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The performance of the expanded programme on immunization in a rural area of Mozambique

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ABSTRACT

Vaccines are an effective public health measure. Vaccination coverage has improved in Africa in the last decades but has still not reached WHO/UNICEF target of at least 90% first-dose coverage for vaccines in the Expanded Programme on Immunization (EPI) implemented in Mozambique in 1979. There are concerns about reliability of vaccination coverage official data from low-income countries, and inequities in vaccine administration. We randomly sampled 266 under-five years children from Taninga, a poor rural area in Southern Mozambique under a Demographic surveillance system and collected data directly from the individual national health cards when available (BCG, DTP/HepB/Hib, Polio, Measles). We also collected data on socio-economic variables through an interview. Overall, only 5% of the participants did not receive all the doses of the vaccines included in the EPI in a timely manner (overall vaccination coverage 95%, 95% CI: 93.5–95.5%). The socio-economic status was homogenously low and no differences were found between vaccinated and unvaccinated children. Vaccination coverage in Taninga was very high, despite the low socio-economic status of the population. The high performance of the EPI in Taninga is an encouraging experience for achieving high vaccination coverage in low-income rural settings.

1. Background

Vaccines are amongst the most cost-effective public health measures currently available in developing countries (Deogaonkar et al., 2012) where they prevent 2.5 annual million deaths (WHO et al., 2009). Vaccination coverage has improved during the last decade. As an example, average coverage of DTP3 (3 doses of diphtheria, tetanus and pertussis vaccine) was 50% in Africa in 1996 and 72% in 2012 (World Health Organization and UNICEF, 2013). A reason for this is that, since 2000, the Global Alliance for Vaccines and Immunisation (GAVI) has supported a growing number of countries (73 in 2010) through a performance-based grant programme to achieve WHO/UNICEF recommended target: at least 90% first-dose coverage for the vaccines included in the Expanded Programme on Immunization (EPI) in 2015 (Le Gargasson et al., 2013; United Nations, 2013). The "Reaching Every District" (RED) WHO approach, implemented in Africa since 2002, has also contributed to improve childhood immunization services increasing coverage rates from 73% to 94% for different antigens in 2009 worldwide (Tao et al., 2013). The continuous uptake of vaccination will avert over 20 million deaths during the 2011–2020 period worldwide, 52% of which will be in African countries (Lee et al., 2013).

Despite the encouraging figures, two main concerns have arisen. First, different authors have questioned the quality and validity of the official data from low-income countries (Bosch-Capblanch et al., 2009; Murray et al., 2003; Ronveaux et al., 2005). The verification factor quantifies under or over-reporting of vaccine doses at a district level. It is based on the ratio of re-counted DTP3 doses in the health unit records by the number of DTP3 doses reported by the health unit to the district (Ronveaux et al., 2005). Audits of official data in countries from Africa, America, and Asia show a low verification factor in vaccine administration, which hampers the ability to track the performance of the programmes and to detect failures and weaknesses (Bosch-Capblanch et al., 2009; Murray et al., 2003; Ronveaux et al., 2005). Furthermore, the official data of vaccination coverage is 20% points superior to data obtained through Health and Demographic Surveillance Systems (Murray et al., 2003; Tao

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Table 1
Immunization schedule in Mozambique.

Age	Visit	Antigen
Birth	1	BCG, OPV0
6 weeks	2	DTP-HepB1-Hib1*, OPV1
10 weeks	3	DTP-HepB2-Hib2*, OPV2
14 weeks	4	DTP-HepB3-Hib3*, OPV3
9 months	5	Measles

BCG = Bacille Calmette–Guerin; OPV = oral polio vaccine, DTP = Diphteria, Tetanus, Pertussis; HepB = Hepatitis B; Hib = *Haemophilus influenza* type b.
* Hib introduced in august 2009.

et al., 2013). The second concern is that global figures could hide inequities in public health interventions coverage, which could jeopardize the achievement of Millennium Development Goals (MDG) 1 -Eradicate extreme poverty and hunger- and 4 -Reduce child mortality- (Lauridsen and Pradhan, 2011; United Nations, 2013). Regarding immunization (DTP3, Measles, fully immunized), differences of coverage between the poorest and the richest quintile from the same country can be as considerable as 20% (Barros et al., 2012; United Nations, 2013). Determinants impairing vaccination coverage are distance to vaccination site, waiting time, unavailability of treatment services, cost, low parental education level and large family size (Falagas and Zarkadoulia, 2008; Nkonki et al., 2011; Rainey et al., 2011; Van Malderen et al., 2013).

