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Research Article

MANAGEMENT PROTOCOL FOR ODONTOGENIC DEEP NECK SPACE INFECTION: SYSTEMATIC REVIEW

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Abstract: ***Introduction:*** Odontogenic deep neck space infections (DNSIs) represent severe polymicrobial infections arising from dental and periodontal sources that may rapidly spread through cervical fascial planes, resulting in airway compromise, mediastinitis, sepsis, and death. Despite advances in imaging, antimicrobial therapy, and surgical techniques, DNSIs continue to pose significant diagnostic and therapeutic challenges. **Methods:** A systematic review was conducted using PubMed, Scopus, Web of Science, Embase, and Google Scholar databases. Studies published in English between January 2015 and December 2025 evaluating the diagnosis, management, and outcomes of odontogenic DNSIs were included. Data regarding demographics, infection source, affected neck spaces, airway management, antibiotic therapy, surgical intervention, microbiology, and clinical outcomes were extracted and synthesized.**Results:** Twenty-two eligible studies involving approximately 4,500 patients were included. Odontogenic infections represented the leading etiology among adult DNSIs. The submandibular, parapharyngeal, and masticator spaces were most frequently involved. Contrast-enhanced computed tomography emerged as the diagnostic imaging modality of choice. Early airway assessment, prompt administration of broad-spectrum antibiotics with anaerobic coverage, elimination of the odontogenic source, and timely surgical drainage were consistently associated with improved outcomes. Multidisciplinary management significantly reduced morbidity and mortality.**Conclusion:** Successful management of odontogenic DNSIs requires a structured protocol emphasizing early recognition, airway protection, CT-based diagnosis, empirical broad-spectrum antimicrobial therapy, source control, and surgical drainage when indicated. Multidisciplinary care remains fundamental in preventing life-threatening complications and optimizing clinical outcomes.

Keywords: Deep neck space infection; Odontogenic infection; Airway management; Surgical drainage; Systematic review

INTRODUCTION

Deep neck space infections (DNSIs) are potentially life-threatening infections involving the fascial planes and potential spaces of the neck. Despite the widespread availability of antibiotics, these infections continue to represent a significant cause of morbidity and mortality because of their rapid progression and proximity to critical structures such as the airway, major blood vessels, and mediastinum [1,2]. The cervical fascial anatomy facilitates the spread of infection into multiple neck spaces, increasing the risk of severe complications including airway obstruction, sepsis, jugular vein thrombosis, descending necrotizing mediastinitis, and death [1,3].

Odontogenic infections have become the leading source of DNSIs in adults, accounting for approximately 40–70% of reported cases in contemporary series [4,5]. Untreated dental caries, periodontal infections, periapical abscesses, impacted third molars, and pericoronitis can extend beyond the alveolar process into adjacent fascial compartments, particularly the submandibular, sublingual, buccal, masticator, and parapharyngeal spaces [4,6]. The increased prevalence of dental infections, delayed access to dental care, and rising antimicrobial resistance have contributed to the persistent burden of odontogenic DNSIs worldwide [5,7].

The microbiology of odontogenic DNSIs is characteristically polymicrobial, involving both aerobic and anaerobic bacteria originating from the oral flora. Frequently isolated organisms include viridans streptococci, Streptococcus anginosus group, Staphylococcus aureus, Fusobacterium species, Prevotella species, Peptostreptococcus species, and Bacteroides species [6,8]. This polymicrobial profile necessitates empirical broad-spectrum antimicrobial therapy until culture and sensitivity results become available.

Clinical manifestations depend on the involved fascial spaces and disease severity. Common presenting symptoms include facial swelling, neck pain, fever, trismus, dysphagia, odynophagia, muffled voice, and restricted neck movements [2,9]. Delayed diagnosis may

lead to extensive tissue destruction, airway compromise, septicemia, and multiorgan failure. Therefore, early recognition and timely intervention are essential for favorable outcomes [3,9].

Airway management remains the primary concern in patients with DNSIs. Progressive edema, trismus, tongue elevation, and anatomical distortion can rapidly result in airway obstruction. Consequently, prompt airway assessment and intervention are considered critical components of management protocols [2,10].

