Guidelines for Prevention and Control of

Japanese Encephalitis

Joint Publication by:

ZOONOSIS DIVISION
National Institute of Communicable Diseases
(Directorate General of Health Services)
22-Sham Nath Marg, Delhi - 110 054

World Health Organization
Country Office for India

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CONTENTS

GUIDELINES FOR PREVENTION AND CONTROL OF JAPANESE ENCEPHALITIS

1. Introduction

Japanese Encephalitis (JE) is a mosquito borne zoonotic viral disease caused by arbovirus (flavivirus), involving the Central Nervous System. In nature, the virus is maintained in ardied birds (e.g. cattle egrets, pond herons etc.) and other animals particularly pigs. Although infection in human is incidental, the virus can cause serious neurological disease in human. Presence of one clinical case in the community suggests that 300 to 1000 people have been infected. The disease occurs with sudden onset and the common symptoms are headache, high fever, stiff neck, abnormal movements (coarse tremor, convulsions in children), impaired consciousness and coma. Case fatality rate in JE is high, ranging from 20-40%.

JE occurs in a large number of countries/area of Asia. It is a disease of public health importance because of its epidemic potential and high case fatality rate. In patient who survive, complications may lead to life long sequelae.

2. Causative agent

The disease is caused by JE virus, an RNA virus, which belongs to genus Flavivirus, and family Flaviviridae.

3. Epidemiology

3.1 Geographical distribution

JE occurs in a large number of countries of Asia, including Cambodia, China, Indonesia, Japan, Laos, Malaysia, Myanmar, Philippines, Korea, Thailand, Vietnam, South-eastern Russian Federation and the Indian subcontinent. In recent decades, JE has gradually spread to previously non-affected Asian regions.

3.2 Situation in India

In India, JE was first recorded in Vellore and Pondicherry in mid 1950s. The first major outbreak of JE occurred in 1973 in Bankura & Burdwan districts of West Bengal. In

1976, wide spread outbreaks were reported from Andhra Pradesh, Assam, Karnataka, Tamil Nadu, Uttar Pradesh and West Bengal. In 1978 JE cases were reported from 21 states and Union Territories. The Directorate of NVBDCP is monitoring JE incidence in the country since 1978. The worst ever recorded outbreak in India was reported from Uttar Pradesh during 1988 when 4485 cases with 1413 deaths were recorded from eight districts with case fatality rate of 31.5%. The highly affected states include Andhra Pradesh, Assam, Bihar, Goa, Karnataka, Manipur, Tamil Nadu, Uttar Pradesh and West Bengal. Outbreaks of JE usually coincide with monsoons and post-monsoon period when the vector density is high. However, in endemic areas, sporadic cases may occur throughout the year. Case fatality rate in newly affected areas ranges from 10 – 70%. However, with early detection and management of cases it has come down to an average of approximately 20%. State wise cases and deaths due to JE from 2001 to 2005 is depicted in Table 1.

Table 1: **State wise JE cases and deaths from 2001 – 2005**

S. No.	States	2001		2002		2003		2004 (P)*		2005 (P)*	
		C	D	C	D	C	D	C	D	C	D
1.	Andhra Pradesh	33	4	18	3	329	183	7	3	0	0
2.	Assam	343	200	472	150	109	49	235	64	145	52
3.	Bihar	48	11	-	-	6	2	85	28	192	64
4.	Chandigarh	-	-	4	-	0	0	0	0	0	0
5.	Delhi	-	-	1	-	12	5	17	0	2	0
6.	Goa	6	2	11	-	0	0	0	0	5	0
7.	Haryana	47	22	59	40	104	67	37	27	38	31
8.	Karnataka	206	14	152	15	226	10	181	6	108	8
9.	Kerala	128	5	-	-	17	2	9	1	-	-
10.	Maharashtra	126	1	27	12	475	115	22	0	66	30
11.	Manipur	-	-	2	1	1	0	0	0	1	0
12.	Punjab	-	-	10	2	0	0	0	0	0	0
13.	Tamil Nadu	-	-	-	-	163	36	88	9	8	1
14.	Uttar Pradesh	1005	199	281	69	1124	237	1030	228	5978	1458
15.	West Bengal	119	21	-	-	2	1	3	1	6	1
	Grand Total	2061	479	1037	292	2568	707	1714	367	6550	1645

