

Measles Immunization Research Western Lake State, South Sudan

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Abstract

Most global estimates indicate that more than 1 million children a year die from acute measles. The actual number of deaths may, however, be considerably higher than this. In addition, the impact of delayed mortality as a result of measles infection is only now being realized. Many months after they contract measles, children continue to experience higher levels of mortality and morbidity than those who do not. Immunization of children against measles therefore prevents mortality and morbidity not only during the acute phase but also during subsequent months. The impact of measles immunization programmes may therefore have generally been underestimated. The effects of measles infection on children during the early months of life are more damaging than those experienced by older children. Children should therefore be immunized against measles as early in life as possible, given the limitations of existing vaccines.

As per DHIS, measles coverage amongst children below one year achieved in the first 10 months of 2018 is 56%. This is slightly lower of what was reported in previous years (going back to 2015, when CUAMM started working in Rumbek East) In a context as South Sudan, where several households live far from the nearest Health Facilities and are used to nomadic habits, it is common for children to access EPI services later than the regular immunization schedule, which stipulates getting vaccinated against measles after the first birthday. However, even merging U1 and U2 vaccinated children, the coverage of U5 population remains extremely low, not surpassing 30%.

Keywords: Expanded programme on Immunization, Vaccinated, Children Under five, measles coverage, Rumbek East, Western Lake state.

Introduction

The WHO Expanded Programme on Immunization (EPI) estimates that 1.6 million children die from measles each year in developing countries (excluding China), making it the biggest killer among the six EPI target diseases. Other workers have estimated that measles is responsible for 0.9-1.5 million deaths per year in developing countries (1, 2). Globally, around 70 million cases occur annually. Opinion has varied not only as to real death toll from measles but also about the value of immunization against the disease. Since, on the one hand, measles mortality is usually associated with both poor living conditions and malnutrition, it has often been suggested that the disease mostly kills children who, in any case, are likely to die from other infections (3, 4). In consequence, measles immunization may increase child survival only to a limited extent, if at all, because prevention of deaths from measles through immunization may result in children surviving, only to die from other causes. On the other hand, many children are weakened and become malnourished after measles infection, so that the disease may lead to excess delayed mortality (5, 6). If so, the number of children who survive because of being immunized should exceed the number of acute measles deaths that are prevented. These contrasting hypotheses have implications for the emphasis given to measles control within primary health care programmes and have prompted us to undertake this review of the available data on the case fatality rates for measles and the mortality impact of measles infection and measles immunization.

Methods Mortality from measles

Magnitude of deaths from acute measles Official estimates of the number of deaths from acute measles infection may be too low. EPI calculates that the case fatality rate (CFR) for acute infection among persons of all ages in developing countries is 2-4%, that the CFR throughout Africa and Asia is 3-4%, and that it is 2% in the majority of countries in South America. It is very difficult, however, to estimate the rate in many of these areas because registration of cases is unreliable. Data from longitudinal community studies indicate that the CFR ranges from 34% to 0% in rural Africa (7-11, 20, 21), b from 21% to 6% in urban Africa (4, 12, 13), and from 5% to 0% in other studies (14-19). With few exceptions (16, 18, 19, 21), CFRs from these longitudinal community studies are higher than EPI estimates, at least during the initial stages of an investigation (20, 21). In particular, for Africa, the difference between official estimates and the observed CFRs is considerable. Notably, for West and Central Africa, mortality from measles in the community may well be two or three times higher than the estimated 3%. Delayed Impact on mortality and morbidity Available data strongly suggest that children who have previously been infected with measles have a significant excess morbidity and mortality compared with community controls. If measles should continue to have an effect on a child after the period of acute infection, it may have a considerably greater influence on mortality than is usually assumed (5). Unfortunately, very few studies have examined the impact of previous measles infection on later morbidity and mortality, and in those that have, the comparison between previous cases and controls is associated with serious methodological problems. Hull et al. reported an outbreak of measles in a village in the Gambia which they re-visited 3 and 9 months later to assess the impact of the disease (22, 23). The results indicated that for children who had contracted measles, the excess risk of dying after the acute infection was highly significantly greater than that of community controls. Deaths were distributed throughout the 8-month follow-up period. The excess mortality seemed to be particularly high for the children under 1 year of age. Other studies in the Gambia (24), Nigeria, c and Burkina Faso (25) suggest an increase in mortality for some months after infection with measles. Furthermore, a study in Guinea-Bissau (6) has reported that the excess mortality extends also to the following year; similar observations of excess mortality that was delayed for more than a year were also made in Guinea-Bissau