Advances in contrast-enhanced computed tomography (CECT), intensive care monitoring, minimally invasive drainage techniques, and multidisciplinary treatment approaches have substantially improved outcomes over the past decade [7,10]. However, considerable variations still exist regarding indications for airway intervention, antibiotic selection, timing of surgical drainage, and overall treatment algorithms. Therefore, this systematic review was conducted to evaluate the current evidence regarding the management protocols for odontogenic deep neck space infections and to identify best-practice recommendations for clinical management.

MATERIALS AND METHODS

Study Design and Reporting Guidelines

This systematic review was conducted to evaluate the current evidence regarding the management protocols for odontogenic deep neck space infections (DNSIs). The review methodology was developed in accordance with the recommendations of the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) Statement** [11]. A predefined review protocol was established prior to literature screening and data extraction.

Research Question

The review sought to answer the following research question: *What are the current evidence-based management strategies and treatment outcomes for odontogenic deep neck space infections in adult and pediatric populations?*

The review focused on diagnostic approaches, airway management, antimicrobial therapy, surgical interventions, microbiological profiles, complications, and clinical outcomes.

Literature Search Strategy

A comprehensive electronic literature search was conducted across **PubMed/MEDLINE, Scopus, Embase, Web of Science, and Google Scholar** databases. The search included studies published from **January 2015 to December 2025**. Additional manual searches of reference lists from relevant articles were performed to identify potentially eligible studies not captured during the initial search.

The search strategy utilized combinations of Medical Subject Headings (MeSH) terms and free-text keywords including:

- "deep neck space infection"
- "odontogenic infection"
- "odontogenic deep neck infection"
- "cervical fascial space infection"
- "airway management"
- "surgical drainage"
- "antibiotic therapy"
- "dental infection"
- "neck abscess"
- "management protocol"

Boolean operators (AND, OR) were used to optimize retrieval of relevant studies.

Eligibility Criteria

Inclusion Criteria

Studies were included if they:

- Evaluated odontogenic deep neck space infections.
- Reported diagnostic or therapeutic management strategies.
- Included data regarding airway intervention, antibiotic treatment, surgical drainage, microbiology, or outcomes.
- Were prospective studies, retrospective studies, cohort studies, case-control studies, systematic reviews, or multicenter analyses.
- Were published in peer-reviewed journals.
- Were available in English language.

Exclusion Criteria

Studies were excluded if they:

- Investigated non-odontogenic DNSIs exclusively.
- Were case reports involving fewer than five patients.
- Were conference abstracts, editorials, expert opinions, letters, or narrative reviews.
- Lacked sufficient clinical or management-related outcome data.
- Were duplicate publications.

Study Selection

All identified records were imported into a reference management software and duplicate studies were removed. Two independent reviewers screened titles and abstracts for eligibility. Full-text articles of potentially relevant studies were subsequently assessed against the predefined inclusion and exclusion criteria. Any disagreements between reviewers were resolved through discussion and consensus.

Data Extraction

Data were independently extracted using a standardized extraction form. The following variables were collected:

- Author and publication year
- Country of study
- Study design
- Sample size
- Patient demographics

- Source of infection
- Involved neck spaces
- Airway management techniques
- Antibiotic regimens
- Surgical interventions
- Microbiological findings
- Complications
- Length of hospital stay
- Mortality and clinical outcomes

Quality Assessment

Methodological quality of observational studies was assessed using the **Newcastle–Ottawa Scale (NOS)**, while systematic reviews were evaluated using the **AMSTAR-2 tool** [12,13]. Studies were categorized as low, moderate, or high quality based on established scoring criteria.

