# CHAMPS

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## Title

# Saving newborn babies in Quelimane Central Hospital, Mozambique: **A CHAMPS-Based Intervention**

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# Summary

Sepsis is a severe and potentially fatal clinical syndrome characterized by systemic inflammatory response to an infection, resulting in organ failure. Prevention of infections that lead to sepsis is crucial. Hospital acquired infections in newborn babies usually lead to sepsis as has been observed at Quelimane Central Hospital through the CHAMPS findings. To address this problem, CHAMPS in collaboration with Department of Pediatrics from Quelimane Central Hospital initiated surveillance for severe invasive bacterial diseases.

This surveillance aimed to identify sepsis cases early to facilitate timely and appropriate treatment, understand the pathogens associated with sepsis and establish a comprehensive database of newborn infections. Prospective hospital-based surveillance enrolled children suspected of bacteremia, sepsis, or meningitis and collected venous blood and cerebrospinal fluid samples for laboratory investigation. From 2019 to 2023, 992 blood cultures were collected, revealing Klebsiella pneumoniae as a major contributor to severe invasive bacterial diseases, similar to CHAMPS findings.

Antibiotic susceptibility testing indicated resistance of K. pneumoniae to multiple antibiotics used in routine care. Lessons learned underscored the importance of consistent clinician requests for blood cultures, effective pathogen identification and antimicrobial resistance testing. Establishing protocols for syndromic detection and reviewing antibiotic protocols are required for successful

> " *By instituting effective surveillance measures, Quelimane Central Hospital aimed to strengthen efforts to reduce severe invasive bacterial diseases and subsequent death in newborns.*"

# Background and Context

Informed by CHAMPS findings and in response to concerning mortality rates, particularly among newborns, Quelimane Central Hospital embarked on an initiative to introduce surveillance for severe invasive bacterial diseases. From 2019 to 2022, CHAMPS recorded 224 newborn deaths in Quelimane, with infection being the primary cause (129 cases tested positive for infectious pathogens)1.

Of blood cultures performed at the hospital in 478 children under 14 years old, 361 were positive; the most common pathogens were Klebsiella pneumoniae, Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, and Haemophilus influenzae. Some of the identified pathogens are related to traditional nosocomial infections and others transmitted from mother to baby during pregnancy, indicating the existence of different sources of infection requiring different prevention and control strategies.

A surveillance programme to monitor infections (severe invasive bacterial diseases in newborns) was established in Quelimane hospital in close collaboration with the CHAMPS programme. The primary objectives of the surveillance were early identification of cases through systematic testing and reporting of infectious pathogens and their susceptibility to available drugs, timely initiation of appropriate treatment and to create a comprehensive database of newborn infections for ongoing research and quality improvement initiatives. By instituting effective surveillance measures, Quelimane Central Hospital aimed to strengthen efforts to reduce severe invasive bacterial diseases and subsequent death in newborns. These results are being used to advocate for public health interventions in the country.

## 01 Interventions

We conducted a prospective hospital-based surveillance of Invasive Bacterial Diseases (IBD) in children admitted to Quelimane Central Hospital from September 2019 to December 2023. Participants were recruited from the emergency services and the paediatric nursery. We prospectively enrolled individuals suspected of having bacteremia, sepsis, or meningitis upon their admission. Eligibility was defined as any child residing in the Quelimane District for at least 3 months and admitted to Quelimane Central Hospital with a body temperature ≥38.5°C or presenting with malnutrition (Kwashiorkor, Marasmus, and Kwashiorkor-marasmic) or neurological alterations of any level but with normal previous neurological status or development or exhibiting clinical signs of infection (sepsis, clinical instability, or focal signs of infection).

