Scientific Research Publishing

Open Journal of Pediatrics, 2025, 15(4), 565-571
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

# Stenotrophomonas Maltophilia Meningitis in the Children Age Group: A Systematic Review of Case Reports

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**How to cite this paper:** Alsharif, A.I., Alsharif, D., Aldhaheri, A., AL-Juhani, M.A., Alanazi, A.M. and Alanazi, M.M.F. (2025) Stenotrophomonas Maltophilia Meningitis in the Children Age Group: A Systematic Review of Case Reports. *Open Journal of Pediatrics*, **15**, 565-571.
https://doi.org/10.4236/ojped.2025.154053

**Received:** June 22, 2025
**Accepted:** July 20, 2025
**Published:** July 23, 2025



## Abstract

**Background:** *Stenotrophomonas maltophilia* (SM) is an emerging opportunistic pathogen in healthcare-associated infections. While it is a well-known cause of pneumonia and bloodstream infections, its role in pediatric meningitis remains rare and underreported. **Objective:** To systematically review and summarize published pediatric cases of *Stenotrophomonas maltophilia* meningitis, highlighting risk factors, clinical presentations, CSF profiles, antimicrobial therapy, treatment duration, and outcomes. **Methods:** Case reports and series were identified using their PubMed ID from 2000 to 2024. Inclusion criteria were: patients aged <18 years diagnosed with SM meningitis confirmed by CSF culture. **Results:** Eight articles were included, covering 10 pediatric cases. Most patients had identifiable risk factors such as prematurity, neurosurgical interventions (e.g., ventriculoperitoneal shunt), or prior broad-spectrum antibiotic use. Common CSF findings included neutrophilic pleocytosis, elevated protein, and hypoglycorrhachia. Trimethoprim-sulfamethoxazole (TMP-SMX), fluoroquinolones (ciprofloxacin or levofloxacin), and ceftazidime were the most used antimicrobials. Clinical outcomes were favorable in the majority of cases, with rare mortality and a few with neurological sequelae. **Conclusion:** Though rare, SM meningitis in pediatrics often occurs in the setting of significant comorbidities or interventions. Awareness, early microbiologic identification, and tailored antimicrobial therapy are key to favorable outcomes.

## Keywords

*Stenotrophomonas maltophilia*, Meningitis, Trimethoprim-Sulfamethoxazole

## 1. Introduction

*Stenotrophomonas maltophilia*, previously known as *Pseudomonas maltophilia* and later as *Xanthomonas maltophilia*, is an aerobic, non-fermentative, Gram-negative bacillus that has gained prominence as an opportunistic pathogen in hospital environments [1].

This organism is commonly found in natural aqueous environments as well as hospital water systems, where it can colonize respiratory therapy equipment, catheters, and even disinfectant solutions [2].

From a microbiological standpoint, *S. maltophilia* is oxidase-negative and motile via polar flagella, forming smooth, glistening colonies with yellowish pigmentation on blood agar or MacConkey agar [3].

It exhibits intrinsic resistance to a wide range of broad-spectrum antibiotics, notably $\beta$-lactams, aminoglycosides, and carbapenems, largely due to the presence of chromosomally encoded $\beta$-lactamases (L1 and L2), multidrug efflux pumps, and reduced outer membrane permeability [4].

This antimicrobial resistance profile significantly complicates empirical treatment and contributes to the organism's emerging status as a multidrug-resistant pathogen [5].

Clinically, *S. maltophilia* is most frequently implicated in hospital-acquired infections such as ventilator-associated pneumonia, bloodstream infections, catheter-related infections, and urinary tract infections [6].

CNS infections due to *S. maltophilia*, including meningitis and ventriculitis, are rare but have been increasingly reported in neonates and infants with underlying conditions such as prematurity, intraventricular hemorrhage, or those undergoing neurosurgical interventions like ventriculoperitoneal (VP) shunting [7].

Due to the rarity of these cases, clinical data are primarily derived from isolated case reports, highlighting the need for consolidated evidence to guide treatment decisions and improve outcomes. This systematic review aims to synthesize available literature on pediatric *S. maltophilia* meningitis to better understand its epidemiology, clinical characteristics, antimicrobial management, and prognosis

## 2. Methods

### 2.1. Search Strategy

A comprehensive search was performed in the PubMed database to identify relevant case reports and case series. The search strategy included the keywords: "*Stenotrophomonas maltophilia*" and "meningitis". The search was restricted to publications from January 1, 2000, to May 30, 2024. Reference lists of identified articles were also screened to capture any additional relevant reports.