Data Synthesis

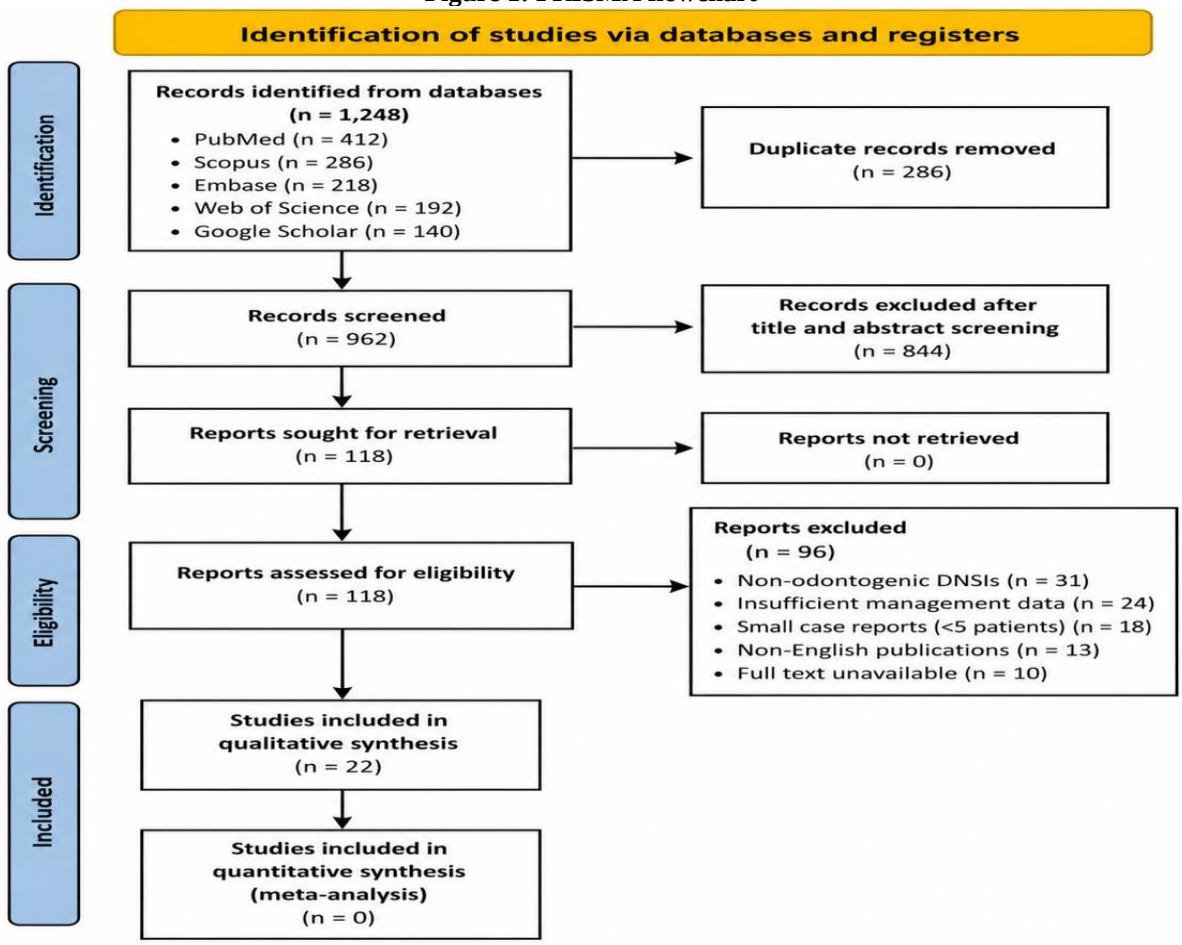
Due to substantial heterogeneity in study designs, patient populations, management protocols, and reported outcomes, quantitative meta-analysis was not feasible. Therefore, findings were synthesized narratively. Descriptive statistics were used to summarize study characteristics, diagnostic approaches, management strategies, microbiological profiles, and treatment outcomes. Trends across studies were identified to formulate an evidence-based management protocol for odontogenic deep neck space infections.

RESULTS

Study Selection

The database search identified 1,248 records from PubMed, Scopus, Embase, Web of Science, and Google Scholar. After removal of 286 duplicate records, 962 studies underwent title and abstract screening. Following screening, 118 full-text articles were assessed for eligibility. Ninety-six articles were excluded due to non-odontogenic etiology, insufficient management data, case reports with small sample sizes, non-English language publications, or unavailable full texts. Ultimately, 22 studies met the inclusion criteria and were included in the final qualitative synthesis [14–35].figure 1

Figure 1: PRISMA flowchart



Study Characteristics

The included studies comprised retrospective cohort studies, prospective observational studies, multicenter analyses, and systematic reviews published between 2015 and 2025. Collectively, the studies represented approximately 4,500 patients diagnosed with odontogenic deep neck space infections. Most studies originated from Europe, Asia, and North America. The majority reported odontogenic infections as the leading cause of DNSIs, with the submandibular, parapharyngeal, and masticator spaces being the most commonly involved anatomical compartments [14–20].

