



A Comprehension Review On Noma

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ABSTRACT:

NOMA is a severe form of orofacial gangrene that typically begins within the gingival-oral mucosa complex before spreading to produce a visibly destructive ulcer. While cases of NOMA have become rare in developed countries, it remains a significant health issue for children in low-income regions, particularly in sub-Saharan Africa, where factors such as poverty, malnutrition, lack of healthcare, and preventable childhood infections are prevalent. Despite a decline in developed nations, the global annual incidence of NOMA is still alarmingly high, with around 140,000 cases reported annually. The mortality rate for untreated cases exceeds 90%, and even for survivors, the condition leads to severe facial disfigurement, intense scarring, trismus (restricted mouth opening), oral incompetence and social alienation.

KEY WORDS:

Cancrum oris, Necrotizing ulcerative stomatitis, Gangrenous stomatitis, Necrotizing gingivitis, Necrotizing periodontitis, Necrotizing stomatitis, Pseudomonas aeruginosa.

INTRODUCTION:

NOMA is a devastating orofacial gangrene primarily affecting malnourished children in the developing world, particularly those weakened by disease. The condition has a high mortality rate and survivors often endure severe facial deformities, leading to social exclusion and rejection from family and community life.

NOMA is caused by bacteria normally found in the mouth and is considered an opportunistic, non-contagious disease. Historically, it was common in Europe and the United States until the mid-20th century.

In fact, in 1649, NOMA was included in the first medical text on neglected diseases, *Observations Medicine de Affectibus Omissis*, by Arnoldus Boëtius. By the end of the 19th century, however, NOMA had largely disappeared in developed nations, although it continues to pose a significant health threat in regions of poverty. Known also as *Cancrum Oris*, NOMA is an infectious disease caused by a mix of polymicrobial organisms.

Key bacterial species involved in NOMA include:

- ✓ **Borrelia vincentii:** A spirochete bacterium.
- ✓ **Fusobacterium necrophorum:** A common microorganism found in NOMA lesions.
- ✓ **Prevotella intermedia:** A bacterial species frequently associated with NOMA infections.
- ✓ **Peptostreptococcus:** Another bacterium linked to NOMA.

In addition to these bacterial culprits, several factors contribute to the development of NOMA, the most significant of which is malnutrition.

Other contributing conditions include:

- ✓ **Necrotizing gingivitis:** A precursor to NOMA, which can often be treated with improved oral hygiene.
- ✓ **Necrotizing periodontitis:** Another precursor that can typically be treated with antibiotics.
- ✓ **Necrotizing stomatitis:** Also a precursor to NOMA, which can be managed with antibiotics.

Because of its complex etiology, the prevention and treatment of NOMA require a multifaceted approach, including addressing malnutrition, improving oral hygiene, and providing prompt medical care to treat early-stage infections.⁽¹⁾

History of NOMA and Its Various Names

The term NOMA is derived from the Greek word "NOMA", meaning "to devour," reflecting the destructive nature of the disease. The word was first used in 1680 by the Dutch surgeon Cornelis van de Voorde to describe a rapidly spreading ulceration that originated in the soft, moist tissues of the mouth. The terms NOMA and *Cancrum oris* are now used interchangeably to refer to this condition.

In 1765, the European scientist Gabriel Lund linked NOMA to poverty, overcrowded living conditions, and malnutrition, which remain significant contributing factors today. Throughout the 19th century, there were debates over whether NOMA and *Cancrum oris* referred to the same disease or two distinct conditions.

In a publication from 1862, NOMA was used to describe ulcerative stomatitis (lesions on the oral mucosa), while *Cancrum oris* referred specifically to gangrenous stomatitis (the death and decay of mouth tissues).

The earliest documented references to conditions resembling NOMA date back to ancient physicians such as Hippocrates (460–370 BC) and Galen (129–200 AD). However, these early descriptions were likely referring to general ulceration and not the specific condition we now recognize as NOMA. The first clinical description of what we now call NOMA was provided by the Dutch physician Carolus Battus in 1620, who referred to it as **“WATER CANKER.”**

In 1848, the French physician Tourdes defined NOMA in a manner similar to how it is understood today: "a gangrenous disease affecting the mouth and face of children living in unsanitary conditions and suffering from debilitating diseases, especially eruptive fevers. The disease begins with an ulcer on the oral mucosa, rapidly spreading and destroying the soft and hard tissues of the face, often resulting in death."

In different regions, NOMA is known by various names. In Laos, it is referred to as **“Pagnad Pak Poue”** meaning "disease of mouth rotting." In Zambia, it is called **“AKA POPO”** which translates to "the child has eaten a stillborn fetus, and the flesh is coming out," describing the sloughing of tissue from the cheek. In Nigeria, among the Hausa-speaking population, several names have been documented for NOMA, including **“CIWON ISKA” “BAKIN KARE”, “DANHURAWA”, “TUAREG”, and “SADDE.”** However, these terms can be problematic, as they are sometimes used to describe other conditions, such as cleft lip and palate, leading to confusion during patient recruitment for treatment programs. Additionally, in **Hausa**, the word “NOMA” also means **"farming,"** further complicating the term's usage in certain cultural contexts.

NOMA has been a longstanding companion to humankind, described by both classical and medieval authors. For centuries, it was a common affliction in Europe and the United States. In 1649, the disease was included in *Observations Medicate de Affectibus Omissis*, the first book dedicated to neglected diseases, authored by Arnoldus Bootius. However, by the end of the 19th century, NOMA began to disappear from hospitals in Europe and the U.S., largely due to improvements in public health and living conditions.

In the 20th century, when NOMA cases were encountered by bacteriologists, no definitive conclusions could be made about the causative microorganisms. It wasn't until 1912, when Stewart's research suggested that NOMA was not a specific infection, but rather an opportunistic one caused by the bacteria that naturally reside in the oral cavity.

The introduction of sulfonamides and penicillin in the 1940s marked a turning point in the treatment of NOMA. With the use of these antimicrobial drugs, the mortality rate of NOMA dropped dramatically from around 85% to approximately 15%.⁽²⁾

Despite these advances in medical treatment, a comprehensive approach to reconstructive surgery for NOMA did not develop until the last 50 years. This progress in surgical techniques has greatly improved the

outcomes for survivors, helping to address the extensive facial disfigurement and functional impairments caused by the disease.

Symptoms of NOMA:

NOMA typically begins with a small ulcer in the mouth, which gradually progresses to necrotizing gingivitis—a condition marked by painful, bleeding gums and inflammation of the interdental papillae (the small tissue between the teeth). As the infection spreads rapidly, it causes generalized inflammation of the mouth and lips, accompanied by facial swelling (edema) and foul-smelling breath.⁽³⁾

If left untreated, within a few days, the infection can advance to involve the facial muscles, the skin, and the upper and lower jaw, resulting in widespread tissue destruction and sloughing (the shedding of dead tissue).

Advanced Symptoms:

As NOMA progresses, tissue destruction in the mouth and face accelerates, leading to:

- Necrosis (tissue death)
- Loss of teeth
- Severe disfigurement and gangrene (tissue decay)
- Foul-smelling discharge from the affected area
- Increased salivation
- Difficulty speaking or articulating words
- Severe weight loss due to an inability to eat or swallow
- Without timely medical intervention, NOMA causes devastating physical and functional damage, which can be fatal or result in lifelong disfigurement.

Complications of NOMA:

Life-Threatening Complications:

- Sepsis (blood infection)
- Meningitis (infection of the membranes surrounding the brain and spinal cord)
- Osteomyelitis (infection of the jawbone)
- Respiratory distress (difficulty breathing)
- Malnutrition due to an inability to eat.

Early Complications:

- Severe pain
- Swelling and inflammation in the affected area
- Necrosis (death of facial tissues, including skin, muscles, and bone)

Late Complications:

- Malocclusion (misalignment of teeth) and tooth loss
- Psychological trauma and social isolation due to disfigurement
- Chronic pain and discomfort.

Long-Term Complications:

- Facial asymmetry (unevenness in facial features)
- Limited mouth opening (trismus, making it difficult to speak, eat, or swallow)
- Speech impairments due to facial and oral damage
- Emotional distress from permanent disfigurement and social stigma⁽⁴⁾

Nutritional Complications:

- Weight loss from inability to eat
- Vitamin deficiencies due to poor diet
- Anemia (low red blood cell count)
- Impaired growth and development in children.

Pharmacological Complications:

- Allergic reactions to medications
- Overdose or toxicity from medications
- Drug interactions with other treatments
- Withdrawal symptoms from medication cessation
- Stevens-Johnson syndrome, a severe reaction to drugs causing blistering and skin peeling.