Methods optimum age for immunization

The delayed effect of contracting measles at under 1 year of age is particularly marked (6, 22).h Also, reduction in mortality is particularly impressive in children who have been immunized at a young age (4, 6, 32, 35).e While these observations need to be studied further, the available data add another dimension to discussions of the appropriate age for immunizing against measles in developing countries. The evidence suggests that measles in the very young must be prevented at all costs. It has been a common expectation that as immunization coverage becomes greater, the average age of children who are infected with measles would increase, and, at the same time, the risk of exposure before 9 months of age would diminish considerably (40). Were this to be the case it might be possible to raise the age of immunization to 12 months, when seroconversion is more efficient (41). However, these expectations have not always been fulfilled. Studies indicate that, in urban African areas with immunization programmes, as many as 20-45% of measles cases occur among children aged under 9 months (40, 42, 43). In such circumstances, between 5% and 10% of children may contract measles before the age of 9 months, which is similar to the proportion of cases among under-9-month-olds in community studies carried out in areas where immunization has not been introduced (30, 44). It is disappointing that, at intermediate levels of immunization coverage, no major drop occurs in the risk of measles infection for children under 1 year of age. Model studies by McLean & Anderson (45) predict that even high levels of coverage in older children may not be protective for those aged under 9 months in environments where transmission rates of measles are high. There is a need for further studies of the incidence of measles in children under 9 months of age, of the factors that contribute to the high risk of transmission in this age group, and of interventions to reduce the transmission among such children. For the present, it therefore seems

unrealistic to expect that the recommended age for measles immunization can be raised; however, there is every reason to pursue strategies that would lower it. One of the most attractive alternatives is a one dose vaccine that can be used to immunize children aged 4-5 months or younger, even in the presence of maternal antibodies. The Edmonston-Zagreb measles vaccine holds such a prospect, and there is increasing evidence that it is more immunogenic than the Schwarz vaccine (46-49). However, before the Edmonston-Zagreb vaccine can come into general use, further studies are needed of its clinical efficacy in children aged under 9 months, including investigations of the optimal dose and the optimal age to administer it (50). Until alternative measles vaccines become available, a viable strategy might be to use a two-dose immunization schedule for areas where measles transmission is high-the first dose being given probably at 6-7 months of age and the second at perhaps 9 months. Although initial predictions obtained in model studies suggest that no benefit is to be gained by adopting a two-dose schedule (45), further investigation is clearly required.

Problem statement



At the beginning of October 2018, few suspected measles cases were identified in Mabor Duang Village, Aduel Payam, Rumbek East County, Former Lakes State. The number has increased in early November, reaching a total of 15 (with one death). Samples have been collected and sent to Juba for confirmation, which was positive for nine cases. An official Measles outbreak declaration has been issued.

As per DHIS, measles coverage amongst children below one year achieved in the first 10 months of 2018 is 56%. This is slightly lower of what was reported in previous years (going back to 2015, when CUAMM started working in Rumbek East), however a careful process of past EPI data validation is ongoing, since CUAMM discovered various cases of number inflation. Regardless, coverage never went above 75%, leaving the infant population extremely vulnerable to outbreak (highly likely where immunization coverage remains below 85%). In a context as South Sudan, where several households live far from the nearest Health Facilities and are used to nomadic habits, it is common for children to access EPI services later than the regular immunization schedule, which stipulates getting vaccinated against measles after the first birthday. However, even merging U1 and U2 vaccinated children, the coverage of U5 population remains extremely low, not surpassing 30%.

