بسم الله الرحمن الرحيم

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Measles epidemiological changes in children under five years old in Shendi Town

A thesis submitted in fulfillment of The requirement for M.Sc of public health

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بسم الله الرحمن الرحيم

الآيـة

قال تعالي :" وَلْتَكُن مِّنكُمْ أُمَّةٌ يَدْعُونَ إِلَى الْخَيْرِ وَيَأْمُرُونَ بِالْمَعْرُوفِ وَيَنْهَوْنَ عَنِ الْمُنكَرِ وَأُوْلَـئِكَ هُمُ الْمُفْلِحُونَ".

الاية (104) من سورة ال عمران

Dedication

- The essence of like meaning of humanity, and fight by honor to put on the candle of freedom on the darkness of ignorance.

And though me how to be available member in the community,

My Dear Mother: Fatima Abdu Rahman

- The one I love, respect and make the life easy and beautiful for me

My Dear Father: Ata Elfadeel Mohammed

May Allah rest their souls in heaven and be merciful to them as they were to me in my childhood.

Acknowledgment

- All Thanks to my ALLAH from the start and the end………
- I would like to acknowledge the contribution of my honest supervisor

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Who guide me and his continuous support in the thesis program.

- For my teacher who did not know nothing about hate and sadness and contribute his efforts to help me

Atejani osman Musa .

- And I am grateful to all those who contribute by their time and efforts to Help me and make this thesis as accurate and use full as possible.

= Finally, my thanks also extended to my teachers, brothers, sisters, colleagues and friends.

Abbreviations

Abbreviation	Term
AIDS	Acquired Immune Deficiency Syndrome.
AIM	Advanced Immunization Management.
HIV	Human Immunodeficiency Virus.
ARC	American Red Cross.
CDES	Communicable Disease Epidemiology Section.
EPI	Expanded Program on Immunization.
GMS	Global Measles Strategy.
IMCI	Integrated Management of Childhood Illness.
ISG	Immune Serum Globulin.
MDG	Millennium Development Goal.
MEFG	Measles Elimination Field Guide.
RIA	Routine Immunization Activities.
SIAs	Supplementary Immunization Activities.
SPSS	Statistical Package for Social Science.
SVA	Supplementary Vaccination Activities.
U.N	United Nation.
U.N.F	United Nation Foundation.
U.R.T	Upper Respiratory Tract.
U.S.CDC	United State Centers for Disease Control.
WHA	World Health Assembly.
WHO	World Health Organization.

English Abstract

- Measles is one of the infectious diseases caused by genus Morbillivirus of the Paramyxoviridae family and is still a serious public health problem worldwide,
- This descriptive-cross sectional study conducted in Shendi town during the period of April 2013 to January 2015 aimed to study the Measles epidemiological change among children under five years old,
- 210 households with 210 children were selected from study area using WHO guidelines for cluster sampling and simple random sampling technique. Pre-designed questionnaires and check lists were used to collect the data of measles prevalence among under five years old children by interviewing their mothers and caretaker on their immunization status, health status, and other measles associated factors,
- The study revealed that out of (36%) were under one year old, while Among those(210 of children) 73% were fully immunized, 20% were partially immunized while 7% of them never received any vaccination. The result also showed that 21% of children were infected with the measles disease, while 79% were not. 69% of immunized children were infected with the disease, while only 31% unimmunized children infected. The study also highlighted the prevalence of disease among under five years old children which was reported to be 43% due to reluctant of parent, poor nutritional and health status of the children,
- The study recommended that every family should be health education by health workers to take their children to the nearest

health centre for immunization and to ensure that every child receive one dose of measles vaccine at nine months of age, health education messages should be given regularly by health workers to the families and all communities members, strengthening community participation in immunization activities, early detection and treatment of measles cases and proper cases management along with supplementation of Vitamin A to avoid serious measles complications.

ملخص البحث

الحصبة هي واحدة من الأمراض المعدية التي تسببها فيروسات من عائلة الفيروسات المخاطانية ولا تزال تمثل مشكلة خطيرة على الصحة العامة في معظم أنحاء العالم.

هذه الدراسة الوصفية المقطعية أجريت في مدينة شندي في الفترة من أبريل 2013 إلى يناير 2015 بهدف دراسة وبائية مرض الحصبة بين الأطفال دون سن الخامسة. وقد تم اختيار 210 أسرة و 210 طفلا من منطقة الدراسة باستخدام تقنية العينة العشوائية البسيطة ودليل منظمة الصحة العالمية للعينة العنقودية. تم استخدام إستبانة مصممة مسبقا لهذا الغرض، كما تم استخدام القوائم لجمع المعلومات عن انتشار الحصبة بين الأطفال دون سن الخامسة ؛ من خلال مقابلة أمهاتهم والمسؤولين عن تسيير الأعمال في برنامج التطعيم، والحالة الصحية، وغيرها من العوامل المرتبطة بمرض الحصبة.

وكشفت الدراسة أن من بين 210 طفلا، (36٪) كانوا في عمر أقل من عام. وكما أن من بين هؤلاء (210طفلا) 73٪ تم تحصينهم بالكامل، كما تم تحصين 20٪ منهم جزئيا بينما 7٪ منهم لم يتلقوا أي تطعيم.

ووضحت النتيجة أيضا أن 21٪ من الأطفال أصيبوا بالمرض ،و79٪ لم يصابوا بالمرض. وكان منهم 69٪ من الأطفال محصنين بلقاح الحصبة، بينما 31٪ فقط من الأطفال غير محصنين. كما تم استيضاح لإنتشار المرض بين الأطفال دون سن الخامسة من العمر والذي أشارت التقارير إلى أن 43٪ كان بأسباب عدم تقبل من الوالدين، وسوء الحالة التغذوية والصحية للأطفال.

وأوصت الدراسة بالتوعية من قبل العاملين الصحيين لكل عائلة لأخذ أطفالهم إلى أقرب مركز صحي لتحصينهم وضمان أن كل طفل يتلقى جرعة واحدة من لقاح الحصبة في تسعة أشهر من العمر، وينبغي مراعاة انتظام رسائل التثقيف الصحي لتنظيم صحة أرباب الأسر وجميع أفراد المجتمعات المحلية، وتعزيز المشاركة المجتمعية في أنشطة التطعيم والكشف المبكر والعلاج لحالات الحصبة وإدارة الحالات المناسبة سوياً، مع جرعات مكملة من فيتامين (أ) لتجنب المضاعفات الخطيرة لمرض الحصبة.

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1.1 Introduction

Measles is a highly contagious viral disease, which affects mostly children. It is transmitted via droplets from the nose, mouth or throat of infected persons. Symptoms: which usually appear 10–12 days after infection, include high fever, runny nose, bloodshot eyes, and tiny white spots on the inside of the mouth. Several days later, a rash develops, starting on the face and upper neck and gradually spreading downwards. Treatment Severe complications from measles can be avoided though supportive care that ensures good nutrition, adequate fluid intake and treatment of dehydration with WHO-recommended oral rehydration solution. Antibiotics should be prescribed to treat eye and ear infections, and pneumonia. All children in developing countries diagnosed with measles should receive two doses of vitamin A supplements, given 24 hours apart. This can help prevent eye damage and blindness. Prevention Routine measles vaccination for children, combined with mass immunization campaigns in countries with high case and death rates. The measles vaccine has been in use for over 40 years. It is safe, effective and inexpensive. It costs less than one US dollar to immunize a child against measles (1).

Measles is one of the leading causes of death among young children even though a safe and cost-effective vaccine is available. In 2008 they were 164000 measles deaths globally- nearly 450 deaths every day or 18 deaths every hour (2).

The problem of measles emergence: Southeast Asia: 126,000, Africa: 28,000, Eastern Mediterranean: 7,000, Western Pacific: 2,000, Americas and Europe: 1,000. From 2000 to 2008, approximately 4.3 million deaths were averted as a result of accelerated activities (both increases in routine coverage and implementation of measles campaigns). Since 2001, the Measles Initiative has supported the vaccination of more than 700 million children, mostly in Africa and Asia. In 2008, (34%) of the 47 measles priority countries conducted SIAs reaching approximately 109 million children and adolescents; in 13 countries. In 2008, more than 22 million infants and children did not receive a dose of measles vaccine through routine immunization services. Our work is far from over. Measles still claims approximately 450 lives each day. The measles SIAs were combined with at least one other child-survival intervention such as an insecticide-treated bed net to prevent malaria, de-worming medicine, vitamin A, or polio vaccine. Measles is one of the most important infectious diseases facing most areas in Sudan, especially in these days; has increased the number of cases in hospitals and health centers. As a result, the researcher started searching and thinking to know the prevalence and distribution of this disease in the town of Shendi, looking for the most important causes and problems that led to the growing of epidemic cases, and efforts to control and treat the cases so as to work for preventing the disease in the future; through spreading the immunization, crazed out by mobility groups, and main and braches centers and sub-programs of interest and awareness, and expanded immunization programs, and primary treatment of the disease and others (3).

1.2 Measles in Sudan

Measles continues to be the most common preventable disease in children who present at the Emergency Hospitals in Khartoum. The most recent measles vaccination coverage data reported in Sudan by the Expanded Programme for Immunization (EPI) was 63%. Vaccination status of the children enrolled in clinical measles cohort study in Khartoum, as evidenced by inspection of a vaccination card, demonstrated high coverage of DTP, polio and BCG vaccines, but rather low measles vaccine coverage. The vaccination coverage in the non-measles rash disease patients, which may be expected to represent a random sample of the population, was found to be 70% (4).

Measles vaccination coverage was expected to be significantly lower in the group of confirmed measles cases, since measles vaccination should of course protect against measles. It therefore worrying that still 59% of this group proved to have been vaccinated against measles. The median age of the laboratory-confirmed measles cases in the cohort was 24 months (range 5 – 168months). Of 91 confirmed measles cases that were followed up for more than three months, 34 (37%) recovered without complications, 48 (53%) developed complications and 9 (10%) died during the first month after measles. Frequently observed complications included gastroenteritis and pneumonia (5).

Immunization program management:

Measles control programmes in emergency settings have two major components: measles prevention, through routine immunization, and measles out-break control. If preventive measures are established early enough and conducted efficiently, outbreaks will not occur (6).

Measles immunization program should be an early priority of emergency relief programmes, and trained personnel, vaccine, cold chain equipment, and other supplies, e.g., needles, syringes, and record cards, should be available as soon as at-risk persons begin to gather at a camp. Strong support and coordination is required from the agency assigned overall responsibility for this aspect of the relief operation; also, responsibilities for each component of the immunization programme need to be explicitly assigned to agencies and individuals, both at the national and local levels. The national expanded programme on immunization (EPI) in the country where the emergency has taken place should be involved from the outset. All emergency health personnel, regardless of their qualifications or experience, can be trained to participate in measles immunization programmes. For this purpose, basic training manuals appropriate for use at every level of the immunization management chain-are available from the national EPI or WHO. Involvement of community leaders is essential in order to achieve maximum cooperation and motivation among the population. Also, community health workers recruited from within the camp or settlement can be invaluable in educating and mobilizing the population for an immunization campaign. Health workers (including expatriates) should receive measles vaccine if they are unsure of their immunization status. Measles vaccine produces a mild, non communicable form of the disease, and, for use in emergency situations in developing countries, single-antigen measles vaccine is recommended. In controlled field settings in developing countries, vaccine efficacy is over 85% for children aged 9 months and approaches 95% among those aged 12 months protection is long-lasting and there is no need for a booster dose (6, 7).

1.3 Problem statement

Children most suffering from measles disease; due to lack of sufficient awareness, the lack of immunization, lack of interest of their parents, especially the illiterate, and the children in hard to reach area.

1.4 Objectives

1.4.1 General objective

To study Measles epidemiological changes in children under five years old in Shendi Town, from 2013 to 2015.

1.4.2 Specific Objectives

1. To study determine the prevalence of measles disease.
2. To determine the factors associated with the prevalence of the disease.
3. To know pattern of the disease among Shendi children.
4. To suggest recommendations .

Literature review

2.1 Initiation

Definition: Measles is one of the leading causes of death among young children even though a safe and cost-effective vaccine is available. Measles is a highly infectious disease. In developing countries, 1-5% of children with measles die from complications of the disease. This death rate may be as high as 25% among people who are displaced, malnourished and have poor access to health care. The disease can also lead to severe health complications, including pneumonia, encephalitis, severe diarrhea and blindness. However there is great reason for optimism, as recent improved immunization efforts have resulted in a 74 per cent reduction in measles deaths globally, from 757 000 in 2000 to an estimated 197 000 in 2007. The largest regional percent reduction occurred in the Eastern Mediterranean is about(90%) and measles in African is about(89%) regions, accounting for 16% and 63% of the global reduction in measles mortality, respectively. This public health achievement helped to prevent an estimated 3.6 million measles deaths during the same period (8,9).

