

REVIEW

PARAMEDIC EXPOSURE AND RESPONSE TO NON-TRAUMATIC DENTAL CONDITIONS: A SCOPING REVIEW

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ABSTRACT

Introduction: As the global demand for emergency health services continues to expand, the role of paramedics persists and grows alongside the expansion of ambulance services. The need to explore alternative pathways for enhancing service efficiency and alleviating hospital demands is increasingly evident, particularly for low-acuity cases. Non-traumatic dental conditions (NTDC) can be ongoing and have far-reaching health implications if not treated correctly. This scoping review aims to explore what is known about the incidence of NTDC cases attended by paramedics internationally.

Methods: Three electronic databases (Medline, Scopus, CINAHL) were searched between 1 Jan 2000 and 30 April 2023, using the primary search terms "paramedics," "prehospital," and "dental emergency." In addition, grey literature was examined using Google Scholar. Studies were included if they investigated NTDC as the primary treatment condition in the prehospital setting (excluding clinical settings) and were written in English.

Results: Of 1755 articles identified only four studies met the inclusion criteria. Three were quantitative descriptive surveys, and one study included interview data. Studies originated in Poland, the United States, Turkey, and India. Paramedics who reported attending an NTDC case varied between 28% and 72%. Two papers reported on the demographics of patients most affected by NTDC, including young children aged 7-15 and older individuals between the ages of 45-64. Despite limitations and bias across all studies, results indicated insufficient knowledge and education of paramedics regarding dental anatomy or proper management of NTDC.

Conclusion: This scoping review identified a paucity of robust research and publications investigating the paramedic role in initial treatment and referral pathways of dental injuries. There was limited information on the paramedic's knowledge, attitude, and training in dental injuries. Further research is required to determine paramedics' preparedness to manage and improve patient outcomes to reduce the growing burden on emergency departments.

INTRODUCTION

Over the last decade, the demand for health and social services has been a global surge, surpassing population growth rates (Jain et al., 2023). The heightened demand is reflected in the increased frequency of emergency department presentations (Lowthian et al., 2011; Romeo et al., 2017), with reported annu-

al increases of between 0.9 and 7.8% as documented in the United States (Pickens et al., 2022), United Kingdom (NHS England, 2024), Canada (Canadian Institute for Health Information, 2024), and Australia (Australian Institute of Health and Welfare, 2022). Consequently, there have been recent expansions in the role of paramedics to address the needs associated with low-acuity clinical presentations, generally defined as semi-urgent or non-urgent cases (Andrew et al., 2020; Eaton et al., 2021). Historically, paramedics attending low-acuity cases had no option other than to transport their patients to the hospital due to the absence of alternative pathways or appropriate scope of practice to manage the cases themselves in the field. While this has been the subject of slow change, it is increasingly recognized that providing alternative pathways can improve ambulance service efficiency and reduce demands on hospital services (Blodgett et al., 2021). Many ambulance services are now developing or have developed pathways which include clinical guidelines for low acuity cases, incorporating options such as treatment without transport, referral to alternative health services, or transport to the hospital where required (Shannon et al., 2021).

Paramedic roles have expanded to accommodate these changes, including practitioner paramedics such as Extended Care Paramedics (Audit Office of New South Wales, 2017; Swain et al., 2010) and Community Paramedics (Chan et al., 2019; O'Meara et al., 2018). As these responsibilities evolve, there will be a natural expansion in the range of low-acuity presentations that are accommodated; however, there remains little evidence in the literature surrounding the current incidence and management of these cases by paramedics.

Non-traumatic dental conditions (NTDC) are one example of a low acuity presentation that, when treated inappropriately, can have multiple impacts on a patient's quality of life. The social impacts are also high as they can be immediate or long-term, impacting aesthetics and psychosocial behavior (Arhakis et al., 2017; Siqueira et al., 2013). There is a lack of recognition of dental conditions as a burden of disease, in part due to inadequate information and standardization, underreporting, poor processing of data, and sparse data collection (Vos et al., 2016). The lack of recognition has created an absence of awareness amongst health professionals and emergency care providers, such as paramedic services (Abbott, 2018; Vos et al., 2016). Dental health is a complex issue, with accessibility concerns and costs of dental care increasing globally, which has led to an increase in the number of patients presenting to Emergency Departments (ED) with dental conditions, including preventable and non-traumatic injuries, across the United States and even in countries with Universal health care, such as Australia, Canada, and the UK (Kisely et al., 2021). NTDC patients receiving treatment in ED have been identified as being at risk of serious complications due to a lack of definitive treatment (Basseby et al., 2020). Paramedics are in an ideal position to improve the outcomes of these patients through immediate management of the condition and referral to dental health professionals where appropriate.

