Australian Government

Joint National Japanese Encephalitis Virus Outbreak Response Plan

June 2023

The Joint National Japanese Encephalitis Virus Outbreak Response Plan (JEV Outbreak Plan) is the first Australian Response Plan for Japanese Encephalitis. The JEV Outbreak Plan provided an agreed framework for nationally co-operative response arrangements for managing Japanese encephalitis virus. It was updated iteratively during the emergency response period, noting that stand down occurred at different times in the animal health and human health sectors.

This document was prepared by the Department of Health and Aged Care and the Department of Agriculture, Fisheries, and Forestry. The final iteration was endorsed by the Australian Health Protection Principal Committee (AHPPC) and the Animal Health Committee (AHC) in April 2023.

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Introduction

Until the 2022 outbreak, Japanese encephalitis (JE) was considered a rare disease in Australia, with most cases acquired overseas. JE is caused by the Japanese encephalitis virus (JEV) which is transmitted by mosquitoes. JE is a notifiable disease in animals and humans in all states and territories. Although symptomatic JE is rare in humans, it can cause encephalitis in approximately 1% of cases, and the case-fatality rate amongst those with encephalitis can be as high as 30%. JEV is the main cause of viral encephalitis in many Southeast Asian countries, with an estimated 68,000 clinical cases every year.

A wide range of animal species may be infected with JEV, but most do not show signs of disease. JE can cause reproductive failure such as stillbirth and abortions in pigs, and encephalitis in horses. JE is a World Organisation for Animal Health (WOAH) listed disease. The change in Australia's JE status may have impacts on the tourism industry and did impact horse and pig industries, including trade implications (predominantly exports of live horses). More information on JE is provided at Appendix 1.

On 25 February 2022, JEV was first confirmed in piggeries in Queensland and New South Wales (NSW). JEV was subsequently detected at piggeries in Victoria on 26 February and South Australia on 3 March. On 3 March 2022, the first human case associated with the outbreak was confirmed in Queensland with several suspected human cases also present across NSW, Victoria, and South Australia at that time.

It is not known how the virus entered southern Australia. The rapidity and extent of spread was not something previously contemplated by animal and human health experts in Australia. It is suspected that the movement of infected mosquitoes or migratory waterbirds may have played a part in spreading the virus. Serological evidence of seasonal JEV activity has been detected in animals in the Torres Strait in most years. Seroconversion has also been documented in sentinel pigs on Cape York Peninsula (Australian Department of Health and Ageing 2004). In 2004, JEV was isolated from a mosquito, also on the Cape York Peninsula (Hanna et al. 1996).

Previously, clinical JE had only rarely occurred in humans in Australia, with only 15 cases notified in the past 10 years, with all but one of these cases having acquired their infection overseas. The one locally acquired case was reported in the Tiwi Islands, Northern Territory in early 2021. Genotype IV has been identified in the affected piggeries, and is the same genotype identified in the 2021 locally acquired case in the Tiwi Islands.

Transmission cycle of JEV

The transmission cycle of JEV involves mosquito vectors and vertebrate hosts. Waterbirds and mosquitoes are considered natural reservoirs of JEV, while pigs and some species of birds (predominantly waterbirds in endemic countries) are amplifying hosts. When infected, these amplifying hosts have significant quantities of virus in their blood, which increases the chances of JEV being transmitted to mosquitoes (Figure 1). In comparison, humans and horses have lower viral loads and are considered 'dead end hosts', meaning their infection cannot result in any subsequent infection (across any species).

Culex annulirostris is suspected to be the main driver of JEV transmission in Australia, which has a wide geographical distribution and is abundant across Australia. JEV was detected in a pool of *Cx. annulirostris* mosquitoes that were collected from an infected piggery in Victoria during early 2022, providing support for the importance of this species in transmission. Other *Culex* species and Australian mosquito species have been shown to be competent vectors of JEV in the laboratory, and are established vectors overseas, but their role in field transmission is unknown and requires further investigation. The potential role of Australian wildlife species in the epidemiology of JEV is not known.

The Australian Government Department of Health and Aged Care, and the Australian Government Department of Agriculture, Fisheries and Forestry are collaborating with state and territory counterparts, representatives from the affected animal industries and key non-government experts in response to the JEV outbreak. Underpinning this collaboration is the One Health principle, which recognises that the health of humans, animals and our environment are all inter-connected.

