

A. Cover Page

Reaching the hard-to-reach mobile pastoralists with the most appropriate vaccination scheme in Central Africa

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Abstract

Our consortium - composed of members of four public health and veterinary institutes - has the overall goal of increasing vaccination coverage among mobile pastoralists in Central Africa. In Chad with its high proportion of pastoralists, research and implementation partners have gained experience in well reaching pastoralists with joint human and animal vaccination campaigns, but a sustained strategy still needs to be better described before translation to policy. We hypothesize that the introduction of an assessed adult vaccination scheme will further increase the demand of pastoralists for vaccination services and lead to more frequent utilization of a mix between mobile, outreach and established fixed vaccination infrastructure. Given that one fifth of pastoralists regularly cross the country borders, Chad will initiate an exchange with its neighboring countries on how to serve pastoralist communities and on the appropriate vaccination scheme . including adult vaccination - among the 'lost-outs'. Main beneficiaries are the pastoralists in remote zones as well as the vaccination services. This operational research will facilitate vaccination campaigns between the health and veterinary sectors in three zones and two years. The campaigns are assessed with qualitative and quantitative approaches regarding the knowledge and perceptions on adult vaccination; randomized surveys will indicate the achieved coverage of women (TT2+) and an in-depth follow-up of few families will further show whether the overall demand to vaccination could be increased when other adult vaccines are added to the schedule. We will disseminate our results to all stakeholders to further explore how vaccinations can be sustainably delivered to these hard-to-reach communities.

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C. Main Section of the proposal

Overall Goal & Objectives

In Central Africa, public health service delivery to remote rural and hard-to-reach communities is heavily constrained by logistical, monitoring and financial limits, which manifests itself in high maternal mortality, below 50% childhood vaccination coverage (with measles storms and pockets of polio cases) and outbreaks of vaccine-preventable livestock diseases. Health care facilities are clustered in urban areas and scarce in poor rural zones, and immunization coverage is higher in urban (example Chad: 21% fully immunized children) than in rural zones (only 9%).² Health facilities in rural zones rarely offer outreach services to more effectively reach the remote populations and their quality of care is generally poor since they most often lack adequate infrastructure, drugs, quality of care and supervision and, therefore, have a weak performance.

Mobility and livestock can - combined - make use of the grasslands that are available at different places and times in the fragile ecosystem of the Sahel. An important proportion of the rural population in the Sahel (50 million pastoralists and 200 million agro-pastoralists) is fully or partly mobile – often across borders (approximately 20% of all pastoralist zones in Chad are in cross-border regions). These communities are highly vulnerable to exclusion from health and vaccination services. Exchange and collaboration with neighboring countries need to be fostered. Our consortium has experience in providing simultaneously human and livestock vaccination services. A challenge is, however, to sustain vaccination campaigns in cross-border regions and among communities who have never benefitted from services before ('left-outs'). This is only possible if pastoralists do not only appreciate such joint campaigns but also take an active role in seeking vaccination. We hypothesize that the introduction of a well assessed adult vaccination scheme will further increase the demand of pastoralists for vaccination services.

Our **overall goal** is to increase the proportion of hard-to-reach highly mobile pastoralists who benefit from vaccination services in Central Africa. For most pastoralist communities it will be the first time they have access to the national Expanded Program on Immunization (EPI), despite that they know and appreciate vaccinations, notably against measles and livestock diseases. WHO, UNICEF and other international organizations recognize that integrated health services are critical for reaching universal health coverage – and that more operational research is needed. To achieve the Millennium Development Goals, public health must be scrutinized for their equity and effectiveness, which needs sensitivity to specific contexts of societies, cultures, and health systems.²⁸

The specific objectives are:

1. To scale up of joint human and livestock vaccination activities in pastoralist zones, particularly in cross-border regions of Central Africa, and to foster a Central African exchange on lessons learned to reach mobile pastoralist that will be led by Chad
2. To assess with qualitative approaches the knowledge and perceptions on adult vaccination (beyond tetanus vaccination of women) of both, pastoralist communities and health personnel and to identify in a transdisciplinary process the appropriate adult vaccination scheme.
3. To monitor the achieved vaccination coverage among women with randomized surveys and to assess with telephone surveys if the introduction of another adult vaccines increases performance of vaccination campaigns

Approach

a Current Assessment of need in target area

In the following, while giving in overview of the problem field of sustained vaccination services for mobile pastoralists in general and the potential role of adult vaccination scheme in particular, we also present our past own operational research that led to the identification of research and translation gaps that will be addressed in this project.

