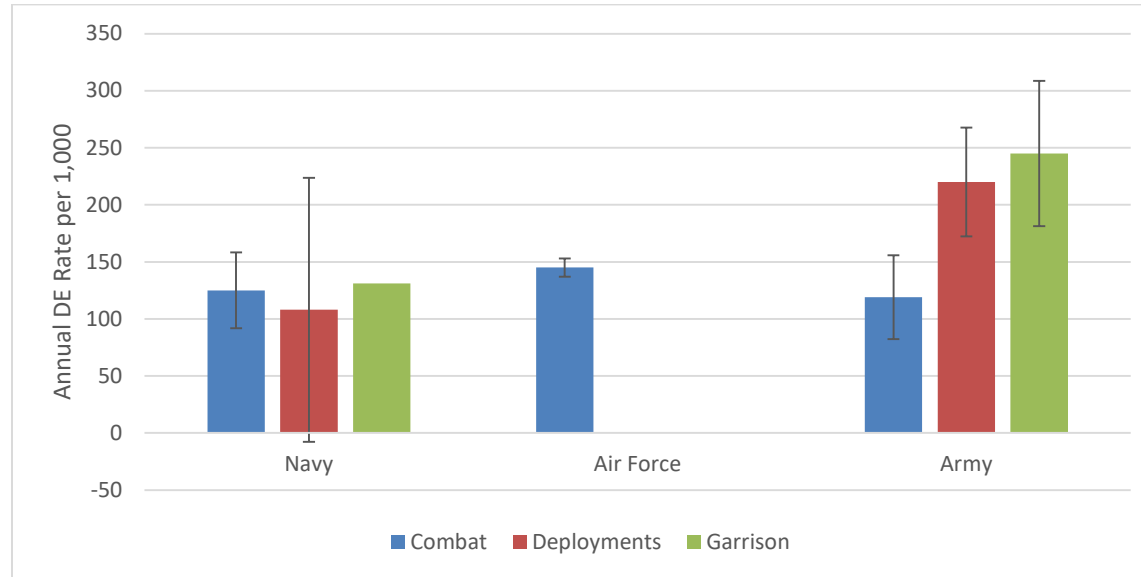
TABLE 1 CONT.

Number and rate of dental emergencies (DE) by study period, military service, location, definition of dental emergency, and method of data collection.

TABLE 2.**Rate of oral-maxillofacial and cranio-maxillofacial (*) injuries by publication year, military, location, and study period.**

Author(s)	Publication Year	Military Service	Location	Study Period	Injury Rate (No. of injuries/1,000 personnel per year)
Jeffcott	1955	U.S.	Continental U.S.	1941-1945	0.6-2.0
Jeffcott	1955	U.S.	Outside Continental U.S.	1941-1945	0.0-3.0
Katz	1979	U.S.	Continental U.S.	1975	3.8
Mitchener	2008	U.S.	Iraq	2003-2004	1.1
Mitchener	2008	U.S.	Afghanistan	2003-2004	1.2
Mitchener	2009	U.S.	Iraq	2005	1.3
Mitchener	2009	U.S.	Afghanistan	2005	2.2
Mitchener	2009	U.S.	Iraq	2006	1.0
Mitchener	2009	U.S.	Afghanistan	2006	1.1
Mitchener	2010	DoD, non-DoD	worldwide	2000-2005	13.2-14.0
Chan*	2012	U.S.	Iraq	2003-2011	21.5
Chan*	2012	U.S.	Afghanistan	2001-2011	23.1
Mitchener	2017	U.S.	Afghanistan	2001-2014	1.1-5.0
Mitchener	2017	U.S.	Iraq	2000-2014	0.7-8.9

FIGURE 1. MEANS AND STANDARD DEVIATIONS OF DENTAL EMERGENCY RATES BY SERVICE AND ENVIRONMENT.