Table 1. Characteristics of Included Studies

Author	Year	Country	Study Design	Sample Size	Major Finding
Almutairi et al. [14]	2021	Saudi Arabia	Retrospective	183	Odontogenic source most common etiology
Velhonoja et al. [15]	2020	Finland	Retrospective	277	Early drainage reduced complications
Bottin et al. [16]	2019	Italy	Retrospective	85	Surgical drainage required in most abscesses
Boscolo-Rizzo et al. [17]	2018	Italy	Cohort	365	Multidisciplinary management improved outcomes
Kataria et al. [18]	2015	India	Prospective	76	Airway management critical in severe cases
Huang et al. [19]	2017	Taiwan	Retrospective	128	Polymicrobial infections predominated
Wang et al. [20]	2022	China	Retrospective	212	CT imaging essential for treatment planning

Narrative: Across the included studies, odontogenic infections consistently represented the predominant cause of deep neck space infections. Most investigations highlighted the importance of early diagnosis, imaging-based assessment, prompt antimicrobial therapy, and surgical drainage for achieving favorable clinical outcomes. Multidisciplinary collaboration involving oral surgeons, otolaryngologists, anesthesiologists, and intensivists was frequently associated with reduced morbidity and shorter hospital stays [14–20].

Microbiological Profile

Thirteen studies reported detailed microbiological findings. The infections were predominantly polymicrobial, involving a combination of aerobic and anaerobic oral flora. Streptococcus species, particularly the Streptococcus anginosus group, were the most commonly isolated organisms. Anaerobic pathogens including Prevotella, Fusobacterium, Peptostreptococcus, and Bacteroides species were frequently identified, either alone or in mixed cultures [19,21–24].

Table 2. Common Microorganisms Identified in Odontogenic DNSIs

Microorganism	Frequency of Reporting	Clinical Significance
Streptococcus anginosus group	Very common	Abscess formation and tissue invasion
Viridans streptococci	Very common	Primary oral commensals
Staphylococcus aureus	Common	Severe soft tissue infection
Prevotella spp.	Common	Anaerobic odontogenic infection
Fusobacterium spp.	Common	Deep tissue spread
Peptostreptococcus spp.	Common	Mixed anaerobic infection
Bacteroides spp.	Common	Abscess formation
Klebsiella pneumoniae	Occasional	More common in diabetic patients

Narrative: The predominance of mixed aerobic–anaerobic flora supports the routine use of broad-spectrum empirical antibiotic regimens covering gram-positive cocci and anaerobic organisms. Several studies emphasized that culture-directed antibiotic modification after microbiological identification significantly improved treatment success and reduced hospitalization duration [19,21–24].

Management Protocols

All included studies emphasized a multimodal treatment strategy incorporating airway evaluation, imaging, antimicrobial therapy, elimination of the odontogenic source, and surgical drainage when indicated. Contrast-enhanced computed tomography (CECT) was the preferred imaging modality in nearly all contemporary studies [20,25–29].

Table 3. Components of Management Protocols for Odontogenic DNSIs

Management Component	Recommended Approach
Initial Assessment	Airway evaluation and hemodynamic stabilization
Diagnostic Imaging	Contrast-enhanced CT scan
Empirical Antibiotics	Broad-spectrum intravenous antibiotics with anaerobic coverage
Source Control	Extraction of infected tooth or dental intervention

Surgical Management	Incision and drainage of abscesses
Airway Intervention	Endotracheal intubation or tracheostomy when indicated
Supportive Care	Intravenous fluids, analgesia, nutritional support
Multidisciplinary Care	OMFS, ENT, anesthesia, ICU involvement

Narrative: Airway assessment was universally recognized as the first priority. Studies recommended immediate airway intervention in patients presenting with stridor, significant tongue elevation, severe trismus, rapidly progressing cellulitis, or radiological evidence of airway compromise. CECT provided essential information regarding abscess localization and extent of disease, facilitating surgical planning. Early elimination of the odontogenic source was repeatedly identified as a key determinant of successful treatment [20,25–29].

