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Brief Report

## Review of the Incidence of Japanese Encephalitis in Foreign-Born and Korean Nationals Living in the Republic of Korea, 2007-2016



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### ABSTRACT

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The Japanese encephalitis (JE) vaccine was introduced to the national immunization program in 1985, which has led to a dramatic decrease in the number of reported cases, but JE continues to occur in foreign nationals residing in or traveling to Korea. Although the incidence is low, this study demonstrated that more Koreans were infected with JE than foreign-born expatriates. The incidence rates of Korean-born nationals were between 0.01 and 0.08 cases per 100,000. In contrast, the incidence rates of foreign-born nationals ranged between 0 and 0.26 cases per 100,000. The incidence rates clearly showed that foreign-born expatriates were more at risk, which underscores the importance of vaccination. We recommend heightened surveillance among JE-susceptible individuals and promote vaccination among foreign-born nationals living in Korea.

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## Introduction

Japanese encephalitis (JE) was a public health threat in the Republic of Korea, affecting thousands of cases per year before the introduction of vaccines [1]. It is among the most important of mosquito-borne diseases, causing a range of conditions from mild self-limiting illnesses, to a severe form of encephalitis, resulting in a case fatality rate of ~30% [2]. JE was first documented in Korea in 1947 and remained endemic until the 1980s [1, 3]. In response to a major JE epidemic recorded in 1985, a vaccine was introduced by the national immunization program in 1985, which led to a dramatic decrease in the number of reported cases [4]. Recently, there have been reports

of JE infection among foreign-born nationals living in Korea who have not been previously immunized. A case series in 2014 reported the death of a 42-year old US citizen due to JE infection [5]. Between 2007 to 2010, out of 45 confirmed JE cases in Korea, 5 (11.1%) were foreign-born nationals who had resided in Korea for more than 3 months before the onset of symptoms [4].

In the Korean population infected with JE from 2011 to 2015, 90.3% were aged over 40 years, and 4.9% were under 30 years [6]. The susceptibility of the adult population to infection by the JE virus is likely to be due to the older adult population not included in the national immunization program. We conducted a review of JE infection among foreign-born expatriates living

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in Korea from 2007 to 2016.

## Materials and Methods

In Korea, the surveillance of JE has been in place since 1954 and involves passive reporting of clinically diagnosed cases to the National Notifiable Disease Surveillance System [7]. A confirmed JE case is defined as a patient that has a febrile illness associated with neurological symptoms suggestive of JE infection, which is confirmed by laboratory diagnosis [4].

National Notifiable Disease Surveillance System data was used to describe the incidence of JE in Korea from 2007-2016. To explore the difference in epidemiology between Korean-born nationals and foreign-born expatriates, the results from an epidemiological investigation survey were reviewed.

The survey included the nationality of the affected patient and other variables. For Korean nationals, the crude incidence rate per 100,000 population was calculated according to nationality using population data from the Korea Statistical Information Service [8]. To obtain the population denominator to calculate the crude incidence rate for foreign nationals, the number of foreign nationals was derived from the Status of Foreign Resident statistics of the Ministry of Legislation [8].

## Ethics statement

All data were collected as part of routine surveillance and all personal information was anonymized. The present study protocol was reviewed and approved by the Institutional Review board of the KCDC Korea National Institute of Health (IRB NO. 2017-07-04-P-A).

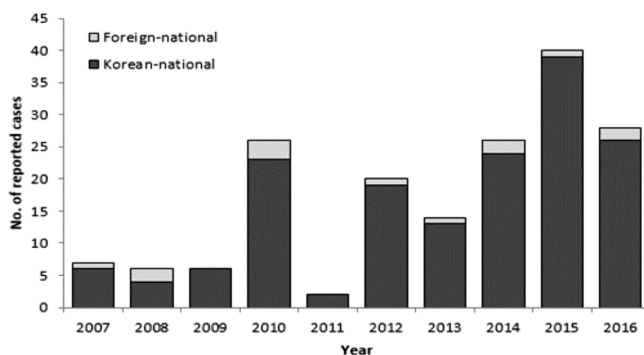


Figure 1. Reported cases of Japanese encephalitis in the Republic of Korea.

## Results

From 2007 to 2016, a total of 175 Korean-born nationals and 13 foreign-born nationals were confirmed as JE cases. One case from Thailand was considered as an imported JE case following a 2-day interval between arrival in Korea and onset of symptoms and was excluded from cases of foreign-born nationals in Korea (Figure 1). The highest incidence of JE was in 2015 with 40 cases, and the lowest incidence was in 2011 with 3 cases. The fatality rate in foreign-born nationals in Korea was 4 deaths out of 13 cases (30.8%). The incidence rates of Korean-born nationals were between 0.01 and 0.08 cases per 100,000 (Figure 2). The incidence rates of foreign-born nationals ranged between 0 and 0.26 cases per 100,000.

Characteristics of JE cases among foreign-born nationals show that most of the cases were male (77%, 10/13), and the median age was 47 years (range: 2 months - 62 years). Three were identified as factory workers, with 1 English teacher, 1 pigsty worker, and 3 restaurant workers. The citizenships of the JE cases were identified as 8 patients from China, 2 from Nepal, 2 from the US, and 1 from Canada (Table 1).

The suspected places of transmission were mostly the metropolitan areas where 10 out of 13 cases occurred (Table 1).