An estimated 50 million pastoralists and up to 200 million agro-pastoralists live from West to East across dryland Africa.¹ Mobile pastoralists are among the communities who are most vulnerable to exclusion from primary social services. UNICEF and WHO refer to 'hard to reach' communities.²⁷ It is now better understood that herd mobility and flexibility are necessary ingredients for managing rangeland environments where the climate is unpredictable or the natural resource base has limited potential as is the case for the Sahel. Pastoralism ensures that it remains more productive than the alternative forms of land use and contributes significantly to agricultural Gross Domestic Product (GDP) in many Sahelian, Central and Inner Asian countries (up to 80%).⁹ Mobility has been restricted with government sedentarisation policies to facilitate 'social control', but mobility is not only curtailed through direct policies or due to invasion of other utilization of drylands (e.g. farms and industrial exploration). Pastoralists also voluntarily settle to access social services, i.e. education and health, despite being acutely aware that this harms their livelihood and their environment.¹⁴ We see our contribution to adapted social services for pastoralists also in the larger scope of relations between policies and environmental outcomes.

Often pastoralists mistrust the health service because they are not considered in their planning that is for settled populations alone and thus do not bother to seek formal health care there.²⁰ Births and deaths among mobile pastoralists largely go unregistered.²⁵ There may be peculiarities of causes of death among mobile pastoral people owing to periodic nutritional and political insecurity and poor access to health services. In more extreme situations, these can translate into one of the highest infant mortality rates of the world: up to 50% of children in Northern Mali die before their fifth birthday.¹⁵ Maternal mortality rates of mobile pastoralist communities are also amongst the highest world-wide given that pastoral women often deliver at home. Mortality due to infections such as measles, maternal and neonatal-tetanus and tuberculosis are foremost signs of insufficient access to health services and appropriate information.

The main diseases and health conditions among pastoralists do not differ substantially from diseases that are typical for people of rural zones in resource-poor countries such as respiratory diseases, malaria and diarrhoea^{6,18}. Loutan¹³ and Swift *et al.*²³ have identified five main factors affecting the morbidity patterns in nomadic pastoralists: i) proximity to animals, ii) a diet rich in milk, iii) mobility and dispersion with resulting difficulties in getting and maintaining treatment [and prophylactic services], iv) the special environment (hot, dry and dusty), and v) socio-economic and cultural factors including the presence or absence of traditional healers. Epidemic disease outbreaks such as Rift Valley fever, cholera and meningitis can hit them hard given their remoteness and often difficult access also in crisis situations.

Our own studies among mobile pastoralists in Chad showed that no woman or child was fully immunized and pastoralist women had virtually never used antenatal care services¹⁸. Although a myth, national (and international) programs too often think that they cannot be included^{19,20}. The consequence of their exclusion is for example their critical role in wild polio virus transmission - among the five last wildvirus cases in 2012 in Chad, three were among pastoralists ('nomads'). The last pockets of the now eradicated diseases small pox and rinderpest were among pastoralists or

their livestock. Only participatory approaches allowed for reaching these remote communities.^{12,}

¹⁸ Actually, there are more program examples and experiences with provision of formal and informal animal health services for pastoralists than for human health services. This reflects the central role of livestock in the lives of pastoralists but likely also the economic importance of livestock produced in pastoral systems to governments.

Vaccination remains a key community-effective health intervention in human and animal health. There are poliomyelitis- and contagious bovine pleuropneumonia (CBPP)-eradication programmes that need to deal with vaccines requiring a cold chain. This necessitates innovations and adaptation to successfully reach all communities and remaining pockets of disease transmission. Livestock vaccine production could benefit from the more stringent and internationally coordinated quality control applied to human vaccines. On the other hand, public health practitioners sometimes envy their veterinary colleagues who have a public good mandate to vaccinate against epidemic and zoonotic diseases. Veterinary authorities may declare a livestock vaccine as compulsory. Vaccination programs rooted either in the public health and veterinary sectors have hardly exchanged in the past, despite the fact to a large extent they target the same populations.¹⁷

Based on findings of a simultaneous assessment of human and health service needs in Chad, a broad agreement was reached with national and local authorities as well as communities to test joint human and animal vaccination services²¹. We have evaluated with the Chadian authorities joint vaccination campaigns from 2000 through 2005, and showed the feasibility of combining vaccination programs for mobile pastoralists and their livestock. Joint human and livestock vaccination campaigns in Chad were highly appreciated by all involved and have led to increased vaccination and cost savings of sectors due to sharing of infrastructure and resources. Sharing of transport logistics and equipment between physicians and veterinarians reduced total costs (15% of the public health sector).¹⁶ The cost assessment was based on a health and veterinary service perspective to determine the proportion of shared costs between the public health and veterinary sectors; household costs were excluded. The same unit fixed and recurrent costs were used for the joint campaigns, the dispensary-based approaches and the stand-alone veterinary vaccination campaigns. Note that several vaccination campaigns have since been conducted by the PEV. Vaccination records were also incorporated in district reports. However, these campaigns were in same zones that have been targeted before. Still, neither they could rely on more consistent services beyond the duration of donor-funded projects.