Pathophysiology of NOMA:

The progression of NOMA is typically divided into five distinct stages, each characterized by a specific set of clinical features and underlying pathological changes. These stages include (FIG:1).



FIG 1: STAGES OF THE NOMA.

Stage 1: Acute Necrotizing Gingivitis (ANG):

Acute Necrotizing Gingivitis (ANG) is a rapidly advancing bacterial infection that causes necrosis (death) of the gum tissue, leading to the formation of painful ulcers and significant tissue destruction. (Figure-2)

Symptoms:

- Severe gum pain
- Bleeding gums
- Painful ulcers or craters in the gums
- Swollen and inflamed gums
- Bad breath (halitosis)
- Fever
- Swollen lymph nodes
- Difficulty swallowing or eating.



FIG 2: SIGNS AND SYMPTOMS.



FIG 3: ACUTE NECROTIZING GINGIVITIS PATIENT

Causes of NOMA:

NOMA is primarily caused by a combination of bacterial infection and underlying health factors. The key causes include:

- **Bacterial infection:** Common bacteria involved include Fusobacterium and Streptococcus species.
- **Poor oral hygiene:** Lack of proper oral care can facilitate bacterial overgrowth and infection.
- **Malnutrition:** Inadequate nutrition weakens the immune system, making the body more vulnerable to infections.
- **Immunodeficiency:** Conditions like HIV/AIDS compromise the immune system, increasing susceptibility to infections like NOMA.
- **Stress:** Physical and emotional stress can weaken the immune system, making it harder for the body to fight off infections.
- **Smoking:** Tobacco use can impair oral health and immune function, contributing to the development of infections like NOMA.⁽⁵⁾

Sub division of Stage-1 of NOMA:

- ✓ **Initial Stage:** Mild gum inflammation, often characterized by redness and slight swelling of the gums.
- ✓ **Early Stage:** Necrosis (tissue death) and ulceration of the gums, leading to painful sores and deeper tissue damage.
- ✓ **Advanced Stage:** Severe tissue destruction, including loss of soft tissue and bone, particularly in the mouth and face.(FIG:3).

Treatment:

- **Antibiotics:** To address the bacterial infection.
- **Pain management:** To alleviate discomfort and manage pain.
- **Debridement:** Removal of dead or necrotic tissue to help prevent further infection and promote healing.
- **Hydrogen peroxide mouthwash:** Used to clean and disinfect the oral cavity.
- **Saltwater rinses:** To help soothe irritated gums and reduce inflammation.
- **Surgical intervention:** In severe cases, surgery may be needed to repair tissue damage and reconstruct affected areas.

Complications:

- **Periodontitis:** Severe gum disease that can lead to tooth loss.
- **Tooth loss:** Resulting from the destruction of gum tissue and underlying bone.
- **Abscesses:** Pockets of pus caused by bacterial infection.
- **Septicemia:** A life-threatening blood infection that can occur if bacteria spread throughout the body.
- **Heart disease:** Complications related to systemic infections, particularly in individuals with weakened immune systems.
- **Diabetes complications:** Poor blood sugar control can worsen infections and slow healing.

Prevention:

- **Good oral hygiene:** Regular brushing and flossing to maintain healthy gums and teeth.
- **Regular dental check-ups:** To detect and treat oral issues before they become severe.
- **Balanced diet:** To support overall health and strengthen the immune system.
- **Stress management:** Reducing stress to maintain immune function.
- **Quit smoking:** Smoking can impair oral health and immune response.
- **HIV/AIDS management:** Proper management of immune system disorders to reduce the risk of opportunistic infections like NOMA.⁽⁶⁾

✚ STAGE 2: Oedema

Oedema is based on the severity of the swelling and the extent of tissue damage (FIG:4).

SYMPTOMS:

- Swelling of the cheeks, lips and gums
- Painful ulcers in the mouth
- Redness and inflammation
- Bleeding from the gums and mouths
- Bad breath
- Rapid progression of swelling and tissue destruction
- Necrosis (death) of tissue and bone
- Exposure of bone and muscle
- Septicaemia (blood infection)



FIG 4: OEDEMA PATIENT

Causes of NOMA:

NOMA is caused by a combination of bacterial infection and underlying health and environmental factors.

Key causes include:

- **Bacterial infection:** Infections are primarily caused by Fusobacterium, Streptococcus, and other anaerobic bacteria that thrive in the mouth.
- **Malnutrition:** Protein-energy malnutrition and deficiencies in essential vitamins weaken the immune system and make the body more susceptible to infections.
- **Immunodeficiency:** Conditions such as HIV/AIDS, measles, and malaria compromise the immune system, increasing the risk of developing NOMA.
- **Poor oral hygiene:** Inadequate oral care allows harmful bacteria to thrive, leading to infections that can progress to NOMA.

- **Lack of access to healthcare:** Limited medical resources and healthcare infrastructure delay diagnosis and treatment, worsening outcomes.
- **Poverty and poor living conditions:** Poverty and overcrowded, unsanitary living conditions are major risk factors, as they contribute to malnutrition and limited access to healthcare.
- **Malaria:** As a common co-infection in impoverished regions, malaria further weakens the immune system, making individuals more vulnerable to secondary infections like NOMA.⁽⁷⁾

Sub division of Stage-2 Oedema:

➤ Mild Oedema:

- Swelling is localized to the cheek or mouth.
- No ulceration or tissue destruction.
- Skin remains intact but may be tender to the touch.
- Minimal pain or discomfort.

➤ Moderate Oedema:

- Swelling extends beyond the cheek or mouth to involve surrounding areas.
- Ulceration or tissue destruction is confined to the mouth or cheek.
- Skin may be broken, with crusting or scabbing present.
- Moderate pain or discomfort is experienced.

➤ Severe Oedema:

- Swelling is extensive, extending to the face or neck.
- Ulceration or tissue destruction is widespread.
- Skin is severely damaged, with significant crusting or scabbing.
- Severe pain or discomfort.

➤ Extreme Oedema:

- Swelling is extreme and poses a life-threatening risk.
- Widespread tissue destruction and gangrene are present.
- Skin is severely damaged, with significant necrosis (death of tissue).
- Extreme pain or discomfort.

Treatment for Oedema:

Medical Treatment:

- ✓ **Antibiotics:** To control the infection and prevent sepsis.
- ✓ **Pain management:** To alleviate pain and manage discomfort.
- ✓ **Wound care:** To promote healing and prevent further tissue damage.

- ✓ **Nutritional support:** To ensure adequate nutrition and hydration, helping to strengthen the immune system.
- ✓ **Physiotherapy:** To maintain mobility, prevent contractures, and support functional recovery.

Surgical Treatment:

- ✓ **Debridement:** Removal of necrotic (dead) tissue to reduce infection and promote wound healing.
- ✓ **Reconstruction:** Surgical repair or rebuilding of damaged tissue and skin to restore function and appearance.
- ✓ **Drainage:** Removal of excess fluid or pus from infected areas to prevent further complications.
- ✓ **Skin grafting:** Use of healthy skin to cover large wounds or tissue defects caused by the infection.
- ✓ **Reconstructive surgery:** More extensive surgery aimed at restoring both the form and function of the affected facial structures, including bones, muscles, and skin.⁽⁸⁾

Complications of NOMA Surgery:

- Airway obstruction due to swelling or tissue damage
- Sepsis (blood infection)
- Meningitis (infection of the brain's protective lining)
- Brain abscess (localized brain infection)
- Sinusitis (infection of the sinus cavities)
- Osteomyelitis (infection of the bones, especially the jaw)
- Severe scarring leading to permanent facial disfigurement
- Malnutrition from difficulty eating and swallowing
- Dehydration due to fluid loss and reduced intake
- Electrolyte imbalances caused by poor nutrition or infection
- Secondary infections as a result of weakened immune function or surgical complications
- Chronic pain from tissue damage or surgery
- Psychological trauma and social isolation due to disfigurement and disability
- Economic burden from prolonged medical treatment and rehabilitation (FIG:5).

Prevention of NOMA:

- Practice good hygiene to reduce the risk of bacterial infections.
- Maintain proper oral hygiene to prevent gum disease and infections.
- Avoid malnutrition by ensuring access to adequate nutrition, particularly for vulnerable populations.
- Avoid tobacco and alcohol use, which can impair immune function and oral health.
- Get vaccinated against preventable diseases like measles and other infections that compromise immune health.