2.2 History of the disease

The terminology for measles has been a source of some confusion. The proper scientific term in English is rubéola, although the illness has commonly been referred to as 10-day measles, hard measles, red measles, and morbilli. However, in Spanish, rubéola means German measles (rubella). Alternative Spanish terms are sarampi◌́n or morbilli for measles and sarampi◌́n Aleman for rubella. The French terms are rougeole for measles and rubéola for rubella (2).

A major goal of the 1990 World Summit for Children was to reduce the number of deaths caused by measles by 95% and the number of cases by

90%, compared with pre-immunization levels. In 2002, this global goal was only partially achieved as deaths were reduced by 89% and cases by 67%. Despite the availability of a safe, effective, and relatively inexpensive vaccine for over 40 years, measles remains the leading cause of child mortality among vaccine-preventable diseases. The World Health Organization (WHO) estimated that 30–40 million measles cases and 530,000 measles-related deaths occurred worldwide in 2003. Nevertheless, global measles mortality decreased by 39% between 1999 and 2003 due to acceleration of measles control strategies throughout the world. Many of those strategies had been developed and first used during the early 1990s in the Americas, when the countries of the Caribbean and Latin America adopted a three-tiered vaccination approach combining routine vaccination ("keep up" vaccination) and mass vaccination campaigns. This approach had a major impact on measles virus circulation and corrected many of the shortcomings experienced by previous measles prevention programs. In light of the certification of polio eradication in the Americas and the success demonstrated by the Caribbean countries in interrupting measles virus circulation, the Ministers of Health of the Americas adopted in September 1994 the goal of measles. Virus elimination from the Western Hemisphere by the year 2000 (Resolution of American Sanitary Conference). Between 1999 and early 2004, countries throughout the Region of the Americas embarked on accelerated measles elimination activities, using strategies defined in the first edition of this field guide (2).

The intensification of measles elimination activities took place within the wider context of accelerated activities of the Expanded Program on Immunization (EPI), and clearly built upon the accomplishments of the polio elimination program. Implementing a measles elimination program has clearly been an ambitious task, requiring the collaboration of ministries of health, the private sector, nongovernmental organizations, and multilateral and bilateral international partners. At the time of publication of this field guide, the goal of measles elimination in the Americas appears close at hand. The last occurrence of widespread measles virus transmission dates to an outbreak in 2001–2002 in Venezuela and Colombia; the last confirmed case in this outbreak had a date of onset of 21 November 2002. During 2003 and 2004, imported and import-related cases occurred sporadically in half a dozen countries. The primary aim of the Measles Elimination Field Guide is to provide health personnel involved in measles elimination efforts at national, state, and local levels with a guide for implementing elimination activities and for sustaining achieved progress. It incorporates knowledge acquired from the measles elimination activities conducted throughout the Caribbean and Latin America between 1987 and 2004, and emphasizes issues related to enhanced surveillance, mass immunization campaigns, mop-up efforts, and outbreak response activities. Routine immunization activities are also described since such activities are crucial for sustaining advances in measles elimination. Prototype forms are included in the annexes, and they can be copied or modified to meet particular local needs (2).

2.3 The Problem

Measles is a highly contagious respiratory infection caused by a virus. The highest fatality rates are usually among children under five, and up to 20% in infants less than one year old. Children affected by measles may suffer lifelong disabilities, including brain damage and blindness. Measles is a widespread killer. In 2004, approximately 454, 000 people died from the disease, often from secondary complications related to pneumonia, diarrhoea and malnutrition. A highly effective vaccine has been available since the 1960s. Despite this, measles remains the leading cause of vaccine-preventable deaths in the world, accounting for over 40% of the 1.4 million annual deaths due to vaccine-preventable diseases. Inequalities in access to vaccines within countries mean that death and disability from measles is concentrated primarily among the poorest, most marginalized and remote people. Failure to deliver at least one dose of measles vaccine to all infants remains the primary reason for high measles mortality. The WHO/UNICEF global plan focuses on 47 priority countries that account for approximately 98% of global measles deaths. These countries, characterized by weak health systems and chronically low immunization coverage, are among the world's poorest. WHO and UNICEF have developed a comprehensive strategy for sustainable measles mortality reduction that was endorsed by the World Health Assembly in 2003 (10).

2.4 The Solution

Why children need to receive a "second opportunity" for measles immunization: A second opportunity for measles immunization is essential to ensure protection against measles. About 24% of children worldwide never receive a single dose of measles vaccine. Moreover, approximately 15% of children vaccinated against measles at nine months of age will not develop a protective immune response. However, virtually all older children who receive a second opportunity for measles immunization vaccination, delivered either through routine immunization services or periodic supplementary immunization activities (SIAs), are completely protected for life against measles. Using this strategy, measles has been eliminated from the WHO Region of the Americas. Furthermore, three other WHO regions (Europe, the Western Pacific and the Eastern Mediterranean) have also set regional measles elimination goals. The objectives of the four-part strategy are to: provide every child with a dose of measles vaccine by 12months of age. give all children from nine months to 15 years of age a second opportunity for measles immunization. Establish effective surveillance, improve clinical management of complicated cases, including vitamin A supplementation. The measles vaccine has been available for more than 40 years and is very effective and safe. Less than a dollar is needed to protect a child for life against measles (10).

2.5 Epidemiology

2.5.1 Infectious Agent

Measles virus is a member of the genus Morbillivirus of the Paramyxoviridae family. The virus appears to be antigenically stable—there is no evidence that the viral antigens have significantly changed over time. However, sequence analysis of viral genes has shown that there are distinct lineages (genotypes) of wild-type measles viruses (10).

When considered along with epidemiological information, identification of a specific virus genotype can suggest the origin of an outbreak. For instance, the genotype of the virus isolated during the 2001–2002 outbreak in Venezuela was a close match to a virus isolated in cases imported into Australia from Indonesia as early as 1999. Vaccination protects against all wild-type genotypes. The measles virus is sensitive to ultraviolet light, heat, and drying (2).

2.5.2 Occurrence

Measles produces a significant amount of illness, death, and disability in developing countries. Measles caused approximately 7% of the estimated 11.6 million deaths that occurred in 1995 in children aged 4 years and under in developing countries. Of the estimated 614,000 measles-related deaths occurring in 2002, 312,000 (51%) and 196,000 (32%) were in Africa and South-East Asia, respectively. Measles occurs worldwide in distinct seasonal patterns. In temperate climates, outbreaks generally occur in late winter and early spring. In tropical climates, transmission appears to increase after the rainy season. In developing countries with low vaccination coverage, epidemics often occur every two to three years and usually last between two and three months, although their duration varies according to population size, crowding, and the population's immune status (2).

Outbreaks last longer where family size, and hence the number of household contacts, is large. In the absence of measles vaccination, virtually all children will have been infected with measles by the time they are 10 years old. Countries with relatively high vaccination coverage levels usually have five to seven year periods when case numbers remain small. However, if the number of susceptible persons becomes large enough to sustain widespread transmission, explosive outbreaks may occur. The introduction of measles vaccine in the Americas in the 1960s resulted in a marked decrease in the number of reported measles cases. The creation of the Expanded Program on Immunization (EPI) in 1977, and the ensuing increase in vaccination coverage, contributed to a further drop in the number of reported measles cases and a tendency toward longer intervals between epidemic years. Between January 2000 and August 2004, 5,078 measles cases were confirmed in the Americas. The majority of the cases occurred during a 2000 outbreak on the island of Hispaniola (1,752 or 30% of cases) and during a 2001–2002 outbreak in Venezuela and Colombia (2,654 or 52% of cases). In 2003 and 2004, approximately 100 cases were reported each year. Most of these cases were directly or indirectly linked to importations of the measles virus from other regions of the world (2).

2.5.3 Transmission

Measles virus is transmitted primarily by respiratory droplets or airborne spray to mucous membranes in the upper respiratory tract or the conjunctiva. Common source outbreaks associated with airborne transmission of measles virus have been documented. Measles is usually transmitted in large respiratory droplets, requiring close contact between patients and susceptible persons. However, measles virus can survive for at least two hours in fine droplets, and airborne spread has been documented. 7,8 Neither a long-term infectious carrier state nor an animal reservoir is known (11).

2.5.4 Reservoir

Humans are the only natural hosts of measles virus. Although monkeys may become infected, transmission among them in the wild does not appear to be a mechanism, and by which the virus persists in nature (2).

2.5.5 Incubation period

The incubation period is approximately 10–12 days from exposure to the onset of fever and other unspecific symptoms, and 14 days (with a range of 7–18 days, and, rarely, as long as 19–21 days) from exposure to the onset of rash (2).

2.5.6 Communicability

Measles can be transmitted from four days before rash onset (i.e., one to two days before fever onset) to four days after rash onset. Infectivity is greatest three days before rash onset. Measles is highly contagious. Secondary attack rates among susceptible household contacts have been reported to be 75%–90%. Due to the high transmission efficiency of measles, outbreaks have been reported in populations where only 3% to 7% of the individuals were susceptible. Whereas vaccination can result in respiratory excretion of the attenuated measles virus, person-to-person transmission has never been shown (2).

2.5.7 Immunity

Prior to the availability of measles vaccine, measles infection was virtually universal. Infants are generally protected until 5 to 9 months of age by passively acquired maternal measles antibody. Immunity following natural infection is believed to be lifelong, and vaccination with measles vaccine has been shown to be protective for at least 20 years (2).

2.5.8 Changing Epidemiology

Since the introduction of effective measles vaccines, the epidemiology of measles has changed in both developed and developing countries. As vaccine coverage has increased, there has been a marked reduction in measles incidence; and, with decreased measles virus circulation, the average age at which infection occurs has increased. Even in areas where vaccine coverage rates are high, outbreaks may still occur. Periods of low incidence (the “honeymoon” effect) may be followed by a pattern of periodic measles outbreaks, with an increase in the number of years between epidemics. Outbreaks are generally due to the accumulation of persons susceptible to measles virus, including both unvaccinated persons and those who were vaccinated but failed to seroconvert. Approximately 15% of children vaccinated at 9 months of age and 5%–10% of those vaccinated at 12 months of age fail to seroconvert, and are thus not protected after vaccination. After the introduction of measles vaccine during the 1960s, countries that had achieved high vaccine coverage experienced a 98% or greater reduction in the number of reported cases. However, periodic measles epidemics continued to occur, especially in large urban areas (2).

These outbreaks occurred primarily among unvaccinated preschool- aged children, but cases and outbreaks were also reported among fully vaccinated school-aged children. For instance, unvaccinated infants and preschool-aged children were at greatest risk for measles infection during the 2001–2002 outbreaks that occurred in Venezuela. Cases among older children and adults also occurred and likely involved those individuals who had not been vaccinated and had previously escaped natural measles infection because of decreasing measles incidence. Since measles vaccine is less than 100% effective, vaccinated individuals might also have contracted measles. In large urban areas, even where measles vaccine coverage is high, the number of susceptible infants and children may still be sufficient to sustain transmission. Conditions such as high birth rates, overcrowding, and the influx of large numbers of susceptible children from rural areas can facilitate measles transmission. In areas where measles remains endemic, a large proportion of cases occur in children aged less than 1 year, an age group that also has the highest age-specific measles case-fatality rates. In those areas, only a brief period (or "window of opportunity") exists between the waning of maternal antibody and children's exposure to circulating measles virus (2).

2.6 Clinical manifestation

During periods of high measles virus circulation, measles infection can be diagnosed clinically with reasonable accuracy. However, the large number of rash-like illnesses that may occur in childhood makes laboratory support the key to definitive diagnosis, especially during periods of low measles incidence. A summarized description of the pathogenesis of measles virus infection and its clinical manifestations is presented as the following (8).