C - Cases ; D - Deaths Source: NVBDCP data; P* - Provisional
Source : NVBDCP

3.3 Transmission

The infection is transmitted through the bite of an infected culicine mosquito. The transmission cycle is maintained in animals and birds. Infection in man is the dead end of the transmission. Man to man transmission has not been documented.

3.4 Reservoir of infection

JE virus has its natural cycle in vertebrates and mosquitoes. The animal hosts mainly include pigs whereas other animals such as cattle and horses have no significant role in disease transmission and amongst birds are the water birds e.g. pond herons, cattle egrets, poultry birds and ducks play a significant role in the natural history of JE virus. Pigs are the major vertebrate hosts and are considered as amplifying hosts. Infection in man appears to be correlated with living in close proximity with animal reservoirs, especially pigs. Currently available evidences does not indicate major role of cattle and horses.

In India, birds particularly those belonging to family Ardeidae and pigs play important role in maintenance of JE virus in nature. Various studies conducted on detection of the presence of JE antibodies in the sera of birds belonging to different species have indicated that *Ardeola grayii* (pond heron) and *Bubulcus ibis* (cattle egret) play a definite role in maintenance of JE virus in nature. In different parts of the country, 12 to 44 per cent pig population has been found to be positive for JE antibodies particularly in JE endemic areas. Besides birds and pigs, bovines and bats have also been found positive for JE antibodies but their role in maintenance of virus in nature is doubtful as the titres found in them are very low.

3.5 Vectors

Mosquitoes belonging to *Culex vishnui* group are most important vector species in India. *Culex* mosquitoes generally breed in water bodies with luxurious vegetation like irrigated rice fields, shallow ditches and pools. Mosquitoes are zoophilic, feeding primarily on animal and wild birds. Epidemics usually coincide with monsoons and post-monsoon period when the vector density is high. Female mosquitoes get infected after feeding on a viraemic host and can transmit the virus to other hosts after an extrensic incubation period of 9 to 12 days. The mosquitoes remain infected for life. The average life period of a mosquito is about 21 days. Culex mosquito can fly for long distances (1-3 kms. or even more).

In India, JE virus was first isolated from wild caught mosquito species at Vellore in 1956. Since then the virus has been isolated from 12 mosquito species in wild caught specimen from different parts of the country. Maximum isolations have been made from Culex vishnui group consisting of *C.tritaeniorhynchus*, *C.vishnui* and *C.pseudovishnui*.

4. Clinical manifestations

The incubation period in man, following mosquito bite varies from 5 to 15 days. The clinical features of JE are those of encephalitis. Majority of the cases are in younger age groups, although all age groups are affected. In areas where disease has become endemic, cases are mainly reported from age groups below 15 years. Various epidemiological studies conducted during investigation of outbreaks, observed that though both sexes are affected, males outnumber females. The patient will give history of acute onset with fever with altered sensorium. Some of the patients may show change in behaviour. There may be history of convulsions. Febrile seizures may mimic a case of JE but the sensorium is not altered. The focal neurological deficits may or may not be present. Disturbances of sensorium are reflected as lethargy, somnolence, irritability, apathy or loss of consciousness. The patient may develop difficulty of speech and other neurological deficits like ocular palsies, hemiplegia, tremor and ataxia. There may also be loss of bladder and bowel control. The focal neurological signs may be stationary or progressive. 5% to 70% patients who recover from the acute episode may have neurological sequelae depending upon the age and severity of the disease viz. mental impairment, severe emotional instability, personality changes, paralysis etc. In majority of the cases, however, the infection is mild with no overt clinical symptoms or mild fever with headache. Clinical laboratory finding in acute encephalitic stage - CSF is clear and may show variable findings: fluid pressure is normal to mildly elevated, CSF glucose is normal and proteins are mildly elevated. Case fatality rate is high i.e. 20 to 40% in severe cases.

