

The role of a mobile laboratory in the vaccine response to meningitis epidemic

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Abstract

Background: Most African countries experience epidemics that can affect rural populations, such as epidemics of meningococcal meningitis or cholera. Accurate laboratory diagnosis is critical for rapidly designing interventions but often is unavailable. Since 2003, Agence de Médecine Préventive (AMP) has overseen the field implementation of mobile microbiology laboratories (LaboMobil®), which currently operate in Burkina Faso, Côte d'Ivoire and Guinea.

Methods: We reviewed the experience of the LaboMobil® in West Africa for epidemic investigation and response; and for neglected Tropical disease investigation for appropriate case management.

Results: In the context of the meningitis and cholera epidemic control programs, the ministries of health of Burkina Faso, the Côte d'Ivoire and, Benin have used the LaboMobil® in areas without effective local laboratories for laboratory confirmation of suspected cases in outbreaks and for strengthening laboratory capacity at the peripheral level by training. Since 2003, these vehicles have been used in 60 outbreak investigations in more than 50 health facilities, with analysis of 547 cerebrospinal fluid and 129 stools samples. Collected data were used by Ministries of Health to develop intervention programs such as the selection of appropriate meningococcal vaccines or implementation of cholera control programs. The primary limitations of the mobile laboratories are current process including many administrative steps (MOH decision to request LaboMobil® intervention followed by administrative authorization for intervention, national reference laboratory approval to engage a technician, and finally actual travel to the site) that may delay response and lack of funding to support such activities regularly.

Conclusion: The mobile laboratories have achieved substantial success over the past decade. Their usefulness could be improved further by use in control of other diseases, improved links to national infectious disease control programs, and designation of dedicated human resources.

Introduction and Objective

> Context

Fixed laboratory capacity in Africa may be inadequate; mobile microbiological laboratories may address this issue but their utility has seldom been evaluated.

The LaboMobil® is:

- a complementary tool for national reference laboratories:
 - ✓ Performs immediate, on-site identification of the etiologic causes of epidemics
 - ✓ Allows communication of data in real-time to health officials for decision-making
- An all-terrain vehicle
- Unit equipped with a microbiology laboratory + removable air locked entrance
- Energy and water independent
- Possibility of intervention in hard-to-access zones



Figure 1: Interior view of LaboMobil® included tailored microbiological class2 laminar flow

Methods

The LaboMobil® unit is used in the field through close collaboration with national authorities, the West Africa Health Organization (WAHO), WHO, and other partners. AMP provides logistics, technical and organizational support. Three main missions : a) Outbreak investigations b) Vaccine impact and epidemiological studies c) Training of technicians

The study involved an outbreak in Benin, the use of The LaboMobil® unit assigned to the Burkina Faso Ministry of Health, African reference laboratories in Togo and Côte d'Ivoire, and international support from AMP and the Pasteur Institute, Paris, France (Fig 2).

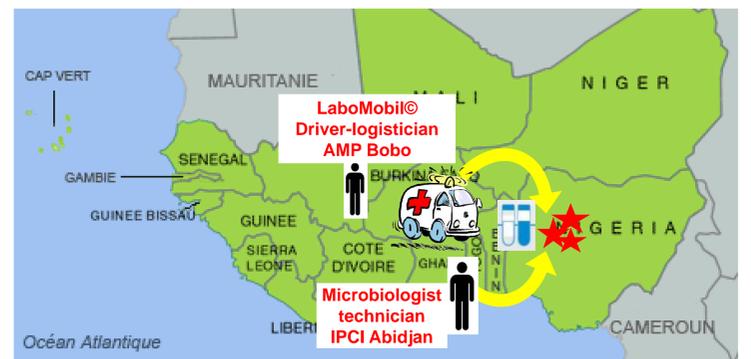


Figure 2: Example of regional solidarity including 3 countries (Burkina Faso, Togo and Ivory Coast) for the investigation of meningitis in Benin in 2012

Results

> LABOMOBIL® for epidemics investigation and response

• Burkina Faso 2004, 2007-2011

- 2004: cerebrospinal fluid (CSF) samples from 58 suspected cases was collected in three remote districts Nanoro (n=19), Zabré (n=26), and Toma (n=13) (median age, 2.5Y; 58% <5Y) and evaluated in LaboMobil®. 23 (40%) had a confirmed bacterial etiology (median age, 9.0Y; 43% <5Y). Etiology differed by location: 8 NmW135 and 5 *S. pneumoniae* (Sp) in Nanoro, 3 NmA and 1Sp in Zabré, and 5 NmW135 and 1 Y/W135 in Toma. The 10 Nm and three Sp tested for antibiotic susceptibility were all sensitive to chloramphenicol, oxacillin and ceftriaxone. One week after the LaboMobil® confirmation of a NmW135 epidemic, Nanoro residents aged 2–29 years received mass vaccination with trivalent Nm A/C/W135 polysaccharide, with administrative coverage of 113%.
- From 2007 to 2011, more than 500 CSF samples were collected during 25 Acute Bacterial Meningitis (ABM) outbreak investigations in 18 districts, covering overall 17,000Km. This contributed directly to the decision to use reactive vaccination as well as the vaccine selected.