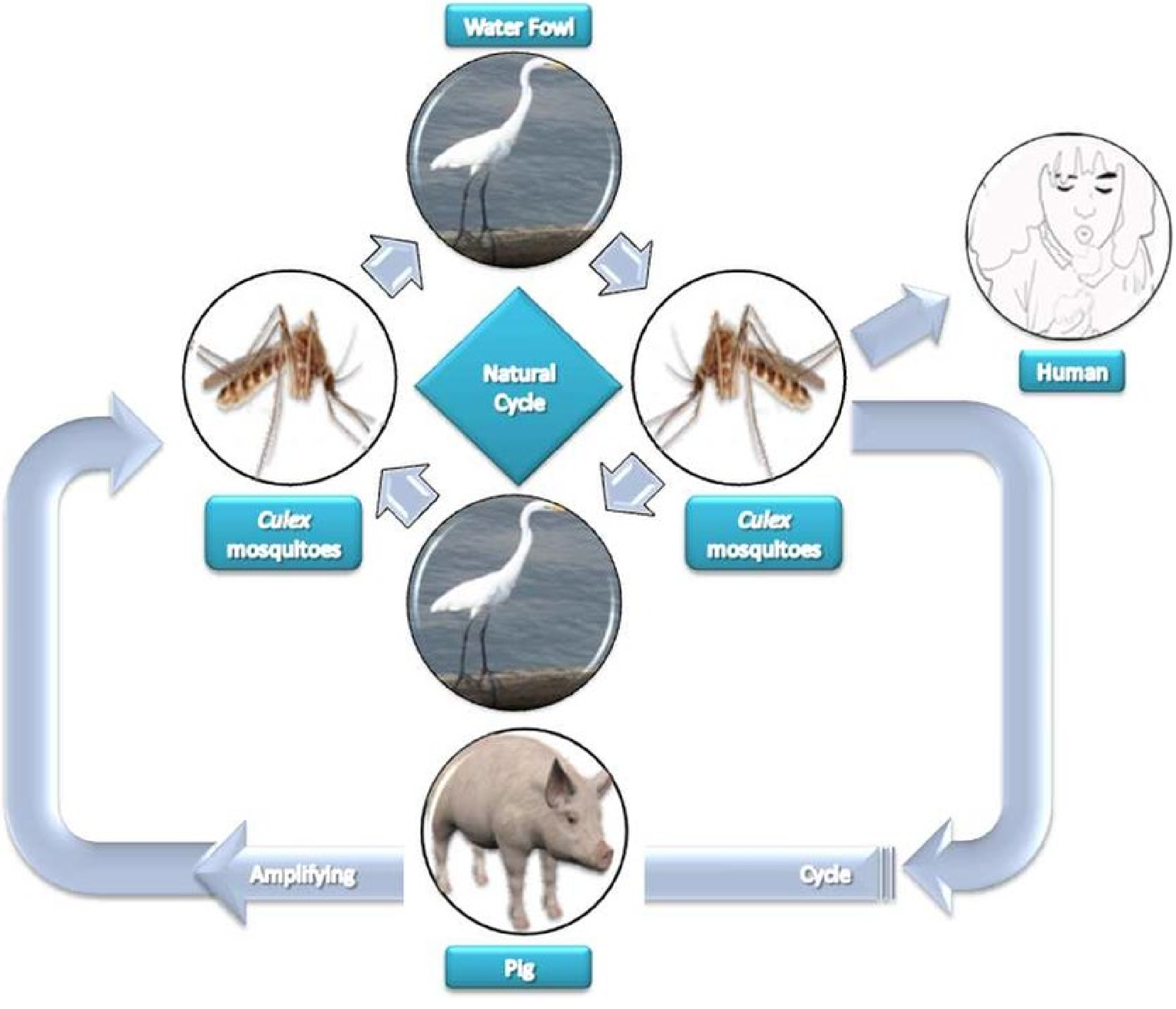

Figure 1 – Transmission cycle of JEV

Source: Tiwari, S., Chitti, S.V.P, 2012. Japanese encephalitis virus: An emerging pathogen. American Journal of Virology

Objective

The Joint National JEV Outbreak Response Plan (JEV Outbreak Plan) was drafted during the initial outbreak phase and updated iteratively as the national response mechanisms and activities advanced. It provides guidance to support jurisdictions to manage the JEV outbreak.

It should be noted that individual jurisdictional and agency responses have evolved in line with local context and risk, and the JEV Outbreak Plan may not represent activity undertaken following transition away from outbreak response to ongoing management of JEV. The JEV Outbreak Plan can support and inform any future responses to JEV outbreaks and may be updated periodically to incorporate new evidence or best practice activities.

Objectives of this plan include:

1. Outline collaboration and coordination between the Australian Government Departments of Health and Aged Care, Agriculture, Fisheries and Forestry, along with state and territory government health and agriculture departments during the initial JEV outbreak response as jurisdictions transition to ongoing disease management.
2. Clarify governance, roles, and responsibilities of the Australian Government and state and territory human and animal health authorities, including inter-jurisdictional committees and decision-making bodies.
3. Outline the surveillance requirements in animals, mosquitoes and humans, to enable the full characterisation of the nature, extent, and magnitude of the JEV outbreak and provide options to address these needs.
4. Describe key management, prevention and control measures that will be implemented in response to the outbreak characterisation.