During these initial evaluations, we have used the mark-recapture method methodology to estimate the achieved vaccination coverage of children and women by first estimating the population sizes. Sizes of the pastoralist communities were largely unknown. Vaccination cards were used as marks during transect studies one year after the vaccination. The vaccination status of randomly selected persons was recorded. A Bayesian model enabled us to combine population estimates and recapture probabilities to obtain estimated coverages of fully immunized children 0–11 months of age (DTP3/polio3) – between 7% and 14% in two zones and for two years – and of women who received TT2+ - between 11 and 36%. These numbers show those fully vaccinated within one year. No cumulative coverage could be calculated because the total population sizes in the vaccination zones varied between years, although we knew that two-third more children started vaccinated, but dropped-out until full immunization – thus 30% of drop-out each vaccination round. However, these children may have been fully immunized in the next year. These first studies clearly showed the high dynamics with flexible routes of the populations - estimated emigration rates were on average 70% of the total population – and that vaccination cards (the

marking) were lost frequently. We have therefore further evaluated the use of finger-prints for unique identification of individuals (since there are no identification cards to be used). This has improved our estimates (because not only numbers but individuals could be linked), but a drawback still was still the high dynamics of the communities. We only re-encountered few women during random transects (only 5% - 56/1081- of initially registered women were encountered twice). Still, this study allowed to establish other health parameters such as fertility.²⁶ We then started to evaluate the use of randomly selected points and later with the use of mobile phone cohorts.¹¹ In the methods below, we describe the methodology that we think is the most appropriate to evaluate and monitor the stated objectives and expected outputs. Non-regarding the monitoring approach, we could show that more children and women could be vaccinated during joint human and livestock campaigns than human vaccination alone rounds.¹⁶ This because joint services created a larger social event and the men felt also more implied – since they had to drive the cattle to the vaccination sites. These joint campaigns also helped improve understanding of how to set-up a system that alternates between mobile and static health services, because outreach and mobile services alone are not sustainable if they operate independently from static health facilities. Important during all these activities were the iterative stakeholder process (transdisciplinary – see below) and the inclusion of a comparison group.^{21, 22}

In 2012 and 2013, we have conducted 23 focus group discussions with islanders of Lake Chad and pastoralists who were newly targeted for polio mass vaccinations ('left-outs') and have interviewed 35 experts (health, veterinary and education sectors) to identify gaps in reaching the hard-to-reach in Chad with effective and sustainable vaccination programs. Note that in 2011, there was great international attention to polio in Chad that had highest incidence (both WPV1 and WPV3) and one quarter of all cases worldwide. The numbers dropped steeply until zero in 2013. Our results from these surveys were regularly communicated to the national EPI, WHO and their partners. Campaigns among islanders and pastoralists in a border region in the South (border with the Central African Republic) could immediately be implemented. Cameroon and the Central African Republic were notified, but no active collaboration was sought. According to all initially registered children, ~65% of children 0-11 months were reached. It was clear for all involved that the full EPI schedule should be offered and not polio alone – and that such a coverage would not have been possible if not coupled to livestock vaccination. Insufficient access to health and veterinary information was an important issue raised by these 'new' communities. In the past, we have developed information materials -- pictograms (example **Figure 1**) and short movies in the three local languages of Fulfulde, Arabic and Gourane with popular nomadic leaders of the three ethnic groups, health and veterinary personnel, actors and artists. Topics were vaccination, but also e.g. care of sick children or the distinction between prevention (vaccination) and therapy (treatment), since the majority of pastoralists perceived no difference. The showing of information material was accompanied by discussions with health and veterinary personnel.

Figure 1 An information campaign tailored to the nomadic way of life. The sequence of images shows that children are protected against polio, whooping cough, tetanus and diphtheria after only three vaccination shots. An evaluation study showed that having seen these pictograms substantially increased the adult's understanding of human vaccination.



Pastoralists in 2012/13 have accused the inequalities in access and made most useful comments on how to improve the effectiveness (and equalities) of the Chadian vaccination program. They and the experts recommended to use increasingly cell phones for timely information on whereabouts of campaigns and to disseminate more information prior to vaccinations (that is a core task of the Government). The experts appreciated the newly available maps of zones of concentration for planning of campaigns in Central Chad (**Figure 2**) and to identify new priority interventions zones, including agro-pastoralists (mixed livestock-crop farmers). Importantly, they have stated that the joint approach needs to be better formalized and that provincial authorities, district medical officers and regional sanitary coordinators - but also the communities- need to make more efforts in the planning – using some of the new tools that are made available to them. Interestingly, experts mentioned that they need more description about the hardship of daily life of pastoralists and the aspect that some veterinary vaccines protect against zoonoses such as rabies and anthrax in people for advocacy and information of decision makers at central level. In a technical steering committee other Ministries – beyond health and livestock production (line Ministries) - should be present (e.g Zoonoses and Control, Water, Agriculture and Administration), NGOs (e.g. the Committee of Islamic affairs that sensitizes the communities to seek health care and to protect themselves against contagious diseases) and the Presidential Office of Chad – thus there was broad agreement that other national and international institutes need to be involved in national and local steering committees such as local administration and health/veterinary delegates, agriculture to expand to mixed livestock-crop farmers, and finances (even the Ministry of Defense for additional funding) since sufficient means for sustained support of regional health services must be mobilized. Indeed, the President Idriss Deby Itno has taken the lead in improving access of hard-to-reach populations and under his initiative a new Directorate for hard-to-reach populations has been created at the MoH.