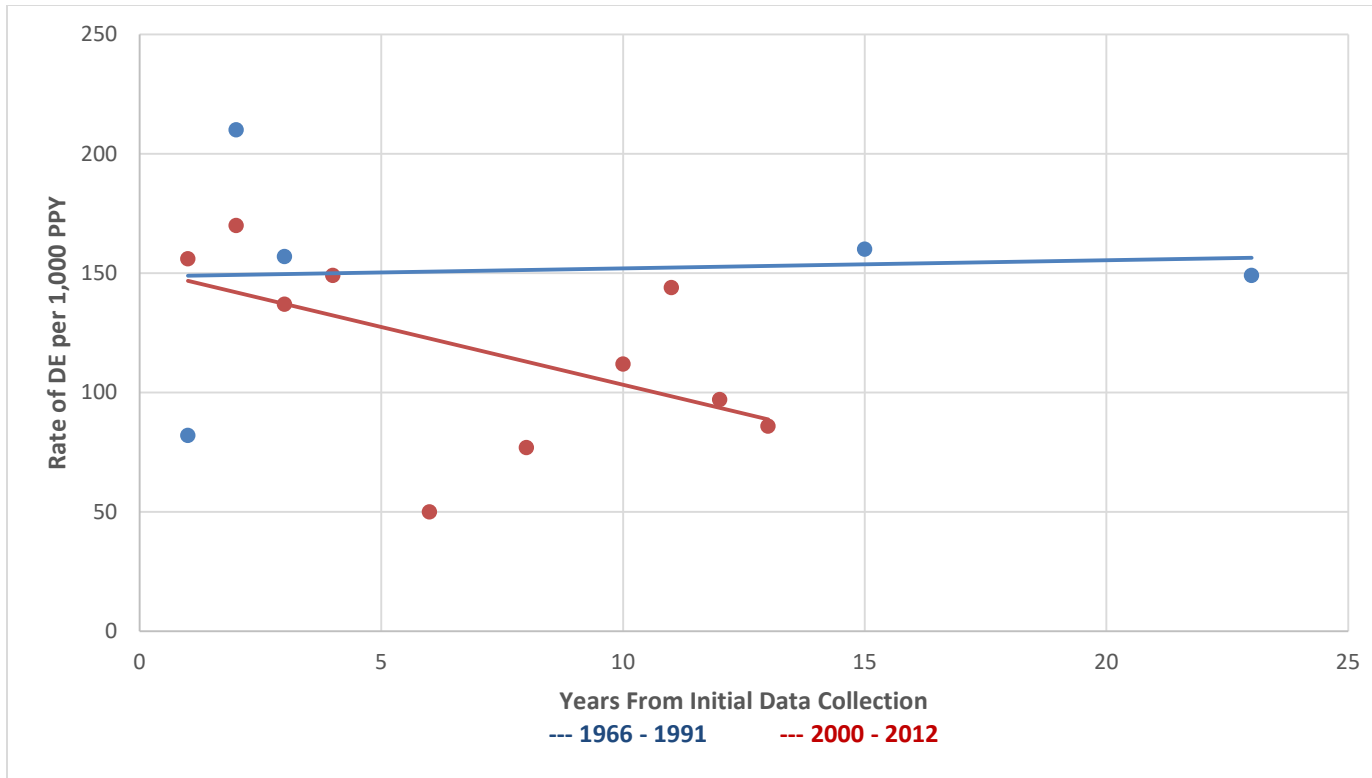
NUMBER OF DE RATES REPORTED FOR EACH ENVIRONMENT AND SERVICE:

NAVY/MARINES: COMBAT N=6; DEPLOYED N=3; GARRISON N=1

AIR FORCE: COMBAT N=3

ARMY: COMBAT N=10; DEPLOYED N=3; GARRISON N=5

FIGURE 2. COMPARISON OF RATES OF DENTAL EMERGENCIES OCCURRING IN U.S. MILITARY PERSONNEL DEPLOYED TO COMBAT OPERATIONS: TREND OF RATES FROM 1966 TO 1999 AND FROM 2000 TO 2012. THE X-AXIS REPRESENTS EACH CONTINUOUS YEAR (TIME POINT) BEGINNING WITH THE FIRST YEAR OF EACH PERIOD SET AT 1.



ALTHOUGH THE SLOPES FOR DENTAL EMERGENCY RATES APPEAR TO BE DIFFERENT FOR THE TWO PERIODS, THE INTERACTION TERM WAS NOT FOUND TO BE SIGNIFICANT ($P = 0.16$).