2.7 Infection, Incubation and Complications

Infection	Incubation	Complications
Aerosol Nasopharynx respiratory epithelium ↓ Regional lymph nodes ↓ Blood ↓ Lymph-reticular system, spleen, liver, bone marrow. ↓ Blood ↓ Kidney, skin, upper and lower respiratory Tract, brain, giant cells, mononuclear cells ,mucosa. ↓ Immunological response ↓ Immunological response ↓ Antibody development ↓ (Continued excretion in nasopharynx and urine) ↓ Decreasing virus in organs	Exposure ↓ **Primary viremia** (2 to 3 days after exposure) ↓ **Secondary viremia** (5 to 7 days after exposure, lasts 4 to 7 days) ↓ Leucopenia ↓ **Prodrome** (10–12 days after exposure, lasts 2–4 Days) Rhinitis, cough, inflamed conjunctivae, tonsillitis, mild Fever, red buccal membrane, Koplik's spots. ↓ **Rash** (14 [7–21] days after exposure, lasts 4–9 days) ↓ Macular (starting on face, spreading to body) High fever Rash fading Fever decreasing ↓ Desquamation ↓ Temperature normal	Otitis media (ear infection) Pneumonia Diarrhea Encephalitis Corneal s carring & blindness ↓

↓ Virus cleared ↓ **Immunity**	Desquamation ↓ **Recovery**	**Death, disability**

(2).

2.8 Clinical case definition

Any person whom a clinician suspects measles infection, or any person with fever and maculopapular rash (i.e. non-vesicular) and cough, coryza (i.e. runny nose) or conjunctivitis (i.e. red eyes). Proteome and general symptoms. Measles infection presents with a two to four day proteome of fever, malaise, cough, and runny nose (coryza). Conjunctivitis and bronchitis are commonly present. Although there is no rash at the onset, the patient is shedding virus and is highly contagious. The severe is nonproductive cough is present throughout the febrile period, persists for one to two weeks in uncomplicated cases, and is often the last symptom to disappear. Generalized lymphadenopathy commonly occurs in young children. Older children may complain of photophobia and, occasionally, of arthralgia. Koplik's spots may be seen on the buccal mucosa in over 80% of cases, if careful daily examinations are performed shortly before rash onset. Koplik's spots are slightly raised white dots, 2–3 mm in diameter, on an erythematous base Initially, there are usually one to five of these lesions, but as rash onset approaches there may be as many as several hundred. They have been described as resembling "grains of salt sprinkled on a red background". The lesions appear one to two days before rash onset and persist for two or three days, disappearing soon after rash onset. Rash. Within two to four days after the prodromal symptoms begin, a characteristic rash made up of large, blotchy red areas initially appears behind the ears and on the face. At the same time a high fever develops. The rash peaks in two to three days and becomes most concentrated on the trunk and upper extremities. The density of the rash can vary (8).

The rash typically lasts from three to seven days and then fades in the same pattern as it appeared and may be followed by a fine desquamation. Whereas rash may be less evident in children with dark skin, desquamation generally is apparent. Some children develop severe exfoliation, especially if they are malnourished (8).

2.9 Signs and Symptoms

The first sign of measles is usually a high fever, which begins about 10 to 12 days after exposure to the virus, and lasts four to seven days. A runny nose, a cough, red and watery eyes, and small white spots inside the cheeks can develop in the initial stage. After several days, a rash erupts, usually on the face and upper neck. Over about three days, the rash spreads, eventually reaching the hands and feet. The rash lasts for five to six days, and then fades. On average, the rash occurs 14 days after exposure to the virus (within a range of seven to 18 days). Severe measles is more likely among poorly nourished young children, especially those with insufficient vitamin A, or whose immune systems have been weakened by HIV/AIDS or other diseases. Most measles-related deaths are caused by complications associated with the disease. Complications are more common in children under the age of five, or adults over the age of 20. The most serious complications include blindness, encephalitis (an infection that causes brain swelling), severe diarrhoea and related dehydration, ear infections, or severe respiratory infections such as pneumonia. As high as 10% of measles cases result in death among populations with high levels of malnutrition and a lack of adequate health care. People who recover from measles are immune for the rest of their lives (8).

2.10 Population At risk

Unvaccinated young children are at highest risk of measles and its complications, including death. Any non-immune person (who has not been vaccinated or previously recovered from the disease) can become infected. Measles is still common in many developing countries – particularly in parts of Africa and Asia. More than 20 million people are affected by measles each year. The overwhelming majority (more than 95%) of measles deaths occur in countries with low per capita incomes and weak health infrastructures. Measles outbreaks can be particularly deadly in countries experiencing or recovering from a natural disaster or conflict. Damage to health infrastructure and health services interrupts routine immunization, and overcrowding in residential camps greatly increases the risk of infection (8).

2.11 The stages of measles

There are three stages in the natural history of measles:

Prodromal stage: After infection, and lasts until 14 days It begins 10 days It is characterized by fever, coryza with sneezing and nasal discharge, cough, redness of the eyes, lacrimation and often photophobia. there may be vomiting or diarrhoea. A day or two before the appearance of the rash Koplik's spots like table salt crystals appear on the buccal mucosa opposite the first and second lower molars (12).

Eruptive phase: This phase is characterized by a typical, dusky-red, macular or maculo-papular rash which begins behind the ears and spreads rapidly in a few hours over the face and neck, and extends down the body taking 2 to 3 days to progress to the lower extremities (12).

post-measles stage: The child will have lost weight and will remain weak for a number of days. There may be failure to recover and gradual deterioration in to chronic illness – due to increased susceptibility to other bacterial and viral infection, nutritional and metabolic effects and the tissue destructive effects of the virus. There may be growth retardation and diarrhoea, cancrum oris, pyogenic infections, candidosis, reactivation of pulmonary tuberculosis etc (12).

2.12 Characters of the virus

2.12.1 The organism

Measles virus is a paramyxovirus of a single serological type, closely related to the viruses causing canine distemper and rinderpest in cattle. Virions consist of an inner nucleocapsid that is a coiled helix of three proteins (N, P, L) and RNA and an envelope containing three proteins (M, H, F). A haemagglutinin (H) protein mediates absorption of the virus to receptors on the host cell and a fusion (F) protein is responsible for the membrane fusion of virus and host cell and penetration of virus into the host cell (13).

2.13 Laboratory diagnosis

The laboratory diagnosis of measles is most often made by detection of measles IgM antibody in a single serum specimen. Approximately 80% of measles cases have detectable IgM antibody by IgM capture EIA within 72 hours of rash onset. Nearly 100% of measles cases demonstrate IgM antibody 72 hours after rash onset. In most instances, a serum sample should be collected for measles IgM at the first clinical encounter. However, if a negative result is obtained from a specimen drawn less than 72 hours after rash onset, another specimen will be required. In general, a positive IgM result obtained at any time during the illness is diagnostic for measles. However, false positive IgM results can occur, particularly when testing is being performed in a low prevalence population (i.e., people who do not meet the clinical case definition or people with no obvious risk factors for measles). In such instances, when a positive IgM result is obtained, the result should be interpreted with caution. Further testing is recommended. Call the Communicable Disease Epidemiology Section (CDES) to discuss. The diagnosis can also be made by isolation of measles virus from a clinical specimen. Urine and respiratory samples are both good clinical specimens for viral isolation. Measles virus isolation is most successful when samples are collected within three days of rash onset. However, virus may still be present in specimens 7 days following rash onset. A negative culture for measles does not rule out the diagnosis. Lastly, the diagnosis can be confirmed by demonstrating a significant rise in measles IgG antibody level in acute and convalescent sera. Demonstrating a rise in measles IgG or seroconversion is not necessary when measles has been confirmed by another method (14).

2.13.1 Specimen Collection and Shipping

Persons suspected to have measles should have serum drawn and specimens collected for viral isolation (nasal wash and urine) at the time of the first health care provider visit. Instructions for collecting specimens follow: **Serum**: Collect at least 1 cc of serum. Store specimen in refrigerator and transport on ice. **Urine:** Collect at least 50 ml of clean voided urine in a sterile container. Store specimen in refrigerator and transport on ice (14).

Nasal wash (preferred respiratory specimen): Attach a small piece of plastic tubing to a syringe. After placing about 3–5 ml of sterile saline in the nose, aspirate as much of the material as possible and add to a centrifuge tube containing viral transport medium. Store specimen in refrigerator and transport on ice. If a nasal wash cannot be performed, collect a nasopharyngeal or throat swab (14).

Nasopharyngeal swab: Swab the posterior nasal passage with a Dacron™ or rayon swab and place the swab in 2–3 ml of viral transport medium. **Throat swab**: Swab the posterior pharynx with a Dacron™ or rayon swab and place the swab in 2–3 ml viral transport medium (14).

2.14 Complications of measles

Complications from measles include diarrhea, otitis media, pneumonia, encephalitis, seizures, and death. Severe measles is particularly likely in malnourished children, especially those who: Do not receive sufficient vitamin A, Live in crowded conditions, and Have immune systems weakened by HIV/AIDS or other diseases (15).

2.14.1 Diarrhea: is common among infants and children in developing countries both during and following acute measles illness. Diarrhea is a major reason measles adversely affects the nutritional status of children in developing countries (15).

2.14.2 Malnutrition: is exacerbated by measles infection because of decreased food intake due to malaise, increased metabolic requirements in the presence of fever, or the mistaken belief that a child's food should be withheld during acute illness. Inadequate nutrition contributes to vitamin A deficiency which, in turn, leads to keratitis. This may result in high rates of childhood blindness during measles outbreaks (15).

2.14.3 Pneumonia: is the most common cause of significant mortality and morbidity in infants and children with measles in developing countries. Most often this occurs because the measles virus weakens the immune system (15).

2.14.4 **Neurological complications:** occur in 1-4 of every 1,000 children infected with measles. The most common manifestation is febrile convulsions. Encephalitis or post infectious encephalopathy affects approximately 1 in every 1,000 infected children (15).

2.14.5 **Case fatality rates:** for measles in developing countries range from 1%-5%, but may be as high as 25% in high risk populations. The highest case fatality occurs in infants 6-11 months of age, with malnourished infants at greatest risk. Children who recover from measles are immune for the rest of their lives (15).

2.15 Treatment

There is no specific medicine that acts against the measles virus. Treatment focuses on managing the symptoms and complications. Antipyretics are used to treat high fever. Children with measles should be encouraged to eat and drink, and should receive general nutritional support as well as oral rehydration therapy to treat dehydration. Prescribe antibiotics only for ear infections, severe respiratory tract infections, and other less common bacterial infections (e.g., skin, eyes). All children in developing countries with suspected measles should receive 2 doses of vitamin A supplements given 24 hours apart. If caretakers suspect exophthalmia, a severe drying of the eye surface with symptoms of night blindness and eye irritation, a 3rd dose of vitamin A should be provided 2-4 weeks later (15).

2.15.1 IMCI Guidelines:

The WHO and UNICEF Integrated Management of Childhood Illness (IMCI) guidelines include the classification and treatment of measles. These guidelines are organized by symptoms, such as presentation of a fever, diarrhea, and ear infection. The table shown below is taken from the WHO/UNICEF IMCI Chart Booklet Guidelines to illustrate how IMCI addresses treatment for measles based on a child with a fever. Other complications of measles, such as pneumonia, diarrhea, and malnutrition, are classified in other IMCI tables (15).

2.16 Prevention and control

2.16.1 Prevention:

Passive Immunity. Passive immunity against measles disease can be induced by the administration of commercially prepared immune globulin (IG) (formerly called immune serum globulin [ISG]), which typically has a high measles antibody titer. Administration of 0.25 mL of IG per kilogram (maximum dose 15 mL) can modify or prevent the development of measles in the exposed person. The IG preparation is most effective if administered within six days of exposure, preferably as soon after the exposure as possible. IG is particularly indicated for susceptible household contacts, especially those who are immunocompromised. Persons in the latter groups are at greatest risk of complications from measles (11).

Routine measles vaccination for children, combined with mass immunization campaigns in countries with high case and death rates, are key public health strategies to reduce global measles deaths. The measles vaccine has been in use for over 40 years. It is safe, effective and inexpensive. It costs less than one US dollar to immunize a child against measles. The measles vaccine is often incorporated with rubella and/or mumps vaccines in countries where these illnesses are problems. It is equally effective in the single or combined form (16).

In 2008, about 83% of the world's children received one dose of measles vaccine by their first birthday through routine health services – up from 72% in 2000. Two doses of the vaccine are recommended to ensure immunity, as about 15% of vaccinated children fail to develop immunity from the first dose (16).

2.16.2 Global health response:

The fourth Millennium Development Goal (MDG 4) aims to reduce the under-five mortality rate by two-thirds between 1990 and 2015. Recognizing the potential of measles vaccination to reduce child mortality, and given that measles vaccination coverage can be considered a marker of access to child health services, routine measles vaccination coverage has been selected as an indicator of progress towards achieving MDG. The Measles Initiative is a collaborative effort of WHO, UNICEF, the American Red Cross, the United States Centers for Disease Control and Prevention, and the United Nations Foundation. The Initiative, together with other public and private partners, plays a key role in advancing the global measles strategy. This strategy includes: Strong routine immunization for children by their first birthday. A 'second opportunity' for measles immunization through mass vaccination campaigns, to ensure that all children receive at least one dose. Effective surveillance in all countries to quickly recognize and respond to measles outbreaks. Better treatment of measles cases, to include vitamin A supplements, antibiotics if needed, and supportive care that prevents complications (16).