Virtually all interviewees sought to work towards more integrated health services (people/livestock and for problems beyond vaccine-preventable diseases such as access to safe water and hygiene [both important for people and animals], distribution of vitamin A capsules, selling of impregnated mosquito nets, fight against Guinea worm - and importantly first steps towards monitoring). A new vaccination policy for farmers and livestock owners should be discussed with neighboring countries. In addition, to truly set up a monitoring/surveillance system we also need to associate NGOs, traditional and local authorities, and international organizations (e.g. WHO, UNICEF) to make better use of existing resources. Major gaps identified were thus a monitoring system that informs about performance and how community-effectiveness can be further increased and a Central African symposium on vaccination of hard-to-reach populations. This proposal is based on most of the stakeholders' recommendations.

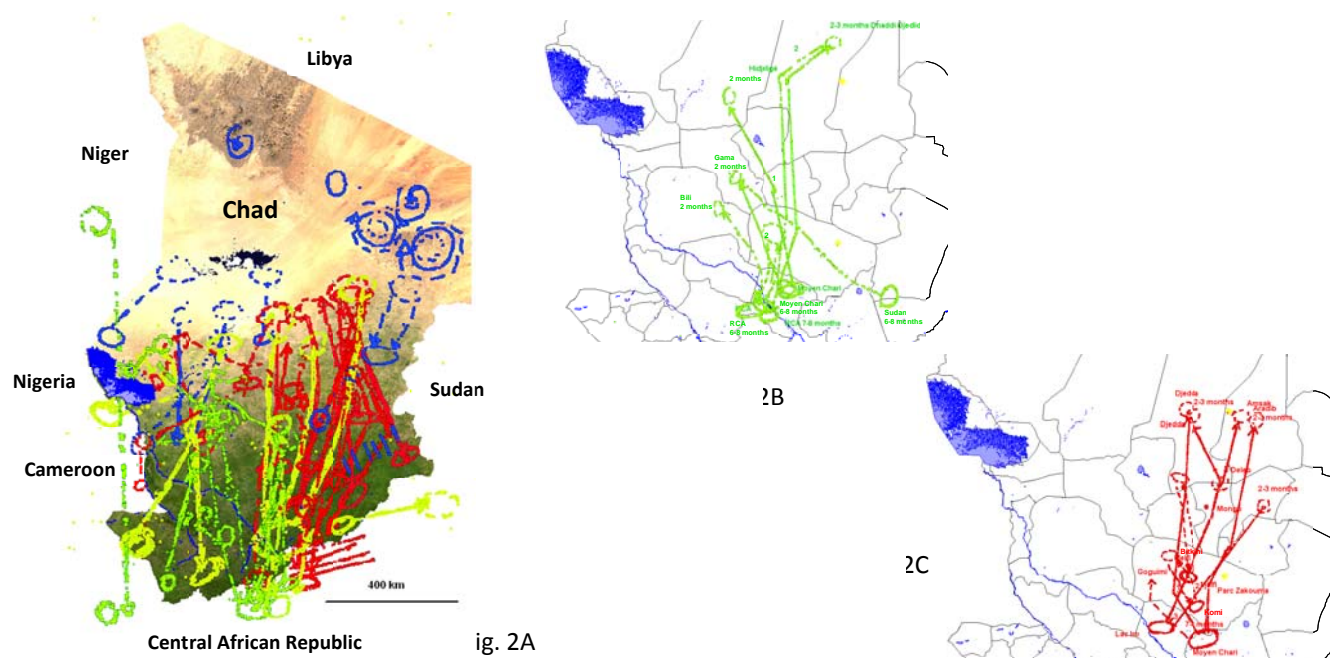
Chad has most experience in the Central African region to reach pastoralists with vaccination programs (but there is space for improvements – particularly towards sustainability and with overall performance as judged by GAVI (**Table 1**)) and neighboring countries can only benefit from Chad's experiences with its partnering with the veterinarians.^{3, 16} Chad has among the Central African countries also the highest relative proportion of pastoralists. The Central African States are low (Chad, Central African Republic, Niger) or lower middle (Cameroon, Nigeria, Sudan) income countries and it is well evidenced that vaccination coverage is correlated indirectly to income (both of countries and of households). For example Cameroon and Chad, DPT3 coverage is 32% and 7%, respectively, in the poorest quintile but 70% and 47% in the richest. Note that Chad and Nigeria are among the 10 countries accounting for 75% of children who either have never received DTP or completed DTP3. Pakistan and Afghanistan or other top 10 countries – all of whom have also important (mobile) pastoralist populations.

