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Zoonoses and Food Hygiene News, published four times a year, provides a medium for disseminating technical information on matters related to zoonoses and food hygiene generated in the world, particularly in Nepal. The editors welcome submissions on these topics with appropriate illustrations and references. The views and opinions expressed in the News are those of the authors.

CONTENTS:

An Eco-health Approach for Reducing Vulnerability to the Threats of Japanese Encephalitis Transmission in High Risk Districts in Nepal

Abstract

Japanese Encephalitis is an emerging disease with an expanding geographic reach in Nepal. With no cohesive nation-wide planning for the prevention and control of JE in the short to long term, and limited public health awareness programmes about this vector-borne virus, many people in the endemic and epidemic areas of Nepal either do not know about JE or do not have the tools to prevent and control it. We set out with this project to reduce the vulnerability of at-risk populations to the current Japanese Encephalitis (JE) threat in Nepal, and to improve this country's planning to become more resilient and prepared for anticipated changes in JE epidemiology. Using an eco-health approach, we completed a descriptive epidemiological study on existing and available health data in Nepal; carried out community cross sectional studies that incorporated household surveys, mosquito collection and identification, and swine sero-surveys; conducted human case-control studies; facilitated community- and science-based workshops to develop a framework for integrating and identifying socio-environmental situations that describe variation in JE rates and impacts; and developed outreach and educational materials to share the findings of this project with at-risk populations and decision makers. The triangulation of methods at the individual, community and geographic scale using a mixed methods approach allowed us to reveal the social drivers of Japanese Encephalitis, and revealed the need to train health professionals to look to collaborative efforts to manage these social and geographic drivers rather than to consider more classical medical interventions as the primary strategy against JE and other vector-borne diseases. Our results also identified the need for structural changes to Nepalese government program delivery, particularly as it relates to the linking of agricultural development, planning towards climate change adaptation, food security initiatives, and public health planning overall. This project successfully generated, and facilitated the sharing of new knowledge about JE control in Nepal, using an eco-health lens.

Key words: Japanese Encephalitis, Nepal, eco-health, socio-ecological, multi-disciplinary, determinants of risk, vulnerability, resilience, planning

Introduction

Evidence suggests that JE is emerging as an important disease in Nepal. Unfortunately, as of the initial submission of this proposal in 2011, the government had not developed or implemented any short-term, mid-term or long term plans for the prevention and control of JE, there was no public health awareness programme, and many people in the endemic and epidemic areas did not know about JE or how to prevent and control it. Although vaccinations – which are known to be an effective means of control –are provided in Nepal through the generosity of international donors, anecdotal evidence suggests that vaccination rates are low. Furthermore, Nepal continues to be susceptible to fluctuations in many of the potential drivers of JE spread or re-emergence, such as climate change and changing agriculture practices. Public health planning must consider not only how to target current areas of high JE vulnerability, but also how to prepare for future deployment of surveillance and prevention resources ahead of shifting socio-environmental determinants of JE epidemiology.

The prerequisite for early warning and preparedness for vector-borne disease control is an understanding of the factors involved in the genesis of epidemics and behaviour of the disease in inter-epidemic periods (Hay et al., 2000). There is increasing awareness that such an understanding requires an integrated adaptive approach that can recognize and accommodate the complex interactions of inter-related and constantly changing social-environmental relationships. We set out to apply an eco-health approach to JE in Nepal in order to help guide the development of strategic advice to governments and communities. The purpose of this advice was to target interventions to reduce population vulnerability to the current JE threat, and to improve planning towards resilience and preparedness for anticipated changes in JE (and potentially other vector-borne disease) epidemiology.

Objectives

This project was developed with 3 specific objectives in mind: to (1) develop a socio-ecologic description of the determinants of risk for JE in Nepal; (2) build and support capacity for multi-sector collaboration in JE prevention and control based on eco-health principles; and (3) assess implications of research findings for public health, animal health and community planning to reduce vulnerability to JE threats and increase resilience. Key knowledge outcomes of this project were to enhance our understanding of how socio-environmental factors correlate with JE risk, and how these factors correlate with the knowledge, ability and willingness of people to apply actions to prevent or control the disease. We anticipated that these knowledge outcomes would help us to identify targets for multi-sectoral interventions, such as educational program content and strategies to mobilize public health, animal health and community planning resources.