At the time of admission, CHAMPS medical technicians completed outpatient forms for all patients. If participants were admitted and their caregivers consented to their enrolment, we filled out inpatient forms to track them throughout their hospital stays until discharge. Study staff screened and enrolled participants based on predetermined inclusion criteria as described above. Venous blood, and cerebrospinal fluid (CSF) were collected using standard clinical procedures. Bacterial isolates from these clinical specimens were identified using culture (Figure 1) by a laboratory technician. Antibiotic susceptibility tests were done on all positive cultures. Subsequent analysis included a comparison between the years 2019 and 2023, focusing on positivity rates, predominant microorganisms, and results of antibiotic susceptibility tests.
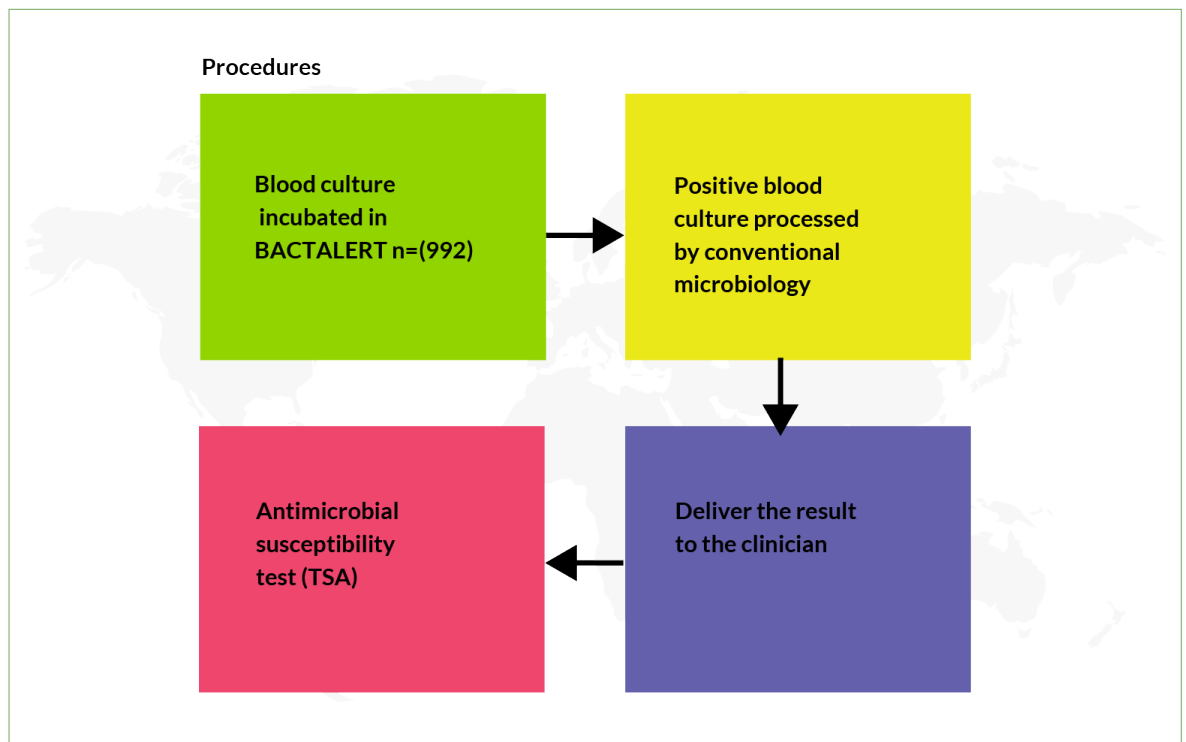