Little is known about the incidence of NTDC cases; however, there is evidence to support that ambulance services are attending to this type of case, both anecdotally and due to the development of clinical practice guidelines relating to NTDC presentations. For example, two of the largest ambulance services in Australia, Queensland Ambulance Service and The Ambulance Service of New South Wales, have clinical practice guidelines

for managing dental presentations (New South Wales Ambulance, 2021; Queensland Ambulance Service, 2019).

A preliminary search for previous scoping or systematic reviews on the topic was conducted in June 2023, utilizing the Cochrane Database of Systematic Reviews, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PubMed. No reviews on prehospital NTDC presentations were identified. This scoping review aims to explore what is known about the incidence of NTDC cases attended by paramedics internationally. The goal is to inform further research inquiries into this type of low-acuity clinical presentation, to better inform future guideline development.

METHODS

This scoping review used Arksey and O’Malley’s methodological framework for conducting a scoping study with enhancements proposed by Peters et al. (Arksey & O’Malley, 2005; Peters, 2016; Peters et al., 2015). Dental conditions in the emergency health setting are often associated with traumatic events, such as car crashes; however, for this study, we were interested in examining cases in which the dental condition was not a secondary treatment consideration. For this reason, only studies investigating a dental condition as the primary reason for paramedic attendance were included. 'Paramedic' was defined as a person trained and certified to appraise and initiate treatment for emergency medical incidents who worked in an emergency medical service, including emergency medical technicians (EMTs). As the scope of practice for paramedics is expanding to include out-of-hospital care, for this study the term 'prehospital' referred to a setting in which emergency care was provided by paramedics, regardless of subsequent transportation or not to hospital.

DATA SOURCES AND SEARCH STRATEGY

Three electronic databases (Medline, Scopus, CINAHL) were searched for articles. In addition, grey literature was examined using Google Scholar. Searches were limited to articles in English published between 1 Jan 2000 and 30 June 2023. This timeframe was chosen to include up-to-date and still relevant strategies and tools. Three researchers (RB, DE, and SB) independently performed the literature search. A healthcare librarian assisted in the development of initial search terms, which were used to search Medline and Scopus to identify common keywords and themes in the titles and abstracts of relevant articles. Full search strategies were then developed and included the search terms "dental emergency," "paramedic," and similar terms using Boolean operators and included Medical Subject Headings (MeSH). The search strategy applied in the CINAHL database is shown in Table 1.

Search Category	Search Term
Population: Paramedics Context: Prehospital	((MH "Allied Health Personnel+") OR (paramed*) OR ("allied health personnel") OR ("emergency medical technician") OR ("emergency medical services") OR (MH "Prehospital Care") OR (MH "Ambulances") OR (ambulance) OR (prehospital) OR ("emergency responders"))
Incidence: Dental emergency	AND (((MH "Tooth Avulsion") OR (MH "Tooth Injuries") OR (MH "Tooth Replantation")) OR ("dental emergenc*") OR ("dental trauma") OR ("dental avulsion") OR (toothache) OR ("oral trauma") OR ("tooth injuries") OR ("oral emergency") OR ("tooth avulsion") OR ("tooth replantation") OR ("maxillofacial injuries")))

Table 1. Search strategy applied to CINAHL database, including key terms, Boolean operators, and MeSH headings.

INCLUSION AND EXCLUSION CRITERIA

Inclusion criteria: Prehospital settings, studies in which NTDC was the primary treatment condition. Exclusion criteria: Clinical settings (dental surgeries, emergency departments, etc), trauma presentations, Non-English language and Other (e.g., full-text planning approach or equivalent referenced not found or available to use).

STUDY SELECTION

Identified articles were imported into the web-based reviewing platform Covidence™ for study selection. Two authors (DE, RB) initially screened abstracts for inclusion against the inclusion and exclusion criteria. Inclusion criteria were: Non-health settings or topics, e.g., Education; Publication date >2000. This timeframe was chosen to include up-to-date and still relevant strategies and tools. Exclusion criteria were non-English language and Other (e.g., full-text planning approach or equivalent referenced not found or available).

Any conflicts were resolved by a third author (SB). Reviewers (DE, RB) then independently assessed the full text against the inclusion and exclusion criteria, with conflicts resolved by a third reviewer (SB). A snowballing approach was used to identify additional relevant papers.

DATA EXTRACTION

Three reviewers extracted data (RB, DE, SB) using the prespecified data extraction table. The information extracted included studies, topic, purpose, study design, context, setting, population, and results.