REFERENCES

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- ¹ Faison CF. Statement of Vice Admiral C. Forrest Faison III, MC, USN Surgeon General of the Navy Before the Subcommittee on Defense of the Senate Committee on Appropriations Subject: Defense Health Program 2016.
- ² Allareddy V, Rampa S, Lee MK, Allareddy V, Nalliah RP. Hospital-based emergency department visits involving dental conditions: profile and predictors of poor outcomes and resource utilization. *J Am Dent Assoc* 2014; 145(4):2014-7.
- ³ Verma S, Chambers I. Dental emergencies presenting to a general hospital emergency department in Hobart, Australia. *Australian Dental Journal* 2014; 59:329-33.
- ⁴ Staats G. My experience while serving with the second division American E.F. n.d. Folder 4, Box 3410, Entry 2144, RG 120 NARA.
- ⁵ King JE. Historical perspective on U.S. Military dental classification. *Mil Med* 2008; 173:3-10. (Suppl)
- ⁶ Department of the Navy: Dental Corps. In: *Manual of the Medical Department*, Chap 6, p 102A. Washington DC, 1993.
- ⁷ Department of the Navy BoMaS. Changes to the Dental Classification System Washington, DC. October 2, 2002.
- ⁸ York A, Moss D, Martin G. A longitudinal study of dental experience during the first four years of military service. *Mil Med* 2008; 173 (Suppl):38-41.
- ⁹ Department of Defense. Individual Medical Readiness Number 6025.19 of January 3, 2006. <http://www.public.navy.mil/ia/Documents/602519p.pdf>. Accessed 28 Aug 2018
- ¹⁰ Department of Defense. Individual Medical Readiness Number 6025.19 of June 9, 2014. <http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/602519p.pdf>. Accessed 28 Aug 2018
- ¹¹ Brauner M, Jackson T, Gayton E. Medical Readiness of the Reserve Component. RAND Corporaton. https://www.rand.org/content/dam/rand/pubs/monographs/2012/RAND_MG1105.pdf. Accessed 30 Aug 2018.
- ¹² Colthirst PM, Berg RG, Denicolo P, Simecek JW. Operational cost analysis of dental emergencies for deployed US Army personnel during operation Iraqi freedom. *Mil Med* 2013;178(4):427-31.
- ¹³ Mahoney G. The operational dental officer in the ADF *Journal of the Australian Defense Health Service* 2003;4:40-4.
- ¹⁴ Research NIODaC. Dental Caries (Tooth Decay) 2016.
- ¹⁵ Leiendecker TM, Martin G, Moss DL. 2008 Department of Defense (DoD) recruit oral health survey. *Mil Med* 2011;176(8 Suppl):1-44.
- ¹⁶ Chisick MC, King JE. Dental epidemiology of military operations. *Mil Med* 1993; 158(9):581-5.
- ¹⁷ Mahoney GD, Coombs M. A literature review of dental casualty rates. *Mil Med* 2000; 165(10):751-6.
- ¹⁸ Deutsch WM. Dental events during periods of isolation in the U.S. submarine force. *Mil Med* 2008;173(1 Suppl):29-37.
- ¹⁹ Keller DL. Reduction of dental emergencies through dental readiness. *Mil Med* 1988; 153(10):498-501.

-
- ²⁰ Ludwick WE, Gendron EG, Pogas JA, Weldon AL. Dental emergencies occurring among Navy-Marine personnel serving in Vietnam. *Mil Med* 1974;139(2):121-3.
- ²¹ Rodden JW, Simecek JW. Dental emergency visits of Marine Corps personnel. *Mil Med* 1995;160(11):555-7.
- ²² Deutsch WM, Simecek JW. Dental emergencies among Marines ashore in Operations Desert Shield/Storm. *Mil Med* 1996;161(10):620-3.
- ²³ Christopher S. Dental support for U.S. Marines in Iraq. *Mil Med* 2008;173(1 Suppl):11-3.
- ²⁴ Simecek JW, McGinley JL, Levine ME, Diefenderfer KE, Ahlf RL. A statistical method to evaluate dental classification systems used by military dental services. *Mil Med* 2008; 173(1): 51-55.
- ²⁵ Dunn WJ. Dental emergency rates at an expeditionary medical support facility supporting Operation Enduring Freedom. *Mil Med* 2004;169(5):349-53.
- ²⁶ Dunn WJ, Langsten RE, Flores S, Fandell JE. Dental emergency rates at two expeditionary medical support facilities supporting operations enduring and Iraqi Freedom. *Mil Med* 2004;169(7):510-4.
- ²⁷ Hutchins D, Barton R. Epidemiology of oral emergencies in combat. Report CSCRD-103. In: Research USAIoD, editor. Washington, DC 1967.
- ²⁸ Teweles RB, King JE. Impact of troop dental health on combat readiness. *Mil Med* 1987;152(5):233-5.
- ²⁹ Chaffin J, Moss D. Review of current U.S. Army dental emergency rates. *Mil Med* 2008;173(1 Suppl):23-6.
- ³⁰ Moss DL. Dental emergencies during SFOR 8 in Bosnia. *Mil Med* 2002;167(11):904-6.
- ³¹ Simecek JW, Colthirst P, Wojcik BE, et al. The incidence of dental disease nonbattle injuries in deployed U.S. Army personnel. *Mil Med* 2014;179(6):666-73.
- ³² Parker WA. Assessment of the relationship between past dental experience and dental sick call in the field. Report 81-103. San Antonio, TX: U.S. Army Academy of the Health Services 1981.
- ³³ Payne TF, Posey WR. Analysis of dental casualties in prolonged field training exercises. *Mil Med* 1981;146(4):265, 69-71.
- ³⁴ King J, Brunner D. Theater of operations dental work load estimation. Report 84-001. San Antonio, TX: U.S. Army Health Care Studies and Clinical Investigations Activity 1984.
- ³⁵ Grover PS, Carpenter WM, Allen GW. Dental emergencies occurring among United States Army recruits. *Mil Med* 1983; 148(1):56-7.
- ³⁶ McClave RJ, Brokaw WC. A study of US Army Dental Fitness Class 3 patients. *Mil Med* 1988; 153(12):633-7.
- ³⁷ Colthirst P, DeNicolo P, Will R, Simecek JW. Use of the dental disease nonbattle injury encounter module to assess the emergency rate on an Army military installation within the United States. *Mil Med* 2012;177(9):1100-4.
- ³⁸ Jeffcott G. U.S. army dental services in World War II. Washington, DC: Government Printing Press Office; 1955.
- ³⁹ Katz RV, Barnes GP, Larson HR, Lyon TC, Brunner DG. Epidemiologic survey of accidental dentofacial injuries among U.S. Army personnel. *Community Dent Oral Epidemiol* 1979;7(1):30-6.
- ⁴⁰ Mitchener TA, Hauret KG, Hoedebecke EL, Darakjy S, Jones BH. Air medical evacuations of soldiers due to oral-facial disease and injuries, Operations Enduring Freedom/Iraqi Freedom. *Mil Med* 2008;173(5):465-73.
- ⁴¹ Mitchener TA, Hauret KG. Air medical evacuations of soldiers for oral-facial disease and injuries, 2005, Operations Enduring Freedom/Iraqi Freedom. *Mil Med* 2009;174(4):376-81.