The strategic objectives guiding the JEV Outbreak Plan are to:

- Provide a coordinated and consistent response across Australia to minimise impacts of JEV on public health, animal health and the environment.
- Utilise Australia’s collective public health, animal health and environmental health expertise under a One Health umbrella, to ensure the best possible outcomes for all sectors.
- Raise awareness and inform the public, industry, key stakeholders, and the media to assist individuals to manage the risk to themselves, their families, and their animals.
- Support any future evaluation of the outbreak response and/or inform future one-health programs.

A One Health approach

A collaborative and multi-disciplinary approach across animal, human and environmental health sectors, is needed at all levels of government to be able to determine and monitor the spread of JEV and respond to the outbreak. Underpinning this approach is the One Health principle, which recognises that the health of humans, animals and our environment are all inter-connected.

The importance of the JEV outbreak to both the public health and the animal health sectors, is emphasised by the declaration of a Communicable Disease Incident of National Significance, activation of the National Incident Centre by the Department of Health and

Aged Care, and the convening of the Consultative Committee on Emergency Animal Diseases (CCEAD). The JEV Outbreak Plan has been endorsed by the Chief Health Officers through the Australian Health Protection Principal Committee (AHPPC), and by the Chief Veterinary Officers through the Animal Health Committee (AHC).

The Department of Health and Aged Care, and the Department of Agriculture, Fisheries and Forestry have worked closely to provide a coordinated and co-operative One Health approach to managing the JEV outbreak. Each jurisdiction has also taken a One Health approach to the surveillance, management, and control of JEV that informed the national coordination mechanisms. Jurisdictions and One Health sectors (animal, human and environment) have shared or committed to sharing:

- Surveillance data across jurisdictions, and nationally, to enable a clear picture of the risk of the disease to be developed.
- Lessons identified and strategies implemented for prevention, control and response measures undertaken.

A data sharing agreement is under development between the Commonwealth, state and territory animal and human health agencies to formalise these arrangements to support the delivery of government services, policies and programs to prevent, protect against, control and respond to JEV in Australia. The agreement will enhance national and jurisdictional analysis and interpretation through collation of consistent data from each sector in a single dataset. The agreement will support existing relationships and data sharing arrangements between local animal and human health agencies and is not intended to replace or duplicate these relationships and arrangements.

JEV detections, including but not limited to those in or around piggeries (in either pigs or mosquitoes or both), require implementation of effective control measures to reduce the risk to human and animal health. Each jurisdiction developed arrangements regarding roles and responsibilities for human health authorities, animal health authorities, as well as other stakeholders to ensure timely implementation of control measures. This included site visits, provision of information regarding JEV, vector trapping, advice about undertaking vector control, biosecurity measures related to livestock movement, and monitoring progress to ensure all required actions have been completed.

Governance

Existing governance arrangements were adapted to respond to the JEV situation using a One Health approach across all levels of government. Environmental aspects of transmission were incorporated through existing human health and animal health mechanisms (e.g. such as the National Arbovirus and Malaria Advisory Committee for advice on mosquitos, Wildlife Health Australia for advice on wild birds, as well as briefings from the Bureau of Meteorology on weather predictions and outputs).

The Communicable Diseases Network Australia (CDNA), Public Health Laboratory Network (PHLN), CCEAD, and subordinate committees or working groups established to inform key areas such as surveillance and response work, included representatives from all One Health sectors. This helped to ensure alignment and information flow, understand roles and responsibilities and minimised the potential for duplication of work.

The Australian Health Protection Principal Committee (AHPPC) and Animal Health Committee (AHC) provided high level oversight of the technical working groups and made decisions on disease control policy based on recommendations from technical groups.

Roles and responsibilities for human and animal health

There is a clear delineation of responsibility for human and animal (including wildlife and water birds) responses across respective departments at a national and jurisdictional level. Human health control measures are governed using public health legislation and reported through existing public health committee structures. Likewise, animal disease control measures are governed using biosecurity legislation and reported through animal health committee structures.

Animal Health

- There are mature arrangements in place for Emergency Animal Disease (EAD) response and governance in Australia involving Commonwealth and state and territory governments, industry, and Animal Health Australia where it is considered feasible and cost-beneficial to attempt eradication of a disease. The key documents are the *Government and Livestock Industry Cost Sharing Deed In Respect Of Emergency Animal Disease Responses*, also referred to as the Emergency Animal Disease Response Agreement (EADRA), and the AUSVETPLAN manuals. These documents clearly set out roles and responsibilities amongst government and industry parties, decision-making and funding processes, and agreed national disease control policies. The EADRA was not invoked in response to this incident. The EADRA and Japanese encephalitis AUSVETPLAN manual served as a reference for the animal health response.

- <u>Role/ responsibility of the Australian Government Department of Agriculture, Fisheries and Forestry:</u>
    - DAFF is responsible for managing the impacts of an EAD outbreak on international trade in live animals and/or animal products.
    - In the event of a large, multijurisdictional outbreak, DAFF provides national response coordination including coordinating requests for resource deployment from within Australia or under the International Animal Health Emergency Reserve arrangements.