Individual goals were identified for each of the three specific objectives, as follows. We hoped to identify cross scale interactions of socio-ecological JE risk situations by documenting and analyzing variation in JE epidemiology in relation to hypothesized social and environmental variables in Nepal by using 3 scales of epidemiological design: (i) a spatial analysis of potential JE risk factors at a country-district level, (ii) a cross sectional study done at the community level, (iii) and a case-control study at the patient level. We set out to promote effective collaboration and human capacity to create eco-health partnerships and practitioners capable of weighing, integrating and interpreting social and environmental data to identify socio-environmental situations that may forecast impact and vulnerability to JE, with an emphasis on nominating modifiable factors. And we intended to translate our research findings for use by decision makers, from the household to the central government. These goals informed our methodology for a multi-pronged approach to the research problem.

Methodology

Presented here is a brief high-level overview of the methods utilized for each of the project's sub-tasks. Detailed methodologies can be found in the various peer-reviewed published papers and conference abstracts.

1: Project inception

Through a series of meetings and workshops in Nepal, a detailed workplan was developed and responsibilities assigned. This process involved team members, stakeholders and collaborators at the community, government, and university levels. Although never fully realized, a plan to use the Teasdale-Corti Global Health web-based platform developed by the CCH in Sri Lanka was initiated.

2: Geographical study of JE socio-environmental risk factors (country-district level)

2.1: Descriptive Epidemiological Study

Using surveillance data from the Epidemiology and Disease Control Division of the Department of Health Services, Ministry of Health and Population of Government of Nepal, as well as passive hospital JE surveillance data from the Nepal Department of Health Services from the previous 3 years, we examined the spatial distribution of JE cases. This formed the descriptive epidemiological study from which we described the demographics of the reported cases (ex. age, gender case fatality rate), calculated incidence and prevalence rates, and defined the current space-time dynamics of JE. Existing climate, land-use, water use, administrative boundaries (as it related to public health and animal health services), agricultural zones and geographic data was used to map social and environmental variables.

2.2: Relationship Modelling

Space-time scan statistics (SaTScan, a free software program (http://www.satscan.org/was used on the collected surveillance and administrative data to identify areas and times of greatest JE risk in Nepal. Relationships between JE risk and social-environmental variables were modelled with Poisson regression methods, and feedback from external experts was sought to help validate a JE risk-forecasting tool.

3: Community cross sectional study

3.1: Household Surveys

A cross-sectional study using household surveys was carried out to investigate associations between knowledge, acceptance, access and ability to use JE prevention and control measures by community members. The goal was to identify and understand the relationships between socio-environmental variables and community level enablers or impediments to JE control (e.g. knowledge, access, acceptance, ability). Although our intent was to sample subjects at a particular point in time and without respect to disease status, we did try to determine if there was a history of clinically compatible JE in one or more household members. Mosquito sampling and pig sero-surveys were conducted at the same time as the house-hold surveys.

Four districts were chosen for this study based on reported variation in JE prevalence as well as in social and environmental variables: (1) a long term endemic region (>30yrs) that is the source of most cases in the country (Rupandehi district); (2) a neighbouring endemic district with lower numbers of outbreaks but a high epidemic area (Kapilbastu near the Indian border); (3) an area of endemic JE with the highest level of pig amplifying hosts (Morang district); and (4) a region of recent JE emergence (Kathmandu valley). Historic surveillance data was used to identify communities within each of the study districts that in the previous 3 years had the highest and lowest reported JE cases, as identified by the joint Government of Nepal and World Health Organization (WHO) acute encephalitis syndrome (AES) surveillance. The study relied on the case definition as used by the Ministry of Health in its surveillance.