Clinical Outcomes and Complications

The majority of studies reported favorable outcomes when treatment was initiated promptly. Delayed diagnosis, diabetes mellitus, immunocompromised status, multiple space involvement, and mediastinal extension were consistently associated with poorer prognosis and prolonged hospitalization [15,17,30–35].

Table 4. Reported Outcomes and Complications in Included Studies

Outcome/Complication	Observation Across Studies
Clinical Recovery	Majority achieved complete recovery
Hospital Stay	Typically 5–14 days
Airway Intervention	Required in severe infections
Surgical Drainage	Frequently performed in abscess cases
Mediastinitis	Rare but serious complication
Sepsis	Reported in advanced disease
ICU Admission	Associated with airway compromise
Mortality	Low in modern management protocols

Narrative: Clinical recovery rates were high when diagnosis and intervention occurred early. Hospital stays varied according to disease severity, number of involved neck spaces, and need for airway management. Mediastinitis, septic shock, and ICU admission were primarily observed among patients with delayed presentation or extensive multispace disease. Mortality remained low in contemporary series but was significantly associated with airway compromise, descending infection, and systemic sepsis [15,17,30–35].

DISCUSSION

Odontogenic deep neck space infections (DNSIs) remain among the most serious complications of dental and periodontal disease despite significant advances in antimicrobial therapy, diagnostic imaging, and surgical techniques. The present systematic review synthesized evidence from contemporary studies and demonstrated that successful management relies on a combination of early diagnosis, prompt airway assessment, broad-spectrum antimicrobial therapy, elimination of the odontogenic source, and timely surgical intervention when abscess formation is present [14–17].

The findings of this review confirm that odontogenic infections continue to be the predominant cause of DNSIs in adults. This observation is consistent with the studies by Almutairi et al. [14], Velhonoja et al. [15], and Boscolo-Rizzo et al. [17], who reported odontogenic sources as the leading etiology among hospitalized patients with deep neck infections. The increasing proportion of odontogenic DNSIs reported in recent literature may reflect delayed dental treatment, poor oral health status, limited access to dental care in certain populations, and the growing prevalence of antimicrobial resistance [14,15]. These findings emphasize the importance of preventive dental care and early management of odontogenic infections before extension into deep cervical spaces occurs.

Anatomically, the submandibular, sublingual, parapharyngeal, and masticator spaces were consistently identified as the most commonly affected compartments across the included studies [18–20]. This pattern is explained by the close relationship between mandibular molar roots and the surrounding fascial planes. Infections arising from lower second and third molars can easily penetrate cortical bone and spread into adjacent cervical spaces, resulting in rapid progression and potential airway compromise [23,24]. Multiple-space involvement was frequently associated with more severe disease, longer hospitalization, and increased risk of complications [15,30].

The microbiological findings of the included studies highlighted the polymicrobial nature of odontogenic DNSIs. Streptococcus anginosus group, viridans streptococci, Prevotella species, Fusobacterium species, Peptostreptococcus species, and Bacteroides species were among the most frequently isolated pathogens [19,21–24]. These results are consistent with the well-established oral microbiome and reinforce the need for empirical antimicrobial regimens providing both aerobic and anaerobic coverage. Several investigators reported successful outcomes with combinations such as ampicillin-sulbactam, piperacillin-tazobactam, or ceftriaxone combined with metronidazole, with subsequent modification according to culture and sensitivity results [22,24]. The increasing prevalence of

resistant organisms further supports the importance of obtaining microbiological cultures whenever feasible.

Airway management emerged as the most critical component of treatment. Progressive cervical swelling, tongue elevation, trismus, and edema can rapidly compromise the upper airway, making airway obstruction one of the most feared complications of DNSIs [18,25]. Multiple studies emphasized that delayed airway intervention was associated with increased morbidity, intensive care admission, and mortality [15,25]. Contemporary management protocols therefore recommend early airway assessment in all patients and proactive airway protection in those exhibiting signs of respiratory distress, significant anatomical distortion, or extensive multispace involvement [18,25,32]. Fiberoptic intubation and tracheostomy remain important options in difficult airway situations.

