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A Short Book of PUBLIC HEALTH

VK Muthu



Second Edition

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CHAPTER

3

Respiratory Infections

Air has direct access to respiratory passage right up to the alveoli. Air is often the vehicle for the transmission of microorganisms from man to man or from environment to man. As the control of air quality is a difficult proposition respiratory infections are common.

Some important respiratory infections discussed here are the following:

- Smallpox
- Chickenpox
- Measles
- German measles
- Mumps
- Influenza
- Common cold
- Diphtheria
- Whooping cough
- Tuberculosis
- Meningococcal meningitis
- Severe acute respiratory syndrome (SARS)
- Avian influenza (bird flu) in humans
- Swine influenza in humans
- Acute respiratory infections (ARI).

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❑ SMALLPOX

Smallpox Eradication—A Success Story

Smallpox was once a killer disease occurring throughout the world having an annual incidence of 10 million cases. An orthopox virus, the variola virus (variola major and variola minor) is the causative agent. WHO started the program of global eradication of smallpox in 1967. India's last case was reported in May 1975 and after a period of 2 years it was declared smallpox free in April 1977 by International Commission for Assessment of Smallpox Eradication. The last case reported in the world was in October 1977 in Somalia except for a laboratory accident in 1978 in Birmingham (UK). Since then the world is free from smallpox. WHO declared the global eradication of smallpox in May 1980 (Fig. 3.1).

The epidemiological features that favored the eradication of smallpox are:

1. The variola virus, the causative agent of smallpox, causes disease only in human beings and no extra human reservoir is known.
2. No carrier state is seen and subclinical cases played no significant role in the transmission.
3. The evolution of an outbreak is slow and therefore control is easy.
4. Secondary attack rate is low.
5. Availability of a potent vaccine, which conferred prolonged protection.
6. Lifelong immunity after recovery from the disease.
7. The disease is easily recognizable even by non-medical personnel and international cooperation.

Since the disease has been eradicated, it is no longer necessary to vaccinate anyone except those who handle vaccine virus for research and vaccine production and those who investigate human monkeypox cases directly.

Currently, variola virus is known to be stored in two facilities—the CDC in Atlanta and the Russian State Center for Research on Virology and Biotechnology, Koltsovo, Novosibirsk region, Russian federation. In the early 1980s, WHO recommended that all

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existing stocks of variola virus held in other countries be either destroyed or shipped to one of the two WHO-approved collaborating centers. All countries reported compliance.

The poxvirus infection in humans in future can come from two sources namely the laboratories, which preserve the virus and the animal poxviruses.



Figure 3.1: Smallpox in an adult [*Courtesy:* Barbra Rice, Centers for Disease Control and Prevention (CDC), Public Health Images Library, May 2001].

The other poxviruses that resemble smallpox virus are monkeypox, cowpox, camelpox, tanapox and tateropox. The monkeypox virus and the tanapox virus have caused diseases in man in Africa. Both are zoonotic diseases that affect man accidentally.

Antibodies against monkeypox virus were identified in several squirrel and monkey species as well as in other wild-caught animals in the endemic areas indicating that monkeypox virus may have a broad reservoir range. Immunity from smallpox vaccination protects against monkeypox with > 85% efficacy. However, currently available smallpox vaccines should not be used in monkeypox-endemic areas until the epidemiologic picture of monkeypox and the risks from vaccination are clarified.

Smallpox vaccine stock enough for 200 million people is maintained by WHO in Geneva, Toronto and New Delhi to meet the needs in the event of an accidental outbreak.

❑ CHICKENPOX

Chickenpox is a childhood disease affecting children below 10 years. It is a highly infectious disease with secondary attack rate (SAR) approaching 90%. It occurs in all parts of the world. Annual incidence is 80–90 million cases.