- <u>Role/ responsibility of states and territories:</u>
    - States/territories have primary responsibility to manage EAD events within their jurisdictions, using their biosecurity legislation to impose appropriate disease control measures
    - State/territory animal health/biosecurity officers undertake critical management activities such as disease investigation, surveillance and tracing and engagement with affected animal owners.

- <u>Role/ responsibility of the CCEAD:</u>
    - The CCEAD is a coordinating body providing the technical link between industry, the Australian Government, and state and territory governments for decision making during animal health emergencies.
    - Membership comprises the Australian and state and territory Chief Veterinary Officers, representatives from the Australian Government Department of Agriculture, Fisheries and Forestry, the Australian Centre for Disease Preparedness (CSIRO) and affected industry bodies, who contribute to decision-making during a cost-shared EADRA response. Animal Health Australia and relevant invited observers (such as Wildlife Health Australia and

the Department of Health and Aged Care) also attend meetings. CCEAD is chaired by Australia's Chief Veterinary Officer.
  - The committee is only convened during an EAD response and stands down at the conclusion of the response.
  - Working groups and other technical groups may be formed under the CCEAD depending on the requirements of the response. During the response to JEV, a national equine working group, a pig vaccine working group, a horse vaccine working group, a property classification working group, a surveillance working group and a national vector management working group were formed. Each had different membership and operated for different lengths of time.

- Role/ responsibility of the AHC:
  - The AHC delivers strategic policy, technical and regulatory advice, and national leadership on animal health and biosecurity matters.
  - Committee members include the chief veterinary officers (CVOs) of the Commonwealth, states and territories, along with representatives from the CSIRO Australian Centre for Disease Preparedness (formerly Australian Animal Health Laboratory), the Department of Agriculture, Fisheries and Forestry (DAFF). Observers join the committee from Animal Health Australia, Wildlife Health Australia, and the New Zealand Ministry for Primary Industries in an advisory or consultative capacity, but do not have voting rights.
  - The AHC may serve as the advisory and/or coordination body for animal health responses that do not fit within other arrangements such as the EADRA.
  - The AHC reports to the National Biosecurity Committee (NBC).

- Role/ responsibility of the livestock industries:
  - Livestock industries contribute personnel with industry-specific expertise and connections to serve as liaison officers, who attend key committee meetings and contribute to working groups during an EAD response. During a cost-shared EADRA response, representatives contribute to decision-making through the CCEAD and the industry (via the EADRA signatory organisation) is liable for a share of the costs of the response.
  - Individual livestock producers and animal owners are responsible for the health and wellbeing of their animals. They must also comply with state and territory biosecurity legislation and associated regulations, in order to minimise spread of an EAD in the event of an incursion.
  - They also have obligations under other legislation, such as that relating for pest and weed control, which may be relevant to minimising the spread of certain EADs.

Human Health

- Role/responsibility of the Australian Government Department of Health and Aged Care:
  - The *National Health Security Agreement* establishes a framework for clear, quick, and informed decision making to support a coordinated national response to public health emergencies.
  - Health and Aged Care provides national leadership and coordination for large multijurisdictional communicable disease incidents as well as collating and analysing surveillance data nationally.

  - The Emergency Response Plan for Communicable Disease Incidents of National Significance (CDPLAN) is activated to ensure seamless implementation of national policy, coordinated public messaging and/or deployment of Commonwealth or inter-jurisdictional resources to assist affected jurisdictions.
  - Under this plan a Communicable Disease of National Significance (CDINS) can be formally declared by the Australian Chief Medical Officer (CMO)

- Role/responsibility of state and territories:
  - State and territory health departments have primary operational responsibility for responding to a communicable disease notification or incident within their jurisdiction. Existing arrangements include public health surveillance (including human cases and vector surveillance), outbreak response, clinical care through the hospital sector, vaccination programs where applicable, health promotion, public communications, public health laboratory testing and research.
  - If required, states and territories will: manage cross-border events on a cooperative basis with neighbouring jurisdictions, deploy medical assistance to other states and territories, and contribute to overseas deployments to other countries in need.