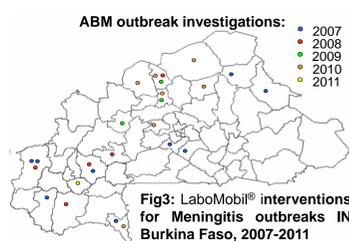
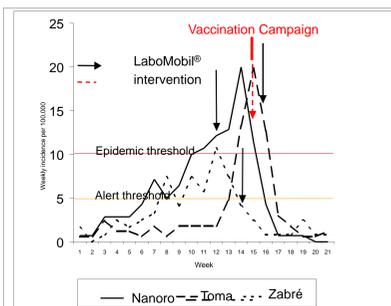


Fig3: LaboMobil® interventions for Meningitis outbreaks IN Burkina Faso, 2007-2011

In Cote d'Ivoire, the LaboMobil® Investigated cholera epidemic in "Africhol" surveillance sites in Abidjan (2011) and in Koumassi and Adiaké sharing border with Ghana (2012)



Adiaké	Stools	Confirmed cases	Serogroup
Numb	77*	24	OGAWA O1

• Meningitis and cholera outbreaks in Côte d'Ivoire: 2012

• Tengréla W2 to W5

27 cases; 3 Death
Epi threshold W3
AR = 10,7/100.000

• Kouto W1 to W6

13 Cases; 2 Death
Epi threshold W3
AR = 10,7/100.000

Fig4: LaboMobil® Interventions for Meningitis outbreaks, 2012

W7: Vaccine response in 2 Health districts of Tengréla and Kouto, with 175.000 doses with aim to protect 90% of population >2 years against NmW135 meningitis

• Meningitis outbreaks in Benin: 2012

Local laboratories initially reported most cases to have Gram positive diplococci suggestive of pneumococcal meningitis. The LaboMobil® evaluated 200 CSF samples and 59 stored isolates collected from 149 individuals. Of the 74 individuals with etiologic confirmation, 60 (81%) had NmW135 and 11 (15%) NmX identified; no pneumococci were identified. Testing in France on 30 NmW135 and 3 NmX confirmed the etiology in all cases. All five districts had crossed the epidemic threshold (10 cases per 100,000 per week), all had NmW135 identified and four had NmX belonging to genotypes W:ST-11: ccST-11:5:2:F1-1 and X:ST-181:ccST-181:5:1:10-1:F1-31 respectively.

The LaboMobil® results confirmed the appropriateness of the earlier decision by the Benin Ministry of Health to implement Nm A+C+W135 polysaccharide vaccine mass campaigns, which was done during week 18. By the time vaccine arrived, all five evaluated districts had a weekly attack rate below 10 per 100,000 persons and thus were no longer considered to be experiencing an epidemic (Figure 5).

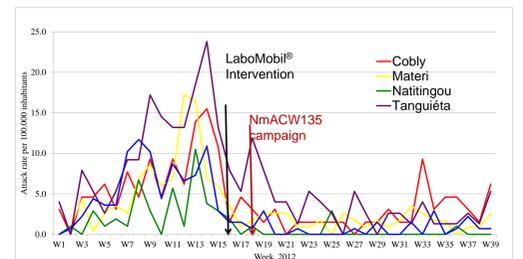


Fig 5. Attack rate of meningitis in epidemic sites, Benin, 2012



Conclusion

Over the short- and medium-term, mobile laboratory units can play an important role by responding quickly to outbreaks, supporting studies by allowing the inclusion of rural populations, training local laboratory technicians, and supporting the rapid transport of specimens to local and international reference laboratories. These roles will be particularly important for surveillance that occurs in the context of new vaccine introductions, given the questions that remain about duration of protection, serogroup/type replacement, disease caused by etiologies not included in vaccines, geographic inequities in vaccine distribution, and other issues.

In addition, the introduction in the LaboMobil of new technologies should further its utility. On example is the FilmArray-Biomérieux combined test, which evaluations over 100 pathogens with 2 minutes of hands-on time and results returned within one hour. Rapid diagnostic tests for diseases with epidemic potential (such as influenza or Ebola) could also be incorporated.

In addition to Burkina Faso and Côte d'Ivoire, the LaboMobil® is now used in Guinea for neglected tropical diseases (NTDs) with the support of American Friends of Guinea (AFG), The Gambia, and Nigeria (with the financial support of the West African Health Organization (WAHO)).

References

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