The reasons behind such concerning situation are various. Rumbek East is characterized by a high level of insecurity, preventing both people from accessing health facilities and health staff to provide static and

outreach services on regular basis. These constraints to population and health personnel mobility have an even worse impact in this County because of its peculiar population distribution features. Rumbek East is the second most populated County in the State and has the highest number of facilities, however they are concentrated along the main road, quite close each other, leaving wide areas completely unserved. Half of vaccinated children are reached by mobile teams, but there are not enough to cover the entire target population. Finally, Rumbek East is crossed by groups moving from one County/State to another, as part of their usual seasonal migration pathway or to escape fighting/clashes. These are mainly cattle keepers and their families, rarely accessing routine preventive care and therefore more prone to bring infectious diseases to an already vulnerable hosting population.

All this considered, a massive vaccination campaign targeting U5 is not only the best (internationally recognized) way to respond to an outbreak, but it might be seen as an alternative strategy to integrate static and outreach services, in the attempt of expanding the coverage and therefore preventing further outbreak.

For this reason, it was decided to extend the mass vaccination campaign to the payams of other counties bordering with Rumbek East, namely Mapourdit, Gheer, Aluakaluak in Yirol West and Makundi in Wulu County (Rumbek Centre was not considered as it was targeted by the same activity last June). Since the beginning of 2018, both Yirol West and Wulu have achieved a measles coverage above 85%, however vaccinated children are not uniformly distributed and there are areas where several U5 have not accessed immunization services. Further, these areas are often those more affected by population movements and therefore more exposed to contacts with infected people.

CUAMM is the implementing partner for health system support in Rumbek East, Yirol West and Wulu Counties, in the framework of Health Pooled Fund program. The program is to sustain routine, rather than emergency services, and its resources are limited. CUAMM cannot cover extraordinary and quite expensive activities as mass vaccination campaigns. CUAMM does not have additional resources to mobilize for this purpose.

Coordination

Since the moment suspected cases were notified, CUAMM has engaged a discussion with the Health Cluster, both at National and State level, for defining the response to be put in place. Being Rumbek East Implementing Partner for Health, CUAMM is the organization responsible for coordinating any action related to this sector, looking for partners able to respond or for funds to implement it directly. It contacted HPF to ask for Emergency Preparedness and Response funds, but it was told it would have not been possible to access them. It contacted Medair, which have intervened in June in Rumbek Centre for similar purposes, successfully cooperating with CUAMM in responding to another measles outbreak, but Medair confirmed it is not in conditions to do the same in Rumbek East at this point in time. RRF remains the only way to go through for being enabled to respond to this emergency, containing it before further spreading.

State Ministry of Health and concerned County Health Departments are being on board since the beginning of the above described process, as leading actors for all Health/Nutrition interventions taking place in the area. CUAMM pays particular attention in guaranteeing local authorities' full involvement and first line role and it has formalized this commitment by signing a three years Memorandum of Understanding with the SMOH, where it recognizes Ministry ownership over the Health System CUAMM is supporting.

For the Social Mobilization Component, CUAMM has linked with CHADO, a local NGO with specific expertise on community-based activities and with an existing network of Boma Mobilizers who will help in spreading the message related to the campaign. The past experience during Rumbek Centre and Yirol East Measles Campaigns were positive and encourage the two organizations to strengthen further their cooperation in the field. CHADO will operate autonomously, in terms of funds, but under SMOH/CHD/CUAMM overall coordination.

Program goal

To contain measles outbreak in Rumbek East County and prevent its spread in the neighboring Counties (Yirol West and Wulu) by improving U5 children access to vaccination through a massive immunization campaign.

Activities (see also Log frame below)

All medical supplies and pharmaceuticals will come from the Health Cluster core humanitarian pipeline. No RRF funds will be used to purchase pharmaceuticals.