In India, it shows a seasonal trend occurring in summer months. Though it is mainly a childhood disease, current epidemiological data shows an increasing incidence of first infections in older age groups. The reason for this is not known, but this has

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important consequences as the infection is more serious in adults and pregnant women.

Causative organism is varicella-zoster (VZ) virus, the human (alpha) herpes virus 3. It is a double-stranded DNA virus belonging to the herpes virus family. Only one serotype is known.

Reservoir and Source

Man is the only reservoir. Cases, inapparent cases and herpes zoster cases constitute the reservoir pool. Nasopharyngeal secretion and vesicular fluid are the source of infective material. Scabs are not infectious. A hospital outbreak of chickenpox in which the source of infection was a cadaver has been reported in India.

Mode of Transmission

Chickenpox is transmitted through droplet infection and droplet nuclei. This virus can cross the placenta and infect the fetus.

Chickenpox can be contracted from herpes zoster (shingles) cases also. Herpes zoster is caused by the same VZ virus and it occurs in individuals who have already had chickenpox. The latent virus gets reactivated when immunity is lowered.

Factors Facilitating Transmission

Overcrowding, ignorance and viral shedding even before the appearance of rashes are some factors, which favor transmission.

Period of communicability commences 1–2 days before the appearance of rash and continues for 4–5 days after the appearance.

Incubation Period

Usually 2 weeks, but may vary between 7 and 23 days.

Clinical Manifestation

Clinical spectrum varies from a mild to severe illness with widespread rash. About 80% of all reported cases occur in children below 10 years of age.

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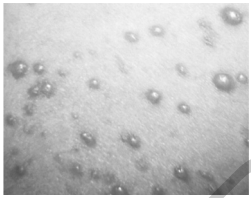

Figure 3.2: Chickenpox vesicles (pleomorphism) *(Courtesy:* Joe Miller-CDC)

Pre-eruptive stage characterized by sudden onset of fever, shivering, malaise and back pain is followed by eruptive stage after 24–48 hours. The rashes will be distributed more on the trunk (centripetal distribution) unlike in smallpox in which the rashes are present more on the face and extremities (centrifugal distribution). All forms of rashes (macule, papule, vesicle and pustule) can be observed at any point of time (pleomorphism) in chickenpox (Fig. 3.2), whereas in smallpox only one type of rash will be present at a given moment. The evolution of the rashes is completed by the 5th day after which scabbing begins. Scabs may remain intact for 1–3 weeks.

Complications like secondary bacterial infection of the skin lesions and pneumonia in adults may occur. Very rarely encephalitis may be a complication. Usually an attack confers lifelong immunity. Herpes zoster manifests as rashes along the course of a peripheral nerve.

Prevention and Control

Japan was among the first countries to vaccinate against chickenpox. Field trials with the Japanese live attenuated vaccine have shown that it is safe and effective. Early childhood immunization is given (single dose) at 12–24 months of age. In adolescents and adults two subcutaneous doses, 4–8 weeks apart are advised.

A routine varicella vaccination program for healthy children would prevent 94% of all potential cases of chickenpox provided the vaccination coverage rate is 97% at school entry. But in India, chickenpox vaccine does not form part of the National Immunization Schedule. Since the vaccine is costly, not everyone can afford it. Thus chickenpox virus still exists in the community.

Contraindications are pregnancy, reaction to previous dose (including reaction to a component such as gelatin), any advanced immune disorder or cellular immune deficiency, symptomatic

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HIV infection and severe illness. Adverse reactions include mild local reaction and mild illness with rash.

Control can be achieved by isolation of patients and separation of high risk individuals from cases. Cyclovir is an approved drug for the acute management of varicella in children and adults. When Cyclovir is given within the first 24 hours of the onset of rash in children, constitutional symptoms and pruritus are diminished. Number of lesions and the time for crusting are also reduced. In immunocompromised patients intravenous Cyclovir is indicated.

Children with varicella should not be given Aspirin because of the increased risk of Reye's syndrome, which is a serious condition that may affect all major systems or organs.