- Implement nutrition programs to address malnutrition in at-risk populations.
- Ensure proper waste disposal to reduce exposure to infectious agents.
- Promote the use of insecticide-treated bed nets to prevent malaria and other vector-borne diseases that weaken immunity.
- Prevention and early intervention are key to reducing the impact of NOMA, particularly in impoverished regions where the disease is most prevalent.⁽⁹⁾



FIG 5: OEDEMA PATIENT

✚ Stage 3: Gangrenous Stage

The gangrenous stage of NOMA represents the most severe and rapidly progressing phase of the infection. It is characterized by widespread tissue death and destruction, typically affecting individuals, especially children, with weakened immune systems.

Symptoms:

- Severe swelling and pain in the face, particularly around the cheek and mouth.
- Ulceration and gangrene of the skin and underlying tissues, leading to tissue necrosis.
- Foul odor from the affected area, accompanied by discharge.
- Fever and chills, as the body reacts to the spreading infection.
- Swollen lymph nodes, indicating the body's attempt to fight the infection.
- Difficulty swallowing or breathing due to the swelling and destruction of tissues around the mouth and throat.

Causes:

- Poor oral hygiene, which facilitates bacterial growth and infection in the mouth.
- Malnutrition, which weakens the immune system and makes the body more vulnerable to infection.
- Weakened immune system, often due to conditions like HIV or other immunocompromising diseases.
- Bacterial infection, particularly *Fusobacterium necrophorum*, which is commonly found in NOMA lesions.

- Viral infections, such as measles and HIV, which further compromise immune function. (FIG:6).

Sub division of Stage-3 of NOMA:

- **Initial Stage:** Characterized by swelling and ulceration of the oral and facial tissues.
- **Progressive Stage:** The infection leads to gangrene and extensive tissue destruction.
- **Advanced Stage:** Severe disfigurement and functional impairment, with significant facial tissue loss and loss of oral function.

At this stage, immediate medical intervention is essential to halt the progression of the infection and manage the complications that can arise, including sepsis and organ failure.⁽¹⁰⁾

Treatment for stage -3 NOMA (Gangrenous Stage):

- **Antibiotics and Antifungals:** To treat the bacterial and fungal infections causing tissue destruction and prevent sepsis.
- **Debridement and Wound Care:** Removal of necrotic tissue and proper care to promote healing and reduce the risk of further infection.
- **Pain Management:** To alleviate severe pain associated with tissue damage and infection.
- **Nutritional Support:** To address malnutrition and ensure the patient receives adequate nourishment for healing and immune function.
- **Surgical Reconstruction:** In advanced cases, surgical intervention is necessary to repair damaged tissues, restore facial function, and improve appearance.

Complications:

- ✓ **Airway Obstruction:** Swelling and tissue destruction can obstruct the airway, making breathing difficult.
- ✓ **Sepsis:** A life-threatening infection that can spread throughout the body if untreated.
- ✓ **Meningitis:** Infection of the protective lining around the brain, which can be fatal.
- ✓ **Brain Abscess:** A localized infection in the brain that can result from the spread of bacteria.
- ✓ **Chronic Disfigurement:** Severe facial scarring and deformities that result from tissue destruction.
- ✓ **Functional Impairment:** Loss of oral function, difficulty eating, speaking, and breathing, impacting daily life.⁽¹¹⁾

Prevention of NOMA:

- ✓ **Practice Good Oral Hygiene:** Regular brushing, flossing, and dental care to prevent infections in the mouth.
- ✓ **Maintain Proper Nutrition:** Ensure adequate nutrition, including protein and vitamins, to strengthen the immune system.

- ✓ **Avoid Tobacco and Alcohol:** These can weaken immune function and contribute to poor oral health.
- ✓ **Get Vaccinated:** Vaccination against diseases like measles, which can compromise the immune system and increase the risk of NOMA.
- ✓ **Manage Underlying Health Conditions:** Proper management of conditions such as HIV/AIDS, malaria, and other immunocompromising diseases to reduce the risk of NOMA.
- ✓ **Promote Community-Based Initiatives:** Encourage early detection and prevention efforts through health education and outreach programs in vulnerable communities.
- ✓ Effective prevention and early intervention are crucial to reduce the incidence of NOMA and improve outcomes for those affected.⁽¹²⁾



FIG 6: GANGERENOUS STAGE

✚ **Stage 4: Scarring Stage**

The scarring stage of NOMA marks the final phase of the disease, where tissue destruction has occurred, and the dead tissue sloughs off, leaving behind significant scarring and permanent disfigurement. This stage reflects the aftermath of the infection and presents ongoing challenges for affected individuals.

Symptoms:

- Severe scarring and disfigurement of the face, leading to permanent facial deformities.
- Contractures (tightening) of the skin and tissues, causing restricted movement and loss of tissue.
- Difficulty with mouth opening and closure due to tissue loss and scarring, making eating, speaking, and breathing more challenging.
- Speech and swallowing difficulties as the structural integrity of the mouth and throat is compromised.
- Emotional distress and psychological trauma as individuals cope with the physical changes, potential social stigma, and loss of function.

Causes:

- **Progression of NOMA:** The disease advances through its earlier stages (necrotizing gingivitis, oedema, gangrene) before reaching the scarring phase.

- **Tissue destruction and gangrene:** The extensive tissue damage from the infection leads to permanent loss of facial structures and functions.
- **Inadequate treatment or delayed intervention:** Failure to promptly diagnose or treat NOMA, especially during the earlier stages, results in more severe tissue damage and long-term disfigurement. (FIG:7).



FIG 7: SCARRING STAGE

The scarring stage presents significant challenges in terms of both physical function and psychological well-being. Reconstructive surgery and ongoing support are crucial for improving quality of life and reducing the social impact of the disease.⁽¹³⁾

Sub division of stage-4: Stages of NOMA Infection and Scarring

- ✓ **Initial Stage:** Swelling and ulceration of the affected areas, often in the gums and mouth, marking the onset of the infection.
- ✓ **Progressive Stage:** Gangrene sets in, and tissue destruction begins, rapidly advancing the disease.
- ✓ **Advanced Stage:** Severe disfigurement and functional impairment occur due to extensive tissue loss.
- ✓ **Scarring Stage:** The final phase, where tissue death has occurred, and the healing process results in significant scarring.

Sub-Stages of Scarring:

- **Acute Scarring:** Immediately following tissue death and sloughing, the scar tissue is raw, red, swollen, and tender to the touch.
- **Subacute Scarring:** As the scar tissue matures, it becomes thicker, more contracted, and may cause restrictions in movement, leading to limited mobility and discomfort.
- **Hypertrophic Scarring:** The scar tissue becomes raised, thick, and discolored, presenting both cosmetic and functional challenges as the area becomes more pronounced.
- **Keloid Scarring:** In some cases, the scar tissue extends beyond the original wound site, forming large, raised, and prominent scars that may require surgical intervention.

- **Contracture Formation:** As the scar tissue tightens, it leads to significant contraction and shortening of tissues, impairing normal function and mobility, particularly around the mouth and face.
- **Chronic Scarring:** The scar tissue is fully matured, but it still causes noticeable disfigurement and can lead to long-term functional impairment, affecting facial expression, speech, and swallowing.
- **Compensatory Mechanisms:** Individuals develop adaptive coping mechanisms to manage the physical and functional limitations caused by scarring. These may include altered facial movements, speech patterns, and use of assistive devices for eating and communication.
- **Rehabilitation:** Physical, occupational, and speech therapy are vital to help individuals regain as much function and mobility as possible, improve appearance, and address psychological impacts. These therapies aim to optimize function and quality of life, restoring independence and reducing the impact of disfigurement.
- Rehabilitation and ongoing care are essential in managing the long-term effects of NOMA, ensuring that individuals can live as fully and independently as possible despite the challenges posed by severe scarring and functional impairment.⁽¹⁴⁾

Treatment for NOMA (Scarring Stage)

- **Surgical Reconstruction:** To repair and restore damaged facial tissues and structures, improving both appearance and function.
- ✓ **Rehabilitation:** The individual undergoes various therapies (e.g., physical, occupational, speech) to optimize function and appearance.
- ✓ **Physical Therapy:** Aimed at releasing contractures and improving movement, particularly in the mouth and jaw.
- ✓ **Speech and Swallowing Therapy:** To help individuals regain the ability to speak and swallow effectively after tissue loss.
- ✓ **Psychological Support and Counseling:** Addressing emotional distress and trauma, supporting mental health and well-being during recovery.
- ✓ **Prosthetic Rehabilitation:** Use of facial prosthetics to improve cosmetic appearance and restore function for individuals with significant tissue loss.⁽¹⁵⁾

Complications:

- ✓ **Chronic Disfigurement and Social Stigma:** Permanent facial changes that may lead to social isolation and psychological challenges.
- ✓ **Functional Impairment and Disability:** Difficulty with daily activities, such as eating, speaking, and facial expression, due to tissue loss and scarring.
- ✓ **Emotional Distress and Psychological Trauma:** Long-term psychological impacts, including depression and anxiety, resulting from the physical and social consequences of NOMA.