The present project will consist of organizing and implementing a massive immunization campaign in Rumbek East County and in selected payams of Yirol West and Wulu Counties, Lakes State targeting the Under 5 population. The measles vaccination campaign will offer, especially to those who were left behind during the previous campaigns and newcomers because of the migratory season, the possibility of being vaccinated against measles. Properly implementing this campaign, ensuring the widest possible coverage and adequate quality level, will be the first step to stem the current outbreak, not only in terms of expanding the immune population but also of increasing the population's awareness about the importance of vaccinating children. For this purpose, CUAMM is involving WHO and UNICEF, trying to maximize their added value on mobilization and technical supervision and is linking with a local NGO operating in the area of social mobilization.

-29 Supervisors for Vaccination Teams (called "Team Supervisors"), each one will supervise three teams (86 teams in total, made up of five people each, resulting in 430 people directly involved in the vaccination activities)

- 12 Payam Supervisors, each one of them supervising activities in 1 Payam (12 payams covered by the campaign)
- 6 County Supervisors, 2 per County (three counties covered by the campaign)
- 3 Cold Chain Technician, 1 per County (three counties covered by the campaign)

A State task force will be established for the overall management and coordination, with a total of four State supervisors and three Cold Chain Technicians distributed over the area concerned by the Campaign.

Team/Payam/County Supervisors and Cold Chain Technicians will attend a two-day training (ToT) on the purpose of the campaign and their role within it. The training will be facilitated by the State Supervisors and Cold Chain Technicians, supported by CUAMM's technical staff (Public Health Expert and Public Health Nurse) and by UNICEF, who will provide the materials. Training contents will follow UNICEF standardized modules. CUAMM's technical staff will ensure the State-level teams are adequately mentored concerning the role they will play. The Training will take place in each counties' Headquarters.

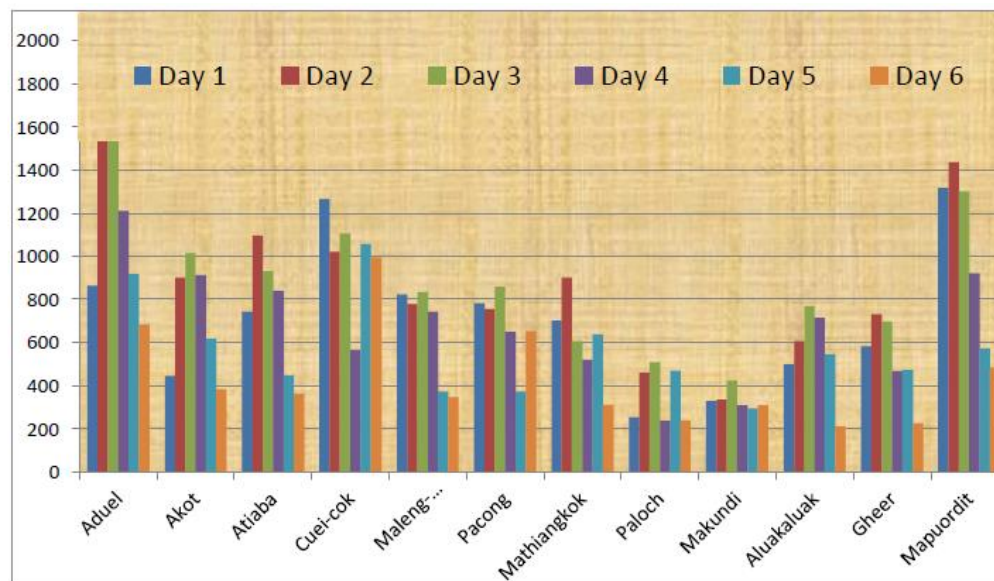
Results

Friedman ANOVA comparison of in each of the three counties A total of 6 Days' data for Measles Immunization 6-59 Months prevalence were extracted from the questioner, for each of the three counties, Collected 6 days.

