



# HENIPAVIRUS

## RESEARCH ADOPTION FORUM

### Final Report

Canberra, 16-17 July 2007  
Rydges Lakeside Canberra  
London Circuit Canberra City

**Forum Steering Committee:**

Deb Cousins, Australian Biosecurity CRC

Hume Field, Queensland Government Department of Primary Industries and Fisheries

**Acknowledgements:**

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and all speakers, chairpersons and participants.

Report prepared by Jo Edmondston & Debby Cousins, November 2007

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## Contents

|   | Page |
|---|------|
| Executive Summary .....                         | 4    |
| Henipa Research Adoption Forum.....             | 6    |
| Background .....                                | 6    |
| Rationale .....                                 | 6    |
| Date, Location and Funding .....                | 6    |
| Delegates .....                                 | 7    |
| Objectives .....                                | 7    |
| Presentations .....                             | 7    |
| Afternoon Workshop Activities.....              | 9    |
| Concluding Remarks & Summation of Outcomes..... | 13   |
| Recommendations .....                           | 15   |
| Evaluation .....                                | 16   |
| Proceedings .....                               | 19   |
| Welcome .....                                   | 20   |
| Program .....                                   | 21   |
| Background .....                                | 22   |
| Objectives & Outcomes .....                     | 23   |
| Abstracts .....                                 | 24   |
| Powerpoint Presentations .....                  | 28   |
| Biographic Details of Presenters .....          | 76   |
| Delegate List .....                             | 79   |
| Evaluation Sheet .....                          | 82   |

## Executive Summary

The *Henipavirus Research Adoption Forum* held at the Rydges Lakeside in Canberra 16-17 July 2007 brought together over 40 delegates representing the public health, animal health and environment sectors. The forum aimed to review henipavirus research funded by the Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease (AB-CRC), identify any key gaps in knowledge, prioritise research projects to fill these gaps in knowledge, and develop an inventory of key information that may support henipavirus-related practice and/or policy. The forum was considered timely given the maturing portfolio of henipavirus research within the AB-CRC and the ongoing and recent outbreaks of Nipah virus in the Bangladeshi region.

The first session of the forum consisted of a series of presentations that provided an overview of henipaviruses from a public health and animal health perspective and a summary of significant national and international events in henipavirus emergence. These talks set the context for the forum and enabled delegates to update their knowledge of the area. The presentations that followed provided an overview of AB-CRC funded henipavirus research projects and recent findings from overseas.

Facilitated discussion sessions in the afternoon provided valuable feedback regarding the significance of the research, gaps in existing knowledge, and future research priorities. The most difficult question addressed by the delegates was how to take research information or knowledge forward to effectively inform changes in practice or policy. Many delegates indicated they felt more information regarding henipaviruses is required before changes to policy and/or practice can be considered.

The most significant gaps in henipavirus knowledge were found to be:

- Knowledge of epidemiology and pathophysiology of henipaviruses in humans
- Knowledge of epidemiology and pathophysiology of henipaviruses in bats
- Understanding of risk posed to Australian human and host populations

To fill these gaps in knowledge, the following research areas were given high priority:

- Improved understanding of henipavirus dynamics in flying fox species
- Improved understanding of henipavirus dynamics in humans
- Ongoing research into bat populations
- Research aimed at improving the capacity to diagnose henipavirus infections and improve human health outcomes

The key information required to enable henipavirus research outcomes to be translated into policy and/or practice was considered to be:

- Improved risk assessment for henipaviruses and improved risk management strategies
- Ongoing research to address identified research gaps and priorities
- Continued cross-sector communication of henipavirus research via AB-CRC facilitated adoption forums, and targeted communication of specific AB-CRC research outcomes to specific audiences including the relevant networks and industries.

It was evident from both the formal and informal feedback that this was a very productive meeting that contributed significantly to the understanding of how current research knowledge can be best utilized and the priorities for future research. In addition, the forum contributed to the delegates combined understanding of these diseases, knowledge of the research that has been conducted to date, and the challenges faced by henipavirus researchers. The feedback also indicated the delegates felt the structure of the adoption forum was useful for bringing together policymakers, practitioners and researchers to share their views of henipaviruses and related issues.