## Discussion

In this study, the status of JE infection in foreign-born nationals residing in Korea was reviewed in the light of increased incidences in recent decades of JE cases. JE cases in foreign-born nationals were observed primarily in adult males and a higher incidence rate was reported compared to cases in Korean-born nationals. Recently, a significant shift in age distribution amongst JE cases has been identified in

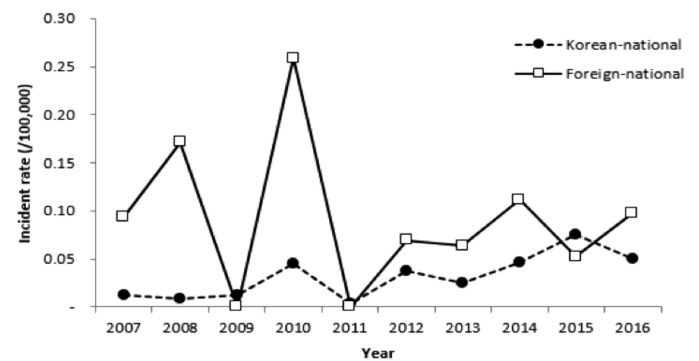


Figure 2. Incidence rates (per 100,000 per year) of Japanese encephalitis in the Republic of Korea by nationalities.

Table 1. Cases of Japanese encephalitis amongst foreign-born expatriates in the Republic of Korea, 2007-2016.

Case	Gender / age (y, mon)	Occupation	Citizenship	Suspected transmission location	Date of symptom onset	Death
1	F/50	Factory worker	China	Pyeongtaek, Gyeonggi	9/25/2008	-
2	M/58	Factory worker	China	Namdong, Incheon	9/25/2008	-
3	M/48	Factory worker	China	Goryeong, Gyeongbuk	10/13/2008	-
4	M/46	English teacher	Canada	Yangju, Gyeonggi	9/20/2010	-
5	M/28	Unknown	Nepal	Yeoju, Gyeonggi	9/27/2010	Y
6	M/62	Pigsty worker	China	Hwacheon, Gangwon	10/21/2010	Y
7	M/42	Unknown	United States	Pyeongtaek, Gyeonggi	8/29/2012	-
8	F/62	Restaurant	China	Iansan, Gyeonggi	8/19/2013	Y
9	M/59	Unemployed	China	Hwaseong, Gyeonggi	9/11/2014	Y
10	M/28	Unknown	Nepal	Dalseong, Daegu	9/22/2014	-
11	F/51	Unknown	China	Suwon, Gyeonggi	9/8/2015	-
12	M/51	Restaurant	China	Paju, Gyeonggi	10/29/2016	-
13	M/2	Unknown	United States	Yongsan, Seoul	10/20/2016	-

F = female; M = male; Y = death.

Korea. Between 2007 and 2010, the median age was 49.4 years in 45 JE affected patients, which increased to 53 years of age between 2010 and 2015 amongst 129 cases [4,9]. The vaccination program introduced in 1985 has ensured that JE is no longer a common disease in children, however it now presents a problem for adults and foreign-born nationals without prior history of JE vaccination.

This study was conducted in a JE endemic country and surveillance data showed severe and fatal JE infection amongst foreign adults. This could be due to the higher proportion of adults travelling or long-term expatriates compared to children. The first description of JE infection in Korea amongst foreign nationals was recorded in the 1940s, during the Korean War [3]. A similar pattern also observed in the 1950s, in US soldiers. The US citizen infected by JE in 2012 had not been vaccinated against JE and had no other relevant travel history other than visiting south Seoul.

Travelers or long-term expatriates from non-endemic countries are typically not vaccinated for JE before arriving in Korea. Amongst >8,000 US citizens traveling to JE endemic countries between 2009 to 2012, over 70% were not vaccinated against JE [10]. Although the overall incidence of JE remains very low in travelers, JE can be a life threatening disease that can be spread worldwide with today's ease of international travel. Therefore, preventive measures should be implemented.

Recently, the American Society of Tropical Medicine Hygiene has revised its recommendation to advise travelers to receive JE vaccination when visiting rural or peri-urban areas of JE endemic countries, irrespective of the duration of visit [11]. In 2015, the Korean Society of Infectious Diseases issued an immunization recommendation to foreigners from non-endemic countries and JE endemic countries without a vaccination program [12]. With the increased number of travelers visiting and expatriates living in Korea, a prophylactic implementation of vaccination guidelines should be in place.

Our review is limited by documentation of clinical information. Moreover, the number of cases is too small to elaborate on epidemiological significance. Despite these limitations, this brief report reflects national data with public health implications. Efforts are needed to promote JE vaccination amongst travelers and expatriates living in Korea, which is still a JE-harboring endemic country.

In conclusion, our study demonstrates that while there were more Korean individuals infected with JE than foreign-born expatriates, the proportion per 100,000 population was lower amongst Korean born nationals. The higher incidence rate per 100,000 foreign-born nationals clearly shows these individuals are more at risk, which underscores the importance of vaccination. We recommend heightened surveillance among JE-susceptible individuals and strongly support vaccination

among expatriates living in Korea. There is a high chance that Korean adults aged 40 or older might have been infected with JE in their youth. As such, this age group shows a high prevalence of JE neutralizing antibodies [13]. Therefore, vaccination is recommended only for those in this age group who do not show evidence of JE immunity [14].

### Conflicts of Interest

The authors have no potential conflicts of interest to disclose

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