Status and Trend of Japanese Encephalitis Epidemics in Nepal: A Five-Year Retrospective Review

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Abstract

Introduction	Japanese encephalitis, one of the mosquito-borne viral infections, is primarily a rural disease. JE epidemic is one of the major public health problems in Nepal.
Objectives	The objective of the study was to review the status and trend of Japanese encephalitis in Nepal within past five years 1998 to 2003.
Methods	Retrospective review of data from published and unpublished documents was made. The data from HMIS and EWARS recording system were collected and analyzed. Health workers including physicians involving in JE treatment, public health officers and veterinary doctors of JE endemic areas were interviewed regarding the status and trend of JE in those areas.
Results	In Nepal, a total number of 8874 cases and 1264 deaths have been reported, with an average case fatality rate of 14.2 percent in aggregate since 1998. During six years period of time, highest number of cases were reported in 1999 (2924 cases) and the second highest were in 2001 (1888 cases). The lowest number of cases (330 cases) with highest mortality (CFR 20.9 percent) has been reported during the year 2003. The overall mortality of JE varies from 9.77 percent during the year 2000 to 20.9 percent during the year 2003. Comparative assessment of disease in different regions showed that Far western and Mid-western Development Regions have reported the highest number of JE cases during the years 1998 to 2003. The reporting districts based on the abundance of number of cases per 100,000 populations are in the order of Banke, Kailali, Kanchanpur, Parsa, Rupandehi and Morang. Cases started to appear in April-May and reached their peak during late August to early September. Cases started to decline from October.
Conclusion	The cases and deaths of JE were found decreasing since 2001. The change in epidemiological pattern of the disease in those days was unpredictable.

Keywords Japanese encephalitis, Epidemics, Retrospective review, Nepal.

Introduction

Topographically, Nepal is divided into three distinct ecological regions namely Mountainous, Hilly and Terai. The eco-system of Terai belt is very favourable for the breeding of *Culex* mosquitoes. The Terai area receives heavy precipitation, ranging between 180-225 cm. The relative humidity varies between 80 percent and 90 percent during the monsoon but declines in the other months. The climatic conditions in the different parts of the country especially in Terai region are favorable for the breeding of *Culex* mosquitoes, the proven vectors of JE and for the availability of the various amplifying hosts of the disease[1].

JE is a severe disease that is widespread throughout Asia and is spreading beyond its traditional habitat. JE is primarily a zoonotic disease infecting mainly vertebrate animals, *e.g.* pigs, birds, horses *etc.* Man is involved in transmission cycle as an incidental host and plays no role in perpetuating the virus. JE is principally a disease of rural agricultural areas, where vector mosquitoes live in close association with the main vertebrate hosts. Pigs, wading birds and ducks have been incriminated as important vertebrate amplifying hosts for JE virus. Humans and horses may become ill in transmission cycle.

In Nepal, clinical cases were reported before 1975 and an epidemic of JE was recognized for the first time in Rupandehi district of the Western Development Region in 1978[2-6]. The disease was then thought to be imported from Gorakhpur and surroundings areas of Uttar Pradesh of India where a JE epidemic occurred in previous years[7]. Subsequently, epidemics occurred in Morang district of eastern Nepal gradually spreading into other districts in successive years. Though this disease is endemic in 24 districts, sporadic cases from other districts have been reported

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in recent years. The three viral strains namely B-2524, B-9548 and Nep-1/90 have been so far isolated in Nepal[8].

In recent years, the epidemiological pattern and geographical distribution of JE has been changed in Asia. In Taiwan, Japan, South Korea and China clinical cases of JE have decreased dramatically. This has been possible through the integrated control effort comprising a human vaccination program, water management, immunization of pigs, systematic piggery and community awareness program. On the other hand, the incidence of JE has increased in India, Nepal, Sri Lanka, Thailand, Bangladesh and Vietnam[7]. A number of outbreaks occurred in India during 1948 to 1978. In 1955, first sero survey was conducted in India. The Haem-agglutination inhibition test (HIT) was done on human and animal serum during 1978 to 1980 in Nepal[9]. In Nepal serological diagnosis has shown that pigs and ducks are main reservoir hosts. During the 1985-86 epidemic, JEV was isolated from human brain/CSF, sentinel pigs and pools of female mosquitoes. A serological survey conducted in Mid-western region of Nepal[10] have found 62 percent significant antibody titres to JE virus.