RESULTS

OVERVIEW OF INCLUDED STUDIES

The database search revealed a total of 1755 articles (Figure 1). After removing 813 duplicates, 942 papers were identified as irrelevant following an initial screening of abstracts. Twenty full-text articles were screened, of which 16 were determined to be irrelevant, including one previously unidentified duplicate (Figure 1). This resulted in including four citations in the review, summarised in Table 2.

The work originated from four different countries: Poland (Lewandowski et al., 2016), the United States (Shenkin et al., 2018), Turkey (Aras & Dogan, 2020), and India (Joybell et al., 2019). All studies were quantitative descriptive survey studies, with one study also including interview data (Joybell et al., 2019). Three studies recruited participants directly from emergency health services, while one used data from the United States National Hospital Ambulatory Medical Care Survey (NHAMCS). Data analyses ranged from basic descriptive statistics to multivariate logistic regression.

The population and sample size varied between studies, making comparison of results difficult. Two studies included paramedics and EMTs working in ambulance stations or hospital emergency departments. In contrast, one study included all employees of ambulance services, with no further explanation of the participants' roles. For the three studies recruiting participants directly from emergency health services, sample sizes ranged from 100 to 389 participants. As studies did not differentiate between paramedics and EMTs in their results, for this section, discussion of 'paramedics' will include EMTs.