-
- ⁴² Mitchener TA, Canham-Chervak M. Oral-maxillofacial injury surveillance in the Department of Defense, 1996-2005. *Am J Prev Med* 2010;38(1 Suppl):S86-93.
- ⁴³ Chan R, Siller-Jackson A, Verrett A, Wu J, Hale R. Ten years of war: A characterization of craniomaxillofacial injuries incurred during operations Enduring Freedom and Iraqi Freedom. *J Trauma Acute Care Surg* 2012;73(6):S453-8.
- ⁴⁴ Mitchener TA, Chan RK, Simecek JW. Oral-Maxillofacial injury surveillance of U.S. Military Personnel in Iraq and Afghanistan, 2001-2014. *Mil Med* 2017; 182(3/4): e1767-73.
- ⁴⁵ McKee KT, Kortepeter MG, Ljaamo SK. Disease and nonbattle injury among United States Soldiers deployed in Bosnia-Herzegovina during 1997: Summary primary care statistics for Operation Joint Guard. *Mil Med* 1998; 163(11):733-42.
- ⁴⁶ Murray CK, Reynolds JC, Schroeder JM, et al. Spectrum of care provided at an echelon II medical unit during Operation Iraqi Freedom. *Mil Med* 2005; 170(6):516-20.
- ⁴⁷ Gunepin M, Derache F, Blatteau JE, Bombert C, Simecek J. Medical evacuation of French forces for dental emergencies: Operation Serval. *Mil Med* 2015; 180(5):578-81.
- ⁴⁸ Simecek JW. Estimation of nonpreventable dental emergencies in U.S. Marine Corps personnel. *Mil Med* 2008; 173(11):1104-7.
- ⁴⁹ Simecek JW, Schultz ST, Anderson WH, 3rd, Gunning RL. The severity of oral/facial problems treated in Iraq March 2008 to February 2009. *J Trauma* 2011;71(1 Suppl):S43-6.
- ⁵⁰ Richardson PS. Dental risk assessment for military personnel. *Mil Med* 2005; 170(6):542-5.
- ⁵¹ Wojcik BE, Szeszel-Fedorowicz W, Humphrey RJ, et al. Risk of dental disease non-battle injuries and severity of dental disease in deployed U.S. Army personnel. *Mil Med* 2015;180(5):570-7.

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14. ABSTRACT The Department of Defense Individual Medical Readiness system was implemented in 2006. Continual high numbers of DE prompted the inclusion of Dental Readiness as one of six conditions that determine service members' readiness and their ability to deploy. Additionally, even with the advances in body armor, Cranio- and Oral-maxillofacial (CMF, OMF) injuries continue to negatively impact mission objectives. This review reveals that the burden of DE and OMF injuries to commanders approximates 12% of all troops deployed to hostile environments. However, the data have a great variability due to non-standardized methodologies used. Advances in technology should be leveraged to perform research that will develop more sensitive methods to predict DE. Quality data concerning the incidence of DE, CMF, and OMF injuries is required for planners to insure that redundancy of capability is taken into account due to these types of casualties. A standardized methodology for routine data collection, across all services is necessary to reduce variability and provide useful data to be implemented to the Dental Readiness assessment.

15. SUBJECT TERMS: Individual Medical Readiness, Dental Readiness Classification, Periodic Health Assessment, Dental Emergencies, Cranio-maxillofacial, Oral-maxillofacial

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