His Majesty's Government of Nepal has identified Japanese encephalitis as a priority program. In this relation, government has shown its commitment to implement different disease prevention and control activities and strengthen the diagnostic capacity for different established JE diagnostic laboratories. Moreover, national protocol has been developed for JE diagnosis and government is committed for better clinical management and treatment of disease. For this, government has planned to immunize 250 thousand populations of different JE endemic areas in current fiscal year.

Methodology

Epidemiological data of six years (1998-2003) on JE diagnosed cases, using both clinical and laboratory methods were the interests of this study. The data were collected from different health institutions, hospitals and from published and unpublished documents. Data from the Department of Health Services were collected by passive surveillance mechanism; from the hospitals rendering services to the JE affected people. In this study, data from two major reporting systems were reviewed and critically assessed.

Attempts were made to collect the outbreak data on suspected/probable cases reported by different health institutions. Review and assessment of different information management systems was made. The information was collected from the existing health information system. The quality of information and its application in decision-making and responses were reviewed. In this relation, views of health professionals about different perspectives were collected and analyzed.

Questionnaires were developed for different levels of health professionals working in JE endemic areas and involved in the JE control program. The physicians treating JE, Public Health Officers, Veterinary Doctors and JE Patients/Relatives were interviewed. The information regarding endemicity of the disease, trend of the disease in recent years, socio-economic effect of the disease, effect of vaccination, clinical presentation of the cases was collected.

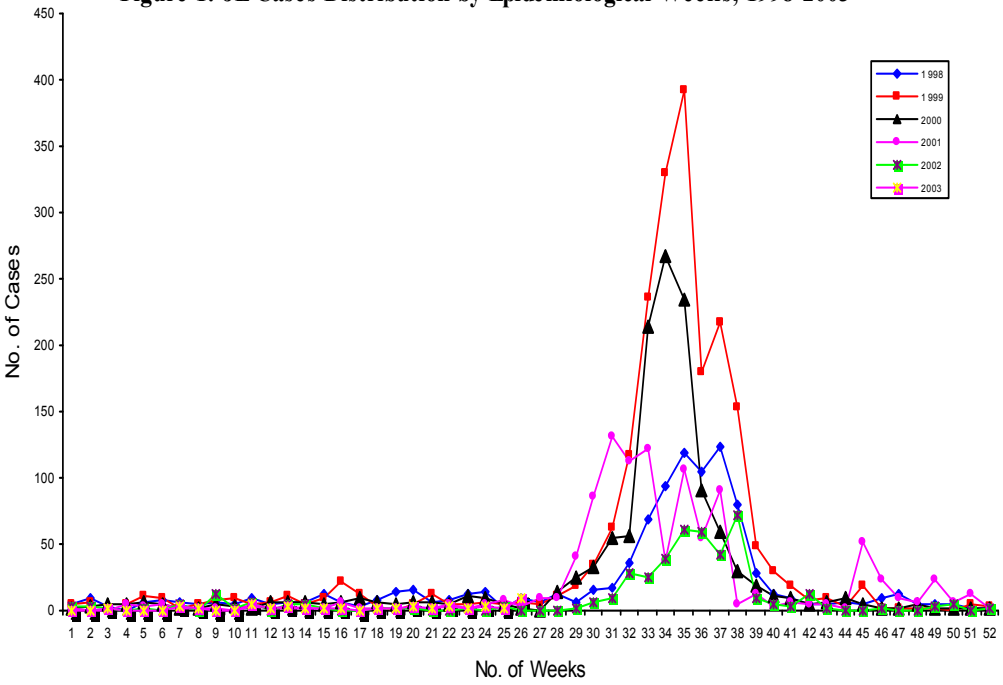
Analysis was of retrospective and descriptive nature. The burden of JE in terms of its morbidity and case fatality was assessed. Age, sex, location and hospital specific incidence and case fatality information was collected with two important indicators namely, *case incidence* (number of cases per 100,000 risk area population per year) and *case fatality rate* (number of deaths/number of cases diagnosed per year). Attempts were made to look for age-sex distribution to characterize the JE outbreaks, and determine seasonal and geographical distribution and the fatality rates (national, as well as district wise) so as to make conclusions to help in prevention and control of JE in Nepal. The collected information has provided comprehensive epidemiological analysis of JE focusing on the trend, distribution, morbidity, mortality as well as the impact of diseases in the family, community and society.