- Role/responsibility of the Australian Health Protection Principal Committee (AHPPC):
  - The AHPPC provides overarching national leadership through cross jurisdictional collaboration in managing health protection incidents and coordinating the national health response to incidents of national significance.
  - The committee also provide leadership on national policy development and implementation on emerging health threats related to communicable diseases, and ensure consistent, timely and accurate communications between jurisdictions and other relevant organisations with the support of the National Incident Centre at the Department of Health.
  - The AHPPC is supported by a number of standing committees. Key standing committees of relevance to vector borne disease include:
    - CDNA, which coordinates the investigation and control of multi-jurisdictional outbreaks of communicable disease and the
    - PHLN, which advises on public health microbiology aspects of communicable disease control.
    - The National Arbovirus and Malaria Advisory Committee (NAMAC), a sub-committee of CDNA which makes recommendations on arbovirus and malaria surveillance, strategic arbovirus and malaria disease management, and vector control.
  - The Australian Technical Advisory Group on Immunisation (ATAGI) is advising the Government on the medical administration of JE vaccines for the response.
  - A CDNA Japanese Encephalitis Work Group, jointly comprising of expertise from CDNA, PHLN, ATAGI and NAMAC (CDNA JEV WG), was convened to provide advice to the CMO as the human outbreak evolved.

Intersection of One Health sectors

To provide a complete picture of the event, and ensure appropriate coordination of decision making, all One Health sectors ensured timely and open communication and information sharing.

Intersection between roles and responsibilities for mosquito vector control and surveillance activities, are detailed in *the National Japanese Encephalitis Virus Mosquito Surveillance and Control Plan* and *the Animal JEV Surveillance Plan*. Jurisdictions implemented these plans in line with locally assessed context, capacity and risk as part of the transition from outbreak response to ongoing management.

Comprehensive data sharing across sectors and jurisdictions is needed to understand JEV spread and to identify high-risk areas. This work is detailed under the *Mapping and Modelling* section of this plan. There are currently no agreed systems or processes in place to facilitate cross-jurisdictional and cross-agency data sharing in the animal sector. A significant amount of work is required to address this issue, which will continue beyond the remit of this plan. Completing this work will contribute significantly to national preparedness for similar events in the future.

Surveillance Plan

Disease surveillance involves the collection, analysis, and interpretation of data from a variety of sources. This information is used to identify cases and their location, monitor trends in spread, support planning and response resource allocation, and evaluate the effectiveness of control measures.

Surveillance in a JE outbreak requires a One Health approach and initially aimed to:

- Rapidly identify new cases in animals and humans.
- Determine the extent of spread (including in wild and feral animal populations, where possible – this may differ between jurisdictions based on local response/risk).
- Identify potential vector species involved in the outbreak and their distribution
- Define at risk human and animal populations.
- Provide data to inform human health and animal health risk assessment, selection of appropriate control measures and public/animal health action including human and animal vaccination policy (if a vaccine for animals becomes available).

The surveillance aims will be achieved by prioritising surveillance of:

- Premises with animals with compatible disease that have not been identified through tracing, for further investigation and testing.
- Wild or feral animal populations as appropriate, for example feral pig sampling, waterbird habitat and migratory paths and rookeries.
- Potential exposure sites for human cases.
- Relevant mosquito breeding sites or areas with suitable habitat.
- Potential vector populations as defined in the *National Japanese encephalitis virus Mosquito Surveillance and Control Plan* .
- Meningoencephalitis cases in humans of unknown origin.

Vector surveillance

The *National Japanese encephalitis virus Mosquito Surveillance and Control Plan* developed by NAMAC, outlines the objectives and prioritised activities for identification and surveillance of the mosquito vector/s.

Data that has been flagged as a priority for synthesis and analysis include:

- Previous knowledge about geographical range of flavivirus disease outbreaks.
- Known mosquito abundance and species prevalence.
- Detections of JEV from mosquito surveillance.

Animal surveillance

The *National Japanese Encephalitis Virus Animal Surveillance Plan* outlines the objectives and prioritised surveillance activities in animals, including wildlife, for the initial outbreak response. Future surveillance priorities and activities are being developed based on the information gleaned through the initial surveillance activities and will be adapted for local context and resources.

Diagnostic testing

There are several challenges associated with diagnostic testing for animals, which are outlined in the *National Japanese Encephalitis Virus Animal Health Surveillance Plan*. In brief:

- Due to the short viraemia associated with JEV infection in animals (~4-5 days), there is only a short diagnostic window for virus detection by RT-PCR in blood and serum samples.
- Flavivirus serology is complex, and experience to date has been that confirming a diagnosis by serology is unlikely.

These issues are important for the development of future surveillance programs and interpretation of surveillance findings.

Human surveillance

The *National Japanese Encephalitis Virus Outbreak- Human Health Surveillance Plan* outlines the objectives and prioritised surveillance activities for humans and includes laboratory testing actions and issues.

Diagnostic testing

There are a number of challenges associated with the diagnostic testing for JEV in humans. The key issues are as follows:

- Not all jurisdictions have the same capacity and capability across the diagnostic modalities.
- Flavivirus serology is complicated, and interpretation requires expertise.
- Flavivirus serology is labour and resource intensive, with competing interests associated with other disease outbreaks or seasonal infections .
- There are few manufacturers of JEV RNA and anti-JEV antibody detection in vitro diagnostics (IVDs), which means in-house IVD development may be required, as well as the associated requirements for IVD regulation.
- Nationally coordinated sequence comparison and analysis between human public health and animal health laboratories is important to understand transmission and exposure pathways. This is being addressed by the PHLN Expert Reference Panel on JEV Diagnostics.