*Figure 1: Conventional microbiology method (culture) process flow*

## 02 Impact of Interventions

From 2019 to 2023, a total of 992 blood cultures were collected from children under 14, with 107 (10.7%) from newborn babies. Klebsiella pneumoniae was a main contributor to severe invasive bacterial diseases, particularly impacting neonatal morbidity and mortality (Figure 2). These findings from Quelimane Central Hospital align with data from CHAMPS, with K. pneumoniae detected in 497 of 2352 CHAMPS child deaths from 2016 to 2021. Klebsiella pneumoniae was resistant to multiple pharmacological drugs, including Penicillin (Figure 3). Specifically, K. pneumoniae demonstrated 100% resistance to Ampicillin (AM) and approximately 80% resistance to Gentamicin (GM), both commonly used as first-line antibiotic therapies in neonatology. Furthermore, there was a high resistance level, approximately 90%, to Ceftriaxone (CRO), a third-generation cephalosporin used as a second-line therapy. Notably, sensitivity to Carbapenems such as Meropenem (MEM) and Imipenem (IPM) was observed, suggesting their suitability for treating severe invasive diseases caused by Klebsiella pneumoniae. However, these drugs are rarely available within the National Health System. These data were shared with the Local government, Hospital directorate and health authorities of the district during a meeting conducted by the CHAMPS Principal Investigator in Mozambique. A positive response demonstrated a willingness to procure specific medicines for particular cases and to develop a protocol for implementation in pediatric nurseries. A need for establishment of an algorithm to predict the strain and prognosis. To address mortality resulting from serious bacterial infections, understanding effective treatment strategies is crucial



### Main pathogens isolated

**2019 (n=70)**

| Pathogen | Value |
|---|---|
| Klebisiella pneumoniae | 22 |
| | 9 |
| E. agglomerans | 6 |
| | 6 |
| E. cloacae | 5 |
| | 5 |
| Leveduras | 4 |
| | 4 |
| Proteus mirabilis | 3 |
| | 3 |
| Enterococcus spp | 3 |
| | 2 |
| K. aerogenes | 2 |
| | 2 |
| BGNFL OX (+) | 2 |
| | 2 |
| Streptococcus sp | 1 |
| | 1 |
| Strep. G. B (Streptococcus agalatiae) | 1 |
| | 1 |
| Enterobacter spp. | 1 |
| | 1 |
| Aeromonas hidrophila/caviae | 1 |

**2023 (n=78)**

| Pathogen | Value |
|---|---|
| Klebisiella pneumoniae | 30 |
| E. coli | 19 |
| BGNFL OX (-) | 9 |
| Pseudomona aeruginonsa | 7 |
| K. aerogenes | 6 |
| E. cloacae | 6 |
| Leveduras | 4 |
| Aeromonas hidrophila/caviae | 4 |
| Streptococcus grupo G | 3 |
| Pseudomonas spp. | 3 |
| Acinetobacter baumannii/calcoaceticus | 3 |
| S. aureus | 2 |
| Citrobacter freundii | 2 |
| S. pyogenes | 1 |
| Strep do grupo F | 1 |
| Serratia liquefaciens | 1 |
| Klebsiella sp | 1 |
| Morganella morganii | 1 |
| Raoltella ornithinolytica | 1 |
| Citrobacter amanoliticus | 1 |
| BGNNFL OX (+) | 1 |
| BGNNFL OX (-) | 1 |
| BGNFL OX (+) | 1 |

