



UMEÅ UNIVERSITET

Umeå University Medical Dissertations, New Series No 2097

---

# Bacterial meningitis in children

## Clinical aspects and preventive effects of vaccinations

**Urban Johansson Kostenniemi**

### Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för  
avläggande av medicine doktorsexamen framläggs till offentligt  
försvar i Stora hörsalen, byggnad 5B, plan 6, målpunkt P, Norrlands  
universitetssjukhus, fredagen den 18 december, kl. 09:00.  
Avhandlingen kommer att försvaras på svenska.

Fakultetsopponent: Docent, Hans Fredlund,  
Institutionen för Medicinska Vetenskaper, Fakulteten för Medicin  
och Hälsa, Örebro Universitet, Örebro, Sverige.

Departments of Clinical Sciences and Clinical Microbiology

**Organization**

Umeå University  
Department of Clinical Sciences  
Department of Clinical Microbiology

**Document type**

Doctoral thesis

**Date of publication**

27 November 2020

**Author**

Urban Johansson Kostenniemi

**Title**

Bacterial meningitis in children. Clinical aspects and preventive effects of vaccinations.

**Abstract**

**Background:** Bacterial meningitis, one of the most severe infections a child can contract, can be caused by several different strains of bacteria. Most commonly, *Haemophilus influenzae* type b (Hib), *Streptococcus pneumoniae* and *Neisseria meningitidis*. These colonize the upper respiratory tract, then either cause localized infections acting as primary foci or directly spread to the brain. As preventive measure, general infant Hib and pneumococcal vaccinations were introduced in Sweden in 1993 and in 2009, respectively. Although evaluated elsewhere, their long-term effects in Arctic regions are less studied. For the individual child with bacterial meningitis, treatment involves many challenges starting with correctly identifying the condition, guiding treatment, and finally identifying both short-term and long-term disabilities. **Methods:** We used two datasets in the Västerbotten Region to investigate incidence rates during the time-periods adjacent to vaccine introductions. This allowed us to study the preventive effects of general infant vaccinations on bacterial meningitis in one of the Swedish Arctic regions. We also reviewed medical records of children being treated for bacterial meningitis in the Västerbotten Region to study clinical presentation, short-term outcome and long-term disabilities, to develop a new predictive score for identifying adverse outcome and need of invasive procedures, and to evaluate clinical guidelines' follow-up recommendations. **Results:** Following introduction of general infant Hib vaccination, incidence of bacterial meningitis in children aged one month to four years declined by 82.3%. Likewise, bacterial meningitis declined by 48.0% following pneumococcal vaccination. In addition, incidence of sepsis caused by *H. influenzae* and by *S. pneumoniae* also decreased in the same age group, as did incidence of several respiratory tract infections. At admission to the hospital, difference in clinical presentation mostly depended on age. Younger children were more ill at admission but also presented with more diffuse symptoms. Notably, no clinical decision rule could detect all cases of bacterial meningitis. The predictive score developed by us could identify all children in need of invasive procedures to manage the intracerebral pressure but were less adept at predicting complications or death. In surviving children, half contracted permanent disabilities with psychiatric disease being diagnosed in 30-35%. Notably, psychiatric disabilities were detected late, in average 14 years after having had bacterial meningitis. **Conclusions:** From these findings, we concluded that vaccinations are excellent at protecting children against bacterial meningitis, also in the Arctic region, with the added bonus of providing protection against sepsis and less severe infections such as pneumonia and acute otitis media. Further, treating children with bacterial meningitis involves several challenges starting with correctly identifying this severe disease. For this task, no clinical decision rule is perfect. When making difficult treatment decisions such as deciding on invasive procedures to manage the intracerebral pressure, the predictive score developed and tested by us, the MeningiSSS, can be very helpful. Finally, permanent disabilities may be more common than previously thought. With more than one third of survivors being affected by psychiatric disabilities, specific long-term follow-up strategies are needed to reduce suffering possibly caused by undetected psychiatric disabilities.

**Keywords**

Bacterial meningitis, children, vaccination, clinical presentation, decision support techniques, disease management, risk assessment, disabilities, neurodevelopmental disorders, psychiatric disease.

**Language**

English

**ISBN**

print: 978-91-7855-355-6  
PDF: 978-91-7855-356-3

**ISSN**

0346-6612

**Number of pages**

75 + 5 papers