- ✓ **Secondary Infections and Complications:** Risk of further infections due to weakened immune function or surgical interventions. (FIG:8).

Prevention of NOMA:

- **Early Detection and Treatment:** Timely diagnosis and intervention are crucial to preventing the progression of NOMA and reducing long-term damage.
- **Practice Good Oral Hygiene and Nutrition:** Preventive measures like regular dental care and a balanced diet are essential for maintaining oral health and immune function.
- **Avoid Tobacco and Alcohol:** These substances can impair immune response and worsen oral health, increasing the risk of infection.
- **Get Vaccinated** (e.g., Measles): Vaccination against diseases that compromise the immune system can reduce the risk of NOMA development.
- **Manage Underlying Health Conditions:** Proper management of immunocompromising conditions such as HIV/AIDS, malaria, and malnutrition is vital for preventing NOMA.
- **Promote Community-Based Initiatives:** Health education programs focused on prevention, early detection, and proper care in vulnerable communities can significantly reduce NOMA incidence.⁽¹⁶⁾



FIG 8: SCARRING DISFIGUREMENT FACE

✚ Stage 5: Sequelae (Long-Term Consequences):

The sequelae stage of NOMA represents the lasting effects that persist after the acute infection has resolved. This phase involves the ongoing physical, psychological, and social challenges that arise from tissue destruction, disfigurement, and functional impairments caused by the disease.

Symptoms:

- **Persistent facial disfigurement and scarring:** Severe, permanent changes in facial appearance due to tissue loss and scarring.
- **Functional impairment:** Ongoing difficulties with speaking, swallowing, and breathing, often due to contractures or tissue loss in the mouth and throat.

- **Emotional distress and psychological trauma:** Individuals may experience depression, anxiety, or post-traumatic stress as a result of disfigurement and social isolation.
- **Social stigma and isolation:** Persistent facial changes can lead to societal rejection, stigmatization, and exclusion from community and family activities.
- **Chronic pain or discomfort:** Ongoing pain or sensitivity in the affected areas due to nerve damage or scarring.
- **Limited mobility or contractures:** Difficulty with facial movements, such as opening the mouth, smiling, or speaking, due to the tightening of scar tissue.
- **Sensory loss or numbness:** Loss of sensation in the affected areas, particularly around the face, lips, or jaw.
- **Difficulty with eye closure or vision:** In severe cases, scarring or contractures around the eyes may cause difficulty fully closing the eyelids, leading to potential vision problems or exposure-related damage.⁽¹⁷⁾

Causes:

- **Residual effects of NOMA disease:** The long-term consequences are a direct result of the extensive tissue destruction and gangrene caused by the infection.
- **Inadequate treatment or delayed intervention:** Failure to treat the disease early or thoroughly can lead to more severe long-term damage and complications.
- **Extent of tissue destruction and scarring:** The severity and location of tissue loss will determine the degree of disfigurement and functional limitations in the sequelae stage.

Sub division of Stages of NOMA Disease Progression:

- ✓ **Acute Phase:** Active infection and tissue destruction, where the infection rapidly spreads and causes significant tissue damage.
- ✓ **Subacute Phase:** Transition from active infection to the chronic phase, where tissue healing begins but damage may still be present.
- ✓ **Chronic Phase:** Long-term residual effects, where the acute infection has resolved but the individual is left with permanent scarring, functional impairments, and psychological consequences.
- ✓ **Rehabilitation Phase:** Ongoing management and rehabilitation, including surgical interventions, physical and speech therapy, and psychological support to help individuals regain as much function as possible and improve quality of life.⁽¹⁸⁾

Treatment and Management:

The sequelae stage requires long-term rehabilitation and psychosocial support to address the physical and emotional challenges that persist after the disease has resolved. Management may include:

- ✓ Reconstructive surgery to restore facial appearance and function.
- ✓ Physical therapy to improve mobility and function, particularly for jaw and facial movements.
- ✓ Speech and swallowing therapy to address ongoing difficulties with communication and eating.
- ✓ Psychological counseling to help individuals cope with emotional trauma, social stigma, and long-term psychological effects.
- ✓ By focusing on comprehensive rehabilitation and ongoing care, the long-term effects of NOMA can be managed, allowing individuals to regain independence and improve their quality of life.

Treatment for NOMA (Sequelae Stage):

- **Surgical Reconstruction and Rehabilitation:** Reconstructive surgeries to repair facial structures and restore form and function. This may include soft tissue and bone grafting, and in some cases, jaw realignment.
- **Physical Therapy for Contracture Release:** To reduce the tightening of scar tissue, improve facial mobility, and restore functional range of motion, particularly in the mouth and jaw.
- **Speech and Swallowing Therapy:** Specialized therapy to help individuals regain the ability to speak clearly and swallow effectively, which may be impaired due to tissue loss or scarring.
- **Psychological Support and Counseling:** Addressing the emotional impact of disfigurement and social isolation, helping individuals manage psychological trauma and build coping mechanisms.
- **Prosthetic Rehabilitation:** The use of facial prosthetics to improve cosmetic appearance and restore functionality in cases of severe tissue loss.
- **Pain Management:** Ongoing management of chronic pain or discomfort resulting from nerve damage, scarring, or tissue contractures.
- **Ongoing Medical Care and Monitoring:** Regular follow-up appointments to monitor recovery, manage complications, and ensure overall health and well-being.⁽¹⁹⁾

Complications:

- **Chronic Disfigurement and Social Stigma:** Persistent facial scars and deformities can lead to social exclusion and emotional distress, resulting in a diminished quality of life.
- **Functional Impairment and Disability:** Difficulties in performing everyday activities, such as eating, speaking, and smiling, due to permanent damage to facial tissues and muscles.
- **Emotional Distress and Psychological Trauma:** Ongoing mental health challenges, such as depression, anxiety, or PTSD, stemming from the long-term effects of NOMA.

- **Secondary Infections or Complications:** The risk of further infections due to weakened immune function, surgical wounds, or chronic open sores.
- **Limited Access to Education, Employment, or Social Opportunities:** Social isolation due to visible disfigurement and functional limitations can reduce access to education, employment, and social integration, creating additional barriers to recovery.(FIG:9).

Prevention:

- **Early Detection and Treatment of NOMA:** Timely identification and treatment of NOMA during its early stages can prevent disease progression and minimize long-term damage.
- **Practice Good Oral Hygiene and Nutrition:** Maintaining proper oral care and a well-balanced diet strengthens the immune system and helps prevent infections that can lead to NOMA.
- **Avoid Tobacco and Alcohol:** These substances can impair immune function and contribute to poor oral health, increasing the risk of NOMA.
- **Get Vaccinated** (e.g., Measles): Preventing underlying diseases, such as measles, which can compromise the immune system, is key to reducing NOMA risk.
- **Manage Underlying Health Conditions:** Proper management of conditions like HIV/AIDS, malnutrition, or immunodeficiency is crucial in preventing the onset of NOMA.
- **Promote Community-Based Initiatives:** Education and outreach programs focused on prevention, hygiene, and early detection can significantly reduce the incidence of NOMA in vulnerable populations.⁽²⁰⁾



FIG 9: SEQUELAE STAGE

Prevention Tips for NOMA:

- ✓ **Maintain Good Oral Hygiene:** Brush teeth regularly and visit the dentist for routine check-ups to prevent oral infections that could lead to NOMA.
- ✓ **Ensure Proper Nutrition:** Eat a balanced, nutrient-rich diet to support a healthy immune system and prevent malnutrition, which is a key risk factor for NOMA.
- ✓ **Stay Up-to-Date with Vaccinations:** Get vaccinated against measles and other preventable diseases that can weaken the immune system and increase susceptibility to infections like NOMA.