**High neonatal mortality due to infectious causes (46%):** *Klebsiella pneumonia* found in more than 26% of the cases.
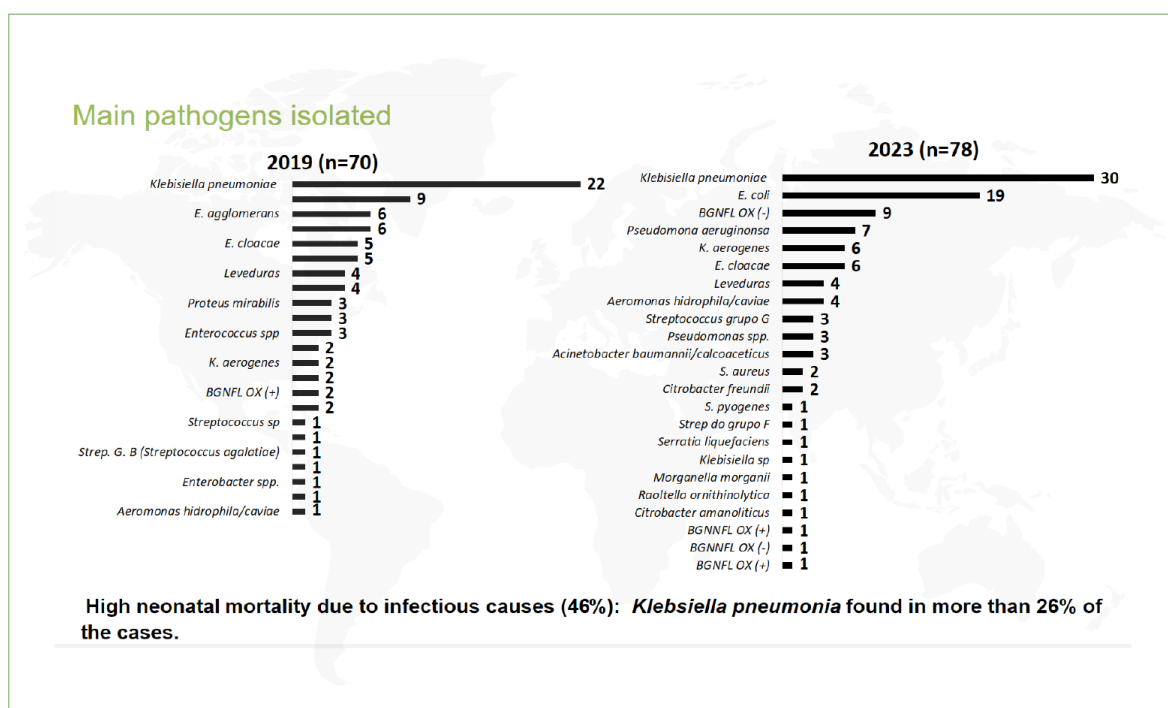
*Figure 2: Pathogens isolated from specimens collected through the hospital-based surveillance of Invasive Bacterial Diseases in children, Quelimane Central Hospital, 2019 – 2023*
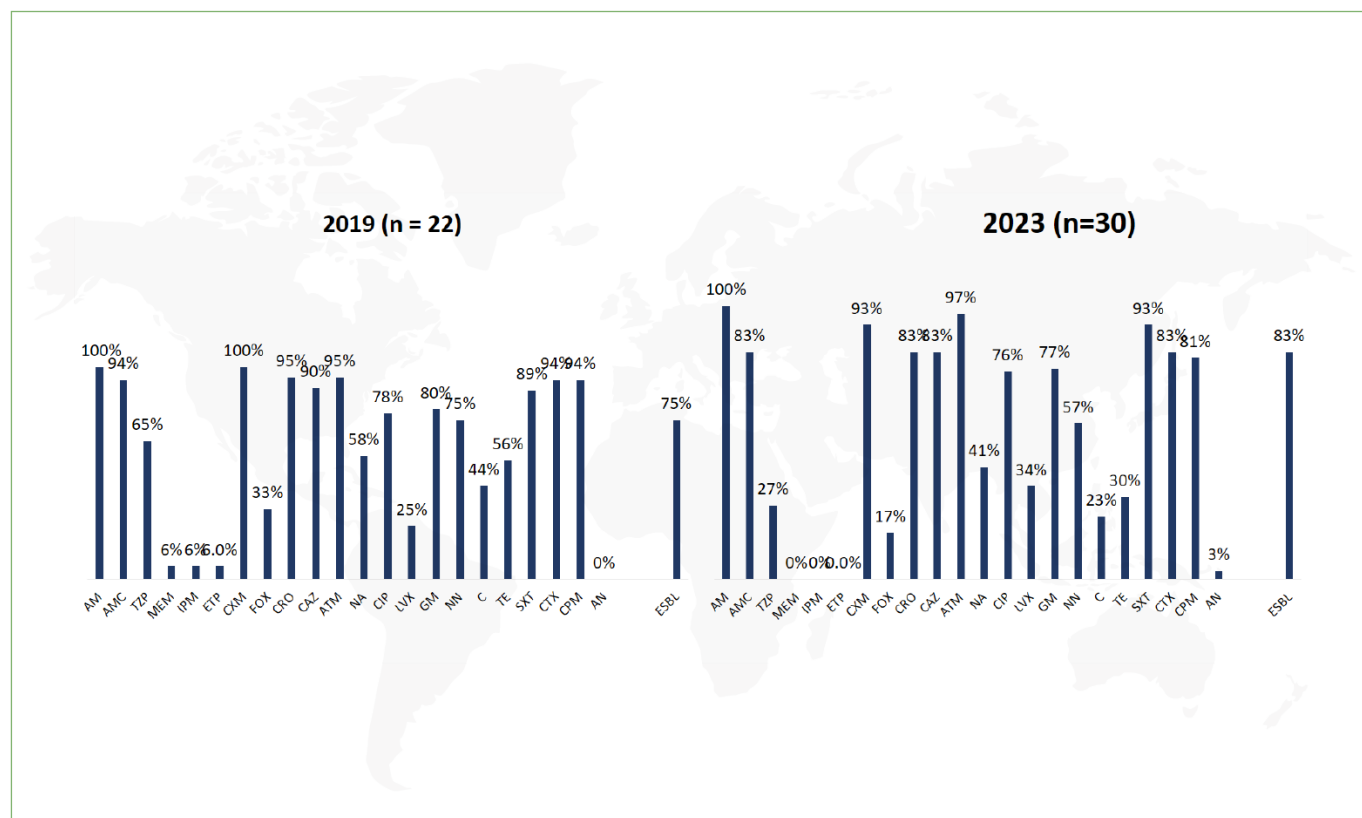
*Figure 3: Drug sensitivity testing outcome from specimens collected through the hospital-based surveillance of Invasive Bacterial Diseases in children, Quelimane Central Hospital, 2019 – 2023*