### 2.2. Inclusion Criteria

Studies were included if they met the following criteria:

1) Case reports or case series published between 2000 and 2024.

2) Pediatric patients (defined as individuals under 18 years of age).

3) Diagnosis of *Stenotrophomonas maltophilia* meningitis confirmed by cerebrospinal fluid (CSF) culture.

### 2.3. Exclusion Criteria

Studies were excluded if they met any of the following conditions:

1) Patients aged 18 years or older.

2) Infections caused by *S. maltophilia* not involving the central nervous system.

A total of **12 studies** initially met the inclusion criteria; however, after the removal of duplicates and non-eligible publications, **8 studies** remained, collectively reporting on **9 pediatric patients** with *Stenotrophomonas maltophilia* meningitis.

## 3. Results

**Table 1.** Summary of pediatric *Stenotrophomonas maltophilia* meningitis cases.

| Author (Year) | Title | Age | Setting | Treatment | CSF Results |
|---|---|---|---|---|---|
| Lo WT [8] | Successful treatment of multi-resistant *S. maltophilia* meningitis with ciprofloxacin in a pre-term infant | 4th day of life | Preterm (30 wks) | Ciprofloxacin | WBC 50/mm$^3$ (20% neut) |
| Rojas P [9] | Successful treatment of *S. maltophilia* meningitis in a preterm baby boy: a case report | Day 19 of his life | Post-NEC, prior carbapenem exposure Preterm (26 wks) | TMP/SMX + Ciprofloxacin | WBC 1200/mm$^3$ (95% neut) |
| Correia CR [10] | *S. maltophilia*: rare cause of meningitis | 4 years | Hydrocephalus + VP shunt | TMP/SMX + Levofloxacin + Ceftazidime | WBC 214 - 476/mm$^3$ (neut not menssioned) |
| Mukherjee S [11] | *S. maltophilia* CSF infection in infants after neurosurgery | 10 weeks of his life | Post-infective hydrocephalus + VP shunt | TMP/SMX | WBC 643/mm$^3$ (89% neut), Protein 0.55 g/L, Glucose 1.7 mmol/L |
| Mukherjee S [11] | *S. maltophilia* CSF infection in infants after neurosurgery | 12 weeks | Preterm 32 weeks ventriculoperitoneal shunt for post-haemorrhagic hydrocephalus | TMP/SMX | WBC **6/mm$^3$** (82% neutrophils) |
| Ibrahim J [12] | *S. maltophilia* meningitis in a term healthy neonate: a case report and literature review | 13 days | Community-acquired | TMP/SMX + Ciprofloxacin | WBC 14/mm$^3$ (65% lymphocytes) |
| Gregory ER [13] | TMP/SMX and Moxifloxacin therapy for pediatric *S. maltophilia* VP shunt infection | 5 months | VP shunt (post-IVH) | TMP/SMX + Moxifloxacin | WBC 1770/mm$^3$ (79% neut), |
| Shah A [14] | *S. maltophilia* as a cause of meningitis in an infant | 9 months | Community-acquired (post-GE) | TMP/SMX + Levofloxacin | WBC 11,200/mm$^3$ (90% neut), |
| Mohzari Y [15] | C. utilis and *S. maltophilia* causing nosocomial meningitis following neurosurgical procedure | 16 years | Post-neurosurgery | Ceftazidime + TMP/SMX | WBC 3/mm$^3$, few neutrophils |

A total of eight published studies reporting on nine pediatric patients with *Stenotrophomonas maltophilia* meningitis were included in this review. The patients' ages ranged from 4 days to 16 years, with five (56%) being under one year of age, including three preterm neonates. Four cases (44%) were associated with ventriculoperitoneal (VP) shunt infections, three cases (33%) were community-acquired, one followed neurosurgical intervention, and one was linked to necrotizing enterocolitis (NEC) in a preterm infant. One case occurred in a neonate with a central line and no prior neurosurgical procedure. CSF white cell counts ranged from 3 to 11,200 cells/mm$^3$, with neutrophilic predominance in most cases; the highest WBC was reported in a 9-month-old infant (11,200/mm$^3$ with 90% neutrophils), while one case had only 3 cells/mm$^3$ with few neutrophils. All patients received trimethoprim-sulfamethoxazole (TMP/SMX) either as monotherapy or in combination, except one neonate who was treated successfully with ciprofloxacin alone. Ciprofloxacin was used in three cases, levofloxacin in two, moxifloxacin in one, and ceftazidime in two; no confirmed resistance to TMP/SMX was noted, though partial susceptibility was reported in one case. No mortality occurred across all cases, and no patient developed neurological impairment (**Table 1**).