- ✓ **Avoid Tobacco and Alcohol:** Refrain from using tobacco and alcohol, as these can impair immune function and contribute to poor oral health, heightening the risk of infection.
- ✓ **Manage Underlying Health Conditions:** Properly manage chronic health conditions such as diabetes, HIV, or any immunocompromising diseases to reduce the risk of infections.
- ✓ **Practice Good Hygiene:** Wash hands regularly, especially after using the bathroom and before eating, to reduce the spread of bacteria and infections.
- ✓ **Avoid Close Contact with Infected Individuals:** NOMA is not contagious but often occurs after infections like measles or malaria; avoid exposure to individuals with these illnesses to reduce risk.
- ✓ **Keep Skin Clean and Protected:** Practice good skin hygiene, avoid cuts, scrapes, and other injuries that can become entry points for bacteria.
- ✓ **Use Clean Water:** Ensure access to clean, safe drinking water and use it for personal hygiene to reduce the risk of waterborne diseases.
- ✓ **Promote Community Awareness:** Educate communities about the importance of early detection, proper hygiene, and nutrition to prevent NOMA from occurring.
- ✓ **Support Research Efforts:** Encourage research on the causes, treatments, and preventive strategies for NOMA to help reduce its impact in vulnerable populations.
- ✓ **Improve Access to Healthcare:** Ensure that healthcare services, including vaccination programs, oral health care, and nutritional support, are accessible, particularly in rural and underserved areas.⁽²¹⁾
- ✓ By focusing on these preventative measures, we can significantly reduce the incidence of NOMA, particularly in high-risk populations. (FIG:10).

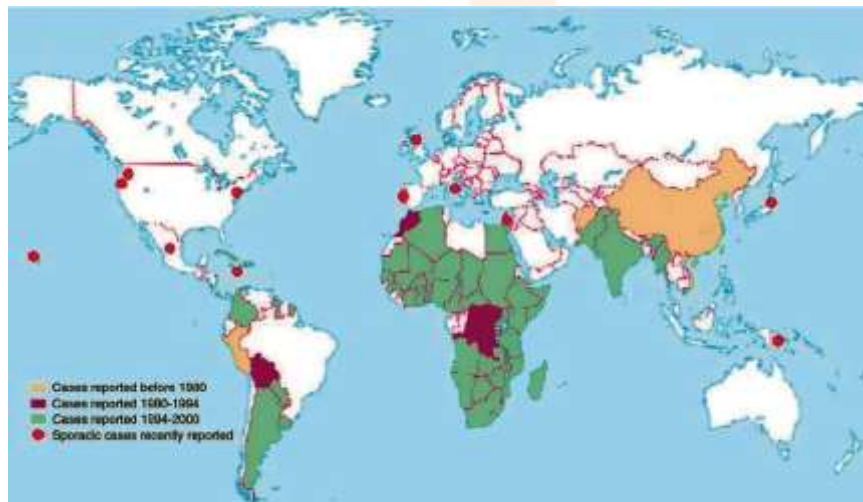


FIG 10: THE NOMA WORLD MAP



FIG 11: Map displaying the locations of NOMA studies published from 2000 to 2021, as featured in this review. (Green dots denote countries where at least one study on NOMA was conducted.)

In 2007, the WHO conducted a survey across African member states, revealing that 39 out of 46 countries had reported NOMA cases in the year prior to the survey.

The countries with the highest reported NOMA cases included Burkina Faso, Ethiopia, Mali, Niger, Nigeria, and Senegal, leading to the term "NOMA belt" being coined to describe this region.

The term "NOMA belt" is commonly used in epidemiological reports to describe the areas most affected by NOMA.

Since 2000, NOMA cases have been reported in a broader range of settings, suggesting a distribution beyond the traditionally identified NOMA belt.

The earliest documented estimate of NOMA's burden comes from a study conducted between 1860 and 1871 in Edinburgh, which found that NOMA was diagnosed in approximately 1 out of every 5,000 children admitted to hospital with an illness.

In 1997, Barnes et al. estimated the prevalence of NOMA in Nigeria, based on data from three referral centers, at 1 case per 1,250 children aged 2 to 6 years annually.

In 1998, the World Health Organization (WHO) estimated that globally, 140,000 new cases of NOMA occurred each year, and that 770,000 people were living with NOMA sequelae. The origin of this estimate remains unclear.

In 1999, an estimate for Senegal suggested an annual incidence of 4.2 cases of acute NOMA per million children aged 1–4 years. This figure was calculated using a WHO-recommended formula, factoring in a 5–20% presentation rate of acute NOMA or its sequelae and an 80–90% mortality rate in the acute stages of the disease.(FIG:11).⁽²²⁾

Etiology:

The pathogenesis of NOMA remains poorly understood, and its exact cause is still a subject of debate. An 1893 statement encapsulates the ongoing uncertainty: "There must surely be a specific organism and a combination of predisposing causes, not poverty alone, but poverty plus a sickly habit of body."

While a range of organisms have been identified in the oral flora of NOMA patients, no single pathogen has been consistently present across all cases, raising doubts about the role of a specific organism in the disease's development.

Other studies suggest that the characteristics of NOMA resemble an opportunistic infection, where a disruption in the balance of commensal bacteria, combined with a weakened immune response, allows for the proliferation of pathogenic microbes. This theory is supported by the fact that most cases of NOMA occur in individuals with compromised immune systems or those suffering from concurrent infections.

NOMA most commonly affects young, severely malnourished children, typically between the ages of 2 and 5 years. These children often have a history of illness, such as measles, scarlet fever, tuberculosis, or other debilitating conditions, which further compromise their immune systems.

Pseudomonas aeruginosa, along with other opportunistic bacteria, has been identified as a major causative agent in NOMA infections. The disease is linked to an interplay of malnutrition and immune deficiency, which allow these microbes to thrive.

Importantly, there is no evidence to suggest that NOMA is directly transmissible from person to person. Instead, the disease arises in the context of specific environmental and health conditions, with malnutrition and immunosuppression being key predisposing factors. (FIG:12).⁽²³⁾

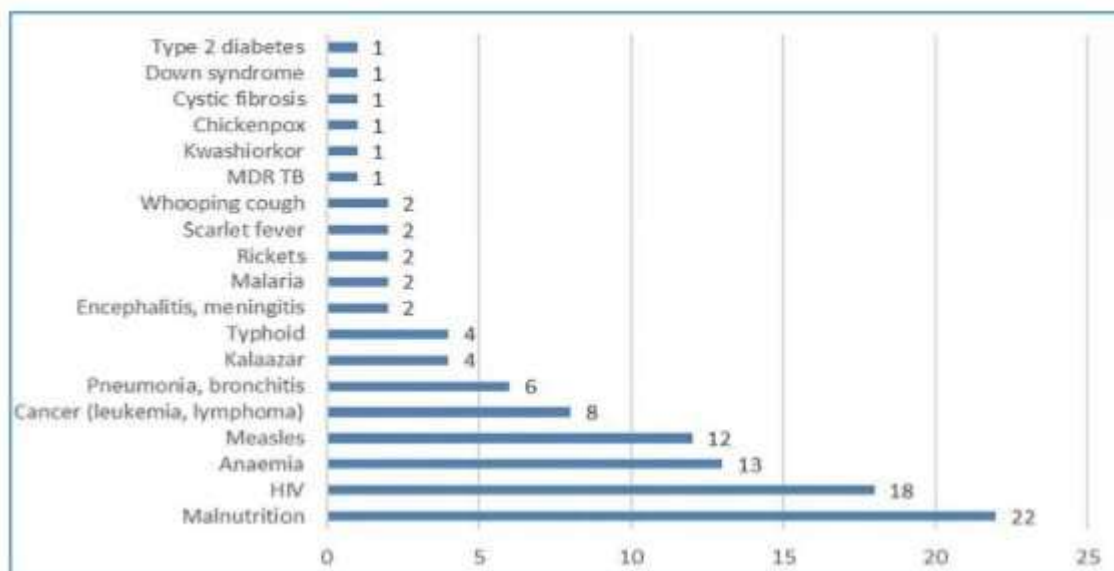


FIG 12: Comorbidities associated with NOMA in case reports and case series.

Risk Factors:

There is limited primary evidence on the specific risk factors for the development of NOMA. However, the available studies provide some insights into factors that may contribute to the disease. It is important to interpret these findings with caution, as they are derived from studies comparing the proportion of cases with specific risk factors versus controls. More robust research is needed to confirm these associations and establish causality.