## 03  Lessons Learned

The implemented surveillance showed key elements that are crucial in management of newborns to reduce mortality. Firstly, there is a need for good diagnostics to detect specific pathogens and their sensitivity to available treatment. This will ensure that newborns are given potent treatment. Clinicians must also be able to detect children at high risk of infection and sepsis, and ensure collection of the right specimens and request for appropriate laboratory investigations. This requires concerted efforts from the MoH and hospital management to ensure the required diagnostic capacity is built especially at tertiary referral hospitals that are likely to attend to at-risk newborns. Lastly, timely delivery of results to clinicians within the shortest time possible is also crucial. The implementation of an electronic results system, will ensure timely reporting of laboratory findings to the attending clinician. Additionally, integrating rapid tests for targeted pathogen detection will increase diagnostic accuracy and timeliness.

Establishing robust protocols for syndromic detection of severe bacterial invasive diseases is paramount as we extend our reach beyond CHAMPS sites and scale up interventions. This proactive approach enables swift detection and response to emerging threats, safeguarding patient well-being. Moreover, a comprehensive review of existing antibiotic protocols is necessary. Aligning practices with evidence-based guidelines is crucial for optimal patient outcomes and combating antimicrobial resistance effectively.

Based on this surveillance, Quelimane Central Hospital, in collaboration with the CHAMPS team, plans to conduct a pilot intervention providing the hospital with antibiotics that are not typically available in the health system, such Carbapinem and Emepinem and monitoring treatment success rates and advocate for their inclusion in the national treatment protocols.

"You cannot prevent the birds of sorrow from flying over your head, but you can prevent them from building nests in your hair."

— Old Chinese proverb

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# CHAMPS

# THANK— YOU

**Child Heath And Mortality Prevention Surveillance**

The CHAMPS network uses innovative approaches to generate and share knowledge that improves understanding and prevention of child mortality.

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