Actions to address these challenges are outlined in the *National Japanese Encephalitis Virus – Human Health Surveillance Plan* at and in guidance provided by PHLN, including the Flavivirus Laboratory Case Definition.

Geospatial Modelling

A complex interaction of factors is required to produce a JEV outbreak in domestic animals and humans. These include: JEV competent mosquito vector numbers (influenced by season, weather patterns such as flooding, and temperature for breeding), the presence of host animal populations that maintain and amplify the virus, and the proximity of these vectors and host animal populations to one another and to humans (within mosquito flight range).

Geospatial modelling was undertaken to better understand JEV distribution, using available population and ecological datasets including:

- Pig properties.
- Feral pig distribution.
- Location, and an understanding of the epidemiology and potential exposure pathway of pig properties that had cases.
- Location of properties with cases in other animal species.
- Information about the ecology of relevant bird species, and data on the abundance, distribution, movements (including known migratory routes), and nesting rookeries where possible.
- Likely exposure locations for human cases.
- Distribution of mosquito species able to transmit JEV, especially in known areas with high densities of *Cx. annulirostris* and other potential vectors.
- Location of previously infected animals and mosquitoes identified through retrospective testing of stored samples and insect collections.
- Locations of testing for JEV in humans, animal hosts and mosquito vectors (including negative records).
- Environmental and climatic data.

This required sharing information, and in some cases data, with a range of stakeholders. Data governance principles are under development and endorsement through key committees, to support information sharing and protect the interests of all stakeholders. This work will contribute significantly to national preparedness for similar events in the future.

The following information is required to accurately map and understand the mosquito vector/s responsible for distribution in Australia:

- Results of current case investigations conducted at a state and territory level, to determine whether some (or all) of the human cases have had potential exposure to known high risk locations (such as visits to piggeries or riverine areas).
- Results of lookbacks on human cases of encephalitis of unknown origin, and samples for flavivirus serology.
- Results of retrospective and prospective mosquito arboviral surveillance, to understand density of competent vector.
- Results of lookback on animal samples.

Geospatial modelling supported the assessment of geographic distribution of human JEV exposure risk in Australia, delineating areas with the highest exposure risk to humans, to inform surveillance and response measures. This work included assessment of variation in the probability of JEV detection, depicting areas where JEV is most likely to be reported if present.

This work helped to identify high risk locations and populations for active surveillance and prevention, such as pre-emptive vector control, public awareness, vaccination recommendations and prioritising vaccine distribution. Whole genome sequencing data has supplemented the modelling work by helping to determine the genetic relatedness of virus obtained from different locations and times to understand the possible spread patterns.

There is a seasonal pattern of JEV transmission in many endemic countries, with increased transmission in association with warm and wet conditions that favour mosquito breeding.

Modelling scenarios for the spread of JEV including expected weather patterns associated with the El Nino Southern Oscillation (ENSO) has been important to understand future risk of JEV to humans and animals in Australia, although longitudinal data collection will be required to better understand transmission patterns.

Management, prevention, and control

Managing, preventing, and controlling JEV in Australia has focussed on:

- Detecting cases in animals, understanding of epidemiology of infection, and management to reduce immediate transmission risk.
- Mosquito vector control to reduce biting pressure where the risk of virus transmission is high.
- Reducing contact between mosquitoes and humans and susceptible animal hosts through mosquito avoidance measures and use of repellents.
- Preventing disease in humans at high risk of exposure by vaccination.

Identification and management of cases in animals

Property designations such as Infected Premises were used during the early animal health response but will not be used for long term management of the disease in Australia. Clinical surveillance of animals continues, however no quarantine measures or movement restrictions have been applied since the emergency response stood down. Vector control is the main preventative measure available to piggeries, and the pig industry is keen to work with public health authorities on integrated vector management program options. There are currently no commercially available vaccines for pigs in Australia. Industry and government are actively pursuing options to import vaccine from endemic countries (noting that these vaccines are designed for protection against genotype III and the circulating strain in Australia is genotype IV). Australian research groups are also pursuing development of a JEV vaccine for pigs.

Mosquito control

Mosquito vector control aims to reduce biting pressure where the risk of virus transmission is high. The objectives and prioritised activities are outlined in the *National Japanese Encephalitis virus Mosquito Surveillance and Control Plan*.

Mosquito avoidance

Mosquito avoidance will remain a key prevention strategy by States and Territories and the Commonwealth, including messaging within local communications to affected areas.

Guides have been developed for integrated management of mosquitoes on pig and horse properties and are publicly available.