Table 1 Key economic, demographic (pastoralist) and vaccination indicators of the six Central African countries according to various sources, particularly GAVI (<http://www.gavi.org/>)

Neighboring country	Income	Pop. mill	DPT3 ^{""}	Comments from GAVI reviews	Pastoralists
Cameroon	Lower middle	23	68%	Cameroon struggles to reach the high influx of refugees from RCA and Nigeria	In Northern Cameroon there is large vast transhumance between Chad and Nigeria
Central African Republic	Low	5	47%*	Weak performance, acknowledgement of proposed extra efforts to reach the mobile pastoralist. Good performance, but geographical inequities, e.g. mobile pastoralists	Cross-border transhumance to Chad other neighboring countries; Current insecurity and conflicts of pastoralists that are moving more and more South
Chad	Low	13	20%		High proportion of pastoralists in all provinces
Niger	Low	19	66%		
Nigeria	Lower middle	179	38%	Management problems	Insecurity in the North-East where many pastoralists are
Sudan	Lower middle	39	59% (2010)	Award given that the DPT3 (WHO/UNICEF estimate) was above 90%	

^{""} last household survey
 *(WHO/UNICEF estimate)

Figure 2 Maps from our consortium on main transhumance routes and zones of concentration of mobile pastoralists in Chad. The different colors show transhumance routes of different ethnic groups (Fig. 2A). Fig. 2B shows transhumance routes and zones of concentration of Fulani pastoralists (green) and Fig. 2C of Gourane pastoralists in the greater Hader-Lamis region as examples of more detailed available maps. Dotted circles indicate rainy season and



Role of adult vaccination within the prevailing need to better reach mobile pastoralists with vaccination programs

We hardly know much about appropriate vaccination schemes among the ‘left outs’. What is the appropriate vaccination scheme for children, adolescents and adults? Pastoralists know about the

most prevailing vaccine-preventable diseases in children, women and livestock – and that vaccines that were highly regarded - exist. They want to have easier access to them. But when designing specific approaches to reach these communities – which services to offer – making greatest use of a first contact? For example, should all presenting themselves be vaccinated against measles? Or only those until 10 years old? All against polio or with MenAfriVac (meningitis A) –both vaccines are available with the EPI in Chad.

We want to explore if adult vaccinations, particularly among men - who were excluded from vaccination services with the exception during meningitis epidemics - would increase overall demand for vaccination services. Men have regularly complained that they were excluded – and the more difficult ones were vaccinated against yellow fever to not endanger acceptance of vaccination services in a family clan. Adult vaccination is a part of integrating delivery of critical health interventions. As for other vaccination services, the delivery must be of high quality, if ever possible demand-based, there must be good data management and monitoring in place and should address equity effectiveness. WHO and partners recommend that one should share more and early what works, more operational research is needed for innovations (e.g. also learn from other sectors) and also the making of the vaccines must be revered (see for example thermo-stable vaccines). Note that our consortium fully acknowledges that strengthening of vaccination services should equally (if not in priority) focus on those communities who are on the radar to approach for re-vaccination (to reduce ‘drop-outs’). However, we now need to also start efforts – as WHO states “to reach the underserved, especially those in remote areas, in deprived urban settings, in fragile states and strife-torn regions.”

Identified gaps

In summary, the gaps we seek to approach are: i) integrated services for neglected communities, ii) innovations needed, iii) all actors can contribute, thus beyond line ministries to reach in the vast Central African regions the ‘left-outs’, iv) no country can do it alone considering mobility, v) good monitoring and data!, vi) seek sustainable approaches, cost-effective and adapted vii) news should be spread widely on what works, and viii) we still need new innovations to increase demands of vaccination services among pastoralists to establish a good mix between mobile, outreach and established fixed vaccination infrastructure.

Beneficiaries

The main immediate beneficiaries of this project are the pastoralists of Central Africa and particularly Chad with the highest proportion. But also the national EPI will benefit – it struggles to reach this populations in its huge territory. In addition, beneficiaries are other sector – such as education – doing efforts in better reaching these communities with social services. Last, also those attempting to increase vaccination services to those least served, including operational research on this topic. Pastoralists in Central African countries certainly are among the most disadvantaged – and this is a main motivation of this consortium to trace new approaches.

b Project Design and Methods

We have conceptualized this project to increase overall knowledge on adult vaccination and on appropriate vaccination scheme among hard-to-reach communities in Central Africa the following activity lines: i) foster regional exchange, ii) studies done during implementation of campaigns to evaluate the knowledge and appropriate and sustainable programs for these communities, iii) prioritize and identify appropriate vaccination scheme during international (regional) and local workshops, and, iv) to establish rigorous monitoring done by the local and national health services.

Foster regional exchange

The project initiates a two regional exchange on appropriate vaccination approaches and schemes for mobile pastoralists, with special emphasis on those crossing borders. The new Directorate for health of hard-to-reach populations of the Chadian MoH will formally lead the consultative workshops together with administrative and organizational support the CSSI and IRED.⁴ The first regional workshop will take place in Month 4 (**M4**) in N'Djaména, Chad. It would be good to have this workshop in a pastoral zone, however, security in Chad and in the region would not allow. The timing will be harmonized so that it does not collide with other major events such as an important WHO EPI meeting.