A number of key recommendations were generated from the outcomes of the forum. These recommendations, listed below, will be used by the AB-CRC for forward planning in henipavirus research and adoption;

- **Recommendation 1:** That the AB-CRC continues to advance knowledge of henipavirus ecology and diagnostics through its research program. The outcomes of current AB-CRC henipavirus research, in combination with the research priorities identified in this forum, should be used to direct further research in this area.
- **Recommendation 2:** That the AB-CRC continues to promote interaction and linkage between end users and researchers using the adoption forum approach. This may include a future adoption forum on henipavirus and/or in other areas of research that is considered to be of interest to end user audiences.
- **Recommendation 3:** That the AB-CRC, in consultation with its partners, target specific groups for the continued communication of relevant henipavirus research material. Communications to be tailored to each target audience.
- **Recommendation 4:** That the AB-CRC consider obtaining permission from invited speakers at the adoption forums to disseminate their presentations (powerpoint slides and audio recordings) to interested parties unable to attend in person (as undertaken for Dr Luby's presentation).

# Henipavirus Research Adoption Forum

## Background

The emergence of Hendra virus (HeV) in Australia in 1994, Nipah virus (NiV) in Malaysia in 1998-99 and more recent outbreaks in Bangladesh (2001-current) have increased the awareness of emerging infectious diseases and stimulated research into henipaviruses. HeV and NiV are able to infect a number of host species, including humans, and cause potentially fatal respiratory and encephalitic disease. These viruses reside naturally in *Pteropus* flying foxes and related species. As the range of these mammals is vast they have the capability to spread disease over a large area, including areas where disease has not been seen previously. To date, no effective anti-viral therapy is available to treat HeV or NiV infection.

## Rationale

The Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease (AB-CRC) has funded research projects that aim to assess the risk of introduction of NiV to Australia, and enhance detection and diagnosis of henipavirus infection. Some of these research projects involve collaborations with international research groups, notably the Consortium for Conservation Medicine (CCM) in New York and the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). In light of the maturation of a number of AB-CRC henipavirus-research projects and recent and ongoing NiV outbreaks, it was considered timely to reflect on the achievements and outcomes of these projects with the aim of maximising those research outcomes and shaping the direction of future henipavirus research in Australia. An adoption forum was considered to be a suitable vehicle for bringing together henipavirus policymakers, practitioners and researchers to consider the latest outcomes in henipavirus research and how they may be potentially adopted into policy and practice.

## Date, Location, & Funding

The *Henipavirus Research Adoption Forum* was convened at the Rydges Lakeside Hotel in Canberra on 16-17 July 2007. The forum was supported by the AB-CRC in partnership with the Queensland Government Department of Primary Industries & Fisheries (QDPI&F) and the Australian Government Department of Health and Ageing (DoHA).

## Delegates

The forum was attended by a total of 44 delegates. These delegates included representatives from the state, territory and federal governments, universities, animal industries, wildlife associations, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and the AB-CRC.

We were also fortunate to have a number of international speakers at the meeting. Through the AB-CRC's research collaborations, four delegates were invited to the adoption forum provide an international perspective of henipavirus research. Dr Peter Daszak from CCM and Dr Raina Plowright from the Foley Laboratory in Vectorborne Diseases and Infectious Disease Ecology at the University of California, attended the meeting in person. Dr Stephen Luby from ICDDR,B and Dr Juliet Pulliam from the Department of Ecology and Evolutionary Biology at Princeton University, contributed to the forum by delivering their presentations remotely by combining a slide presentation synchronised with audio linkup.

## Objectives

The broad objectives of the adoption forum were to:

- Provide an update on progress of AB-CRC supported henipavirus research projects;
- Provide an update on scientifically relevant work on henipavirus being led by key researchers overseas;
- Summarise key findings from the research focussing on those that may affect practice and/or policy within the Australian context;
- Identify any key gaps in knowledge, and explore possible research projects to fill them;
- Develop an inventory of key information and/or actions that are needed to shape changes to henipa-related practice and/or policy.

## Presentations

The first part of the forum consisted of a series of presentations by representatives of the animal and human health sectors in Australia, AB-CRC funded researchers, and a number of international speakers. Each presentation was followed by a brief questions and answer session facilitated by a chair of the session.

The first presentation session was chaired by Dr Peter Black, from the Department of Agriculture, Fisheries and Forestry (DAFF). This session began with two brief talks that provided an overview of henipaviruses from animal health and public health end users. Dr Andrew Moss from the Australian Quarantine and Inspection Service – North Australian

Quarantine Strategy (AQIS-NAQS) gave a talk called *NAQS Nipah Perspective* and Dr Linda Selvey from Queensland Health gave talk called *Public Health Aspects of Henipavirus for Australia*.

Dr Hume Field from QDPI&F and Dr Peter Daszak from CCM presented in the second half of this session. Dr Field provided some background to henipaviruses including known spillovers, natural reservoirs of the disease and factors effecting emergence of these zoonotic diseases. Dr Daszak gave an overview of NiV emergence, a summary of the relevant aspects of bat ecology, and a list of key questions that remain unanswered, including: What is the true diversity of Henipaviruses? Why has NiV spilled over more frequently? How do NiV and HeV persist in populations? Do NiV and HeV cause persistent, latent infections in bats? And what is the risk of a NiV pandemic?