Table 1. Data for Measles Immunization 6-59 Months

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Aduel	863	1846	1829	1210	918	684
Akot	445	902	1015	914	618	384
Atiaba	744	1095	930	838	449	362
Cuei-cok	1265	1021	1105	566	1057	995
Maleng-Agok	823	780	834	743	373	348
Pacong	781	754	858	650	373	653
Mathiangkok	702	901	607	521	637	312

Paloch	253	461	508	238	470	239
Makundi	329	335	425	309	295	310
Aluakaluak	498	607	770	715	547	210
Gheer	583	730	698	468	472	225
Mapuordit	1317	1437	1299	921	574	485



Discussion

Expected quantitative results

- 29 Team Supervisors Trained (each person chosen to be a Team Supervisor expected to supervise three vaccination teams)
- 12 Payam Supervisors Trained (each person chosen to be a Payam Supervisor expected to supervise one Payam)
- 6 County Supervisors Trained (each County expected to have two people as County Supervisors)
- 3 County Cold Chain Technicians Trained
- 4 State Supervisors Mentored
- 3 State Cold Chain Technicians Mentored

Expected qualitative results

The campaign implementation will be closely monitored, to ensure its adherence to the recognized international standards.

Identification and Training of Vaccination Team Members

CUAMM will form 86 Vaccination Teams. Each Vaccination Team (VT) will be expected to vaccinate 600 children (considering each team should have capacity to vaccinate 120 children per day), reaching a total of approximately 51,600 children. Every VT will include two vaccinators, one recorder, one crowd controller. They will attend a two-day training, facilitated by their Team Supervisors who are under the overall monitoring of State Supervisors. The training will take place in the same locations Vaccination Team members are from and they will be asked to implement the activities. Training contents will follow UNICEF standardized modules.

- 172 Vaccinators Trained
- 86 Recorders Trained
- 86 Crowd Controllers Trained

Expected qualitative results:

The campaign will be implemented as per the recognized standard (Supplemental Immunization Activities Field Activities Guidelines, issued by the MoH in cooperation with WHO and UNICEF).

The vaccination team members will promote routine vaccination schedule adherence even beyond the time of the campaign, spreading EPI knowledge and awareness deep in the field.

Campaign logistic preparation

In the two days preceding the beginning of the campaign, the State Ministries of Health will receive all the needed supplies from UNICEF and WHO, and CUAMM will support their distribution to the 12-targeted payams. The Cold Chain Technicians at State and County levels will guarantee the needed fridges are fully functional and set at the right temperature from the moment vaccines will reach the field, up to the end of the activities and for the time required to have enough ice packs for vaccine carriers and cool boxes. Fuel will be provided to run the fridges.

Expected quantitative results:

- 86 Vaccination Teams daily provided with adequately refilled vaccine carriers

The vaccines will be stored at the right temperature in all phases of the campaign and in all places, they will be transported, as per required quality MoH standard.

Conclusion

The campaign last six days, five vaccination days with an additional mop up day for going back to those areas where children were missing or where supervisors noticed some mistakes in the conduction of the activities.

Each Vaccination Team will be given an area to cover and a map defining the sites to be based each day prior to starting activities. In each site they will set up a sort of temporary vaccination post, where families will bring their U5 children. Each child will be vaccinated and screened for malnutrition with the use of MUAC tape. While the two vaccinators will perform these functions, the recorder will keep track of all access by filling the tally sheet and the crowd controller will organize the people approaching the post. The recorder will fill also the forms related to MUAC screening results.

This modality constitutes a reasonable compromise between the household vaccination (quite time and resource consuming, while contributing passive attitude towards service delivery) and the facility-based immunization program (with several families living too far to access them).

The Team Supervisors will closely follow the team under their responsibility, while Payam, County and State Supervisors will move over the entire territory they are referees for using motorbikes and vehicles made available for this purpose. Each evening, a debriefing meeting will be held at the different levels to analyze the conducted work and identify weaknesses and lessons learned to be addressed in the following days.