Comorbidities: The primary studies, including case-control studies, cohort studies, and retrospective chart reviews, report several comorbidities associated with NOMA. These include:

- ✓ Malnutrition
- ✓ Respiratory diseases
- ✓ Diarrhea
- ✓ HIV
- ✓ Malaria
- ✓ Vaccine-preventable diseases, particularly measles.
- ✓ **Prevalence of Comorbidities:** In many case reports and case series, at least one comorbidity was listed. The most frequently reported comorbidities were malnutrition, HIV, anaemia, and measles.
- ✓ **Limitations:** As these findings are primarily based on case reports and case series, which typically come from healthcare settings, it is difficult to draw conclusions about causality or the strength of the associations between these risk factors and NOMA.
- ✓ **Host Factors:** Infections like NOMA are generally a result of a compromised host immune system and may involve a single pathogen or multiple pathogens. The presence of comorbidities or predisposing conditions like malnutrition and immunosuppression may increase susceptibility to infections, but distinguishing between predisposing factors, comorbidities, and actual causative agents is challenging.⁽²⁴⁾
- ✓ **Age-related Risk:** One theory for the higher incidence of NOMA in children aged 2 to 5 years is that this period coincides with the development of deciduous (baby) teeth. This process may reduce blood circulation to the gums, making them more vulnerable to infections.
- ✓ **Weaning and Nutritional Factors:** A study from Zambia suggested that the weaning period, when children transition from breastfeeding to solid foods, might increase the risk of NOMA. Solid foods at this stage are often less nutritious and less hygienic than breast milk, potentially putting children at greater risk for infections. Another study emphasized that improperly prepared weaning foods, contaminated with pathogens, can contribute to diarrheal diseases, which is a recognized risk factor for NOMA.⁽²⁵⁾

- ✓ In summary, while a range of risk factors—such as malnutrition, infections, and immunodeficiency—are linked to the development of NOMA, further research is necessary to confirm these associations and clarify their causal relationships.(FIG:13)

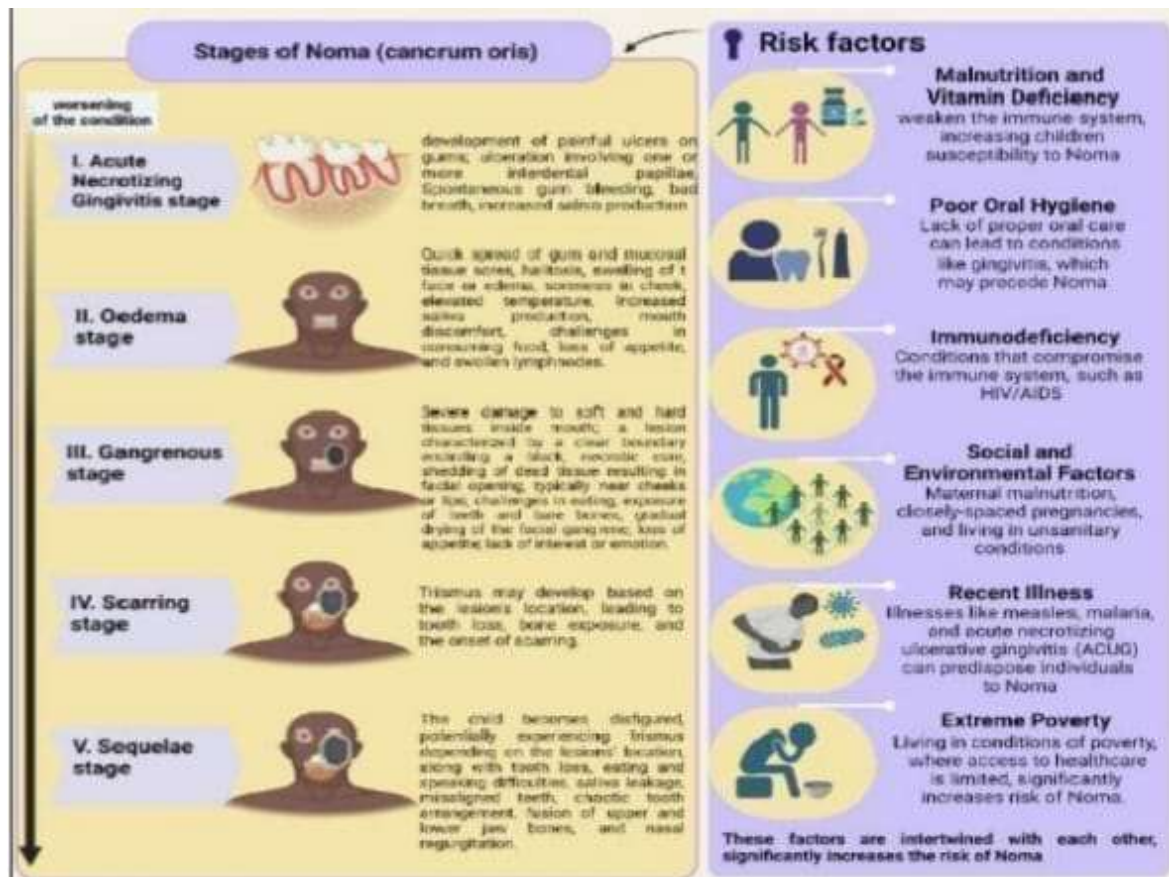


FIG 13: RISK FACTORS OF NOMA.

Medical History:

- **Ancient and Medieval Recognition:** NOMA has been known to humanity for centuries, with descriptions of the disease appearing in classical and medieval texts. It was once common in Europe and the United States, particularly affecting vulnerable populations.
- **Inclusion in Medical Literature:** In 1649, NOMA was featured in *Observations Medicate de Affectibus Omissis*, a pioneering work by Arnoldus Bootius, which addressed neglected diseases. This marked one of the earliest mentions of NOMA in medical literature.
- **Decline in Western Countries:** By the late 19th century, NOMA began to disappear from hospitals in Europe and the U.S., largely due to improvements in public health, sanitation, nutrition, and overall living conditions. As a result, the disease became rare in these regions.
- **Early 20th Century Studies:** In the 20th century, as bacteriologists began to study the disease, they struggled to identify a definitive causative organism. It wasn't until 1912 that Stewart concluded NOMA was not caused by a specific pathogen, but rather an opportunistic infection that arose from the normal oral flora when the body's defenses were compromised.

- **Impact of Antibiotics:** Following the introduction of antibiotics like sulfonamides and penicillin in the 1940s, the mortality rate of NOMA dramatically decreased from around 85% to approximately 15%. The advent of antimicrobial treatment significantly improved survival rates for those affected.
- **Reconstructive Surgery:** Despite advancements in medical treatments, the development of a clear approach to reconstructive surgery for NOMA patients only emerged in the last 50 years, highlighting the need for both medical and surgical interventions in managing long-term sequelae of the disease.
- In summary, NOMA has evolved from a widespread and poorly understood disease to a condition more effectively managed through modern medicine, though challenges in reconstructive treatment and comprehensive care remain.⁽²⁶⁾

Epidemiology:

- ✓ **Global Incidence:** Although comprehensive epidemiological data on NOMA remain limited, current estimates suggest that there are between 30,000 to 40,000 new cases each year worldwide. Between 1950 and 2019, NOMA was reported in 88 countries globally.
- ✓ **Recent Cases:** In the last decade, NOMA cases have been documented in 23 countries, with a notable concentration in Niger, Senegal, Mali, Togo, and Zambia.
- ✓ **Prevalence and Incidence Estimates:** The World Health Organization (WHO) has estimated that there are 140,000 new cases of NOMA each year globally, with 770,000 people living with the sequelae of the disease, underscoring its significant public health impact (WHO, 1998).
- ✓ **Africa as the Primary Affected Region:** NOMA remains a critical health issue, particularly in sub-Saharan Africa, within the so-called "NOMA belt". This includes countries like Nigeria, Niger, and Chad, as well as other African nations such as Ethiopia, South Africa, and Zimbabwe.
- ✓ **Regional Variation in Incidence:** The incidence of NOMA varies widely by region. In eastern Ethiopia, annual incidence rates range between 1.64 and 13.4 per 100,000 children aged 0–9 years. In contrast, northwest Nigeria reports significantly higher rates, with an alarming 640 cases per 100,000 individuals.
- ✓ **Mortality:** Mortality data for NOMA remain sparse, but studies have highlighted its severity. In the Zinder region of Niger, the mortality rate among treated cases was reported to be 8.5%.
- ✓ **Incidence in Nigeria:** In Nigeria's north-central region, the incidence of NOMA is estimated at 8.3 per 100,000, with variation across different states ranging from 4.1 to 17.9 per 100,000.
- ✓ **Period Prevalence:** A study in Nigeria showed that the period prevalence of NOMA—accounting for all cases observed during the study period—was 1.6 per 100,000 of the population at risk.
- ✓ **Age Group Most Affected:** NOMA primarily affects children, with the highest risk observed in those aged 1 to 6 years.

- ✓ These statistics highlight the diverse and complex factors contributing to NOMA's continued burden. Disparities in incidence across regions underscore the need for targeted interventions, improved data collection, and a comprehensive approach to combating the disease globally⁽²⁷⁾.

