Vital prognostic factors of mortality in bacterial meningitis in Meknes, Morocco 2004-2015
Sanah Essayagh, PhD 1, Meriem Essayagh DVM, PhD 2, and Touria Essayagh, PhD 3
1 Laboratory of Biochemistry and Neuroscience, Faculty of Science and Technology Settat, University Hassan I, Department of Bacteriology and Parasitology, 2 Teaching Military Hospital Rabat, University Mohamed V, 3 Epidemiology Cell of the Prefecture of Meknes, Ministry of Health, Morocco

Abstract
Infectious bacterial meningitis occurred at an incidence rate of 3 per 100,000 populations in Morocco in 2012. Hence, this disease is a serious threat to public health requiring physicians to notify all meningitis cases to the Moroccan "Direction d’Épidémiologie et de Lutte contre les Maladies" via surveillance epidemiology cells spread throughout the Kingdom in an attempt to manage the scenario. Bacterial meningitis is an inflammatory disease of the meninges and the cerebrospinal fluid that can be caused by bacterial infection through three main vectors namely Neisseria meningitidis, Haemophilus influenzae, and Streptococcus pneumoniae. Mass vaccination programs targeting Haemophilus influenzae and Streptococcus pneumoniae have been introduced in 2007 and 2010 respectively in Morocco. Despite these preventive measures lethality ratios kept increasing since 2004 in Meknes from 12.7%, 18.8% to 23.2% between 2007-2009, 2010-2012 and 2013-2015 respectively. However, there is to our knowledge no study characterizing the predictor factors of mortality for a better management of cases. Hence, we sought to analyze data collected over the last 12 years in the epidemiology cell of Meknes to improve meningitis case management in Meknes.

Methods
Protocol of the surveillance system for meningitis in Meknes. Surveillance for meningitis has been established in Meknes following the guidelines established by the Health Ministry of Morocco in accordance with a generic protocol developed by the World Health Organization. Thence, the surveillance program is enforcing the referral of suspected and confirmed cases of meningitis to the provincial public hospitals. Between January 2004 and December 2015, 271 cases were reported to the epidemiology cell of Meknes.

Case-record forms and data collection. Case-record forms were used to collect data on patient’s symptoms and signs on admission, outcome and neurological capacities at discharge. Putative meningitis was diagnosed by sudden onset of intense headache, fever, nausea, vomiting, photophobia and stiff neck. In addition, later neurological signs were also recorded such as lethargy, delirium, coma, and/or convulsion. However, infants may have illness without sudden onset of stiff neck but may instead present with bulging fontanel. Patients with presumed bacterial meningitis were given third-generation cephalosporin as primary care treatment. Laboratory investigation of cerebrospinal fluid (CSF) was obtained by lumbar puncture, allowed confirmation of meningitis cases and differentiation of the bacterial types of meningitis. Abnormalities of the CSF during meningitis episodes typically comprise pleocytosis, hyperproteinorachia (>3 g/L) and hypoglycorrhachia (0-2 g/L). Culture of CSF to identify the pathogen that cause meningitis — Neisseria meningitidis (meningococcus), Streptococcus pneumoniae (S.p.), and Haemophilus influenza type b (Hib) — allows positive cases of meningitis to be classified as CMM when meningococcal meningitis was confirmed, pneumococcal meningitis and Haemophilus influenza meningitis respectively. Cases were classified as probable bacterial meningitis (PBM) when the CSF displayed at least one of the following features: i. cloudy or purulent aspect of the CSF; ii. CSF leucocyte count (>100 cells/µL) and iii. positive Gram coloration.

Data analysis. We conducted a case series study over 12 years to characterize the predictor factors of mortality caused by bacterial meningitis in Meknes. We included all patients admitted in the hospitals of Meknes and for whom meningitis was probable or confirmed. Statistical analysis was performed using Epi Info 7 and Excel 2007. The outcome variable of interest was death. Univariate analysis and logistic regression were conducted to identify vital prognostic factors. The statistical significance of the results obtained was assessed using confidence interval of the estimated odds ratios and the Pearson chi-square test. The significance threshold was set at p ≤ 0.05. Quantitative data were expressed as mean and standard deviation (SD) and qualitative data as percentages.

Results
Table 1: Meningitis patients' socio-demographic characteristics between 2004 and 2015 in Meknes, Morocco.

Table 2: Multivariate odd ratios (p-value) for mortality caused by bacterial meningitis infection, 2004-2015, Meknes, Morocco.

Table 3: Multivariate odd ratios (p-value) for mortality caused by bacterial meningitis infection, 2004-2015, Meknes, Morocco.

Conclusion
During this analytical study that we performed on the 271 cases reported in Meknes between 2004 and 2015 only consciousness alteration, coma and PMM were identified as predictor factors of mortality. Surprisingly the analysis did not highlight any association between the delay before admission and death. This is not concordant with previous results described in the literature. This absence of association in this analysis could be explained by the fact that these delays are reported in days in our current system of surveillance and not hours as it usually done in the literature. Indeed, hourly data are not registered in our reporting system. This has certainly introduced a limit in the study of predictor factors of death. Nevertheless, following bacterial meningitis admission to death, within hours remains impossible to predict and there is not any strategy to prevent its occurrence; in these special instances, delays before admission are not important.

Acknowledgments
No private funding was used to conduct this work.