5. Laboratory diagnosis of JE

5.1 Detection/isolation of antigen/virus

(i) Demonstration of viral antigen in the autopsied brain tissue by the fluorescent antibody test

(ii) Isolation and identification of the virus from CSF, occasionally from peripheral blood (within 3 to 4 days after onset of symptoms) or autopsied brain tissue.

5.2 Detection of antibody

The diagnosis of JE is supported by serological tests. The tests include detection of IgM antibodies which appear after the first week of onset of symptoms and are detectable for one to three months after the acute episode.
A four fold rise in IgG antibody titre in paired sera taken at an interval of 10 days or more is confirmatory.

IgG antibodies indicate previous infection and are useful for conducting sero-epidemiological studies to determine the extent of silent infection and immunity levels in the local population.

The detection of antibodies to JE virus can be done routinely by Haemagglutination Inhibition Test (HI) test to demonstrate four fold rise in total antibodies and IgM Capture ELISA test for demonstration of IgM antibodies. National Institute of Virology may be contacted for antigens and reagents.

Note:

- During an epidemic situation, the laboratory receiving the samples under prior intimation should receive the samples round the clock.
- Laboratory should prioritize the testing of the samples even during the holidays.
- All tests should be performed as per standard guidelines using standard kits along with the kit controls and internal quality controls.
- The results should be communicated to the user at the earliest to initiate preventive and control measures in the affected area.
- Efforts should be made to have external proficiency tests between the laboratories so that more and more laboratories can be added to this list.

5.3 Interpretation of results

Confirmatory diagnosis is made by one of the following:

- Isolation of virus
- Antigen detection
- IgM antibodies in CSF and/or serum
- IgM antibodies in serum with relevant clinical history in a known area in an epidemic situation
- Four fold rise/fall in IgG or total antibodies in paired sera

6. Management

There is no specific treatment of JE. However, supportive treatment and good nursing care can significantly reduce case fatality rate. It is, therefore, important that encephalitis cases should be referred to a hospital as early as possible so that treatment is started without waiting for serological laboratory results.

Treatment of JE

The treatment for JE would encompass:

- Management of an unconscious patient
- Reduction of increased intracranial pressure (ICP)
- Treatment of convulsions
- Management of respiratory failure if present

Management of unconscious patient:

- Maintenance of airway and breathing
- Maintenance of circulation – fluid restriction to 70% of total requirement of fluid per day. Fluids - Dextrose saline, 5% Dextrose or Ringers Lactate

Reduction of increased ICP:

- Osmotic diuretics – Mannitol 20% (2-5 ml/kg/dose) given 4- 6 hourly; Lasix 1 mg/kg
- Contraindication of mannitol – pulmonary oedema, fluid overload

Treatment of convulsions

Diazepam (0.25 – 0.5 mg/kg) intravenously to control the acute episode followed

by anti-convulsants.

(a) Dilantin 5 – 8 mg/kg/day

(b) Phenobarbitone 5 – 8 mg/kg/day

Management of respiratory failure

- If needed : Oxygen inhalation
- Ventilatory support

Disability limitation and rehabilitation

Patient needs to be followed up for the detection and management of disabilities. The patient may require: Physiotherapy, speech therapy and special support as per the deficit.

7. Prevention and control of JE

7.1 Surveillance

The component of JE surveillance consists of three major areas: (1) Clinical/ syndromic surveillance through PHC system for early diagnosis and proper management of JE patients. (2) Vector surveillance in JE prone areas for monitoring vector behaviour and population build up for timely implementation of intervention methods (3) Sero-surveillance to delineate high risk population groups and to monitor JE specific antibodies in sentinel animals or birds as an indication of increasing viral activity.