Expected quantitative result

- Mass Measles Vaccination Campaign implemented in 12 payams, distributed over three Counties of former Lakes State
- 344 volunteer staff engaged in field vaccination activities for six days (namely 172 vaccinators, 86 recorders, 86 crowd controllers)
- 63 supervisors and technicians engaged in monitoring activities for six days

Expected qualitative result

The mass measles vaccination campaign will be completed as per agreed schedule and covering the agreed geographical area, reaching the estimated target number of U5 children.

Campaign's data collection, reporting and analysis

At the end of each day, Team Supervisors will collect and go through the filled tally sheets, using the findings (on vaccines used and waste, on target population achievement rate) to inform the discussion during that day's debriefing/following day briefing meeting and support orienting the Vaccination Teams on how to improve their work. At the end of the campaign, Team Supervisors will be asked to bring all the filled tally sheets to the County Headquarters, where they will take part, together with the other supervisors, in data consolidation and transmission to the relevant authorities, donor, and Health Cluster.

Expected quantitative result

- 1 campaign report compiled, validated and disseminate

Concerned counties and State will have a comprehensive view of the measles immunization status in their area, to be used for planning further vaccination and booster activities.

Independent campaign monitoring and assessment

Two weeks after the campaign, a team of three independent monitors will be deployed to conduct two-day field supervision, aimed to confirm mass vaccination has been implemented as proposed, from a quantitative and qualitative perspective. In addition to this, WHO, UNICEF, and RRF monitors will move across the targeted areas to verify fieldwork is being conducted as expected.

Expected quantitative result

- 1 independent assessment report available

Expected quantitative result

Concerned counties and State will have technical feedback on the quality of the work they have conducted, to be used as lesson learned for improving further on these kinds of activities and to achieve better results during future campaigns.

Community health education and behavior change

Inclusion and training of County Social Mobilizers in campaign coordination and supervision mechanism

To ensure the widest possible response from the target population, social mobilization referees will be included in the multilevel mechanism of coordination and supervision to be established as described above. Each County will have one Social Mobilization Supervisor to plan and define the social mobilization activities to be conducted before and during the campaign. The County Social Mobilizers will communicate with the 86 Social Mobilizers the planned activities to mobilize the communities for the campaign. They will join the Team/Payam/County Supervisors and Cold Chain Technicians during the two-day training for instruction on the purpose of the campaign and explanation of their role within it.

Expected quantitative result

- 3 County Social Mobilizers Trained

Expected quantitative result

The specific social mobilization/communication component will be an integral part of the vaccination campaign.

Identification and Training of Social Mobilizers to be included in the Vaccination Team

In each Vaccination Team (constituted as described above), a Social Mobilizer will be included. They will join the other Vaccination Team members at the two-day training facilitated by their Team Supervisors, under the overall monitoring of State Supervisors.

Expected quantitative result

- 86 social mobilizers Trained

Expected quantitative result

The information on campaign schedule and contents will be timely and widely disseminated, covering the entire target area.

The social mobilizers from vaccination teams will constitute a potential critical mass at the community level to promote routine vaccination schedule adherence even beyond the time of the campaign, spreading EPI knowledge and awareness deep in the field.

Pre-Campaign Information and Sensitization Program Implementation.

In the two days preceding the beginning of the campaign, a vehicle, rented for this purpose, will move along the main roads and crossing the main villages in the concerned area, with a megaphone announcing the campaign schedule and sites, calling families to bring their children for vaccination. In the same two days, a daily radio message will be transmitted, explaining the reasons why a vaccination campaign has been organized and the importance of children being vaccinated (accessing both campaign's team and routine EPI services) and radio spots will remind all listeners of campaign schedules and stations. These spots will continue in the following 6 days as well. To ensure these messages to reach also the most remote villages, CUAMM has linked with CHADO, a local NGO with a wide network of boma-based mobilizers; bicycles will be rented for their use and will be instructed to go house-to-house informing community members about the upcoming campaign.

Expected quantitative result

- 44 Boma Mobilizers engaged in campaign preparation.
- 2 Radio Talks transmitted on the campaign purpose and schedule.
- Radio Spots broadcast for 8 day on campaign purpose and schedule.