Mortality:

- **Limited and Inconclusive Evidence:** The pathogenesis of NOMA leading to death remains poorly understood, with limited and inconclusive data on the exact mechanisms of mortality. Several factors influencing survival—beyond antibiotic treatment and wound debridement—are still unknown.
- **Mortality Rate Variability:** The mortality rate for NOMA varies widely and depends on numerous factors, making it difficult to provide a clear, consistent estimate. The World Health Organization (WHO), based on expert opinion and retrospective chart analyses, estimates that the mortality rate for untreated NOMA is as high as 90% within weeks of the disease's onset.
- **Speed of Death:** The speed at which death occurs is debated in the literature. Some reports suggest that death can occur as quickly as two weeks after the first symptoms appear, though the exact symptoms triggering this rapid progression remain unclear. The most consistent finding is that death can occur within days of the onset of oedema (swelling). However, timely identification and treatment of NOMA drastically reduce mortality, emphasizing the importance of early intervention.
- **Impact of Treatment:** Studies show significant differences in mortality rates between treated and untreated cases. For patients who receive no antibiotic treatment, mortality rates range from 49% to 94%, whereas for those who receive antibiotic treatment, the mortality rate drops to between 0% and 38%. These figures come from retrospective case series and chart reviews, where standardized staging and follow-up periods were not always applied, leading to potential over- or underestimates of mortality.
- **Mortality by Subgroups:** The mortality rate for NOMA is influenced by several factors, including disease severity and the presence of complications. Mortality rates by subgroup include:
 - Untreated NOMA: 70% to 90% mortality rate.
 - Treated NOMA: 20% to 50% mortality rate.
 - NOMA with complications: 50% to 80% mortality rate.
 - NOMA in malnourished children: 80% to 100% mortality rate.
 - NOMA in adults: 50% to 70% mortality rate.

These estimates underscore the critical role of early diagnosis, timely treatment, and access to healthcare in improving survival outcomes for individuals affected by NOMA⁽²⁸⁾.

Diagnosis:

- **Clinical Diagnosis:** The diagnosis of NOMA is primarily clinical, based on the patient's signs and symptoms, as well as their medical history. Key indicators include a recent history of illness (such as

measles, malaria, or malnutrition), the onset of facial swelling, and a malodorous discharge from the mouth. These symptoms, especially in a malnourished child, strongly suggest NOMA. As the disease progresses, more severe signs, including tissue necrosis and facial disfigurement, become evident.

- **Laboratory Tests:** Laboratory investigations play a supplementary role in confirming the diagnosis and guiding treatment. These include bacterial cultures to isolate and identify the causative organisms (e.g., *Fusobacterium*, *Pseudomonas aeruginosa*), along with antibiotic susceptibility tests to determine the most effective antibiotics for treatment.⁽²⁹⁾
- **Differential Diagnosis:** It is crucial to differentiate NOMA from other conditions with similar clinical presentations. Diseases that can mimic NOMA include:
 - Leprosy
 - Post-kala-azar dermal leishmaniasis (PKDL)
 - Leishmaniasis
 - Mucor mycosis
 - Oral cancer
 - Acute herpetic gingivostomatitis
 - Chemical burns
 - Syphilitic yaws
 - Acute necrotizing ulcerative gingivitis
 - Streptococcal or clostridial gangrene
 - Fatal midline granuloma
- **Progression of NOMA:** NOMA advances through distinct stages, each characterized by specific clinical manifestations. Early stages may involve gingival inflammation and ulcers, while later stages show extensive necrosis of the gums, cheeks, and underlying tissues. As the disease progresses, facial disfigurement and functional impairments, such as difficulty swallowing or speaking, become increasingly apparent⁽³⁰⁾.

Laboratory Tests:

- ✓ **Blood Tests:** Used to detect signs of infection, inflammation, and assess immune system function.
- ✓ **Microbiological Tests:** To identify any bacteria, viruses, or fungi that may be responsible for the infection.
- ✓ **Nutritional Assessment:** To evaluate the patient's nutritional status and identify potential deficiencies⁽³¹⁾.

Stepwise Diagnostic Guide for NOMA:

- ✓ **CBC (Complete Blood Count):** To assess overall blood health and detect signs of infection or anemia.

- ✓ **CRP (C-Reactive Protein):** To measure levels of inflammation in the body, which can indicate infection or tissue damage.
- ✓ **MRI (Magnetic Resonance Imaging):** To evaluate soft tissue and identify any changes or damage caused by the infection.
- ✓ **CT (Computed Tomography):** To assess the extent of tissue involvement and provide detailed imaging of the affected area.(FIG:14)⁽³²⁾.

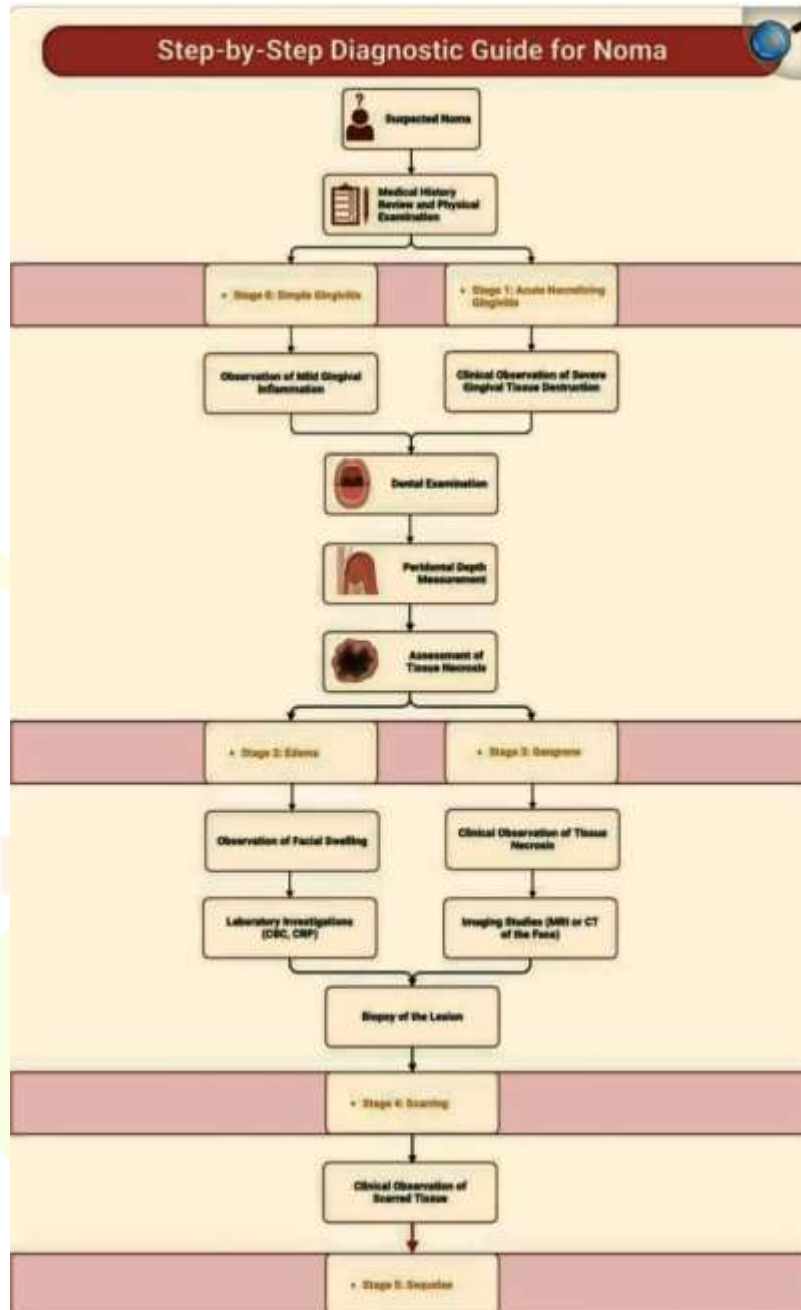


FIG 14: STEPWISE DIAGNOSTIC GUIDE FOR NOMA.

Treatment for NOMA:

- **Clinical Indicators:** A medical history of recent illness, combined with facial swelling and foul-smelling discharge from the mouth in a malnourished child, strongly suggests NOMA.

- **Differential Diagnosis:** Other conditions that may resemble NOMA include Buruli ulcer, mumps, angioedema, tooth abscess, herpetic stomatitis, or local cellulitis leading to facial gangrene.
- **Diagnostic Confirmation:** The clinical picture typically becomes clearer within a few days, though at that stage, antibiotics may not prevent the spread of the lesion⁽³³⁾.