Relevant measures to avoid being bitten by mosquitoes include:

- Preventing mosquito entry to buildings (for example, fly screens). Physical barriers should be installed and in undamaged condition, and keeping unscreened windows and doors closed.
- Avoiding being outside when mosquitoes are most active, particularly at dusk and dawn, which are peak activity periods for the mosquitoes likely to be vectoring JEV.
- Wearing loose, long light-coloured clothing to cover skin against mosquito bites as practical, with Workplace Health and Safety (WHS) restrictions regarding long or loose clothing work sites also to be taken into consideration.

- Mosquito trap devices (for example, 'bug zappers' and vacuum traps) are not suggested for use other than by surveillance professionals due to inconsistent performance.

Repellents for human use

People are encouraged to use Australian Pesticides and Veterinary Medicines Authority (APVMA) approved insect repellents according to label direction, particularly with regard to reapplication frequency, in situations where mosquito exposure cannot be avoided. The most effective mosquito repellents contain Diethyl Toluamide (DEET), Picaridin, or Oil of Lemon Eucalyptus (OLE). These messages will be communicated to the public as outlined in the joint Communication Strategy below.

Wild animal considerations

The ability of wild or feral animals to become infected and contribute to transmission is still being determined but is important epidemiological information to support decision making. This will be complemented and informed with an understanding of population biology, reproduction, and migration/movement of known or suspected hosts. For example, in some areas, surveillance of feral pig populations augments surveillance in domestic animal populations.

Vaccination

Human health

Vaccination is the best protection for humans. During an outbreak, primary vaccination of humans confers protection from clinical disease but does not influence the epidemic spread of JEV.

There are two human vaccines currently available to the Australian market, Imojev (Sanofi-Aventis Australia up to March 2023, and subsequently Biocelect on behalf of Substipharm France) and JEspect (Seqirus). Imojev is a single dose live attenuated virus vaccine (which cannot be given to people who can’t have a live virus vaccine, such as pregnant women and those who are immunocompromised) and JEspect is a two dose (inactivated) vaccine which requires a 28-day interval between doses.

A National Vaccination Strategy has been developed as outlined on the Department of Health website: Japanese encephalitis virus (JEV) vaccines | Australian Government Department of Health. Individual jurisdictions have subsequently developed vaccine eligibility criteria based on local epidemiology, risk assessment and vaccine availability.

Animal health

While horses do not transmit the virus, a small number may develop acute encephalitis and require euthanasia. Work on an application for an emergency use permit for Japanese encephalitis vaccine is underway so that horse owners may vaccinate their horses if they so choose. The vaccine is currently permitted for use in horses being exported to countries where the disease is endemic.

There is no vaccine registered for pigs in Australia. In pigs, the most common clinical signs are mummified, stillborn or weak piglets, some with neurological signs, born to sows that became infected during gestation. Piglets infected after birth can develop encephalitis which presents as paddling, or other neurological signs in the first six months of life. In other cases, wasting, depression or hindlimb paralysis may be seen in suckling piglets and weaners. Adult sows do not typically show overt signs of disease at the time of infection. If boars are present on farm, they may experience infertility. Pigs are typically viraemic for 4 -5 days after infection, after which the level of virus quickly falls and the pigs become immune. Most commercial pigs are processed at between 16-22 weeks of age. Loss of litters at infected piggeries can vary from 10-60%. This has a significant impact, with each litter valued at approximately $3,000-5,000. This has given rise to the pig industry now looking at options to import or develop a suitable vaccine.

Anticipated future

Can JEV be eradicated from Australia?

There are still many knowledge gaps that need to be addressed to determine future transmission patterns for JEV in Australia. These include:

- The origin and pathway of the virus in Australia.
- The competence of other vector species apart from *Cx. annulirostris*.
- Environment, changing climatic conditions and different vector/host transmission dynamics that influence JEV spread in different locations across Australia.
- The role of other potential vertebrate hosts.

The evidence currently available suggests that the virus is widespread (present in multiple states), and present in feral pigs and vectors which may provide an environmental reservoir for the virus, meaning eradication is therefore unlikely.

Based on this, the CCEAD determined that eradication of JEV was not immediately feasible. Temporary elimination may be achieved in some areas, but reintroduction from enzootic foci is highly likely based on the epidemiology and natural history of JEV in other countries and related flaviviruses in Australia.

Potential scenarios

There is a wide spectrum of disease patterns and activity between elimination and high levels of endemicity, and consideration should be given to the likelihood and implications of each. Very broadly, the potential scenarios for transmission dynamics of JEV might include:

- Sporadic activity similar to Murray Valley encephalitis virus (MVEV) currently in the southeast (where a small number of cases are observed every few years).
- Ongoing enzootic activity with a small number of seasonal cases, similar to MVEV currently in parts of northern Australia.
- Ongoing enzootic activity with frequent seasonal cases observed and large outbreak potential.

Notably, a combination of the above categories may be observed in different locations. Thus, risk to humans and animals will likely be dynamic and vary across regions and seasons.