Mozambique is one of the poorest countries in the world. In 2011, it had the fourth lowest Human Development Index worldwide (UNPD, 2013). The EPI was introduced in Mozambique in 1979, and the RED approach in 2008. However, RED has only been implemented in 66 out of 144 Mozambican districts (Ministry of Health, 2011). The verification factor of the vaccines administered (DTP3) was less than 0.70 in 2002–2003, which implies over-reporting and inability to verify the administration of DTP3 (Ronveaux et al., 2005). Furthermore, among 54 countries monitored by countdown to 2015, Mozambique was the 14th in terms of income-specific inequity in measles vaccine administration (Barros et al., 2012). The official national estimate for DTP3 coverage was 76% in 2011 (GAVI Alliance, 2013). Administrative data showed DTP3 coverage of 49.2% in Maputo province, and 90.2% in Maputo city, which provides an idea of differences in rural and urban settings (Ministry of Health, 2011). It is important to determine the validity of this figure before introducing new vaccines.

The aim of the study was to determine the coverage of the EPI vaccines in a rural area of southern Mozambique included in a Demographic Surveillance System (DSS), and to describe the socioeconomic determinants of vaccination within this area.

2. Material and methods

2.1. Study population

The study was conducted by the *Centro de Investigação em Saúde de Manhiça* (CISM), located in Manhiça, Maputo Province, Southern Mozambique from september to november 2012. CISM runs a DSS in its study area and a morbidity surveillance system at Manhiça District Hospital (MDH) and other health posts in the area. Manhiça district hospital and the peripheral health posts are facilities from the national public health system that receive support from CISM. The DSS covers a 500 km^2 area with 90,000 people, who are individually given a unique and permanent identification number, and 18,000 households, which are geopositioned. A field worker fills a demographic questionnaire at each household at least once a year. Independently from the DSS, each child has a national health card with information about vaccination. Taninga is a rural area of the DSS 30 km north from Manhiça, and it only counts with one health post providing clinical assistance to the neighbouring population.

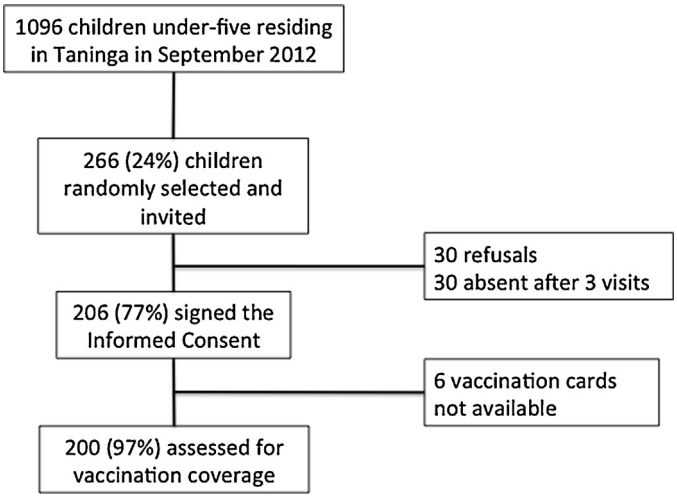

Fig. 1. Study profile.

CISM does not directly intervene in EPI administration, but it provides support to Taninga health post with health workers (medical agents, microscopists and nurses) since 2005. Since then, the health post has been open and available 24/7 for medical assistance. CISM has also established community councils with community leaders of the study area on a regular basis. Taninga was chosen as the site for this study as example of a very rural area. At the time of the study, there were 1096 children under five years of age in Taninga according to the DSS.

2.2. Selection of participants

This sub-analysis is part of a larger study designed to determine the prevalence of viral infections among healthy children in the community, approved by the Institutional Ethics Committee of CISM, the National Ethics Committee of Mozambique, and the Institutional Review Board of Hospital Clinic in Barcelona. Sample size was calculated according to the primary endpoint of the larger study, and thus was not based on any predefined hypothesis on expected vaccination coverage rates. We obtained the sampling frame selecting from the DSS database all the children aged less than 5 years living in Taninga. Selection of participants was done by simple random sampling using STATA with the permanent identification number as identifier. A field worker visited the participant household to invite the legal guardian and the child. If the legal guardian was absent during the visit, a maximum of two more visits were done to invite the child. In case of repeated absence or refusal to participate in the study, another child of similar age and household location was approached. If the guardians accepted the invitation, they were taken with their child to the Taninga health post on the next day. Guardians were interviewed and children examined only after they had signed the informed consent form.

2.3. Vaccines received and definitions of correct vaccination

The EPI in Mozambique includes a Bacille Calmette–Guerin (BCG) and an Oral Polio Vaccine (OPV) dose at birth, a tetra/pentavalent (Hepatitis B, Diphteria, Tetanus, Pertussis, plus *Haemophilus influenzae b* since august 2009) at weeks 6, 10 and 14, and a measles vaccine single dose at month 9 (Table 1). Pneumococcal conjugate vaccine (PCV-10) has recently been introduced (10th April 2013) but was unavailable at the time of the study. Vaccination is scheduled with the mother at child's birth when the first doses are given and successive vaccinations are done at the nearest health post and recorded in the patient's individual