Immunosuppressed persons may be protected by giving varicella-zoster immunoglobulin (VZIG) within 72 hours of exposure.

❑ MEASLES (RUBEOLA)

Measles is an acute highly infectious childhood disease, which occurs both in endemic and epidemic form. Epidemics occur once in 2–3 years because of waning immunity among the people (Fig. 3.3).

There were an estimated 30–40 million cases of measles in 2000 causing some 777,000 deaths worldwide. Number of reported cases globally in 2011 has come down to 344,276. Number of measles deaths also has dropped from 777,000 in 2000 to 139,300 in 2010 globally.

Mostly children were the victims. The biggest decline (90%) occurred in the Eastern Mediterranean region.

India is still haunted by measles despite the availability of an effective vaccine for over 40 years. The disease burden is high. 29,339 cases were reported in 2011, which is a little less than in 2010. Factors such



Figure 3.3: Measles *(Courtesy:* Centers for Disease Control and Prevention)

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as malnutrition, overcrowding and low socioeconomic status add to the mortality and morbidity.

Causative organism is an RNA paramyxovirus.

The virus has a single serotype although 23 genotypes have been identified. Infection by any genotype can induce lifelong immunity against all genotypes. All major epidemics in European region were associated with genotypes D4, D6 and B3. In India, genotypes D4 and D8 have been identified (WHO, Feb 2012).

Incubation period is 11–12 days usually, but may vary from 8 to 16 days. The patient is infectious from the prodromal period up to the first few days of the rash.

Reservoir and Source

Measles cases form the reservoir. No extra human reservoir is known. Inapparent infection and long carrier state is not seen. Respiratory secretion is the source of infective material.

Mode of Transmission

Measles is a highly infectious disease with secondary attack rate of over 80%. Transmission occurs by means of droplet infection and droplet nuclei and the virus enters through the respiratory tract. Unlike poliomyelitis, recipients of measles vaccine are not infectious to others.

Factors Facilitating Transmission

Overcrowding, population mobility, ignorance and superstitious beliefs favor transmission.

Clinical Manifestation

Measles is a disease of children. Infants below 6 months may not be affected if they have maternal antibodies. This disease runs a very severe course in malnourished children and the mortality is 400 times higher in the malnourished than in well-nourished children.

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Two stages of the disease are described. During the initial pre-eruptive prodromal stage, the child will have fever, cough, sneezing, running nose and congestion of eyes, which may last 3–4 days. Two days prior to the appearance of rash, red spots with a pale surrounding called 'Koplik's spots' may be seen over the buccal mucosa opposite to the upper second molar tooth and it is a pathognomonic feature of measles. The eruptive stage is heralded by the appearance of maculopapular rashes first on the face and then over the trunk and extremities. The fever comes down 3–5 days after the appearance of rashes. The rashes begin to fade after 5–6 days and may leave a brownish discoloration on the skin.

Although usually a mild illness in children, measles can have serious complications and be fatal to children who are immunosuppressed. Among those who survive measles, up to 10% may suffer disabilities such as blindness, deafness and irreversible brain damage. Commonest complications are otitis media and pneumonia. Postmeasles diarrhea is another common complication, which often precipitates protein energy malnutrition (PEM) in infants. Serious complications like encephalitis may occur in 1 in 1,000 cases. Subacute sclerosing panencephalitis (SSPE) and multiple sclerosis (MS) may follow measles. Measles during pregnancy may result in prematurity, fetal wastage and congenital defects.

Prevention and Control

Immunizing agents both active and passive are available against measles. Immunoglobulin (human dose 0.25 mL/kg body weight with a maximum 15 mL) given within 3 days of exposure can protect those with deficient immunity.