7.2 Case definition

Clinical case description

Japanese Encephalitis virus infection may result in a febrile illness of variable severity associated with neurological symptoms ranging from headache to meningitis or encephalitis. Symptoms and signs can include:

Headache, fever, meningeal signs (neck rigidity), stupor, disorientation, coma, tremors, paresis (generalised), hypertonia, loss of co-ordination. The encephalitis cannot be distinguished clinically from other central nervous system infections.

Suspect case

- High grade fever of acute onset with at least two of the following:
- Decrease in level of consciousness independent of convulsions
- Significant change in mental status either in behaviour or personality
- Convulsions

Probable case

- Suspected case of Japanese encephalitis with or without signs of meningeal irritation and varying degree of neurological deficits, and
- Usually not more than a few cases (1-2) in one village
- Presence of animal hosts and high density of vector
- Elevated levels of HI antibodies to JE virus

Confirmed case

- Presence of IgM antibody in serum and/or CSF
- Four fold difference in IgG antibody titre in paired sera
- virus isolation from brain tissue
- Antigen detection by Immunofluoroscence/PCR

7.3 Control

(i) Interruption of Transmission

Prevention of transmission is possible through vector control. For effective control of vectors, residual insecticidal spraying has been suggested in all animal dwellings with appropriate insecticide before the onset of transmission season. The detailed guidelines for vector control formulated by Directorate of NVBDCP are annexed.

(ii) Vaccination

Three types of vaccine against JE is presently produced and used worldwide. Inactivated mouse brain (Japan, Korea, Taiwan, Thailand, Vietnam, PR China, India), inactivated and live attenuated primary hamster kidney cells are manufactured in China. However JE vaccine produced in mouse brain is distributed commercially and available internationally.

In most areas of Asia, the mouse brain vaccine produced from the Nakayama strain is given subcutaneously in 2 doses of 0.5 ml (1.0 ml for people > 3 years) 1 to 4 weeks apart with a booster dose at 1 year and additional booster doses thereafter at 1 to 3 year intervals. Vaccination should be carried out during inter-epidemic period in the age group of 1 to 15 years. In India, the vaccine is being produced at Central Research Institute, Kasauli.

The live attenuated (SA-14-14-2) vaccine is produced and has been licensed and used in China since 1988. Recently countries like Nepal, South Korea and Sri Lanka have licensed this vaccine for use in their countries. The live vaccine when given in single dose and has a high efficacy (data reported from several countries have shown efficacy to be between 80 – 99% following a single dose vaccination and 98% or greater with two doses of vaccination). The live vaccine has excellent safety record and no severe adverse effects have been reported. However, live attenuated vaccine requires 'field testing' in Indian context, specially in known endemic areas.

(iii) Management of cases

There is no specific curative therapy for JE patients. The cases are managed symptomatically and early diagnosis with proper and adequate management helps in reducing the associated fatality and neurological sequelae.

(iv) Health Education and Community involvement

It has been observed that there is a direct relationship between the time lag in onset of symptoms and initiation of therapy. Immediate management of cases reduces fatality to a considerable extent. Since the disease is predominantly prevalent in rural areas, generating awareness helps in early reporting. Further health education helps in encouraging personnel protection.

8. Guidelines for collection, storage and transportation of specimens for Japanese Encephalitis

The laboratory diagnosis of JE depends upon the proper collection of clinical material from human cases. In epidemic situations it becomes necessary to collect vector mosquitoes also for isolation of JE virus.

8.1 Collection of specimens from human cases

Clinical samples for diagnosis of JE

- Blood
- CSF
- Autopsy brain samples
- Vectors

8.1.1. Serum : Serum samples should be collected from suspected JE cases within 4 days after the onset of illness for isolation of virus and at least 5 days after the onset of illness for detection of IgM antibodies. A second, convalescent sample should be collected at least 10 – 14 days after the first sample for serology.

Blood collection

- Aseptically collect 4 - 5 ml of venous blood.
- Keep it at room temperature for about 15 minutes to enable it to clot.
- Separate the serum from the clot and transfer to a screw capped leak proof sterile container.
- Seal the container with adhesive tape and label the container with appropriate information viz. patient's name, identification number, date of collection etc.
- Place the serum in refrigerator if there is delay in transportation to laboratory (Annex-1).