Results

In Nepal, a total number of 8874 cases and 1264 deaths have been reported, with an average case fatality rate of 14.2 percent in aggregate since 1998. Since JE diagnostic laboratories established only during recent past and not available in entire JE endemic areas, most JE reported cases were suspected cases. Cases start to appear in April-May and reached their peak during late August to early September. Cases started to decline from October. Past trend of the disease had shown that JE outbreaks were circumscribed and did not cover large areas. However, it depends on the flight range of the vector mosquitoes, presence of pigs as an amplifying hosts and the presence of a susceptible human population.

The monthly assessment of the disease shows that the cases of JE have been reported throughout the year in this period. Epidemic occurs during rainy season from Central Development Region (134 cases). The region-wise population based JE case incidence

Figure 1: JE Cases Distribution by Epidemiological Weeks, 1998-2003



(monsoon). Analyzing the weekly reported data of the last six years, cases started to build up in the month of March/April and reached its peak during the month of August and September. Subsequently cases started to decline by the end of September and beginning of October to level off in the month of November. Approximately, 80-90 percent of the cases were concentrated in the period ranging from June to October, coinciding with rainy season. Similar pattern was also observed in the past.

During six years period of time, highest number of cases were reported in 1999 (2924 cases) and the second highest were in 2001 (1888 cases). The lowest number of cases (330 cases) with highest mortality (CFR 20.9 percent) has been reported during the year 2003. The overall mortality of JE varied from 9.8 percent during the year 2000 to 20.9 percent during the year 2003.

Comparative assessment of disease in different regions showed that Far western and Mid-western Development Regions have reported the highest number of JE cases during the years 1998 to 2003.

During the year 1998, Mid-western Development Region reported highest number of JE cases (324 cases). The lowest numbers of cases were reported estimation was also made. The highest incidence of 30.9 cases per 100,000 population and 30.8 cases per 100,000 population were reported by Far-western and Mid-western Development Regions respectively. During 1998, highest mortality (CFR 26.1%) was reported from Central Development Region with lowest morbidity among the regions. During the year 1999, Mid-western Development Region reported the highest number of cases (733 cases) with 67.8 cases per 100,000 population. The case fatality rate was also higher in this region (CFR 22.5%). The Far-western Development Region reported second highest number of cases (719 cases) with incidence rate 21.9 cases per 100,000 population. The Western Development Region reported low number of cases (81 cases). Similarly, during 2000, Far-western Development Region and Mid-western Development Region reported high number of JE cases 801 (87.6 cases per 100,000 population) and 500 cases (33.5 cases per 100,000 population) respectively. Central Development Region reported lowest number of cases 73 (3.3 cases per 1000,000 population) with highest mortality (CFR 19.2%).

During 2001, Mid-western and Far western Development Regions reported the increasing trend of disease 808 cases (70.74 cases per 100,000 population) and 629 cases (66.65 cases per 100,000

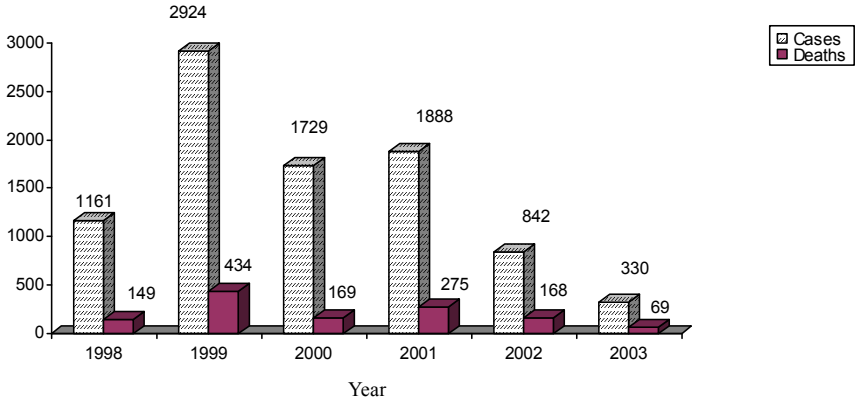
population) respectively. Again the case fatality rate was the highest in Central Development Region (CFR 20.8%).

During the year 2002, the highest number 429 cases (33.7 cases per 100,000 population) were reported in Mid-western Development Region. During the year 2003, 119 cases (7.4 cases per 100,000 population) and 99 cases (2.8 cases per 100,000 population) were reported from Mid-western Development Region and Eastern Development Regions respectively. However, case fatality rate was higher in lesser number of cases reporting regions, Central Development Region (CFR 31.8%) and Western Development Region (CFR 31.3%).