Immunity can be induced actively by measles vaccine, a live attenuated vaccine. Freeze-dried measles vaccine has to be stored at recommended temperature. Now heat-stable vaccines are also available. One dose gives 95% protection for at least 15 years. Measles vaccine is advised for infants above 9 months of age, but not below that age because maternal antibodies may interfere with the antibody production. Susceptible contacts can be protected by measles vaccine, if the vaccine is given within 3 days of exposure. Very rarely serious complication like SSPE may be

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produced by the vaccine, the incidence of which is much less than that in natural infection.

Between 1985 and 1988, it was found that the children who received only 1 dose were not always protected from the disease. This led to the recommendation of a 2nd dose for children between the ages of 5 and 19 years to ensure protection. According to UNICEF, India is the only country in the world giving only 1 dose of measles vaccine. But according to experts 1 dose of measles vaccine is not sufficient to give protection to the whole population against measles.

It has also been found that the premature infants respond as well as the full-term infants to MMR vaccination and chickenpox vaccination. Therefore giving MMR and chickenpox vaccines on time to premature babies is the best way to protect these children from these diseases.

Measles vaccine is better avoided during pregnancy. It is contraindicated in immunocompromized children, those on steroid therapy and those with history of convulsions, allergy or eczema, acute illness and active tuberculosis.

Control is achieved by isolation, concurrent disinfection and immunization of contacts and by surveillance. Quarantine is impractical.

Eradication

Measles meets the technical criteria for eradication. Humans constitute the only natural reservoir for the causative virus and there are no healthy carriers of the virus (as in hepatitis B). An effective vaccine has been available for over 3 decades and today costs only US$ 0.26 for a single dose including safe injection equipment. Natural immunity to the virus is lifelong.

However, measles eradication is still a long way off. One reason is the priority given to polio eradication, scheduled for 2005. But in the meantime, efforts are being continued to reduce measles deaths throughout the world through immunization and vitamin A supplementation. Because measles is a highly contagious disease, the new plan calls for immunization of at least 90% of children worldwide. The current global vaccine coverage rate is only 85% (in 2010).

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As the 1st dose of vaccine is only about 85% effective in developing countries, the plan recommends a 2nd dose of vaccine for all children, through either routine vaccination or mass immunization campaigns.

Measles Initiative

The measles initiative is a partnership led by the American Red Cross, the United Nations Foundation, UNICEF, the US Centers for Disease Control and Prevention and WHO, committed to reducing measles deaths worldwide. The measles initiative has been in operation since 2001 for reducing measles mortality in Africa. The measles initiative expanded its support to countries affected by measles in the Eastern Mediterranean, South-East Asia and Western Pacific regions of WHO. Since 2007, the measles initiative supports vaccination campaigns in all regions of the world, made possible by new funding from the International Finance Facility for Immunization.

WHO Measles Elimination Strategy

The WHO advocates a three phase strategy for measles elimination.

1. Catch up: This is a nationwide campaign to vaccinate all children between the ages of 9 months and 14 years regardless of measles history or vaccination status.
2. Keep up: This is the routine vaccination schedule in which the aim is to vaccinate at least 95% of children in each successive birth cohort.
3. Follow-up: It is conducted every 2–4 years after the catch-up phase. All children born after the catch-up phase are vaccinated.

Many countries around the world have adopted the three phase WHO strategy for eliminating measles and for decreasing mortality and morbidity. Not enough susceptibles will accumulate to cause an epidemic. Each importation will only lead to a few secondary cases (unlikely to be more than 100).

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❑ GERMAN MEASLES (RUBELLA)

German measles, first described in Germany. It is a common exanthematous disease having worldwide occurrence. It occurs as an epidemic mostly in children, but also can occur in adults. It is known for its propensity to cause congenital defects in the newborn if infection occurs during pregnancy.

Rubella has worldwide distribution. Before the introduction of large scale rubella vaccination programs, the usual age range of infection was between 6 and 12 years in high-income countries and between 2 and 8 years in urban areas of low-income countries.