Official invitation letters will be sent to the EPI and MoH of Niger, Cameroun, Nigeria, Central Africa. We do not (yet) foresee Sudan. Other participants are from the line Ministry of Livestock production (Ministry of Agriculture, Livestock and Fisheries (Direction of veterinary services), Ministry of Education (Direction of nomadic schools), Medical faculty, other MoH Directorates (DGRP, DOSS, DSPELM, DSIS), Institute of breeding, National veterinary services, University of N'Djaména). Invited parties are also - importantly - from international Organizations (WHO, UNICEF, CDC), NGOs (particularly MSF – Médecins sans Frontières) and research institutes (from the public health and veterinary sectors) who pursue research in more thermo-stable vaccines that are better to reach the hard-to-reach communities in hot and remote regions as well as other research and health institutes, funding agencies such as the European Commission and media. The concerned communities from the 3 major mobile pastoralist ethnic groups (Gourane, Fulani and Arabs) are represented by the Association of young pastoralists and delegations of elders. In total, there will be 40 national and 20 international (neighboring countries and from Europe) participants.

During the 2 day workshop, in plenary sessions and moderated breakout sessions the following topics (and objectives) will be covered: i) To launch regional exchange of appropriate vaccination of mobile pastoralists, ii) presentation of obtained results and good practice of approaches tested in Chad, iii) experiences 'what works' from other countries than Chad iv) what is the appropriate vaccination schedule; v) what do we know about adult vaccination and its epidemiology, and vi) how can one harmonize vaccination across borders, e.g. with portable vaccination cards, vii) how could data between countries be exchanged? Finally, cross-border migration and transhumance of pastoral groups in Central Africa is increasingly related to conflicts between pastoralists and local communities given that pastoralism is so important in Chad. Chadian authorities undertook to secure cattle migration roads, amend the pastoral code and reinforce the cattle farming sector¹⁰. Health services cannot be delinked from security aspects and ways to enhance security will be discussed among participants.

By launching a transdisciplinary process we mean a process that allows scientists to engage with stakeholders (e.g. communities and authorities) on a societal-relevant problem field – in this case vaccination. Interdisciplinary research among academic disciplines is one aspect, more importantly is that they link to the society they work. Repeated consultative stakeholder seminars are crucial elements to define priorities of the populations and the authorities jointly – indeed formulating health service priorities from a range of options and readjusting ongoing interventions but also cross-checking the relevance of activities with data from field studies. A priority setting process can start from health system driven approaches – pragmatic in the sense that interventions can be carried out by the health and veterinary services and can be validated by involved scientists – and then move incrementally towards the inclusion of other communities' priorities. An iterative

problem-oriented operation research program can become the interlocutor between pastoralists and the authorities.²² All participants can identify new research and intervention objectives and, if considered, trust and mutual respect can build gradually. The expected outputs and deliverables of this activity line are i) initiate regional exchange, ii) include pastoralist in the process, iii) identify further gaps to be addressed by research or implementation, iv) pre-define a vaccination schedule for 'left-outs' and for cross-border pastoralists, v) agree on future communication managed by two countries and vi) make recommendations on an agreement on a cross-border vaccination zone that is managed by a policy shared by two countries. Such a regional workshop will be repeated in **M25** when some of the recommendations made are implemented in the vaccination campaigns and respective surveys. These workshops are related to the Deliverables **D1 and D6**.

Assessment of knowledge and potential of adult vaccination to increase effectiveness

Vaccination campaigns are set up with local staff in two cross-border pastoralist zones in the South and East and in Central/Eastern Chad (provinces of Batha, Guéra and/or Ouaddaï), where there are large pastoralist communities who have rarely benefitted from vaccination services. The PEV, and IRED will play a central role in providing and bringing the vaccines. The CSSI will organize and harmonize and Swiss TPH will coordinate the collection of data.

The mixed health and veterinary teams provide childhood vaccines (tuberculosis, diphtheria, poliomyelitis, neonatal tetanus, whooping cough, yellow fever, measles, viral hepatitis B and meningitis haemophilus influenzae type B [i.e. meningitis in the newborn]) and tetanus for women as well as the livestock vaccines (such as anthrax, blackleg and contagious bovine pleuro-pneumonia). Meningitis A (MenAfrivac) vaccine is available for young adults (>= 24 years) – upon request or offered to men (who are registered.) To cover the three zones – according to different schedules, we will need 8 months (**M4-M11**), and leads to **D2**.

The mixed teams are accompanied by backstopping personnel will conduct focus group discussions (FGDs) with community members according to an interview guide on knowledge and perceptions of adult vaccination. FGDs will be done with men and women separately and are done in a local language that is well spoken by interviewees and interviewer (commonly Chadian Arabic). All FGDs and interviews are registered with a digital recorder. Transcripts are prepared in French. These are coded and analyzed with the help of MaxQDA (VERBI software GmbH, Germany) that is a software for text analysis that facilitates making codes and categories and also links research notes to the codes - only a tool for organizing the material, not an interpretative software). We plan to have a minimum of 30 FGDs, however, if saturation is not yet reached (e.g. still new aspects and perceptions are mentioned) we will continue with FGDs to evaluate the pros and cons put forward by all actors to expand vaccination programs to other adult vaccinations (such as boosters or first vaccination of measles and DTP, or Rubella for all women. As a comparison community (that we judge important), interviews will also be done with randomly selected adults in N'Djaména who have long-term experience with the national EPI program. This assessment is repeated after the second round of implementation of vaccination campaigns and relates to Deliverables **D2, D3, D4 and D5**.