Preference should be given to collection of samples from suspected cases during an outbreak period over contacts and animal reservoirs.

8.1.2. Cerebrospinal fluid (CSF) : Collect CSF specimen in sterile screw capped bottles under all aseptic precautions for attempting isolation of virus and antibody detection. Label these containers properly and transport at the earliest as described for serum. All attempts should be made to collect the CSF samples for confirmation of diagnosis. The CSF should be collected by a trained person.

8.1.3 Brain Tissue: To make an initial diagnosis of JE, wherever feasible, obtain brain tissue within hours of patient's death during the first two weeks of illness. It is the best source for the isolation of virus. Collect small pieces of tissue from different parts of the brain-cerebral cortex, cerebellum, basal nuclei and brain stem. Immerse the brain tissue (s) thus obtained in 2ml of Virus Transport Medium (VTM) in sterile screw capped bottles. VTM should be obtained from the laboratory testing the samples. If transport medium is not available, glycerol-saline may be used. Alternatively, nutrient broth medium with antibiotics can be used. The brain sample for isolation of virus should be sent under prior intimation to the receiving laboratory. Brain samples for virus isolation and antigen detection should not be sent in formalin.

8.1.4 Collection of vectors

In an epidemic situation, it is desirable to collect mosquitoes from the affected areas-both indoor and outdoor, so that they may be processed for virus isolation. This may give an indication of the species acting as vector and also provide some information on the mosquito fauna of the area. Mosquitoes can be collected by standard method such as aspirator, baited traps, biting collections and light traps.

The mosquitoes should be held alive in 'Barraud Cages' wrapped with moistened lint or cloth. If the collection locality is not far from the laboratory or transportation can be done within a day or two, they may be transported alive in Barraud cages. For such transportation, it is necessary to provide raisins soaked in water or a cotton pledget soaked in 10 percent solution inside the Barraud cage.

If the collection locality is far from the laboratory and immediate transportation is not possible, mosquitoes may be identified, pooled species wise and stored in liquid nitrogen, refrigerators or on dry ice for subsequent transportation to the laboratory. If facilities for liquid nitrogen or dry ice storage are not available in the field, transport medium may be used to store the mosquito pools. It is, however, necessary that such pools are constantly kept in the refrigerator or transported on wet ice.

Note:

- Samples for virus isolation and antigen detection – CSF, blood, autopsy brain tissue
- Samples for virus isolation and antigen detection should be collected (as early as possible) within 4 days after the onset of illness.
- Samples for antibody detection should be collected at least 5 days after the onset of illness.
- Paired sample should be collected at an interval of at least 10 – 14 days after the 1st sample for demonstration of sero-conversion or four fold difference in antibody titre.

8.1.5 Storage and Transport

Place the specimens at +4^{0}C as soon as possible after collection. Dispatch these at the earliest possible opportunity on wet ice in a large thermos or an ice-box or vaccine container to the designated laboratory vide infra. Considering the emergency, preference should be given to hand carry the sample to the designated laboratory. Samples for PCR should be transported on dry ice. Every specimen must be accompanied by the pertinent information as shown in annexure-1.

To avoid rejection of samples the following precautions should be taken while collection and transportation of samples:

- Sample vial should be properly sealed to prevent leakage of sample.
- Sample should be collected in plain, clean, dry vial to prevent haemolysis as it interferes with the test result.
- Sample should be collected under aseptic precautions to prevent contamination as it interferes with the test results.
- Sufficient quantity, as indicated should be collected.
- Proper cold chain should be maintained during transportation.
- Sample should be properly labeled.