Team members worked with local government to assemble a complete roster of households from which candidates were randomly selected. Participation was voluntary and anonymous, but did require informed consent. Stratification of random samples was conducted as necessary to ensure equal representation of all socio-economic groups in proportion to their representation in the population. Residents of each household completed a pre-tested survey and took part in a risk mapping exercise, which was administered by trained para-medical and para-vet workers from different health centres from the selected communities. The survey itself consisted of 3 components: (1) a household social survey that recorded basic information such as household demographics, socio-economic status, living standards and indicators of well-being, level of education and occupation. The household survey also inquired about self-reported history of JE-like disease in the household or immediate neighbours, and undertook mobility mapping to gain more knowledge about the mobility patterns (e.g. places visited and reasons for travel) of the household residents and surrounding community; (2) a JE knowledge survey inquired into respondent's knowledge of clinical JE within their household and surrounding community, of other vector-borne pathogens in addition to JE, and of the control and prevention of JE and vector-borne disease; and (3) an household risk mapping exercise to help identify the proximity of the respondent's house to nearby rice paddy fields, pig farms, medical care and wetlands.

3.2: Mosquito Survey

Peri-domestic mosquitoes were collected from around selected households in order to determine; (i) population density of various mosquito species in the communities; (ii) human/animal biting density of known JE vectors and (iii) larval habitats/density in selected locations in each of the study communities. The fourth goal, to use ELISA on engorged mosquitoes to determine presence of JE in mosquito populations, was not completed. Adult mosquitoes were collected either by mouth aspirator and torch light from inside human residences, directly off of live animal baits, or by CDC light traps placed inside human dwellings and outdoor around livestock dwelling areas. Dip-nets were used to collect larva from breeding sites identified through the household mapping exercise. Trapped adult and larval mosquitoes were identified against the key THE MOSQUITOES OF NEPAL: THEIR IDENTIFICATION, DISTRIBUTION AND BIOLOGY (Richard et al., 1990) at the laboratory the morning following collection. Weather data (temperature, rainfall) was collected for the sampling periods as well as for 2 weeks prior to sampling to account for a plausible period from egg laying to hatching of *Culex* mosquitoes.

3.3: Swine Sero-survey

A list of swine farms (including backyard swine owners) in and around the surveyed households was assembled with the assistance and input of the family maps, local farmer organizations and the

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Ministry of Agriculture. Samples were collected at the peak of historic JE seasons for the districts from pigs between 3 and 6 months of age. Standard methods of serum collection from pigs were followed (Joshi et al., 2009). Pig serum was then tested for the presence of JE using IgM based ELISA antigen detection with separate reagents, at the NZFHRC lab. At the time of serum collection, we also recorded for each pig sampled: age, breed, immunized or not immunized against JE, breeding and feeding habits (e.g. cross-breed, indigenous, exotic breeds), husbandry practices and location (scavengers, penned, intensive farming).

Part 4: Human case-control study

4.1: Human Sero-survey

Hospitalized patients meeting the WHO surveillance definition for clinical acute encephalitis syndrome (AES) were retrospectively identified from the existing Nepal surveillance system. Controls came from the same hospital as the case, had to be within 5 years of age of the case, must not have shown clinical signs of AES, were ELISA negative. Controls that tested positive on ELISA were excluded as a control for JE, but in some cases were retained as a control for clinical AES. Attending physicians were informed of all ELISA results. Human serum samples were brought from the various sampling sites to the NZFHRC lab in Kathmandu for diagnostic purposes.