## 4. Discussion

*Stenotrophomonas maltophilia* is an opportunistic, multidrug-resistant gram-negative bacillus increasingly recognized as a cause of severe infections in immunocompromised and hospitalized patients [1] [2].

While bloodstream infections and ventilator-associated pneumonia are more frequently reported, central nervous system (CNS) involvement, particularly meningitis, remains rare [16].

This review synthesizes evidence from nine pediatric cases of *S. maltophilia* meningitis and sheds light on associated risk factors, clinical variability, and treatment responses in this vulnerable population. **Prematurity** and **neurosurgical intervention** emerged as the most prominent risk factors [8] [9] [11] [13].

Three of the nine patients were born preterm, a population already at risk due to underdeveloped immune function, frequent antibiotic exposure, and prolonged hospital stays [8] [9] [11].

Additionally, four cases were associated with **ventriculoperitoneal (VP) shunt infections**, typically in children with post-hemorrhagic or post-infective hydrocephalus [11] [13] [15].

These findings align with prior reports emphasizing the importance of hardware-associated infections in the pathogenesis of nosocomial meningitis caused by multidrug-resistant organisms [11] [13] [15].

The use of broad-spectrum antibiotics, central lines, and repeated surgical interventions may further disrupt the host microbiome and create niches for opportunistic pathogens such as *S. maltophilia* [8]-[15].

Notably, not all infections occurred in traditional high-risk contexts [10] [12] [14].

Three cases were **community-acquired**, including term infants and previously healthy children, presenting after gastrointestinal or ophthalmic illness [10] [12] [14].

One neonate developed meningitis during the workup for **ophthalmia neonatorum** [12], and another 9-month-old previously healthy infant developed symptoms following **gastroenteritis** [14].

This clinical variability suggests that *S. maltophilia* should also be considered in the differential diagnosis of **community-acquired CNS infections**, even in the absence of prior hospitalization or known immunodeficiency [10] [12] [14].

Cerebrospinal fluid (CSF) profiles were inconsistent across cases [8]-[15].

While some patients had classic features of bacterial meningitis—**neutrophilic pleocytosis, elevated protein, and hypoglycorrhachia**—others had **minimal CSF inflammation** [8] [11] [14] [15].

One report described a WBC count of **only 3 cells/mm³ with few neutrophils**, raising concern for potential underdiagnosis in early or partially treated cases [15].

This variation underscores the importance of maintaining a high index of suspicion, even in the presence of relatively normal CSF parameters [8]-[15]. Treatment regimens were heterogeneous [8]-[15].

**TMP/SMX** was the most commonly used agent, either as **monotherapy or in combination** with fluoroquinolones or ceftazidime [8]-[15].

However, one patient showed **clinical failure on TMP/SMX monotherapy**, despite documented susceptibility, requiring **escalation to combination therapy** [10].

This case suggests that **in vitro susceptibility may not reliably predict clinical response** in CNS infections due to pharmacokinetic limitations or host factors [10].

Several patients responded well to **dual therapy**, particularly those with VP shunts or prior surgical intervention [9] [11] [13]. Despite the presence of a multidrug-resistant pathogen, **no mortality** was reported across all nine cases [8]-[15].

In conclusion, *S. maltophilia* meningitis is a rare but clinically significant infection in children, particularly in those born preterm or with prior neurosurgical interventions [8]-[15].

However, its occurrence in previously healthy, community-dwelling infants emphasizes the need for clinicians to maintain diagnostic vigilance [10] [12] [14].

Appropriate CSF analysis, consideration of **combination therapy**, and attention to hardware-related infection risk are critical to improving outcomes in this emerging clinical entity [8]-[15].

## 5. Conclusion

*Stenotrophomonas maltophilia* meningitis, although rare, should be considered in pediatric patients with neurosurgical hardware, prematurity, or unexplained

community-acquired CNS infections. Early identification and appropriate antimicrobial strategies, particularly in high-risk patients, are essential for optimal outcomes. Further research is warranted to define standardized treatment protocols and assess long-term outcomes.

## Limitations

This review is limited by the small number of reported cases and the lack of standardized data across studies. The reliance on case reports may introduce publication bias, and outcomes may not be generalizable to broader pediatric populations.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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