CHARACTERISTICS OF INCLUDED STUDIES

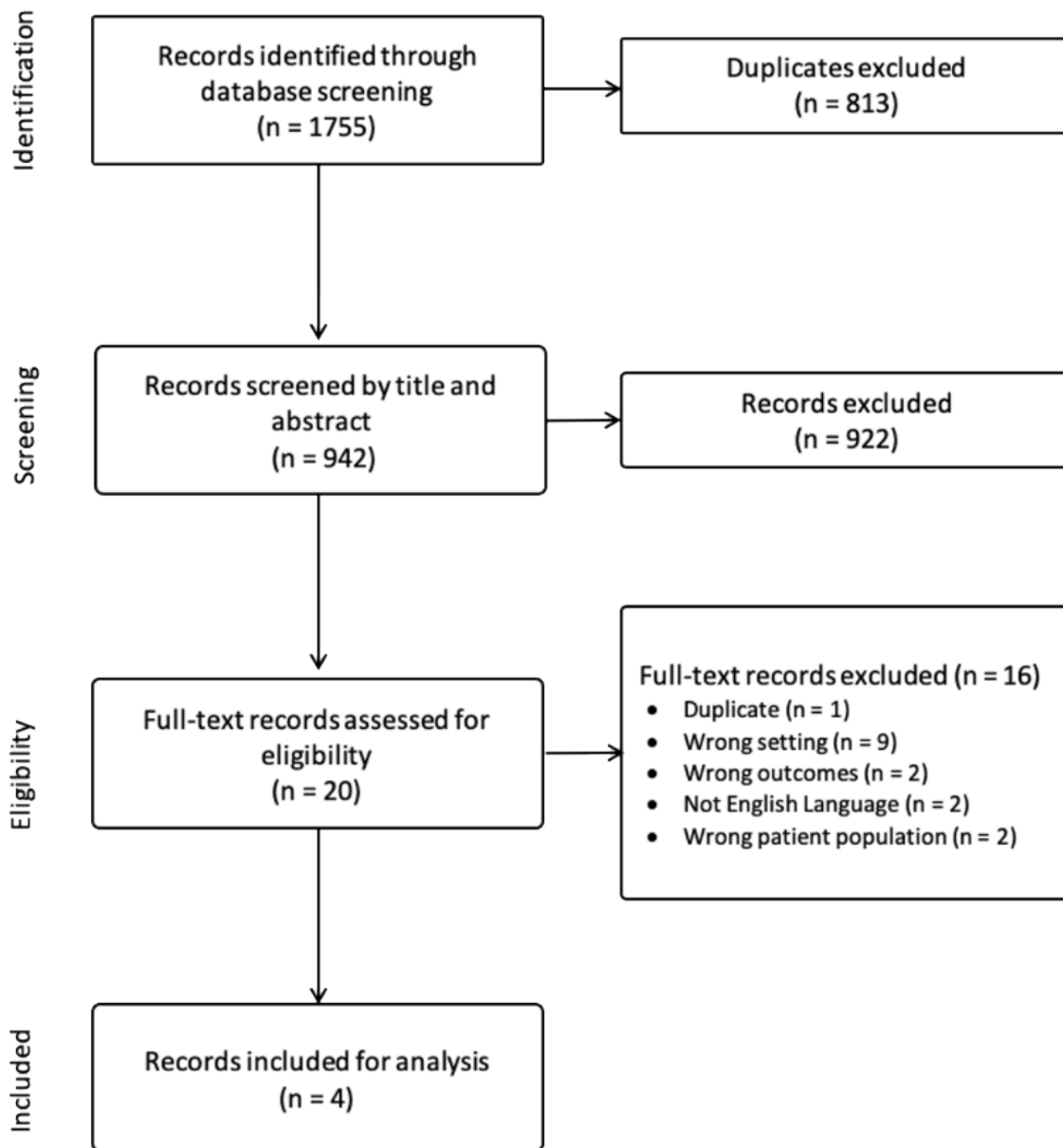


Figure 1. PRISMA Flow Chart.

This review found only four unique citations.

EXPOSURE TO NTDC

Paramedics who reported having attended an NTDC case varied between 28% and 72%; however, the incidence was identified as rare. While the order of cases varied between studies, tooth avulsion, tooth fracture, and tooth displacement were identified as the most encountered cases. Shenkin et al. reported that 1.1% of ED visits for tooth pain were transported by ambulance (Shenkin et al., 2018); however, did not identify the cause of pain nor report on cases that were not transported by ambulance to the ED.

Authors / Year / Country	Stated Aim	Design / Population / Sample size / Analysis	Findings	Conclusions / Limitations
Aras and Dogan, 2019 Turkey	To evaluate the training that emergency medical technicians and paramedics received about traumatic dental injuries, the cases they encountered in the field, and their knowledge of the issue.	Quantitative descriptive survey study. EMTs and paramedics working in emergency ambulance stations or hospitals. N=389 Descriptive statistics.	Over 63% of participants had encountered NTDC cases. The most common dental injury attended by participants was tooth fracture, followed by tooth avulsion and displacement. The 7-15 year age group was identified as the most likely to experience TDI; fall was recognized as the most common cause of TDI. Most respondents indicated they did not receive training specific to TDI.	There needed to be more training or knowledge regarding TDI. Risk of recall bias; survey not based on case numbers.
Joybell, Kumar and Ramraj, 2019 India (Tamil Nadu)	To assess the attitude, awareness, and knowledge of the personnel employed in ambulance services towards the immediate emergency management of dental trauma.	Quantitative descriptive survey study. Employees of emergency ambulance services (108 services total). N=100 Descriptive statistics; non-parametric independence tests.	NTDC was frequently encountered by almost a third of respondents. 28% of respondents indicated they had used ambulance services for DI. There was no association between exposure or transport with any tested variable.	There needed to be more training or knowledge regarding TDI. Risk of recall bias; responses were binomial (frequency of exposure either often or rare); no information on employee role in service; survey not based on case numbers; small region of India
Lewandowski et al., 2016 Poland (Rzeszów region)	To evaluate knowledge of traumatic dental and oral cavity injuries. To determine whether factors such as education, professional experience, and place of employment had an impact on paramedics' knowledge in the field.	Quantitative descriptive survey study. Paramedics working in ambulance stations and hospital emergency departments. N=138 Descriptive statistics.	Majority (72%) of respondents had been exposed to a tooth injury incident. The most commonly reported consequence of dental trauma was an avulsed tooth, followed by tooth displacement and fracture of tooth root.	There needed to be more training or knowledge regarding TDI. Risk of recall bias; low completion rate; survey not based on case numbers.
Shenkin et al., 2018 USA	Prevalence of and factors associated with ambulance use for nontraumatic tooth pain visits to emergency departments.	Quantitative survey study. Patients report tooth pain as the primary reason for ED visit. N=3649 Descriptive statistics; non-parametric independence tests; multivariate logistic regression	Ambulance transport was recorded in 1.1% of tooth pain visits to the ED. Age and payment type were significantly associated with ambulance use. The 45-64-year age group had almost four times higher odds of transport to the ED by ambulance.	

Table 2. Characteristics of Included Studies.

Two papers reported on the demographics of patients most affected by NTDC. Aras and Dogan²¹ identified that children aged between 7 and 15 were the age group most exposed to NTDC, while Shenkin et al. found that patients aged between 45 and 64 were significantly more likely to be transported to ED for tooth pain than other age groups (Shenkin et al., 2018). Shenkin et al. also suggested that transportation for tooth pain increased in publicly insured populations and that there was a need for alternative pathways to reduce the burden on emergency health systems (Shenkin et al., 2018).