2.16.3 Phases of measles control:

The introduction of measles vaccine into routine immunization programs results in a marked reduction in incidence of the disease and its associated morbidity and mortality. There are three sequential phases for measles immunization programs: measles control phase, measles outbreak prevention phase and measles elimination phase (16).

2.16.3.1 Measles control phase:

Measles control is defined as a significant reduction in measles incidence and mortality. When high levels of vaccine coverage are attained (i.e. vaccine coverage (80%), measles incidence decreases and the intervals between outbreaks are lengthened (e.g., 4-8 years) when compared to those observed during the pre-vaccine era (e.g., 2-4 years). As high levels of vaccine coverage are maintained, an increasing proportion of cases will occur among individuals in older age-groups. As vaccine coverage improves, the proportion of cases with a vaccination history increases (13).

2.17 <u>WHO and UNICEF a strategy to reduce measles mortality:</u>

It has four objectives: provide every child with one dose of measles vaccine at nine months of age or shortly thereafter via routine health services. Give all children a second opportunity for measles immunization, generally through mass vaccination campaigns. Establish effective surveillance for measles; and enhance care for those with measles including the provision of vitamin A supplementation (9).

2.17.1 Infection Control Recommendations / Case Management:

In addition to standard precautions, hospitalized patients should be cared for using airborne precautions until 4 days have passed since the onset of the rash (or for the duration of illness if the patient is immunocompromised). Persons suspected to have measles should be advised to do the following during the contagious period (until 4 days have passed since the onset of the rash or for the duration of illness if the patient is immunocompromised). stay home and not go to child care, school, work, public places or social activities. prohibit contact with susceptible children (particularly infants),susceptible pregnant women, and immunosuppressed Individuals. avoid contact with susceptible family members and visitors. Avoid exposing other people at health care facilities by calling ahead and making special arrangements to prevent contact with others (14).

2.17.2 Measles Management:

Use the contact with Measles Management; because they are contact with whom exposure potentially to measles case:

2.17.2.1 Symptomatic Contacts:

Any contact with a rash illness compatible with measles should be referred to a healthcare provider for assessment. Susceptible contacts with respiratory symptoms or fever should stay home and call their local health jurisdiction. If a contact goes a healthcare provider for evaluation of possible measles, the patient or public health should call ahead to ensure that facility personnel are aware of the specific reason for referral so that special arrangements can be made to keep them out of areas used by other patients. Persons with possible measles should avoid contact with others until the diagnosis is known (14).

2.17.2.2 Active Immunization with Measles Vaccine (persons 12 months of age or older):

Vaccinating susceptible contacts within 72 hours of exposure may prevent disease. If 72 hours has passed since the exposure, vaccination is still recommended to prevent future infection. Susceptible, previously unimmunized persons should receive their first MMR and persons who have received one dose should receive a second dose, if indicated. See Section 8 for recommendations and contraindications for vaccination. Whenever possible, persons without documentation of immunity should have blood drawn and tested for measles IgG prior to being vaccinated. Exclusion will not be necessary if the person is found to be immune. Public health may need to arrange special clinics to vaccinate susceptible contacts and others from the community (14).

2.17.2.3 Passive Immunization with Immune Globulin (IG):

IG can prevent or attenuate infection with measles if given within 6 days after exposure. IG is recommended primarily for susceptible household contacts and other close contacts who are at increased risk of severe infection (e.g., pregnant women, immunocompromised persons, children <1 year old). IG is not recommended for close contacts who have received one dose of vaccine on or after the first birthday unless they are immunocompromised. Patients should be warned that IG may modify but not prevent measles infection and may also increase the incubation period to 21 days. To be effective, IG (0.25 ml/kg[0.5 ml/kg for immunocompromised persons]; maximum dose 15 ml) must be administered intramuscularly as soon as possible but not more than 6 days after exposure of virus. If possible, persons without documentation of immunity should have blood drawn prior to administration of IG to test for measles IgG. Susceptible contacts who received high-dose IG for measles prophylaxis should be immunized against measles 5 months (if given 0.25 ml/kg) or 6 months (if given 0.5 ml/kg) after IG was given if the vaccine is no longer contraindicated. See the 2006 Red Book p. 445 for additional details regarding administration of vaccines after receipt of immune globulin (14).

2.17.2.4 Exclusion

Susceptible, previously unimmunized contacts should avoid all public settings from 7 days after the first date of exposure until 21 days after the last date of exposure regardless of whether or not they received vaccine within 72 hours or IG within 6 days of exposure. Contacts who received one dose of measles-containing vaccine prior to the exposure do not need to be excluded from public settings. However, they should be educated about symptoms of measles and told to isolate themselves if symptoms develop (14).

2.17.2.5 Education

All exposed persons regardless of immune status should be told to watch for symptoms of measles until 21 days after the last exposure to the communicable person. If suggestive symptoms develop, they must isolate themselves and call the local health department as soon as possible. If exposure has occurred among a large group or in a public setting, consider educating potentially exposed persons and making recommendations via letters or press release (14).

2.17.3 Management of Other Exposed Persons:

Persons potentially exposed to the same source as the case or present in the same high risk setting during the likely exposure period should be told to watch for symptoms of measles particularly during the 7 to 21 days following exposure regardless of immune status (14).

2.17.4 Environmental Measures

If a person communicable with measles is examined in a health care facility, the examination room should be cleaned and closed to use for 2 hours (14).

2.18 Epidemic control

2.18.1 Management

The term "outbreak" is generally used when the number of cases observed is greater that the number normally expected in the same geographic area for the same period of time. The definition of an "outbreak" will vary according to the phase of measles control. For instance, a single case may mark an outbreak in a country aiming at elimination. The occurrence of a measles outbreak in a highly immunized population does not necessarily represent a failure of the routine immunization programs. Investigation of outbreaks provides an opportunity to identify high-risk groups, changes in measles epidemiology, weaknesses in the routine immunization program or in the management of measles cases. When an outbreak occurs that has not been predicted, or could not be prevented, the response needs to be rapid, since measles is highly infectious and spreads rapidly (13).

2.18.2 Detection:

Detection of an outbreak relies on the ability of the responsible authority to recognize an increase in measles cases significantly above the number normally expected. This recognition is simpler if a routine surveillance system collects either summary or case-based information on clinical and confirmed cases of measles. The availability of such data allows for the establishment of background activity levels and the establishment of a local outbreak (or epidemic) threshold. This threshold value is usually a number of cases in a defined period in excess of (a predetermined) expected number. The attainment of a threshold value should be considered as signaling an outbreak and should trigger specific responses. In the absence of an effective surveillance system it may be difficult to detect small or limited outbreaks. However, large outbreaks may be detected by the existence of large numbers of cases, health clinic attendances, admissions to hospital, deaths or media reports. In all these situations it will be important to confirm the outbreak (13).

2.18.3 Confirmation

When an outbreak is suspected: A preliminary case investigation must be carried out to confirm the diagnosis, assess the extent of the outbreak and identify the population at risk. This is best done by health workers using a standard form, seeking details on cases (e.g. clinical syndrome and immunization status) and contacts. It is important that blood samples be collected from the initial 10 reported cases of an outbreak, to confirm or not whether measles virus is the cause of the outbreak. For countries in the measles elimination phase, laboratory investigation of all suspected measles cases is mandatory. Blood samples should be taken and sent to reference laboratories to allow measles virus isolation for genomic sequencing and mapping purposes. This information will be valuable in tracking measles virus circulation and establishing virus importation. The collected data should be analyzed locally and rapidly to determine the extent of the outbreak and consequently the population at risk. This can be done by creating a line listing of cases with key variables or, more efficiently by entering the data into a computer program such as EPI-INFO. Analysis should include the construction of an epidemic curve, graphing the age distribution of cases and spot-mapping the cases. Vaccine efficacy and the proportion of cases that could have been prevented through immunization should be calculated (age and immunization status of cases are essential elements). If population data are available, age-specific attack rates should be calculated. In addition, the investigation must document measures taken so far and any identifiable reasons for the outbreak (13).

2.19 Priority during outbreaks is to provide appropriate treatment and reduce mortality

In addition, collection of data on the epidemiology of the disease will help identify high risk populations, evaluate and modify current immunization strategies, and predict future outbreaks. Supplementary immunization activities in the setting of an outbreak undertaken with the aim of interrupting transmission of the virus may not have a substantial impact on the course of the measles outbreak. Supplementary vaccination activities in the course of an outbreak are not recommended unless there is substantial political and or community pressure to undertake control measures. If implemented, supplementary vaccination activities should focus on unaffected areas where the epidemic is more likely to spread. There is one exception to this recommendation. Outbreaks in closed communities or institutions such as refugee camps, hospitals and military barracks may necessitate immediate supplementary immunization activities under any circumstances. In refugee camps, vaccination of all children below five years of age is indicated as soon as they arrive to the camp. Delay in implementing this recommendation may result in high morbidity and mortality (13).

2.19.1 Management of response:

Once a clear strategy has been defined, it is necessary to mobilize and manage the resources required for the response. It is best if an inventory of resources already exists as part of a preparedness plan. If not, such an inventory should be drawn up rapidly. These resources will need to be mobilized in a co-ordinate fashion. It is important to know the roles and responsibilities of national, regional and district levels during an epidemic. Relevant international and non-governmental organizations should be involved as early as possible. Assigning responsibilities prior to an epidemic reduces the need to divert time and energy during the outbreak. An epidemic response team should co-ordinate epidemic preparedness and response activities at local health centers. It must function on a continuous basis, and meet periodically even when no epidemics are present. When an epidemic is declared, the epidemic response team must convene more frequently on a regular basis to plan and review activities. These meetings should include a review of the most recent data, an agreement on control measures and the assignment of a person responsible for the implementation of each measure. The response will need to be monitored regularly and must ultimately be subjected to formal evaluation after the outbreak (13).

2.19.2 Public information:

When an outbreak is declared, there is likely to be widespread public concern and media attention. It is important to keep the public informed about the outbreak and the outbreak response. Public information can be transmitted by a number of simple means, either directly to the community via schools or community meetings, or via the mass media such as radio, newspapers and television. Simple, clear public information material can help to: allay fears, convey public health messages regarding appropriate treatment of cases and immunization. It is important that such material: give information on the natural history of measles infection, the care of a child with measles and the signs and symptoms that should prompt a parent to seek expert advice. encourage parents whose children have had a recent onset of rash and fever to notify health workers. Give clear information on the age for immunization and on the locations and time-schedule of any vaccination activities. The media are useful partners in keeping the population informed. Regular press releases and conferences are essential in that they help the media play their role and help avoid "media hounding" of team members. A single spokesperson must be appointed and made known to the media. This person must receive clear instructions from the team and up-to-date information. The spokesperson can arrange for other team members to be interviewed as necessary. If the media are to be enlisted in the delivering of health messages to the population, it is essential that these messages are reproduced as exactly as possible. It is not a good idea to rely on media for the interpretation of detailed health education material and for expert decisions on what to publish (13).

2.19.3 <u>Predicting further outbreaks</u>:

It is important to try and predict the onset of further outbreaks: Imminent outbreaks among other populations an early, determination should be made as to whether an outbreak is localized or if disease is likely to spread to other areas. If disease is likely to spread, efforts to improve immunization coverage by routine or supplementary immunization may be advised in these areas. Future outbreaks in the population currently experiencing an outbreak. Data collected on age-specific attack rates and vaccine coverage during the epidemic will assist in this type of prediction (13).

2.19.4 <u>Post-outbreak activities:</u>

After an outbreak, the Epidemic Response Team must carry out a thorough evaluation of the following: cause of the epidemic, surveillance of measles and detection of the outbreak, preparedness for the epidemic, management of the epidemic and immunization program goals and operations. The findings of this evaluation should be documented in a written report containing clear recommendations regarding: epidemiological characteristics of the epidemic, surveillance (assess the surveillance system, recommend actions to enhance measles surveillance in the affected areas), preparedness /recommend action to improve outbreak response), immunization activities and strategies to increase coverage and cover high-risk areas (13).

2.20 Preparedness for global epidemics and emergencies

Some vaccine-preventable diseases occur periodically in the form of widespread regional epidemics, only to fade away for several years before reoccurring. Examples of these epidemic diseases include meningococcal meningitis, yellow fever and Japanese encephalitis (17).