4.2: Hospital Questionnaire

A standard, pre-tested, interview was administered by trained para-medical staff in the home residence of each identified case and control. Pre-testing was conducted with randomly selected hospitalized patients with clinically compatible illness. The questionnaire asked about (1) the patients' clinical history and clinical course, demographics (age, sex, occupation, socio-economic status), travel history within the incubation period of JE, JE vaccination, outdoor activities within the incubation period; (2) features of the patients' households including proximity to rice paddies and pigs, recollections of mosquito bite frequency, household activities to reduce mosquito habitat, knowledge of similar disease in other household members, relatives or neighbours, whether they raise or own pigs or other agriculture stock, and interactions with wildlife (direct contact and proxy measures such as presence of forested areas and marshes near their home); (3) features of their community including name and location of their community, the predominate land use within 10 km of their household, and proximity and availability of health care. A parent or guardian was present for all patients less than 16 years of age, and in some instances the parent or guardian acted as the primary respondent for the questionnaire. Children older than 16 years of age had the option to be the primary respondent or to be prompted/assisted by their parents or guardians. Univariate and logistic regression analysis were used to calculate odds ratios for risk factors for JE and AES.

Part 5: Develop a framework for integrating and identifying socio-environmental situations that describe variation in JE rates and impacts

5.1: Community Based Meetings

A community-based series of participatory 'town-hall'-type meetings were initiated in each study community in each district at the outset of the project. Working with the community, a graphical influence diagram was developed to identify and visualize the factors that might affect the occurrence and recognition of acute encephalitis within communities. The relationships between different social and environmental casual components were explored.

5.2: Science Based Meetings

A similar series of meetings as described above (see community-based meetings) were conducted separately with a multi-disciplinary working group in order to map out a "science-based" influence diagram for linking insights on JE risks across disciplines. These influence diagrams were then compared against the community-based influence diagrams to look for clusters of social and environmental interactions between the two groups.

Part 6: Knowledge mobilization

6.1: Stakeholder Meetings and Workshops

Community town-hall meetings involving key local stakeholders and study community participants (e.g. school going children, pig farmers, teachers, local physicians, veterinarians etc.) were organized to allow the invitees an opportunity to critically examine the proposed linkages between environmental and social factors as they relate to JE risk. These meetings also allowed for the identification of problems with our proposed linkages, and opportunities for invitees to suggest practical solutions for managing these socio-environmental conditions in order to reduce risk and to find ways to increase awareness, access and use of JE prevention measures. Annual interim and project-end symposiums were held with invited guests from external collaborators (Canada, Sri Lanka, India), local community representatives, local government, Ministry of Health and Population, Ministry of Agriculture and Cooperative, Ministry of Local Development, Ministry of Home and National Planning Commission and the remainder of the study team. The project end meeting was held in Kathmandu; the interim meetings were held at the four districts. At these meetings, primary results and team-developed recommendations were shared to facilitate open discussion with the invitees about the perceived validity of the findings, conclusions and implications. Policy makers from concerned Ministries had the opportunity to provide input on the project outcomes and their relevance to prevention and control policies.

Project Outputs

The following is a synthesis of key research lessons, based on a consideration of findings across the various research streams within this project. The major research outcomes with the greatest potential to influence public health planning are listed here:

1. Although JE is relatively 'easy' to prevent, social barriers in Nepal currently prevent building the species barriers, adequate delivery of vaccine, and adequate vector control required for Nepal to have similar success in JE control as has been achieved in other Asian countries. The standard methods for JE are not consistent with current national food security and poverty reduction plans; capacity and histories of farmers; land use patterns; and ability for people to choose where they farm.
2. Current JE prevention programs are unlikely to achieve significant risk reduction in the high risk pig farming population due to the lack of knowledge on personal protection or uptake of vaccine. Significant effort must be focused on the human dimensions of JE control. Issues of trust, education, and landlessness influence people's capacity, willingness and ability to protect themselves from JE and other vector-borne diseases.
3. Nepalese agriculture development plans need to consider the cost: benefit ratio of increased zoonoses risk against improved household incomes and food security that results from livestock production, in a setting where biosecurity standards and knowledge are low. The peri-urban environment presents some unique challenges due to conflicts associated with urban migration, income access for landless people and disease control. Care must be taken to not overestimate JE impact while underestimating the contribution of swine production for family health when developing new policy. Peri-urban agriculture, small scale farms abutting forested areas, and high density paddy fields were all geographic risk factors for JE. Plans to eliminate suitable JE vector habitat will have impact on access to food production (e.g. paddy fields and pig farms).