KNOWLEDGE, ATTITUDE, AND TRAINING

In addition to presentation data, knowledge and attitude were investigated in three of the four included studies (Aras & Dogan, 2020; Joybell et al., 2019; Lewandowski et al., 2016). The results indicated insufficient knowledge and education regarding dental anatomy or proper management of NTDC. In one study, up to 42% of paramedics answered incorrectly when questioned about dentition and oral anatomy (Lewandowski et al., 2016). Knowledge of the correct management of an avulsed tooth was identified as a primary concern, with as few as 3% of paramedics reporting that they would implant an

avulsed tooth and between 12% and 59% of paramedics identifying a correct medium for transportation. All three studies suggested that most paramedics were unsatisfied with the level of training they received for NTDC (70–86%) and reported positive attitudes towards further education (62–85%).

DISCUSSION

This scoping review aimed to explore the prehospital care of and emergency response to non-traumatic dental conditions, including tooth avulsion, dental injuries, and replantation.

The review identified papers from diverse regions of the world; however, there needs to be more literature regarding NTDC. We note a lack of diversity in the research narrative, which is unsurprising as there is little epidemiological research regarding dental trauma; even less is known about the emergency response to NTDC by ambulance services. Yet, the involvement of paramedics as first responders is important due to a growing demand for their services, which is particularly true for NTDC given they are recognized as a condition for which hospitalization is potentially preventable with appropriate management (Australian Institute of Health and Welfare, 2023).

The included studies surveyed paramedics exposed to NTDC cases and reported insufficient knowledge of the principles of providing first aid in managing dental conditions among responders (Aras & Dogan, 2020; Joybell et al., 2019; Lewandowski et al., 2016), indicating a need for more experience and training regarding the proper management of these cases. The researchers aligned years of experience and level of position with knowledge and competency, suggesting that increased exposure and vocational learning results in improved management of such cases (Joybell et al., 2019).

Non-traumatic dental conditions are common and may or may not present with other injuries. The lack of research and lack of adequate information on dental conditions reported globally leads to inadequate management and policies, as outlined by Abbott (2018). More focused research can raise awareness amongst health professionals of NTDC and reduce diagnostic confusion, misclassification, and non-classification of dental injuries. Our paper highlights the lack of global research on NTDC in the prehospital setting, supporting our suggestion that more research would provide new opportunities to understand the care and emergency response required, as well as the oral health outcomes experienced by patients.

Any dental condition can be a significant public health concern with a substantial burden on healthcare systems due to their frequency, impact on quality of life, and resource requirements. While our review has highlighted that children most often present with NTDC, the long-term consequences impact the individual, the family, and the broader community (Antunes et al., 2020). Furthermore, the severity of a dental condition can influence the prognosis of deciduous teeth and the formation of permanent successors with potentially long-term complications on oral health-related quality of life (Antunes et al., 2020). The potential role of paramedics in relation to initial treatment and referral to specialist pathways requires further research. There is the possibility that prehospital management will reduce disparities in oral health status between privileged and underprivileged population cohorts, including children and adolescents, as well as those that have difficulties accessing healthcare.

LIMITATIONS

A difficulty with all prehospital research is the variation in education and training and clinical practice guidelines, not only between countries but also between states and regions. This variation leads to difficulties in comparing studies, identified in this work. There needed to be more clarity regarding the role of paramedics attending NTDC in the included studies. The research design and approach to data collection could be improved by incorporating more details, such as how patients arrive at hospitals or health care facilities (i.e. transported by ambulance or other means) and whether they require emergency response. In addition, the details of the condition itself and any injury of the dentoalveolar system are necessary to understanding the size of the problem. This would provide valuable information for emergency healthcare services for the development of clinical practice guidelines, professional development, and education programs.

CONCLUSIONS

This scoping review has highlighted the paucity of robust research and publications investigating paramedic and prehospital healthcare workers' recognition of and exposure to NTDC. Given the recognized increase in both dental presentations to hospitals and increased preventable dental conditions, understanding the role of paramedics in both initial treatment and referral to specialist pathways is vital to improved patient outcomes and assisting in reducing the growing burden on emergency departments. Further research is required to determine the prevalence of cases of NTDC in the prehospital setting and the treatment provided by healthcare workers to determine if it should be an education focus.

Primary care and allied health professionals must recognise their role in treating oral injuries and preventing compounding conditions. Developing a collaborative relationship between dental practitioners and primary care providers may improve oral health care in rural and remote communities where access to oral health services is limited (Stuart et al., 2017). Emergency health services are developing a range of mechanisms to manage the growth in demand due to low acuity cases, from the inclusion of practitioner models of service delivery (Eaton et al., 2021) to the implementation of secondary triage models (Eastwood et al., 2019) and incorporation of oral health into emergency preparedness.

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