Expected quantitative result

Targeted population will develop better knowledge and deeper awareness on importance of vaccines and relevance, being encouraged to access not only campaign related vaccination posts, but also routine EPI services in the future.

Social Mobilization during Campaign Implementation

The campaign will last five days, with an additional mop up day, for going back to areas where children were missed or where supervisors noticed some mistakes in the conduction of the activities.

During the five days of regular campaign implementation, each VT will count on the presence of a Social Mobilizer to precede the Team to the vaccination posts. They will be required to start early morning to mobilize people, reminding them of the coming vaccinators and explaining the reason why the campaign is important. His /Her work will begin one day before the campaign launch, to prepare the field by informing the local population about the impending activities. They will be provided with basic IEC materials and megaphones.

Expected quantitative result

- 86 social mobilizers staff engaged in field vaccination activities for 6 days

Expected quantitative result

The mass measles vaccination campaign will be completed as per agreed schedule and covering the agreed geographical area, reaching the estimated number of U5 children.

The campaign last six days, five vaccination days with an additional mop up day for going back to those areas where children were missing or where supervisors noticed some mistakes in the conduction of the activities.

Each Vaccination Team will be given an area to cover and a map defining the sites to be based each day prior to starting activities. In each site they will set up a sort of temporary vaccination post, where families will bring their U5 children. Each child will be vaccinated and screened for malnutrition with the use of MUAC tape. While the two vaccinators will perform these functions, the recorder will keep track of all access by filling the tally sheet and the crowd controller will organize the people approaching the post. The recorder will fill also the forms related to MUAC screening results.

Table 2. Activities work plan

Month 2018	Oct-2018				Dec -2018			
Week	1	2	3	4	1	2	3	4
Activities (list below)								
Activity 1.1: Definition of State/Payam/County Supervision mechanism, identification and training of supervisors/referees for the various campaign's components			x					
Activity 1.2: Identification and Training of Vaccination Team Members			x					
Activity 1.3: Campaign Logistic Preparation			x					
Activity 1.4: Campaign Implementation				x				
Activity 1.5: Campaign's data collection, reporting and analysis				x				
Activity 1.6: Independent Campaign Monitoring and Assessment						x		
Activity 2.1: Inclusion and training of Social Mobilization Referee in campaign coordination and supervision mechanism			x					
Activity 2.2: Identification and Training of Social Mobilizer to be included in the Vaccination Team			x					
Activity 2.3: Pre Campaign Information and Sensitization Program Implementation			x					
Activity 2.4: Social Mobilization during Campaign Implementation				x				

General instruction

Because investigating an outbreak requires many person-days of work, personnel are frequently transferred to the activity from other areas in the health department or from other health departments and may only be involved in outbreak investigation for a few days before they are replaced by others. This turnover in personnel can cause problems unless activities are organized so that the status of the investigation is documented at all times. Some practical suggestions for organizing this activity are listed here. Identify a team leader for case investigators so that at least one person knows about all the new cases called in that day and what still needs to be done. Daily briefings are a good way of keeping the whole staff informed of the status of the investigation. Use a logbook (electronic spreadsheet preferred) to record all suspected cases as they are received. The person who receives the initial telephone call should attempt to obtain the information needed to fill in the line listing. Create a column in the logbook for actions needed for each suspected case ("draw blood," "call pediatrician for vaccination history," "notify contacts"). Keep the logbook in one well defined location, preferably with folders containing the case investigations of all the cases that have been reported. It is useful to have one stack of all confirmed cases, one stack of suspected or probable cases awaiting further investigation or lab results, and a separate stack of discarded cases. Establish protocols for control measures necessary for all likely situations (exposure in

a childcare center, school, doctor's office, workplace) and clearly define who (local health officer, immunization program manager) will make the decision to proceed when a case investigator identifies a situation that might require major investments of health department resources (such as vaccinating an entire school).

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