Countries at risk of epidemics need preparedness plans that are firmly rooted in their overall immunization plan and services. Similarly, capacity is required at country and global levels to prepare for a rapid and appropriate response to emergencies and natural disasters since that response may involve the rational use of vaccines. In the case of influenza, a global laboratory network monitors the circulating virus strains and all countries need up-to-date preparedness plans for coping with a pandemic. Many national preparedness plans, however, do not exist, are out of date, or lack practicality. Governments, WHO, UNICEF, vaccine manufacturers and research institutes are currently involved in efforts to support the development of national preparedness plan sand to expand capacity for production of influenza vaccine worldwide, including work on the development of a new vaccine against virus strains with pandemic potential (17).

Responding to needs: the global strategy

Immunization services throughout the world have achieved remarkable progress to date, mainly through a focus on infants and with only a limited number of vaccines available to developing countries. However, over the past two decades coverage levels have stagnated at sub-optimal levels in many countries. Glob-ally, out of every four children born each year, one will not receive commonly available vaccines and, as a result, will be exposed to morbidity, disability, stunted growth or pre-mature death that could have been averted by timely immunization. The global strategy proposes to sustain immunization to those who are currently reached, extend immunization to those who are currently unreached and to age groups beyond infancy, introduce new vaccines and technologies and link immunization to other health interventions as well as to the development of the overall health system. It places immunization firmly within the context of sector-wide approaches to health, highlighting the way immunization can both benefit from and contribute to health-system development and the alleviation of system-wide barriers. This document offers a framework within which national policies, programmes and action plans can be elaborated. The global strategy take son the challenges of increasing access, the target population, and the range of products that will become available. It outlines what needs to be done at global, country and service-delivery level, in a way that can be adapted for regional and national strategic plans. It offers the potential to use available budgets more efficiently and to ensure better coordination between all stakeholders towards the reduction of vaccine-preventable diseases, disability and deaths (17).

Materials and methods

3.1 Study type

descriptive-cross sectional community based study.

3.2 Study area

Shendi town located at a distance of 176 kilometers north of Khartoum State, 110 kilometers south of Atbara on the east bank of the River Nile bordered in the east with Gadaref State. Shendi population was 65263 from different parts of the Sudan. According the last census is about 250,000. (180.000) of them were in rural areas while (70,000) in the town, and 68% of the population engaged in agriculture activities, 32% engaged in commerce and trades. The Immunization Program (EIP)in Shendi town, include: 32 centers. Total children: 8501under one years old and 39048 under 5years old, that distribution with: 14 units basic center (under one year is about 6300 children, under 5year is about 32215 children, in 2012), and 18 units branches (under one year is about 2201 children, under 5year is about 6833 children, in 2012). Shendi town consist of 30 squares, where the most educational and health services are founded; especially in the field of health care; where there is the largest hospitals, specialized centers for kidney. There is also the atomic treatment hospital, and modern laboratories in Almak Nemir hospital ,and in Shendi educational hospital. The University of Shendi contributed to the development and prosperity of the town of Shendi retrieved for the best qualified medical and health institutions of health care and, management of immunization, and treatment from all over the local and neighboring like Almatama locality rather than the other localities in the River Nile state and also other states. Also this research is chosen for there are rarely researches in Sudan in this field, especially in epidemiology (18).

3.3 Study population

The study population were children in Shedi town with at least one under 5 years old child.

3.4 Sampling

3.4.1 Sample size

210 samples for children under five years old and 210 households were selected for this study using WHO guidelines on cluster sampling (19).

Estimate the number of questionnaires =

$$\frac{\text{Estimate sample size(210)*Community size(250.000)}}{\text{Estimate sample size(210)+ Community size(250.000)-1}} = 210 \text{ questionnaires}$$

account the extent of the sample =

$$\frac{\text{Number of children under 5 years of age (47 549)}}{\text{Number of Population (250,000)}} = 5.25$$

3.4.2 Sample technique:

Simple random sampling and cluster sampling technique were used to select the households, sampling interval of 5 was used for the identification of 210 HHs.

3.5 Data collection methods:

The data was collected during the period of (April 2013- January 2015) in Shendi town using structured and predesigned questionnaires during the visits. The study variable included were age, number of under one year,1-2years and 3-5years, families economic status, health status, seeking of diagnosis and treatment, disease complications, preventive and control measures …etc, vitamin A supplementation immunization status, and risk factors.

3.6 Data Analysis:

Data analyzed by using SPSS (Statistical Package for Social Science) program.

And the results was presented in tables and figures.

1-Tables

Table (I) Income of population of Shendi town (2013).

Family income	Frequency	Percent
Under 400 SDG	41	20%
Between 400-800 SDG	116	55%
Over than 800 SDG	53	25%

Table (II) knowledge of parents towards factors associated with measles transmitted in Shendi town (2013).

Measles transmitted	Frequency	Percent
By house dust	41	20 %
Over crowded	38	18 %
Children patient	81	39 %
By hospital infectious	50	24 %

Table (III) knowledge of mothers about symptoms in Shendi town (2013)

The patients symptoms in house	Frequency	Percent
Fever	95	45 %
Skin rash	41	19 %
Face and neck rash	31	15 %
Pain in neck	12	6 %
Bad R.T	31	15 %

Table (IV) Prevention and control of measles in Shendi town (2013).

Protect the children for measles	frequency	Percent
Complete vaccine	163	78 %
Isolation	47	22 %

Table (V) knowledge about 2nd dose in Shendi town (2013).

the children take basic dose of measles	frequency	Percent
After 9 months	194	92 %
After one year	16	8 %

Table (VI) when they can take 2nd doses in Shendi town (2013).

the child take the poster dose of measles	frequency	Percent
At infected	69	33 %
Return infected	36	17 %
At cure	52	25 %
At contact patients	53	25 %

2- Figures

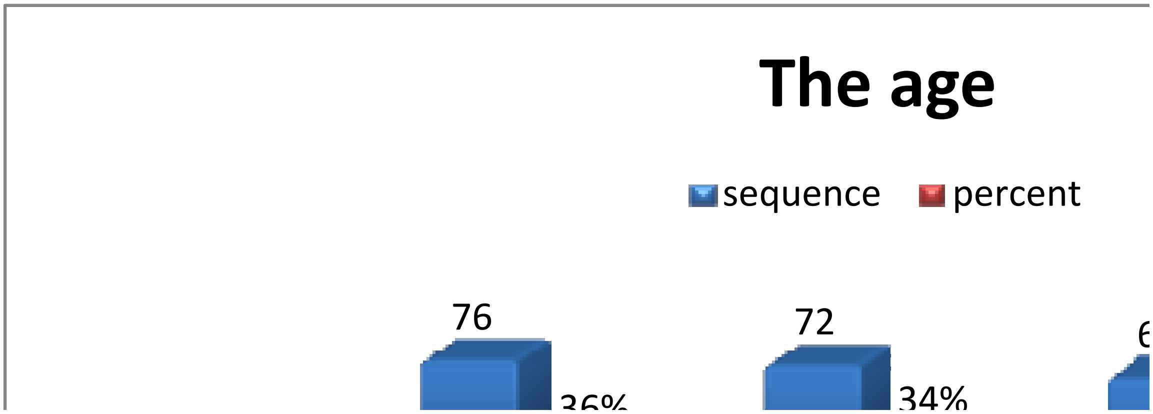

Figure (I) Age distribution of the children under 5 years old in Shendi town (2013).

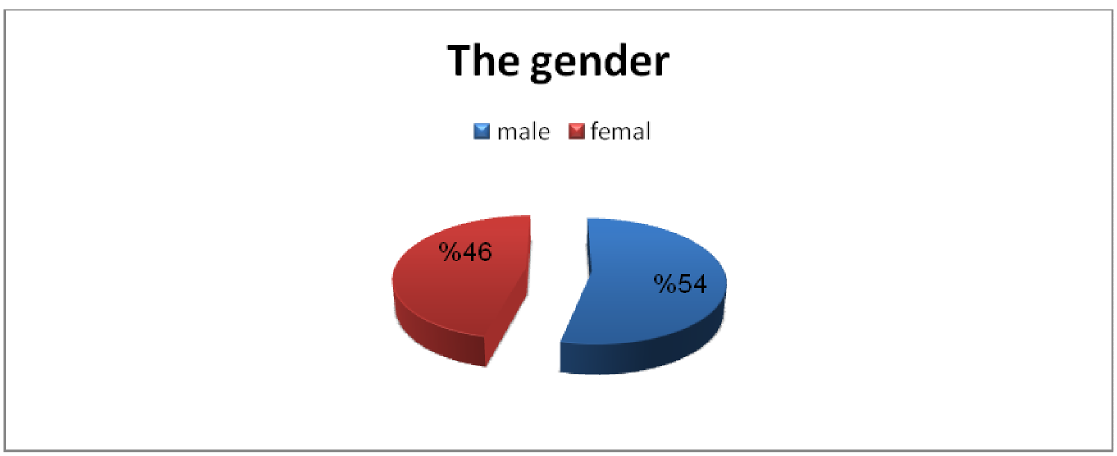

Figure (II) Gender distribution of children under 5 years old in Shendi town (2013).

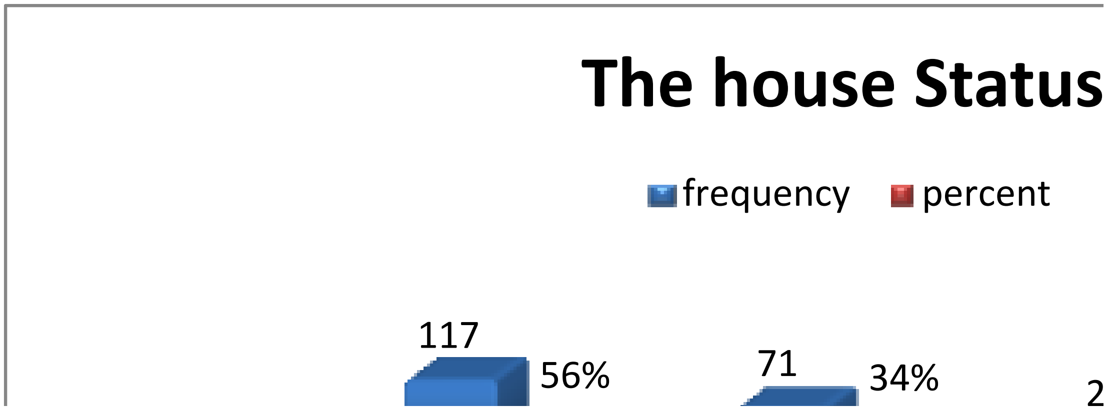

Figure (III) Accommodation of children under 5 years old in Shendi town (2013).

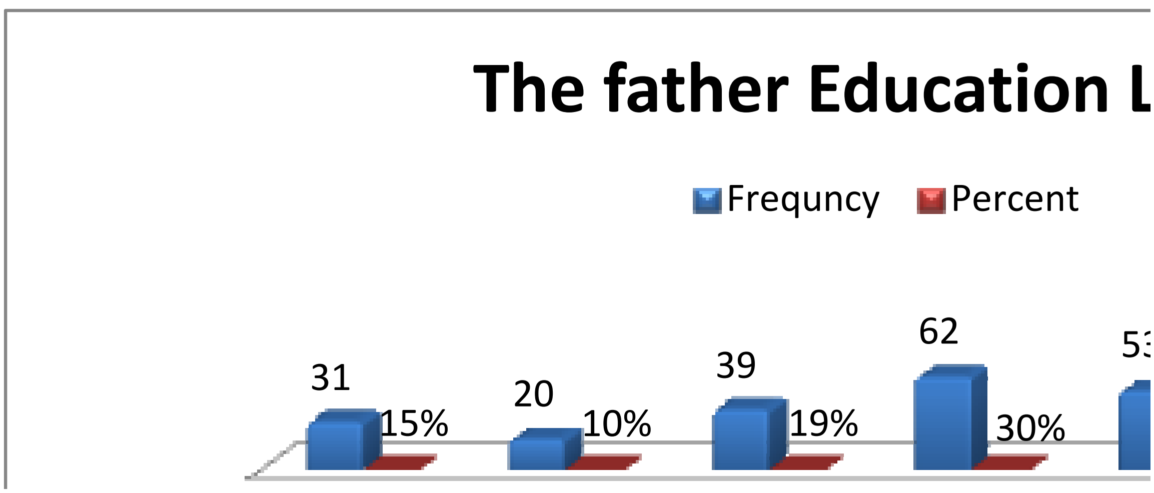

Figure (IV) Education level in Shendi town (2013).