The second presentation session was chaired by Dr Hume Field from QDPI&F. This session comprised a series of talks from AB-CRC funded researchers and collaborators. Dr Raina Plowright from the University of California provided a summary of her research on modelling the effects of land-use changes on the emergence of HeV from flying foxes. Dr Plowright described the use of computational models to evaluate how environmental changes may have changed HeV dynamics in flying fox populations, resulting in a decline in herd immunity and increased likelihood of viral transmission to horses and humans.

Dr Juliet Pulliam from Princeton University provided a talk via remote telephone linkup and powerpoint. This talk summarised her work with the Henipavirus Ecology Research Group (HERG) in relation to agricultural practices and epidemic enhancement of NiV in Malaysia. She suggested that vaccination of commercial pig populations is unlikely to be a cost effective option for prevention of NiV, and targeted surveillance of large commercial pig farms which overlap with flying fox distributions is important for the detection of spillover events and the prevention of widespread infection.

Andrew Breed, an AB-CRC PhD student based at University of Queensland, provided an overview of his research - *A risk assessment of the introduction of Nipah virus to Australia via flying foxes*. Andrew's work has generated valuable molecular, telemetry, and sequencing data on the distribution of NiV infection and level of contact among flying foxes in the Australian border regions. Andrew's data, experience and knowledgeable assessments were recently included in the AB-CRC's report on the *Risk of Nipah Virus Entry and Establishment in Australia*, commissioned by DoHA.

Dr Linfa Wang then provided an overview of AB-CRC funded henipavirus research undertaken in collaboration with Dr Katharine Bossart. Both of these scientists are from CSIRO's Australian Animal Health Laboratory (AAHL). Dr Wang described the development of novel serological assays for the henipaviruses and explained how these new tests provide

a sound base for supporting research (such as the work undertaken by Dr Field and Andrew Breed), as well as a new diagnostic tool that has been made available to collaborators in Malaysia and Australia.

The final presentation of the forum was provided by Dr Stephen Luby (ICDDR,B), who presented by remote link-up from Bangladesh. Dr Luby provided an update on NiV in Bangladesh, emphasising the recurrent seasonal outbreaks of the disease, multiple pathways of transmission from wildlife to humans, and up to five generations of person-to-person transmission. He also emphasised what isn't known about NiV infection: What triggers spillover from bats to people? Are some strains of NiV more likely to lead to human-to-human transmission? And, what can be done to prevent NiV spillovers and transmission?

### Afternoon Workshop Activities

In the afternoon, delegates were assigned to groups to address specific focus questions. Facilitated by Dr Lisa Adams (AB-CRC), this workshop consisted of two sessions. In Workshop Session 1 the delegates were asked to consider gaps in henipavirus knowledge. In Workshop Session 2 the delegates were asked to consider henipavirus research priorities and the way in which the AB-CRCs research outcomes can be utilised.

Individuals were assigned groups to discuss these questions. Each group contained delegates from across the sectors and a designated facilitator from the AB-CRC. To maximise mixing of the delegates, the group allocations in session one differed from the allocations in Workshop Session 2. The questions and the outcomes for each group are summarised below.

#### **Workshop Session 1 - Question 1: *Given the issues identified in the previous research presentations, what do you consider to be the three most significant gaps in henipavirus knowledge?***

The delegates were divided into six groups. All individuals were asked to respond to this question and record their responses on a post-it note. Each group then sorted, summarised, and prioritised their responses. The three top priorities of the group were recorded on a flipchart and a nominated individual from each group presented these priorities to all delegates.

All of the significant knowledge gaps identified in Session 1 are presented below. A number of these items were identified by more than one group:

- Human-animal interactions / risk factors
- Human disease prevalence and susceptibility
- Treatment of NiV infection in Bangladesh

- Seroprevalence of NiV in Bangladesh, India and surrounding region
- Modes of transmission of NiV - faeces, urine etc of infected humans
- What behaviours practices exist in Papua New Guinea / Timor Leste / Pacific Islands that provide spillover opportunities similar to date palm juice transmission in Bangladesh?
- Any genetic susceptibility to infection in humans?
- Any co-infection in humans involved?
- Route of entry into humans – respiratory tract and/or digestive tract / behaviour of virus / distribution in tissues - Contribution to human-human transmission / excretion / pathogenicity (increasing or stable?)