9. Laboratories undertaking work on JE in India (locate the address, phone/fax nos. and e-mails of each laboratory)

1. National Institute of Virology, Ambedkar Road, Pune
2. National Institute of Communicable Diseases, 22-Sham Nath Marg, Delhi
3. Sanjay Gandhi Post Graduate Institute of Medical Sciences, Raibareily road, Lucknow
4. King George's Medical College, Lucknow
5. Armed Forces Medical College, Pune
6. School of Tropical Medicine, 110 Chittaranjan Avenue, Kolkata
7. Veterinary Biological Institute, Hyderabad
8. King Institute of Preventive Medicine, Chennai
9. National Institute of Mental Health and Neurological Sciences, Bangalore
10. Christian Medical College, Vellore

10. Notification

If an outbreak of JE is suspected it must be reported immediately to the district health office. The state health authorities must be informed through the quickest mode of communication, preferably through telephone, fax or e-mail of the details of the outbreak including investigation and control measures initiated. The National Institute of Communicable Diseaes, 22-Sham Nath Marg, Delhi – 110054 (Ph: 23971272, 23971060, 23913148; Fax: 23922677; Telegram: COMDIS, Delhi, e-mail address: dirnicd@bol.net.in, dirnicd@nda.vsnl.net.in) is expected to be kept informed of the action taken.

PROFORMA FOR Suspect JE

DATE:	C.R. NO. HOSPITAL:
1. NAME OF THE PATIENT:	
2. AGE/SEX:	
3. ADDRESS:	
4. WHETHER VISITED ANY OTHER : AREA DURING LAST ONE MONTH	
5. DATE OF ONSET OF FEVER:	
6. HISTORY OF PRESENT ILLNESS:	
CLINICAL LABORATORY FINDINGS:	
PRESENT CONDITION OF PATIENT:	
SPECIMEN COLLECTED: BLOOD/CSF/BRAIN/ANY OTHER	
DATE OF COLLECTION:	
ANY OTHER PERSON ILL IN THE FAMILY/VILLAGE DURING LAST ONE MONTH WITH SIMILAR ILLNESS	
ANY OTHER INFORMATION	
NAME & ADDRESS OF PERSON SENDING SPECIMEN: **Signature** **Tel No & Email**	

Source : Directorate of NVBDCP

ANNEXURE

PREVENTION AND CONTROL OF JE

Directorate of National Vector Borne Disease Control Programme (NVBDCP) is a nodal agency for control and prevention of Japanese Encephalitis (JE) in the country.

The strategy includes:

6.1 Early case detection and treatment

Early diagnosis and proper management of JE cases to reduce case fatality through strengthening of diagnostic and clinical management of JE cases, at PHCs/CHCs and District Hospitals.

In order to avoid JE related morbidity, mortality and complications in endemic areas, estimation of the actual disease burden and development of appropriate control measures need to be intensified in JE endemic areas. JE burden can be estimated satisfactorily if the facilities for JE confirmation are made available at least in referral hospitals.

Considering the merits and demerits of each diagnostic test and the patients representing different clinical phases of infection, establishment of two diagnostic tests, one for detection of JE Reverse Transcriptase - Polymer Chain Reaction (RT-PCR) and one for detection of virus antigen/virus genome is necessary.

6.2 Vector Control

6.2.1 Indoor Residual Spray (IRS)

Vector control is a serious challenge for JE control because of exophilic and exophagic behaviour of JE vectors, which limits effectiveness of conventional

vector control methods like Indoor Residual Spray (IRS). Hence IRS is not recommended for prevention and control for JE. However, in areas where vector is endophilic like *Mansonia annulifera*, IRS may be considered for vector control in high risk pockets.

6.2.2 Fogging

The guidelines developed by the Directorate of NVBDCP for use of fogging for epidemic control was presented and discussed in the meeting of TAC held under the chairmanship of DGHS on 16-3-04. It was highlighted that fogging would be a very cost intensive vector control tool but with limited effect and therefore, not recommended as a routine vector control measure. In case of JE outbreaks, since the vectors are mainly outdoor resting and outdoor feeding, peri-domestic fogging could be resorted to very carefully for containment of outbreaks. It has been suggested that most of the states may resort to fogging whenever there is any JE outbreak so that they can make their efforts visible in the community besides its impact on adult population of vector mosquitoes.