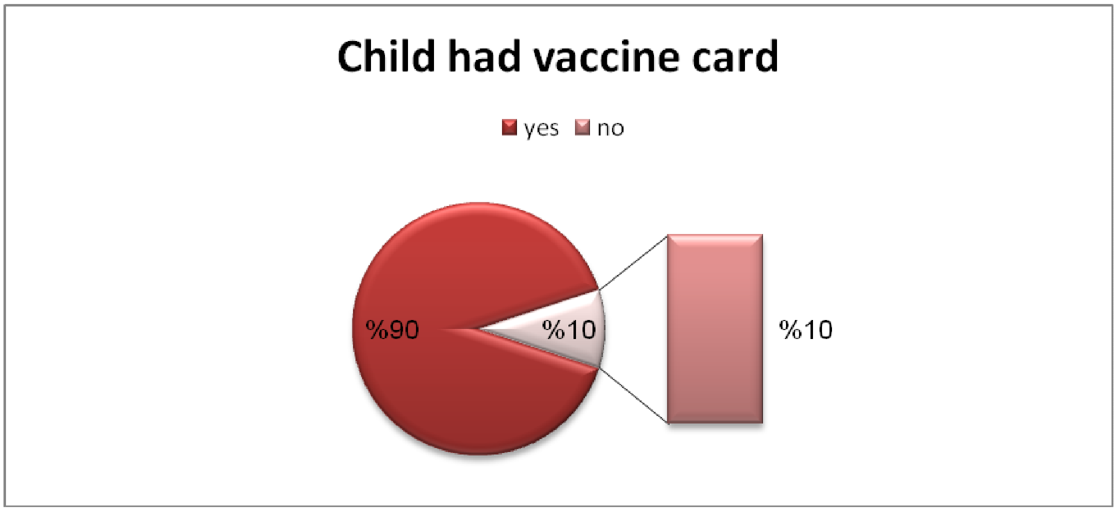

Figure (V) Availability of vaccination card in Shendi town (2013).

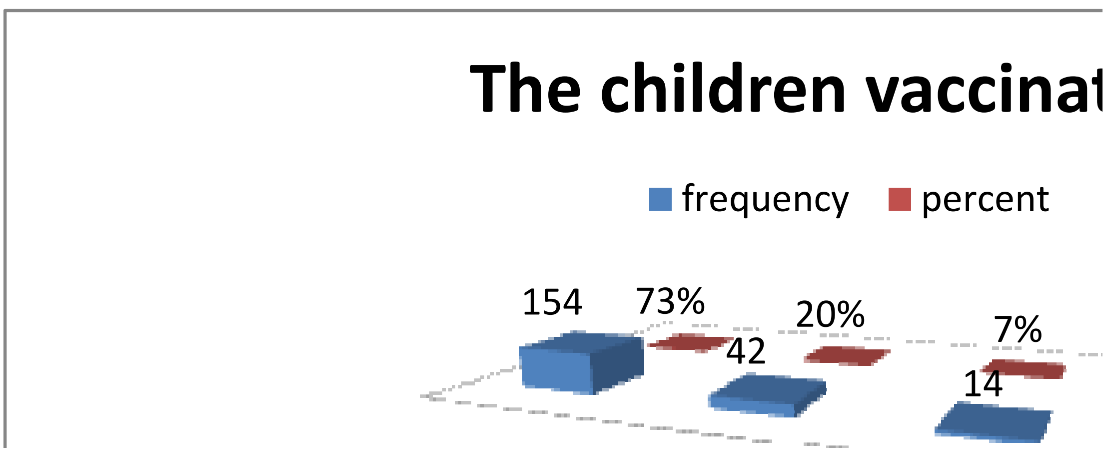

Figure (VI) Coverage of children by measles vaccine in Shendi town (2013).

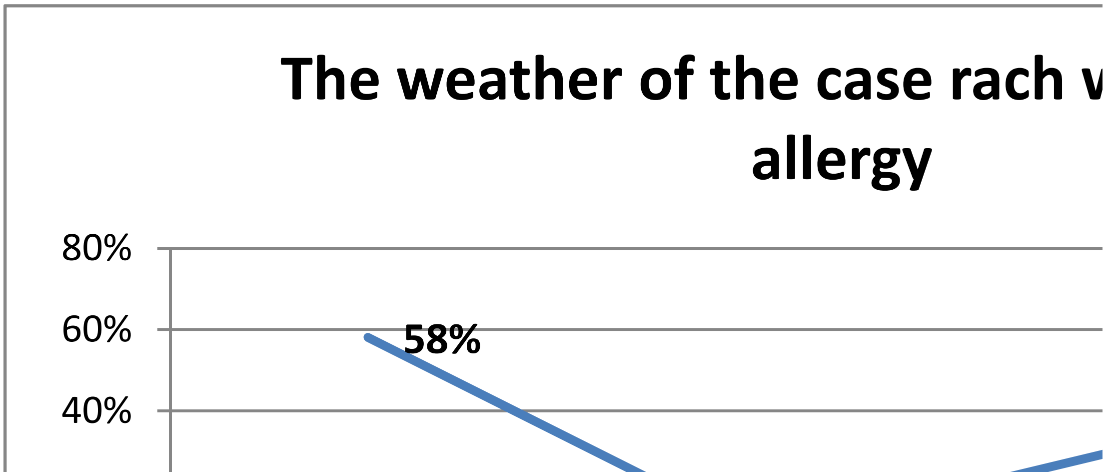

Figure (VII) knowledge about increasing of rash cases in Shendi town (2013).

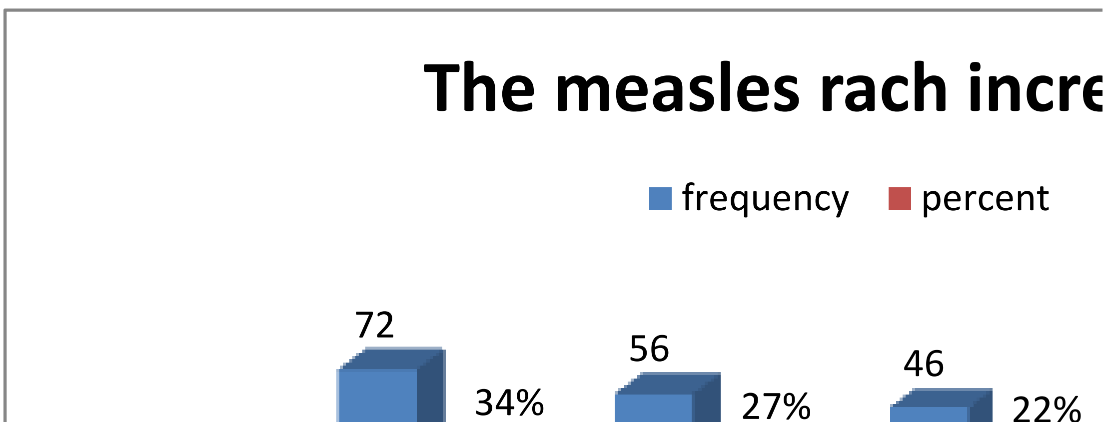

Figure (VIII) knowledge of parents about reasons of rash increasing in Shendi town (2013).

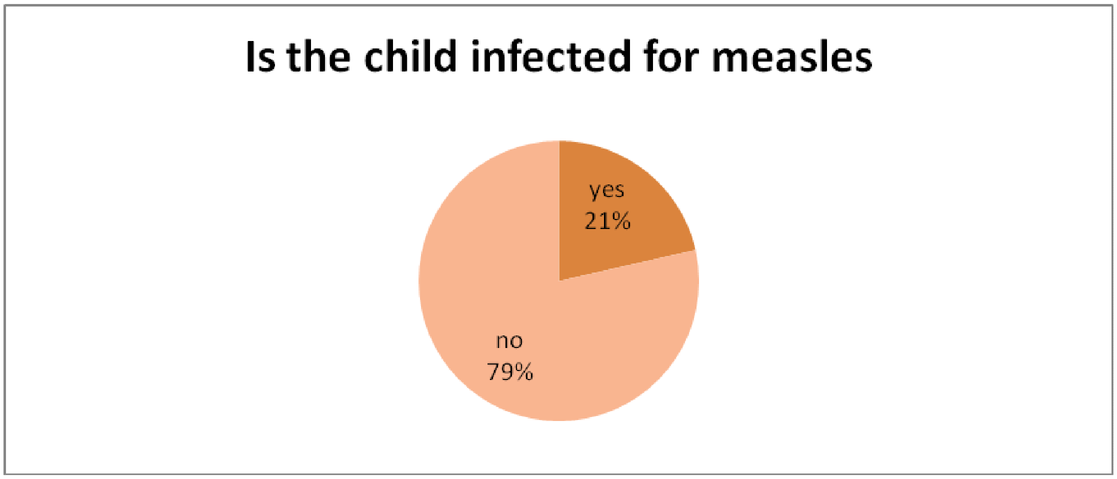

Figure (IX) The prevalence of measles among children under 5 years old in Shendi town (2013).

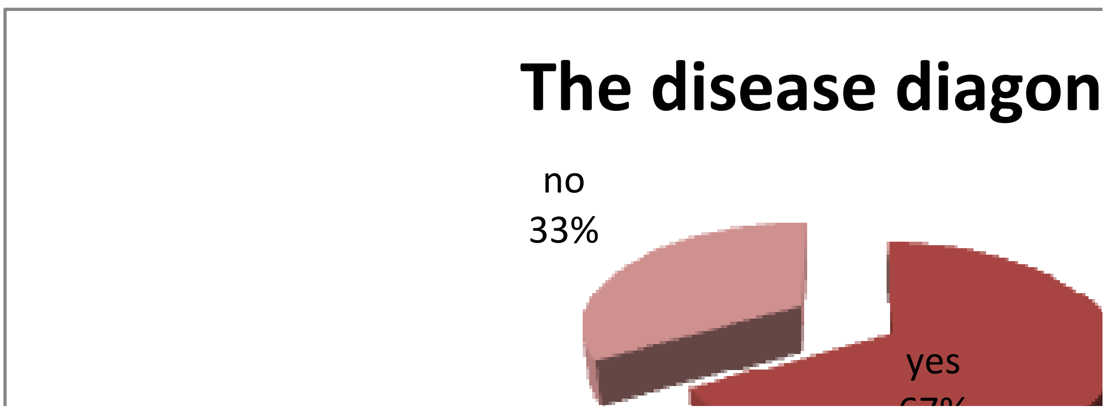

Figure (X) laboratory result in Shendi town (2013).

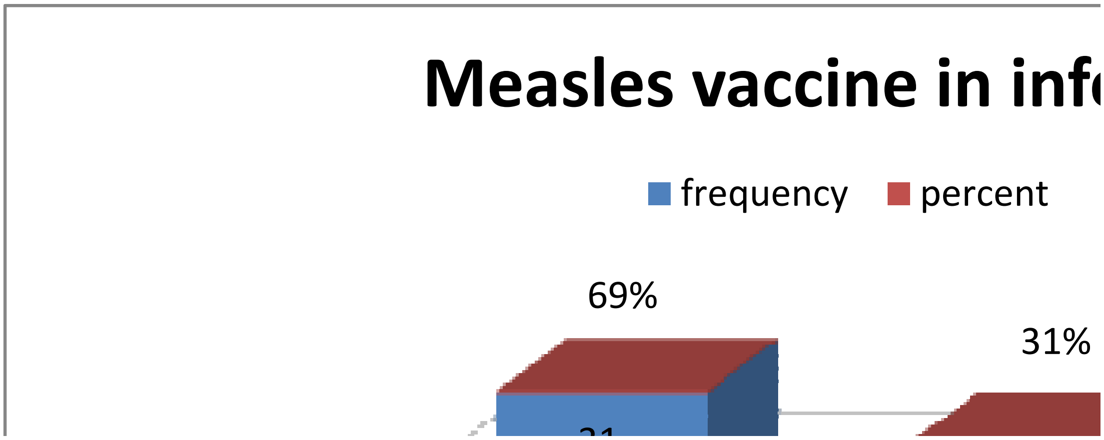

Figure (XI) Immunization status among infected children under 5 years old in Shendi town (2013).