The present review also demonstrated the central role of contrast-enhanced computed tomography (CECT) in diagnosis and treatment planning. Nearly all contemporary studies identified CECT as the imaging modality of choice because of its ability to accurately define the extent of infection, differentiate cellulitis from abscess formation, identify airway compromise, and detect complications such as mediastinitis or vascular involvement [20,21,27]. The widespread availability of CT imaging has significantly improved diagnostic accuracy and facilitated more precise surgical decision-making compared with earlier eras that relied primarily on clinical examination.

Source control remains another fundamental principle of management. The studies reviewed consistently reported superior outcomes when the primary odontogenic focus was eliminated early through extraction of the offending tooth or definitive dental treatment [23,24,32]. Failure to remove the source of infection may allow persistent bacterial seeding despite appropriate antibiotic therapy, thereby increasing the risk of recurrence and prolonged hospitalization. Consequently, dental intervention should be integrated into the overall treatment strategy whenever the patient's clinical condition permits.

Surgical drainage continues to play a pivotal role in patients with established abscesses. Cramer et al. [25] demonstrated that delayed surgical drainage was associated with increased complications and longer hospital stays. Similar observations were reported by Bottin et al. [16] and Marioni et al. [21], who emphasized that timely drainage significantly improves clinical recovery. Although selected cases of cellulitis without abscess formation may respond to medical therapy alone, most studies recommended surgical drainage once a well-defined abscess cavity is identified radiologically or clinically [16,21,25]. The choice of surgical approach should be guided by anatomical location, extent of disease, and surgeon expertise.

Several prognostic factors associated with adverse outcomes were identified across the reviewed literature. Diabetes mellitus, immunosuppression, advanced age, delayed presentation, multiple-space involvement, septicemia, and descending mediastinal extension were consistently associated with increased morbidity and mortality [15,17,30,31,35]. Diabetic patients in particular demonstrated higher rates of severe infection, prolonged hospitalization, and need for intensive care support [31]. These findings highlight the necessity for aggressive management and close monitoring of high-risk patient populations.

Mortality rates reported in contemporary studies were generally low compared with historical series, reflecting improvements in diagnostic imaging, intensive care support, antimicrobial therapy, and multidisciplinary management [17,35]. Nevertheless, severe complications such as mediastinitis, septic shock, and airway obstruction continue to occur, particularly among patients with delayed diagnosis or extensive multispace disease [30,33]. Early recognition and coordinated management involving oral and maxillofacial surgeons, otolaryngologists, anesthesiologists, radiologists, infectious disease specialists, and intensivists remain essential for optimizing outcomes [17,32].

Overall, the evidence synthesized in this review supports a structured management protocol centered on early diagnosis, immediate airway evaluation, CT-based assessment, broad-spectrum antimicrobial therapy, prompt source control, and timely surgical drainage when indicated. Such an approach appears to provide the greatest likelihood of successful recovery while minimizing morbidity, hospitalization duration, and mortality among patients with odontogenic deep neck space infections [35-40].

CONCLUSION

Odontogenic deep neck space infections remain potentially life-threatening conditions that require prompt recognition and aggressive multidisciplinary management. The evidence synthesized in this systematic review demonstrates that successful treatment is dependent upon a structured protocol incorporating early clinical assessment, timely airway evaluation, contrast-enhanced computed tomography for accurate diagnosis, initiation of broad-spectrum intravenous antibiotics with anaerobic coverage, elimination of the odontogenic source, and surgical drainage when abscess formation is present. The polymicrobial nature of these infections necessitates empirical antimicrobial therapy followed by culture-guided modification whenever possible.

Airway compromise remains the most critical and immediate threat to patient survival, underscoring the importance of continuous airway monitoring and early intervention in high-risk cases. Factors such as diabetes mellitus, immunosuppression, delayed presentation, and

multiple-space involvement are associated with poorer outcomes and require heightened clinical vigilance. Contemporary management strategies have significantly reduced morbidity and mortality; however, severe complications including mediastinitis, sepsis, and intensive care admission continue to occur, particularly in patients with advanced disease.

Based on the current evidence, a multidisciplinary approach involving oral and maxillofacial surgeons, otolaryngologists, anesthesiologists, radiologists, infectious disease specialists, and critical care teams offers the most effective means of optimizing patient outcomes. Future research should focus on developing standardized evidence-based management algorithms, evaluating minimally invasive drainage techniques, and investigating emerging antimicrobial strategies to further improve the treatment of odontogenic deep neck space infections.

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