Community informed consent and of all head (Boulama) of all enrolled pastoralist camps as well as written informed consent of all individuals (with fingerprint and additional witness signature if illiterate) will be sought. We will submit the project for ethical approval to the Ethikkommission Nordwest Schweiz and the newly established ethical committee of the Ministry of Health in Chad. Research authorization will also be obtained (**M2**). Any members of the enrolled camps who

reported being sick will be examined and treated by local health staff or referred to the next health center.

Set-up a monitoring program

To assess an increase of fully tetanus immunized (TT2+) women in childbearing age (15-45 years of age) from 5% to 40%, a survey is needed because the size of the total population is not known. The first (baseline) survey in each vaccination zone is done just as before the vaccination campaign to target the same population as is targeted for the vaccination (before families move outside the vaccination zone). The same survey is repeated after the vaccination.

We consider that randomly selected pastoralist camps include 2-8 with a median of 4 women. All women are enrolled within such a cluster. The cluster sample size calculation is for testing our assumption of an increase of 5% to 40% considers an alpha 0.05 (level of confidence of 95%); power 90% , a design effect of 2.2 and an increase of 20% to correct for those women who said that they had been vaccinated earlier, but have lost their vaccination card and are excluded. The simple random selection sample size is 34 for the baseline and vaccination coverage survey. The cluster sample size calculation further considers an intraclass correlation coefficient (ICC, also called 'rho' - showing the degree of homogeneity within clusters) of 0.4, which is appropriate for a vaccination coverage.^{5, 7} Such a rather high ICC leads to a higher design effect D, indicating that women within clusters are more likely to have the same immunization status than women in other clusters. We multiply the initial sample size with D, and add 20% non-eligible women, resulting in 90 women (2-8 women in 23 camps). Random selection of camps will be done with random points within the designated zone of vaccination. At each point, all visible camps are enrolled. The assumed visibility is 500 meters. Then the team drives for 1 kilometer northwards and starts to drive around the point clockwise. The radius of each point becomes 1.5 kilometers. All camps are visited (in contrast to only the first spotted camp) to not oversample camps in sparsely populated areas (better ensuring that all camps should have equal chance of selection). Local and national services will be fully engaged in this assessment – for training (of GIS, data registration) and management and discussion on future monitoring with mobile phone applications for illiterate users using culturally validated pictograms are further assessed.

Further, in each vaccination zone, four women are randomly selected to be enrolled for follow-up as a family unit. A family unit is a (randomly selected) woman, her husband and their children (of the selected wife alone) and a herd (the husband designates the herd to be included in the study, either his own or of a son). A random number is generated and every 23rd woman is asked if she will do telephone surveys for the next 14 months to assess demographic and health parameters^{11, 16, 24} after first and second implementation of campaigns – and in-between. A family (represented by the randomly selected woman) is equipped with a cell phone. Telephone interviews will be done every 4-8 weeks - in the local language of each ethnic group or in Chadian Arabic. After a phone interview, participants will receive a small compensation (USD 2) of credits transferred to their telephone. The following will be assessed: position of the camp; presence/absence of family members, births/deaths and illness events, utilization of health services (that is compared to baseline data to see if there is an increase of frequency). Randomly enrolled adults can report any more severe ill-health event such as birth-giving problems – and the projects assist the health services to become active. Telephone questionnaire data is double entered in Access and after cleaning of entry errors corrected is analyzed with Stata 12. The assessment after first and second vaccinations – that are different – shall allow the identification of key elements of acceptability and demand.

Identify appropriate vaccination scheme

This activity line is truly a combination of both workshop and the two field study results. Until the second regional workshop we will have analyzed and prepared the field data. The second regional workshop will trigger remaining questions in special working groups. All workshop reports and field data summaries will be discussed among partners (if ever possible also feed-back and discuss with communities) to derive final recommendations for vaccination decision makers in the region but also for all those seeking to reach the 'hard-to-reach'.

c Evaluation Design

We first state here what we expect as outputs during the duration of this project, and below linked to a deliverable (if not already described above, below in more details), before we outline our dissemination strategy and the expected longer term outcomes.

Quantified expected changes

The first output of this operational research relates to the monitoring of routine and supplementary adult immunization activities among mobile pastoralist communities. We expect that the targeted communities had rare (if at all) access to vaccination services in the past. We expect an increase of fully tetanus immunized women (TT2+) in childbearing age (15-45 years of age) from 5% to 40%. This assumption will be tested with a baseline and survey just before and after a vaccination campaign as described above. It will be key to also report on 'drop-outs' – thus women who have received one vaccination but no further. These women (the same is true for children) do not figure in any statistics, despite the fact that they have acquired some immunity (in the case of children and measles full immunity) and that the government has made investments in their basic vaccination.