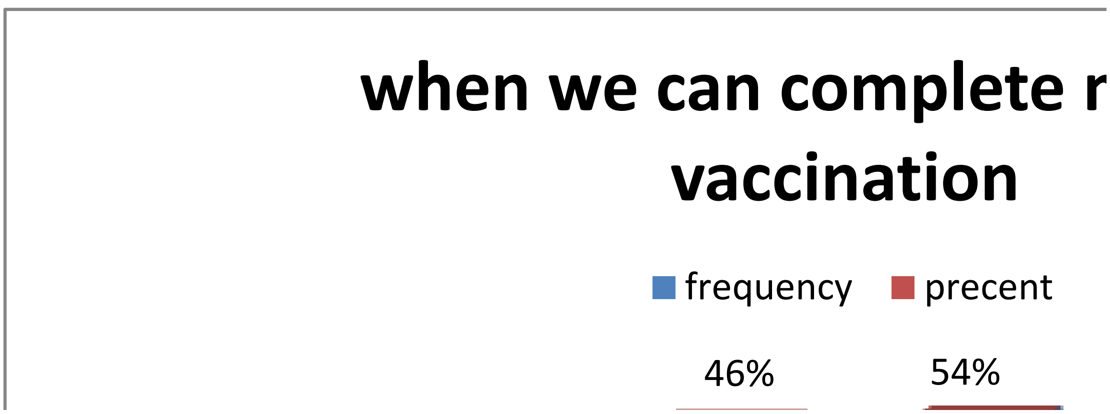

Figure (XII) The immunization status by measles vaccine among children under 5 years old in Shendi town (2013).

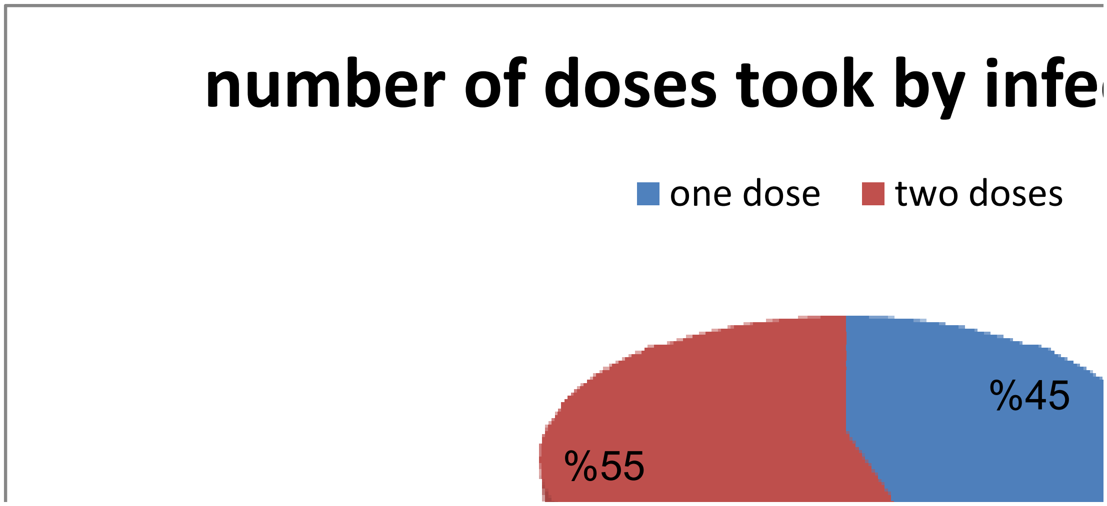

Figure (XIII) knowledge about number of doses for infected children in Shendi town (2013).

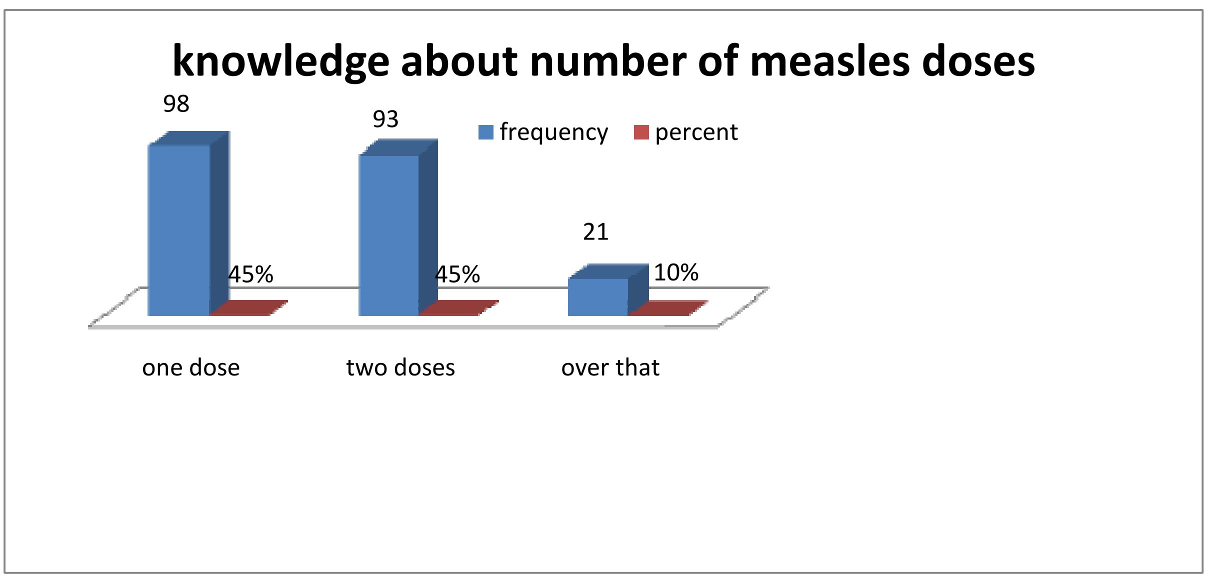

Figure (XIV) knowledge about number of measles doses in Shendi town (2013).

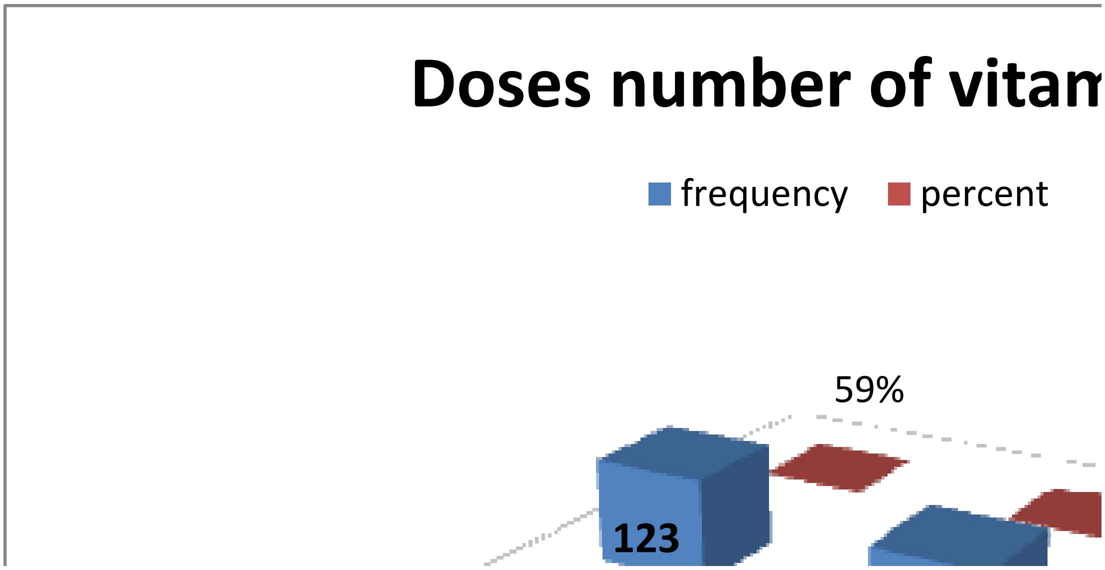

Figure (XV) Number of doses of vitamin " A " taken by children under 5 years old in Shendi town (2013).

Figure (XVI) knowledge the vitamin " A " took by children under 5 years old in Shendi town (2013).

5.1 Discussion

This descriptive-cross sectional community based study was conducted in Shendi town on (210) households and mainly on (210 children under five years old). The result shows that the age distribution as follow: 36% of children (under one year) as the highest age group exposed to measles disease, 34% (1-2 years), and only 30% (3-5years), This is agrees with Dr. peter Salama& Dr. Jean Marie stated that " The highest fatality rates are usually among children under five, and up to 20% in infants less than one year old."; due to the immunity system for this children was uncompleted and not yet eligible for vaccination; because the vaccine take in 9 months of age.

The study the revealed that the measles prevalence (Gender) of children under 5 years old Shendi town, was higher among male (54%). That it is agree with Dr. Edmond Jones who wrote that "Emphasizes issues related to enhanced surveillance, mass immunization campaigns, mop-up efforts, and outbreak response activities."; due to their life style e.g. play grouped of children: crowded- inhalation- some infected by measles- more contact with others), and the females were playing in their houses.

The result reveals that the fathers low education level in Shendi town, i.e. secondary school level, was the highest levels one of (30%), and the high education level was the lowest of (2%). The matter that agrees with Dr. Edmond Jones who said: "periodic measles epidemics continued to occur, especially in large urban areas. These outbreaks occurred primarily among unvaccinated preschool- aged children… In large urban areas, even where measles vaccine coverage is high, the number of susceptible infants and children may still be sufficient to sustain transmission."; because the low of Education, is considered as important factor of many diseases such as:

measles, malaria, respiratory infections. And because the Education is very important for the life; because they educated people look for improving their health status, and so it is a useful indicator for control.

The result of availability of vaccination card for children under 5 years old is (90%) is available immunization cards, while the (10%) were in lack of the immunization cards. That is agree with Dr. Edmond Jones, he wrote "Routine immunization activities are also described, since such activities are crucial for sustaining advances in measles elimination. Prototype forms are included in the annexes, and they can be copied or modified to meet particular local needs.". Due to the active of routine immunization activities, improvement by knowledge of diseases for children in the family's children and activity of health immunization centers.

The result showed the children vaccination took in health centers, that (73%), of children were fully immunized, while (20%) partially immunized, whereas (7%) are never received any immunization. That is agree with WHO(may1999) witch wrote "As high levels of vaccine coverage are maintained, an increasing proportion of cases will occur among individuals in older age-groups. As vaccine coverage improves, the proportion of cases with a vaccination history increases."; because the improvement by knowledge of diseases for children in the family's children, active of health centers immunization and vaccine coverage has increased (provide every child with a dose of measles vaccine).

The result shows that the parent's children knowledge for the factors associated with measles transmitted by response of mother in Shendi town, that (39%) of children transmitted by infected children, while the (24%) of children infected in hospital, while (20%), (18%) of children infected by dust and crowded. That is agree with Dr. Edmond Jones, said: "Measles virus is transmitted primarily by respiratory droplets or airborne spray to mucous membranes in the upper respiratory tract or the conjunctiva. Common source outbreaks associated with airborne transmission of measles virus have been documented.", and WHO(Public Health& preventive Medicine 2009) shows that: " Measles is usually transmitted in large respiratory droplets, requiring close contact between patients and susceptible persons. However, measles virus can survive for at least two hours in fine droplets, and airborne spread has been documented."; because the infected children of measles need to be isolated from other children to prevent the spread of the disease among others.

The result shows that the children parent knowledge for the causes of rash that (34%) by dust, (27%) by polluted smells, (22%) by polluted air "fumes", and (17%) by tired. That is agree with Dr. Edmond Jones, who wrote: " Infectivity is greatest three days before rash onset. Measles is highly contagious. Secondary attack rates among susceptible household contacts have been reported to be 75%–90%.", and WHO (December 2009) wrote: "The rash peaks in two to three days and becomes most concentrated on the trunk and upper extremities. The density of the rash can vary. The rash typically lasts from three to seven days and then fades in the same pattern as it appeared and may be followed by a fine desquamation."; because the dust includes the virus from measles patients and this virus transmission through by: inhalation, cough, sneezing, sputum and other methods.

The study shows the prevalence of measles in infected children under 5 years old in Shendi town was (21%) infected, while (79%) not infected by measles. That is agree with Dr. Edmond Jones, he wrote: "Immunity following natural infection is believed to be lifelong, and vaccination with measles vaccine has been shown to be protective for at least 20 years.", and Department of Health, Washington state (2008) said: "Vaccinating susceptible contacts within 72 hours of exposure may prevent disease. If 72 hours has passed since the exposure, vaccination is still recommended to prevent future infection. Persons who have received one dose should receive a second dose."; because the parents of children improvement in knowledge for measles and important for their children early, and activity of supplementary immunization activities.

