

ICRAMCS 2026

THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON
RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 23-24-25, 2026 | Marrakech, Morocco



Mathematical Modeling and Control Strategies for Meningitis Transmission

Communication Info

Authors:

Mohamed BAROUDI¹

Mohamed BELAM²

Abderrahim LABZAI²

¹ Laboratory LMACS, Sultan
Moulay Slimane University,
Department of Mathematics and
Computer Science, Khouribga
Polydisciplinary Faculty,
Morocco.

² Laboratory of Analysis
Modeling and Simulation,
Department of Mathematics and
Computer Science, Faculty of
Sciences Ben M'sik, Hassan II
University of Casablanca,
Morocco.

Keywords:

- (1) Control optimal
- (2) Matlab
- (3) Meningitis

Abstract

Meningitis is a severe infection with high global morbidity and mortality, especially in the sub-Saharan "meningitis belt." Its main bacterial agents include *Neisseria meningitidis*, *Streptococcus pneumoniae*, and *Haemophilus influenzae*. We propose and analyze an extended SEIVHRQ model integrating voluntary quarantine (Q) and proactive vaccination (V), capturing both medical and behavioral interventions.

Using optimal control, we assess three strategies: reducing asymptomatic transmission, limiting symptomatic spread, and enhancing awareness and adherence. Simulations show that combining vaccination, isolation, quarantine, and awareness campaigns significantly reduces disease burden, supporting cost-effective strategies aligned with the WHO "Defeating Meningitis by 2030" roadmap.

© ICRAMCS 2026 Proceedings ISSN: 2605-7700

References

- [1] Donovan, Claire, and Jane Blewitt. "Signs, Symptoms and Management of Bacterial Meningitis." *Nursing Children and Young People* 22, no. 9 (2010).
- [2] Mazamay, Serge, Jean-François Guégan, Neby Diallo, Didier Bompangue, Eric Bokabo, Jean-Jacques Muyembe, Nadège Taty, Tonton Paul Vita, and Hélène Broutin. "An Overview of Bacterial Meningitis Epidemics in Africa from 1928 to 2018 with a Focus on Epidemics "Outside-the-Belt"." *BMC Infectious Diseases* 21, no. 1 (2021): 1027.
- [3] World Health Organization. Hepatitis B. WHO/CDS/CSR/LYO/2002.2. Geneva: World Health Organization; 2002.
- [4] Ali, Syeda Ayesha, Muhammad Kamran Taj, and Syeda Hafsa Ali. "Antimicrobial Resistance Pattern of Bacterial Meningitis among Patients in Quetta, Pakistan." *Infection and drug resistance* (2021): 5107-20.
- [5] Durski Kara N., "Emergence of Monkeypox—West and Central Africa, 1970–2017." *MMWR. Morbidity and mortality weekly report* 67 (2018).