The second output is on assessed perception on role of adult vaccination. We conduct qualitative surveys (FGDs and workshop reports). The results are fed back to stakeholders during workshops, where a prioritization process is established. The summary of quantitative and qualitative survey and workshop reports will be presented in technical reports that serve as basis to further develop policy briefs and publications. Importantly, we base this data on assessments done over time and include to vaccination campaigns (telephone survey).

Addressing the practice gap

Studies show that rather than taking the traditional approach of initially serving those who are easiest to reach, approaches designed to increase coverage first among disadvantaged groups show most progress towards universal health coverage⁸. This consortium subscribes itself to this focus. We are keen to conduct more operational research particularly on the role of adult vaccination because this represents one part (a other may be cultural acceptance) – to provide incremental benefits to those in greatest need of vaccination services. A comparison group for assessment of what we have seen regarding the role of adult vaccination§ will be central. The approaches we will use are described above.

The big practice gap for us is a central government policy that is appreciated and implemented by district health officers. We are very aware that there are (too) many policies (already sought and implemented by some with little data) and not all are followed or implemented – which is understandable with the forest of policies. This we consider as the most important practice gap. Local health officers and personnel are sometimes in a conflict about what they and should do. Our aim is to base any new recommendation on the needs and experiences of the actors – and approach policy makers with well-rooted information.

Public engagement and Dissemination strategy

We anticipate that this research on potential role of adult vaccination among the ‘lost-outs’ will lead to a better understanding of the links between demands of communities and best offers of national programs. Pastoralists in Central Africa are the primary beneficiaries and we consistently seek their collaboration and inputs into the process from research to action, through qualitative key informant interviews and health center based surveys, to discussions on policy in the light of pastoralism, economic viability and sustainability, and environmental, social and institutional risk for vaccine preventable diseases.

Our aim is to contribute to bridging the divide between health services and daily livelihood struggles of pastoralists to support vaccination efforts by district Health Services and National Ministries of Health. We will produce policy briefs, reports and open access peer-reviewed publications. However two areas we believe are highly important in the process i) public engagement in developing health policy relevant to pastoralists and other neglected populations, and ii) cross-border bi-lateral communication between Chad and its neighbors to develop collaborative strategies to address pastoralist health. The products of our research can be used by local health and veterinary managers, governmental and non-governmental health and livestock production, environmental and pastoralist organizations. Particularly, they should inform policy at the sub-national, national and regional level.

Dissemination of the results and products will be through newly established sub-national and regional contacts between the health systems and representatives of pastoralist communities developed during consultation workshops, and through national and international research conferences.

Our working group has extensive experience and guidelines for producing policy briefs. Importantly, all communication is careful to not stigmatize and contribute to further marginalization of already often vulnerable pastoralist populations. By providing specific policy input through policy briefs we will emphasize the need for Central African countries to provide access to health services for pastoralists in order to also improve the health conditions of their national population. Dissemination mechanisms should lead to increased healthcare services (primarily vaccination of people and livestock as well as appropriate adapted health information) and benefits for pastoralist and remote populations, particularly in areas with high pastoralist mobility.

In addition, relevant national and sub-national services and also peripheral agencies such as education will be informed of the study goals and expected results. Upon finalization of the research analysis, and the results and evidence on the relationship between daily livelihood and vaccination, we will organize a second consultation workshop with sub-national, national and regional experts on vaccination and integrated services. Through this mechanism we will have input on the focus of the policy briefs to be prepared, which will assist in drafting relevant recommendations for health and pastoralist policy communications. We have reserved budget lines for workshops and for dissemination of results.

Workplan and Deliverable Schedule

The total duration of the project is 30 months starting 1. January 2015 and ending June 2017. We will use the first month between notification and start to prepare agreements and research and ethical approvals. The project is divided in first year's activities with the first regional workshop

and evaluation of campaigns (**M1-M14**) and a second phase with repetition of campaigns and their assessment and a second workshop (**M15-M25**). The last 4 months are used for synthesis reports and publications (**M26-30**). Vaccination campaigns and field surveys need to consider seasonality and transhumance routes/zones of concentration for best timing of activities.

Activity	Months	Del. no	Deliverable	Del. month
Signing of agreements	M1			
Submission of research and ethical approval	M2			
Preparation of field studies and workshop	M2-M3			
First regional workshop	M4	D1	Detailed workshop report	M5
Implementation of vaccination campaigns	M4-M11	D2	Summary report on progress of campaigns	M12
Assessment of achieved coverage (TT2+)	M4-M11		First detailed technical report	M12
Qualitative evaluation of knowledge and perceptions (FGDs)	M4-M11	D3	Summary report of qualitative data from the field and with further analyses workshops discussions	M14
FGDs in comparison groups in N'Djaména	M12			
Telephone follow-up survey	M5-M20			
Second Vaccination campaigns and surveys	M15-M19	D4	Intermediate progress report	M22
Analyses of overall qualitative and quantitative data		D5	Second technical report	M24
Second regional workshop	M25	D6	Workshop report	M26
Communication and publications	M26-M30	D7	Manuscripts	M30
Final technical and financial report	M30	D8	Third technical report	M30

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