The incidence of rubella, including maternal infection, has decreased in countries implementing routine immunization against rubella with high coverage.

In 2011, 112,531 rubella cases and 214 cases of congenital rubella syndrome (CRS) were reported to WHO.

In India, comprehensive evidence about the true burden of CRS is not available. It is only now that the subject is sought to be revived on the country's health agenda. However, studies indicate that around 15%–30% of women in the childbearing age are susceptible to rubella in India. CRS accounts for 10%–15% of pediatric cataract. It is also the main cause of deafness in India.

Causative organism is an RNA virus of togavirus group. There is only a single serotype. It is a major cause of birth defects among the toxoplasmosis, rubella, cytomegalovirus and herpes (TORCH) simplex group of organisms causing congenital anomalies. Natural infection confers lifelong protection.

Incubation period is usually 18 days; but may vary from 14 to 21 days.

Reservoir and Source

No extra human reservoir is known. Cases of rubella form the reservoir. Subclinical cases also contribute for the transmission. Nasopharyngeal secretion is the source of infective material.

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Mode of Transmission

Transmission is by means of droplet infection and droplet nuclei. It is the only togavirus known to be transmitted via the respiratory route. This virus can cross the placental barrier and infect the fetus in the womb. Period of communicability is several days before and several days after the appearance of rash.

Factors Facilitating Transmission

Overcrowding, ignorance, occurrence of subclinical cases and inadequate immunization coverage all favor transmission.

Clinical Manifestation

Rubella is usually a mild, self-limiting infection. Mild fever and malaise is followed by the appearance of maculopapular rash, the 'blueberry muffin' skin lesions, which spread rapidly from the face down the trunk. Lymphadenopathy is common and arthralgia may be present in 50% of adult cases. Testicular pain has also been reported. Serious complications are rare. Asymptomatic infection is common. Compared to measles, rubella is usually a milder illness with a shorter duration.

Complications include thrombocytopenia in about 1 in 3,000 cases and encephalitis in about 1 in 6,000 cases. Arthritis and arthralgia may affect up to 70% of adult females who become infected.

The importance of this disease lies in the fact that it can cause congenital defects in the newborn if the mother is infected during pregnancy—CRS. It was ophthalmologist Norman McAlister Gregg who first linked epidemic congenital cataracts (Fig. 3.4) in Australia to intrauterine rubella in 1941. Miscarriage, preterm birth and stillbirth are common when rubella is contracted in early pregnancy. The risk of defects drops as the pregnancy progresses. After 20



Figure 3.4: Congenital cataract in a newborn *(Courtesy*: Centers for Disease Control and Prevention)

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A Short Book of PUBLIC HEALTH

The first edition was compiled as a handy volume, especially for paramedical personnel. Now the second edition has been brought out with a wider scope. It can cater to the requirements of medical students as well as medical, health and paramedical personnel. While retaining basic issues in public health needed for understanding the subject, the public health horizon has been much expanded. Many new chapters have been added. Latest information and data on the subject have been incorporated as far as possible. Topics on drug resistance, newer vaccines, emerging infectious diseases and many communicable diseases, which were not covered in the first edition of the book, have been incorporated, thereby improving the quality of the book by providing a wider coverage. This edition, with a comprehensive coverage and rational reorganization of the subject, will be of much use to the medical fraternity. The author will be pleased to receive criticisms and suggestions for the improvement of the book.



VK Muthu MBBS DPH MSc graduated in medicine in 1971. After a period of clinical practice, he specialized in public health and taught the same in Gandhigram Rural Institute, a deemed University in Dindigul, Tamil Nadu, India, from 1984 till his retirement as Associate Professor in 2012. He has also obtained an MSc (Applied Nutrition) degree from the National Institute of Nutrition, Hyderabad, Andhra Pradesh, India. He has published articles on various topics at national and international levels. Besides, he is also a poet and a writer on social issues.

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