Discussion

The disease burden estimated by the interviewing health professionals varied and differs from the available national health statistics. Most of the physicians reported the numbers of recently treated JE cases. These numbers were corroborated with the hospital reporting and found different. This might be due to poor reporting of the cases treated by the physicians in their private practice. The hilly areas reported to have sporadic disease distribution and rural Terai areas as endemic and Terai urban areas as hyper endemic. The zonal hospitals of disease endemic areas have better management of JE cases.

Figure 2: JE Situation in Nepal (1998-2003)



The district-wise estimation of JE cases per 100,000 population was made. The reporting districts based on the abundance of number of cases per 100,000 population are in the order of Banke, Kailali, Kanchanpur, Parsa, Rupandehi and Morang. However other districts were lesser reporting with unpredictable trend of disease. The higher numbers of JE reporting districts have reflected lesser case fatality rate.

Table 1: Morbidity and mortality trend of JE in Nepal (1998-2003)

Year	Cases	Deaths	Case Fatality rate %
			12.8
1998	1161	149	14.8
1999	2924	434	9.77
2000	1729	169	10
2001	1888	275	20
2002	842	168	20.9
2003	330	69	14.2
Total	8874	1264	

Source: Compilation of HMIS and EWARS Data, 1998-2003.

Most of the cases were cured. The physicians have reported that 6-30 percent of JE cases developed sequelae even after the disease recovery.

The reported sequelae after disease recovery included paralysis, mental retardation, spontaneous abortion in pregnant woman and epilepsy. In JE endemic districts the hospital occupancy by JE cases during JE season varied from 60-90 percent. During outbreak, sometimes it needs extra beds to accommodate all the JE cases.

The risk of travellers acquiring JE was very low (monthly incidence was less than one per million travellers among short term and urban travellers, 0.25 to 1 per 5000 travellers among rural travellers to endemic regions)[11]. JE has not been reported among the travellers in Nepal yet.

The major factors responsible for the transmission of JE are *Culicine* mosquitoes and JE virus amplifying hosts like pigs and ducks[12-14]. The JE endemic districts have vaccination program for the pigs. They were using Malaysian vaccine for vaccination and they also have piggeries development projects.

The age groups below 15 years were found more affected. Males were found more affected by JE than females. JE cases were reported from July to September and higher number of cases was reported in August. Tharu ethnic group was found mostly affected by the disease[15,16].

Patterns of JE transmission varied within individual countries and from year to year. In endemic areas, the annual incidence of disease ranges from 10-100 per 100,000 population. An endemic situation, with occurrence of sporadic cases throughout the year, was present in tropical zones. In temperate regions of Asia and the northern tropical region, JEV was transmitted seasonally. A probable explanation could be the prolonged mosquito larval development time and longer extrinsic period of JEV at cooler temperatures in temperate regions, which could reduce the viral transmission. In some instances, outbreaks have been associated with rainfall, floods, or irrigation of rice fields[17].

More number of cases has been reported in Nepal in post-monsoon period. There might be relationship of disease with rainfall, flood and irrigation system. During heavy rainfall and flood, the number of JE cases got reduced where as high number of cases has been reported in sunny days followed by the heavy rain[18].

The epidemiological trend of the disease is unpredictable. Few years' back, the patients showed high fever with chills but recent time there is low fever but patient gets unconsciousness. This showed that there was change in the clinical presentation of the JE[19]. The change in epidemiological trend of the disease might be due to vaccination. The vaccination program is found effective in reducing the JE cases in JE vaccinated districts. Some JE cases have been reported even after vaccination, which might be due to the administration of vaccine in incubation period[20-22]. The JE has great socio-economic impact on the people especially with low economic status in Terai Nepal[23]. The JE endemic districts didn't have special JE control program. The regular vaccination program for both human and animals are important for future control of JE.

Conclusion

In the current review of retrospective study between 1998 to 2003 in Nepal, a total number of 8874 cases of Japanese Encephalitis were found in which 1264 deaths were recorded, with an average case fatality rate of 14.2 percent in aggregate since 1998. The overall mortality of JE varied from 9.8 percent during the year 2000 to 20.9 percent during the year 2003. The epidemiological trend of the disease was found changeable and unpredictable.

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