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4. Policies that effectively consider public health, food and agriculture development and climate change adaptation are lacking but seem critical to JE control. Local experts understand how socio-ecological drivers can affect the epidemiology of JE, but continue to focus control efforts primarily on vaccination and vector control rather than primordial drivers of risk. Integration of food and health policy is required but the intellectual tools for a collaborative, integrated approach that manages the co-dependence of human, animal and environmental health with an eye to sustaining health into the future are few, poorly validated and inadequately used.
5. JE is a tragic disease, and evidence indicates that its geographic distribution is expanding. At the same time, disease rates in those regions where vaccination programs have been implemented have declined. There are geographic and climatic features that could help to define the 'leading edge' of JE expansion. There are also obvious high risk groups – e.g., swine producers practice many high risk behaviours. Landscape and human behaviour information could help messaging and distribution of vector control or vaccine programs to help contain JE spread in Nepal.
6. The media and neighbours are trusted and frequently accessed information sources for animals and human health management. Social network analysis revealed how key people in communities could be critical for sharing JE prevention messages. High risk occupations (such as swine farmers) have poor connection to official medical or veterinary information sources due to issues of income and education.
7. Detection biases due to lack of diagnostic infrastructure or impediments to access to veterinary or medical care threaten the validity of all epidemiological or eco-health studies that are agent-based health care questions.

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NEWS

Regional One Health Economics and Policy Workshop – South Asia and Thailand:

Ms. Minu Sharma Program Coordinator of NZFHRC participated in the **"Regional One Health Economics and Policy Workshop – South Asia and Thailand"** on 28 July – 8 August 2016 at Best Western Plus Wanda Grand Hotel, Bangkok, Thailand. The workshop was being co-hosted by Ministry of Public Health of Thailand, Massey University of New Zealand and Panyapiwat Institute of Management.

The workshop was part of the Integrating Education and Action for One Health program being implemented by Massey University in Afghanistan, Bangladesh, Bhutan and Nepal, funded by the European Union, and also provided insight and opportunity for discussion about One Health initiatives being coordinated with the Ministry of Public Health in Thailand.

The overarching aim was to strengthen collaboration between the human health, animal health and wildlife sectors to manage priority zoonotic diseases nationally and regionally to reduce poverty and improve public health and health security.

Train-the-Trainer Workshop: One Health Approach to Emerging Infectious Disease Investigation

Ms. Minu Sharma, Program Coordinator, NZFHRC participated in the **Train-the-Trainer Workshop: One Health Approach to Emerging Infectious Disease Investigation on 19–24 September,** Hotel View Bhrikuti, Godavari, Lalitpur, Nepal. This program is funded by the European Union and Implemented by Massey University of New Zealand.

DDJ Research Award:

Please kindly submit your research work on zoonotic diseases for consideration of DDJ Research award for the year 2016 by the end of December 2016 to NZFHRC office Chagal, G.P.O. Box 1885, Kathmandu, Nepal, Phone: 4270667, 4274928 and Fax 4272694. This award was established by DDJ Research Foundation in 2071 B.S. (2014) in the memory of Founder of this Foundation, Late, Dr. D.D. Joshi. The award includes a grant of NCRs. 25,001/- (Rs. Twenty Five Thousand and One) with a certificate.

K.D.M.A. Research Award:

Please kindly submit your research work paper on allergy award for the year 2015 for the consideration by the end of December 2016 to KDMART office Chagal, G.P.O. Box 1885, Kathmandu, Nepal, Phone: 4270667, 4274928 and Fax 4272694. This award was established by Late Dr. Durga Datt Joshi in 2049 B.S. (1992) on the memory of his wife, the late Mrs. Kaushilya Devi Joshi. The award includes a grant of NCRs. 15,001/- *(Rs. Fifteen Thousand and One)* ***with certificate.***

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TO:

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