6.2.3 Personnel protection methods-

Preventive measures like use of insecticides treated bed nets, repellents, use of full clothing to cover forearm and legs, etc. should be encouraged.

6.2.4 Anti larval operations

On regular basis for JE vector control is neither cost effective nor operationally feasible.

6.2.5 Other Vector control methods

Some of the vector control methods have been well demonstrated and published for JE control, as described below:

1.1.1.1 **Reduction of breeding sources for larvae:** Two feasible methodologies have been demonstrated to control breeding of mosquitoes in rice fields. They are (i) water management system with intermittent irrigation system and (ii) incorporation of neem products in rice field. The water management is nothing but a strategy of alternate drying and wetting water management system in the rice fields. By using neem products as fertiliser in rice fields, they not only

enhance the grain production but also suppress the breeding of culicine vector of JE.

1.1.1.2 **Larvivorous fish:** Introduction of composite fish culture for mosquito control in rice fields has been evaluated and proved to be successful. In other large and small water bodies release of larvivorous fish will prevent the JE vectors breeding.

1.1.1.3 **Biolarvicides:** Biocides like *Bacillus thuringiensis* var. israelensis and *Bascillus sphaericus* were promoted and anticipated to have great implications as biological larvicides against different mosquito species. Lack of suitable delivery system and short duration of larvicide effect restricted its use in vector control strategy.

1.1.2 **Reduction in man-vector contact:** Pyrethroid-impregnated bed nets and curtains have shown to reduce man-mosquito contact. However people may not prefer to use bed nets due to high temperature and humidity. In such areas, people do accept impregnated curtains instead of bednets. The limitation with this technology is the repeated impregnation of the curtains once in 6 to 9 months and periodic assessment of vectors for development of insecticide resistance to this product. More studies are required to incorporate these methods in JE control programme.

6.2.7 Control of Pig

Pigs constitute the amplifying host of JE and mosquitoes when bite pigs get infected that later infect humans. In JE endemic areas, pigs are found associated with human habitations. Control methods can include immunizing, slaughtering pig, use of mosquito proof piggeries, etc.. Segregating pigs at least 4-5 km away from human habitations can be used wherever it is possible by implementing some by-laws by local administration.

Several studies conducted in Japan showed that pig immunization was effective in eliminating disease in pigs, which may reduce animal transmission and possibly lower human incidence. But it has not been used at the national level because pig immunization requires large number of newborn pigs to be immunized each year and because the period of vaccine effectiveness is limited.

6.3 Behaviour Change Communication (BCC) or (Information Education Communication)

Health Education should be imparted through all probable approaches on personal prophylaxis against vector, segregation of amplifier hosts by mosquito proofing and for early reporting of cases.

Each endemic state should conduct a media advocacy and health education workshop a month prior to the expected season to educate media about the upcoming JE season and enlist their support in dissemination of messages on self protection methods and early case reporting at nearest medical facilities, etc., thereby avoiding any adverse uninformed, adverse publicity.

6.4 Training

i. For the success of any control operation, deployment of trained personnel is important for proper transformation of control strategy into field activities. Therefore, training must constitute an integral part of any control approach.

6.5 Immunization against JE

There are three types of JE vaccine in widespread production and in worldwide use for control of JE. These are (i) inactivated mouse brain derived vaccine; (ii) inactivated primary hamster kidney cell –derived vaccine, and (iii) live attenuated vaccine.

Under immunization protocol, immunization of pigs is to be considered which may reduce viral transmission by limiting or preventing viraemia in pigs. JE vaccines for pigs and equines have been used in various areas of China.

6.6 JE vaccine in India

JE vaccine used in India is a formalin-inactivated product prepared from mouse brains infected with Nakayama JE virus manufactured at Central Research Institute, Kasauli, Himachal Pradesh. The virus is purified with protamine sulphate treatment and ultra centrifugation. The final vaccine is supplied in a freeze dried form and reconstituted in 5.4 ml of sterile pyrogen free distilled water supplied by the laboratory.