The study result shows that the immunization status by measles vaccine among infected children under 5 years old, was (69%) immunized and (31%) unimmunized. That is agree with Dr. Edmond Jones, said: "As vaccine coverage has increased, there has been a marked reduction in measles incidence; and, with decreased measles virus circulation, the average age at which infection occurs has increased. Outbreaks are generally due to the accumulation of persons susceptible to measles virus, including both unvaccinated persons and those who were vaccinated but failed to seroconvert. Approximately 15% of children vaccinated at 9 months of age and 5%–10% of those vaccinated at 12 months of age fail to seroconvert, and are thus not protected after vaccination.", and WHO(December 2009) wrote: "Unvaccinated young children are at highest risk of measles and its complications, including death. Any non-immune person (who has not been vaccinated or previously recovered from the disease) can become infected."; because the measles vaccine was not coverage for some children, this is indicator of low active immunization centers, and some parents of children not response for 2nd dose; because the one pottel of measles vaccine contain 10 doses and destroy after 6 hours for the begin of preparation, the vaccine could not active after that, and in immunization centers one day in a week work the measles vaccination.

The study found out that the knowledge of health education of number of measles vaccine for children under 5 years old by mothers in Shendi town was (45%) of those who took one dose, while (45%) took two doses and only (10%) above that. That is agree with WHO(December 2009) wrote: "In 2008, about 83% of the world's children received one dose of measles vaccine by their first birthday through routine health services – up from 72% in 2000. Two doses of the vaccine are recommended to ensure immunity, as about 15% of vaccinated children fail to develop immunity from the first dose."; because the children received one dose of measles vaccine by their first birthday (at 9 months) through routine health services, and they should take 2^{nd} dose of the vaccine which is recommended to ensure immunity, and to develop immunity from the first dose.

The result shows that (answer by the parent's children) times of measles poster(2^{nd}) dose was (33%) at infected, while (17%) at return infected, while (25%),(25%) at cure and at contact with patients. That is agree with Dr. peter Salama& Dr. Jean Marie stated that: "virtually all older children who receive a second opportunity for measles immunization vaccination, delivered either through routine immunization services or periodic supplementary immunization activities(SIAs), are completely protected for life against measles."; because the measles is very infected killer disease and very speed transmission disease(worldwide) specially in the children groups, and the one dose is un-responsibility in some children after immunized, this is an indicator of the some population didn't differential between early measles and sensitivity, and didn't have full knowledge of the patients isolation.

The study result shows the knowledge of times of measles vaccine can completed doses by mother's children that of (54%) once in those who had one dose, while (46%) two doses. That is disagrees with WHO(may 1999) which said: "When high levels of vaccine coverage are attained (i.e. vaccine coverage >80%), measles incidence decreases and the intervals between outbreaks are lengthened.". In addition to that WHO(December 2009) wrote: "In 2008, about 83% of the world's children received one dose of measles vaccine by their first birthday through routine health services – up from 72% in 2000."; and that might be because the children received one dose of measles vaccine by their first birthday (at 9 months) through routine health services, and weak received for 2nd dose.

The result also showed the vitamin " A " took by children under 5 years old that (90%) were taken, and (10%) didn't taken. That agrees with WHO (October 2009) wrote: "All children in developing countries with suspected measles should receive 2 doses of vitamin A supplements given apart in 24 hours. If caretakers suspect exophthalmia, a severe drying of the eye surface with symptoms of night blindness and eye irritation, a 3rd dose of vitamin A should be provided in 2-4 weeks later."; because the vitamin "A" improved the immunity system and activities, and prevent complications by receiving 2nd dose of vitamin "A" supplements given apart in 24 hours. If caretakers suspect exophthalmia, a severe drying eye saw with night symptoms (took to blindness) and eye irritation.

The study showed, too, the signs and symptoms of children's patients by measles, that (49%) fever, while (23%) skin red, (10%) skin rash, and runny nose (19%). That agrees with WHO (December 2009) which said: "The first sign of measles is usually a high fever, which begins about 10 to 12 days after exposure to the virus, and lasts four to seven days. small white spots inside the cheeks can develop in the initial stage. After several days, a rash erupts, usually on the face and upper neck. Over about three days, the rash spreads."; because the signs of measles usually are a high fever about 10-12 days, and it is the first sign of measles, and this is indicator of high knowledge population for skin rash, and some families didn’t differentiate between early skin rash of measles and skin sensitivity cause by hot weather and other factors.

Finally the study showed the parents can prevent and control the children from the measles, that (78%) by complete vaccines, while (22%) by isolated patients. That agrees with WHO(may 1999) which wrote: "Avoid contact with susceptible family members and visitors. Avoid exposing other people at health care facilities by calling ahead and making special arrangements to prevent contact with others."; because some children didn't receptor of once dose for measles vaccine (because 2^{nd} dose taken after three months), and avoid contact the patients of measles, and by isolate patients and complete vaccines.

5.2 Conclusion :

This study concluded that the most affected group were those under one year(36%), and the prevalence of measles disease was(21%), and this may be due to the factors associated with the prevalence of the disease like: age group has low immunity(46%) once dose and are not yet eligible for immunization, and house status(11%) bad, In addition of that there was significant number of mothers who didn't take their children for immunization immediately after they reach their 9 month of age. Also, early immunization before one year; because to prevention of measles. Finally in this study the data shows that 7% of children are never received any immunization of measles. And the patterns of the disease among Shendi children were normal and didn't risk; because often their children were not complications.

5.3 Recommendations

1. Every family should be inform by health workers from the nearest health facilities that it is very important take their children for immunization by measles vaccine immediately after they complete their 9 months of age.

2. The mother should be educated on how to protect their children from getting infected with disease, their children should not e.g. share the cups, toys or other objects with infected children that could be contaminated with the measles virus.

3. And proper cases management of infected children to reduce the burden of complications and to prevent other children from getting infected with measles.

4. The community contribution in supporting immunization activities should strengthen through sensitization meeting and group discussion.

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6.2.Appendices

No.(1).questionnaire

بسم الله الرحمن الرحيم

Shendi University

Faculty of Graduate Studies And scientific Research

questionnaire

This study for measles epidemiological changes in children under five years old in Shendi town (2013)

place: ....

Address: ………………………………….

1-Age of child: a/under one year( ) b/1-2years( ) c/ 3-5 years( )

2-Gender: male ( ) Female ( )

3- Marital status: married ( ) widow ( )

4- house status: best ( ) good ( ) bad ( )

5- Family size: >6 ( ) 6 ( ) <6 ( )

6- Number of children under five years: ( )

7- Economic status (family income):

under 400 SDG ( ) 400-800SDG ( ) over 800SDG ( )

8- Father's education level:

Illiterate( ) Khalwa( ) primary school ( ) secondary school( ) University( ) H.E( )

9- Is any patient of this symptoms in house now:

Fever ( ) skin rash( ) face and neck rash( ) pain in neck ( ) bad R.T( )

10- Is the child had vaccine card ? yes ( ) No ( )

11- Is the child completed vaccines? Completed doses ( ) some doses ( ) no any dose ( )

12- Is an any cases of rash without the allergy? Yes ( ) No ( )

13- If the answer (12) yes, when? In summer ( )in winter ( )in raining ( )

14- How the measles transmitted ? by house dust ( ) over crowded ( ) children patient( ) by hospital infectious( )

15- How the measles rash increase ?dust ( ) smelling( )air pollution ( ) tiered ( )

16- What are the symptoms of measles? Fever ( ) skin red ( ) rash ( ) runny nose( )

17- Is the child infected for measles? Yes ( ) No ( )

18- If the children infected , what do you do ? go to doctor ( ) vaccine ( ) local cure ( )

19- Is the disease diagnosis in any health center ? Yes ( ) No ( )

20- If the answer (19) yes, what the type of treatment used ? Medical ( ) local ( )

21- In the cases, is the patient took measles vaccine ? yes ( ) No ( )

22- If the answer (21) yes, how many doses took it? One dose ( ) two doses ( )

23- If the answer (21) No, why ? …………………………………………..

24- How to protect the children for measles? Complete vaccine ( ) Isolation( )

25- How many doses for measles vaccine ? One dose ( ) two doses ( ) over that ( )

26- When the children take the basic dose of measles ?After 9 months ( )After one year( )

27- When the child take the poster dose ?

At infected ( ) at return infected ( ) at the cure ( ) at contact patient ( )

28- How many time the child completed measles vaccine ? Once ( ) twice ( )

29- Is any patient of measles in this family ? yes ( ) No ( )

30- What is the type of vaccine used in the center ? ..……………………..

31- Is the child took the vitamin "A" ? yes ( ) No ( )

32- How many doses of vitamin "A" ? Once ( ) twice ( )

33- Evaluation of vaccines in the vaccine center ? Good ( ) Middle ( ) Bad ( )

34- Is the vaccines enough in the vaccine center ? yes ( ) No ( )

35- If the answer (34) No, why ? ………………………………………..

Appendices No.(2).Weekly surveillance report

Weekly Special Surveillance Report

Reporting unit: ________________________________

Dates: from ____________ to ____________

1. Number of suspected measles cases: _____

(Attach forms on any case; if no cases to report, indicate 0.)

2. Number of acute flaccid paralysis cases:___

(Attach forms on any case; if no cases to report, indicate 0.)

3. Other: ____________ ; ___________________

(Other designated disease or condition.)

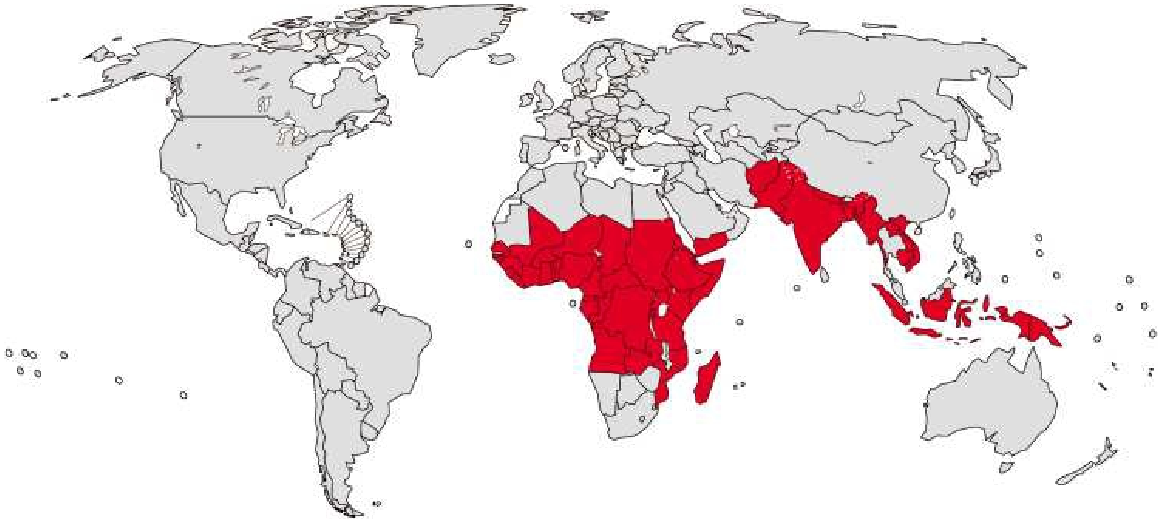
Person filling out report: _____________________________

Date: ____________ .

Please send by messenger, telephone, or fax by Tuesday.

Appendices No.(3). Pictures

The 47 priority countries for measles mortality reduction:



Source: WHO/IVB database, 2004.

Priority countries

Blindness caused by corneal scarring due to vitamin A deficiency.

Pneumonia and diarrhea are common complications of severe measles (**9**).

Koplik's spots (10).

TABLE 1. Reported measles vaccination campaign coverage, by state — Darfur, Sudan, 2004

State	Total target population*	Target population in accessible areas*	No. vaccinated	% coverage in accessible areas	% coverage of total population
South Darfur	1,260,324	1,197,308	1,216,590	102	97
North Darfur	657,774	512,058	490,166	96	75
West Darfur	688,984	461,619	301,446	65	44
Total	**2,607,082**	**2,170,985**	**2,008,202**	**93**	**77**

Source: Expanded Program on Immunization at the Federal Ministry of Health in Sudan.
* Children aged 9 months–15 years. Estimated target population before the conflict.

TABLE 2. Number of measles-related cases and deaths in internally displaced persons located in West and North Darfur before mass vaccination campaigns, by location — Darfur, Sudan, 2004

Location	Dates of outbreak	No. of cases	No. of deaths	Case-fatality rate
Fur Baranga, West Darfur	March 1–April 27	48	NA*	NA
El-Mashtal, North Darfur	March 27–June 16	521	88	17%
Habilla, West Darfur	April 1–June 3	142	20	14%

* Data not available.