Treatment Approach:

- ✓ **Antibiotics:** Prompt administration of antibiotics such as amoxicillin or penicillins is essential for controlling the bacterial infection and preventing further spread.
- ✓ **Nutrition:** Proper nutrition is crucial to strengthen the body's immune response and facilitate tissue recovery. A high-protein, high-calorie diet may be necessary to support healing.
- ✓ **Surgical Intervention:** In severe NOMA cases with extensive tissue destruction, surgical treatments such as debridement (removal of dead tissue) and reconstructive procedures like skin grafting or tissue flap surgery may be required.
- ✓ **Dental Care:** Maintaining adequate dental hygiene is vital, as dental infections can lead to tooth loss and damage to the gums and jaw. Dental management may involve:
 - ✓ Extraction of infected teeth
 - ✓ Restoration of dental structure
 - ✓ Provision of dental hygiene education, including tooth brushing and regular use of chlorhexidine mouthwash to remove bacterial plaque⁽³⁴⁾.

Supportive Care:

- Hydration and nutritional support are key to managing the infection and preventing complications.
- Treating any underlying diseases or deficiencies is important to avoid life-threatening complications.

Challenges:

- Access to necessary medical facilities and care is limited in regions where NOMA is prevalent.
- There is limited knowledge of multidrug-resistant microorganisms in the poor communities where NOMA is most common.
- Healthcare Level: The treatment of acute NOMA requires specialized secondary healthcare services.

Stages of NOMA and Treatment Approach

Early Detection/Prevention:

Key interventions include basic hygiene practices, timely antibiotic therapy, improved nutrition, and oral care.

Surgical options may include oral and maxillofacial surgery or reconstructive plastic surgery to address physical deformities.

Stage 1: Acute Necrotizing Gingivitis

Treatment:

- ✓ **Antibiotics:** Amoxicillin and Metronidazole
- ✓ **Oral care:** Chlorhexidine mouthwash and hydrogen peroxide for cleaning

Stage 2: Edema Phase

Treatment:

- ✓ **Antibiotics:** Amoxicillin with Clavulanic Acid, Gentamicin, Metronidazole
- ✓ **Oral care:** Chlorhexidine mouthwash

Stage 3: Acute/Gangrenous Phase

Treatment:

- ✓ **Antibiotics:** Same options as Stage 2 (Amoxicillin, Gentamicin, Metronidazole)
- ✓ **Oral care:** Chlorhexidine mouthwash
- ✓ **Pain management:** Ketamine
- ✓ **Lesion care:** Honey dressings for wound healing

Stage 4: Scarring Phase

Treatment:

- ✓ **Antibiotics:** Same as in Stage 2 and Stage 3
- ✓ **Oral care:** Continued use of chlorhexidine mouthwash
- ✓ **Pain management:** Ketamine
- ✓ **Lesion care:** Honey dressings for wound healing.

Supportive Care Across All Stages:

- ✓ **Nutritional Support:** High-protein diet, vitamin A or other necessary nutritional supplements
- ✓ **Hydration:** Proper fluid intake is crucial
- ✓ **Physiotherapy:** Essential to prevent or minimize trismus (jaw stiffness) and improve functions like eating, chewing, and speaking. (FIG:15)⁽³⁵⁾.

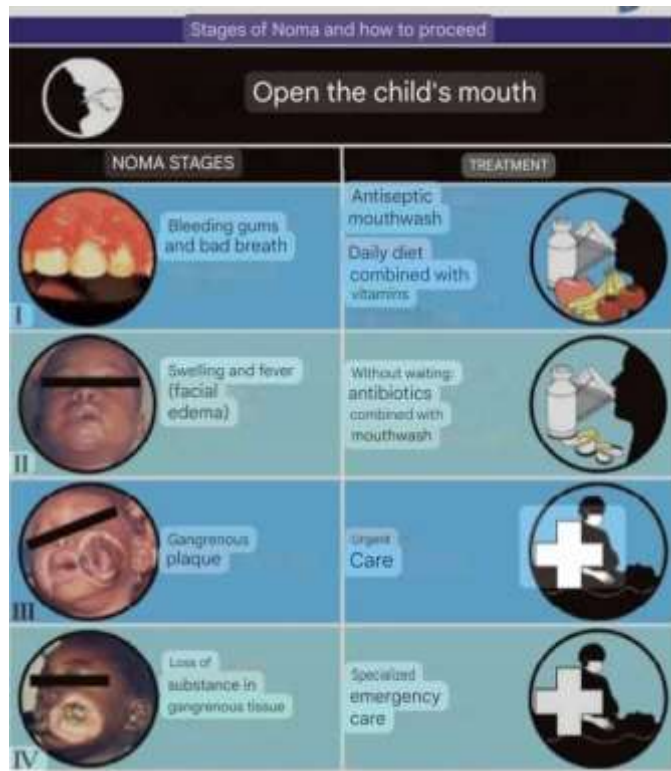


FIG 15: STAGES OF NOMA AND PROCEED.

Traditional Treatments for NOMA:

In countries like Mali and Nigeria, traditional healers had limited knowledge of NOMA, but some in Nigeria reported treating various stages of the disease. Traditional approaches included the use of ground herbs, plants, ointments, and even the piercing of the swollen cheek during the edema phase. Healers often referred patients with advanced stages of NOMA to hospitals or clinics and expressed interest in assisting with patient referrals and attending training on the disease.

Standard Treatment for NOMA typically involves a combination of the following:

- ✓ Antibiotics:
 - Metronidazole
 - Amoxicillin
 - Gentamicin
 - Clindamycin

- ✓ Pain Management:
 - Acetaminophen
 - Ibuprofen

- Morphine
- ✓ Wound Care:
 - Debridement (removal of dead tissue)
 - Cleaning and dressing of the wound
 - Topical antibiotics (e.g., metronidazole gel)
- ✓ Nutritional Support:
 - High-calorie diet
 - Vitamin supplements (e.g., Vitamin A, C)
 - Mineral supplements (e.g., zinc, iron)
- ✓ Surgical Reconstruction (for advanced cases):
 - Rebuilding damaged tissue
 - Restoring function and appearance⁽³⁶⁾.

Additional Medications:

Some studies suggest that the following antifungal drugs may be effective in treating NOMA:

- Amphotericin B
- Fluconazole
- Voriconazole
- Posaconazole

Conclusion:

The World Health Organization's (WHO) recognition of NOMA as a neglected tropical disease (NTD) marks a significant milestone in global health. This designation not only highlights the urgent need for collective action to combat this devastating condition, but it also opens the door to increased research, funding, and international collaboration aimed at reducing the disease's impact on the world's most vulnerable populations. The WHO's decision serves as a call to the global health community to direct resources and expertise towards the eradication of NOMA. It underscores the importance of a comprehensive, multisectoral approach—one that extends beyond medical treatment to address the root causes of the disease, including poverty, malnutrition, and poor sanitation and hygiene(FIG:16).

With concerted, coordinated efforts and a commitment to tackling the underlying social determinants of NOMA, significant progress can be made in reducing its prevalence and improving outcomes. However, substantial gaps remain in our understanding of the disease, its burden, and its long-term effects (FIG:17).

There is a growing appreciation within the small community of clinicians and researchers who focus on NOMA care. Several studies have emphasized the need for greater awareness of the disease and have called for the inclusion of NOMA on the WHO list of neglected tropical diseases. Such inclusion would elevate NOMA on the global health agenda and facilitate greater attention and resources for its prevention and treatment.

From this literature review, some key gaps in knowledge emerge. These include a lack of comprehensive data on the burden of the disease (both incidence and prevalence), the true mortality rate, the pathogenic causes of NOMA, and the role of comorbidities in its progression. Further research is needed to identify factors that influence prognosis, assess the effectiveness of different antibiotic treatment protocols, and determine the best approaches for both surgical and nonsurgical care.(FIG:18).

The knowledge and preparedness of healthcare workers in high-risk areas also require attention, as well as the integration of NOMA into medical and tropical medicine curriculums in medical schools. Exploring the role of various healthcare actors in prevention efforts is crucial to tackling the disease at the community level.

Efforts to combat extreme poverty may contribute to a reduction in NOMA cases, and in the long term, could potentially lead to the elimination of the disease.

This review also acknowledges several limitations, particularly the difficulty in accessing earlier manuscripts (from the 1800s to the present), which may not be indexed in current databases and, as a result, were not included in this analysis.

In conclusion, NOMA is a preventable, yet devastating and often fatal disease that primarily affects young children in impoverished communities (FIG:19). Despite being well-documented in the literature for hundreds of years, significant gaps in knowledge persist. What is clear is that NOMA affects diverse regions around the world, and further studies are needed to better understand the disease's burden, distribution, mortality rate, and pathogenic causes. Addressing these gaps will be essential to developing effective, targeted interventions to reduce the global burden of NOMA and improve outcomes for the most affected populations⁽³⁷⁾.



FIG :16 Different stages of NOMA

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