Seasonality

Detection of JEV via mosquito surveillance may be subject to seasonal fluctuations in mosquito densities in line with seasonally-influenced transmission. Cooler weather in the southern parts of Australia usually suppresses adult mosquito activity which is expected to reduce transmission. JEV is likely to remain present in areas where there are appropriate host populations (e.g. feral pigs and water birds) and vector activity). It may take some time after vector activity resumes before animal or human cases are detected in areas where vector activity is seasonal. This depends on when insect activity resumes, particularly if drier conditions suppress mosquito numbers.

Animal and mosquito surveillance across multiple seasons is required to provide insight into transmission cycles across locations.

Communication strategy

The Department of Health and Aged Care, and the Department of Agriculture, Fisheries and Forestry developed a joint communication plan to ensure the community is well informed. The joint communication plan outlines, goals, messaging, channels, and audiences and the communication approach taken by the Commonwealth.

State and territory governments undertake communication to the public and health care sector at the jurisdictional and local level as required, and have direct responsibility for communication to hospitals, public health and community health services.

The Department of Health and Aged Care continues to work with the Department of Agriculture, Fisheries and Forestry and state and territory health departments to coordinate nationally consistent communication, to ensure the public has clear, factual, and timely information – appropriate to the public health risk posed.

The National Biosecurity Communication and Engagement Network (NBCEN) worked to ensure coordinated messaging to animal health stakeholders. NBCEN consists of communication managers from the Commonwealth, state and territory agriculture agencies, Plant Health Australia, Animal Health Australia, CSIRO's Australian Centre for Disease Preparedness, and the Australian Government Department of Health and Aged Care. Communications have been implemented by member organisations according to local need and resourcing.

The primary focus of communication efforts is to increase awareness of the need for the community to protect themselves from mosquito bites, and the availability of vaccinations for groups identified as at risk in a national vaccination strategy. Initial efforts focussed on utilising owned and earned channels, supported by a targeted media buy for impacted areas.

The experience of the COVID-19 pandemic also highlights the importance of investing in proactive communication to ease community concerns and prevent panic and misinformation.

Appendix 1 – Background on Japanese encephalitis

Japanese encephalitis (JE) is a rare disease caused by the Japanese encephalitis virus (JEV). It is spread to humans by infected mosquitoes.

The virus

JEV is a member of the Flavivirus genus of the family Flaviviridae. JEV is related to dengue, yellow fever, Murray Valley encephalitis and West Nile/Kunjin viruses. JEV infection in humans and animals is a notifiable disease in all states and territories in Australia. JEV is part of a serological complex known as the JE serogroup. There is one serotype of JEV and five reported genotypes.

Where it is found

JEV is the main cause of viral encephalitis in humans in many countries of Southeast Asia with an estimated 68,000 clinical cases every year. Currently, 24 countries in the World Health Organization's (WHO's) South-East Asia and Western Pacific regions have endemic JEV transmission, exposing more than 3 billion people to risks of infection.

The disease in humans

The majority (about 99%) of JEV infections in people produce no symptoms. Some infected people experience an illness with fever and headache. Those with a severe infection may experience neck stiffness, disorientation, tremors, coma, convulsions (especially in children) and paralysis. The case-fatality rate among those with encephalitis can be as high as 30%. Permanent neurologic or psychiatric sequelae can occur in 30%–50% of those with encephalitis. Symptoms (if they are to occur), usually develop 5 to 15 days after being bitten by a mosquito carrying JEV.

There is no cure for the disease. Treatment is focused on relieving severe clinical signs and supporting the patient to overcome the infection.

Safe and effective vaccines are available to prevent JE disease in humans. The WHO recommends that JE vaccination be integrated into national immunisation schedules in all areas where JE disease is recognised as a public health issue. Vaccination does not eliminate natural transmission of JEV.

Between 2012 and 2021, there were 15 cases of JEV notified in Australia. All but one, were acquired overseas. In 2021, there was a locally acquired case notified in a resident of the Tiwi Islands. Genotype IV has been identified in the affected piggeries, and this is the same genotype that was identified in the Tiwi Islands case. Previous JEV detections in Australia have been identified as genotype I or genotype II.

The virus in animals

A wide range of animal species may be infected by JEV, but most do not show signs of disease. Waterbirds and mosquitoes are natural reservoirs of JEV. The potential role of Australian wildlife species in the epidemiology of JEV is not known.

Waterbirds (particularly wading birds like herons and egrets) and pigs have significant quantities of virus in their bloodstream when infected, which increases the chances of infection being passed to mosquitoes.

Pigs and equids (horses and donkeys) are the species recognised as most susceptible to clinical disease. Rarely, disease has been reported in cattle, and young chicks and ducks. Infected humans and equids do not hold sufficient quantities of virus in their blood to infect mosquitoes and are therefore not epidemiologically important in virus transmission cycles (sometimes referred to as dead-end hosts).