As the groups presented their findings, the results were collated on a powerpoint slide and projected to enable the delegates to comment and provide consensus on the significant gaps in henipavirus knowledge. It was agreed that the following points represented the combined views of the groups:

- Better diagnostic capacity
- Intervention strategies & tools (based on molecular biology of henipaviruses)
- Risk assessment for NiV entry and establishment in Australia
- Interest in the strain and genome variability, characterization of the virus, and the continuum of henipaviruses from Bangladesh to Australia
- Henipavirus epidemiology in humans
- NiV and HeV treatment regimes
- Risk factors involved in human transmission, modes of transmission, and serological surveys for subclinical infection
- Henipavirus dynamics in human populations
- Epidemiology in bats & population ecology in bats
- Henipavirus dynamics in flying fox species
- Bat-to-bat transmission
- Australian bats - sampling framework and geographical spread of bats, henipavirus strain diversity and temporal occurrence of infection in bats

In summation, it is considered by the authors of this report that the most significant gaps in henipavirus knowledge identified in this workshop session can be summarised as follows:

- Knowledge of epidemiology and pathophysiology of henipaviruses in humans. In particular:
  - Diagnostic, intervention and treatment strategies and tools
  - Characterisation of strain variation and the underlying genetic polymorphisms, particularly how strains vary throughout the region
  - Virus dynamics in human populations, risk factors involved in human transmission, modes of transmission, and serological surveys for subclinical infection
- Knowledge of epidemiology and pathophysiology of henipaviruses in bats. In particular:
  - Virus dynamics in flying fox species

- Population ecology, including modes of transmission between bats, zoonotic transmission, and geographical spread
- strain variation and temporal occurrence of infection
- Understanding of risk posed to Australian human and host populations

**Workshop Session 2 - Question 2: *What do you consider to be the three top priorities in henipavirus research and why?***

In Workshop Session 2 the delegates were divided into three groups. Group one addressed Question 2 (listed above) and the other two groups addressed Question 3 (see below). Group one consisted of approximately 12 individuals (predominantly with research backgrounds and/or interests). This group considered their question in a round-table discussion and recorded the results of this discussion on a flipchart. The following research priorities recorded by this group were presented to the delegates as a whole:

- Better understanding of henipavirus dynamics in flying fox species, specifically modes of henipavirus transmission, immune responses to HeV and NiV infection, evidence of disease, and the implications of co-infection with NiV and HeV
- Better understanding of henipavirus dynamics in humans, including modes of transmission, and the implications of genetic diversity of the virus for infection and adaptation to increased transmission and pathogenicity
- Ongoing research into bat populations, including additional research regarding their distribution and ecological impacts
- Research aimed at improving the capacity to diagnose henipavirus infections, and improved human health outcomes

**Workshop Session 2 - Question 3 - *Can you identify what key information and/or actions are required to enable henipavirus research outcomes to be translated into policy and/or practice? Specifically, which of the research outcomes are most relevant to your area of work? What can the AB-CRC do to facilitate use of these research outcomes in your area? What barriers need to be overcome for these research outcomes to be applied in your area?***

Two groups, which consisted predominantly of delegates with an interest and/or expertise in policy, considered this question. These groups took different approaches to answering this question. Group two asked each individual to provide their views answers individually. Group three had a round-table discussion. Both groups recorded the outcomes of their discussions on paper and a representative from the group gave an oral summation of the groups' conclusions to the delegates as a whole. The results for groups two and three are detailed below. It should be noted that both groups considered this the most difficult question to answer. Many felt more evidence was required before consideration of changes to policy and/or practice could be considered.

Group two identified the following points as key information and/or actions that are required to enable henipavirus research outcomes to be translated into policy and/or practice:

- An understanding of the connection between HeV and NiV, Specifically, will bats positive for HeV will have protection for NiV? It was considered that more longitudinal data and more surveillance data required.
- Knowledge of the degree of henipavirus strain variation in Australia. Specifically, is there variable transmission and pathogenicity? Virus sample required for further research.
- Awareness of existing risk management policies. What is the level of exposure risk management? What kinds of responses are required? Is there sufficient information for bat handlers? Is there sufficient testing for henipavirus. Communication of henipa relevant information to the Communicable Diseases Network Australia (CDNA).
- Testing of undiagnosed encephalitis cases may be required. Should not think only risk is via horses but may need to consider other intermediate hosts such as cattle and/or possums.
- Diagnostic capacity needs to be improved. Need other labs with capacity to test for henipaviruses.
- Is it worth spending the money on henipaviruses? What is the balance between dollars spent and industry and human risk? Movement of bats from Malaysia to Australia should be proved. No NiV isolates from bats from Bangladesh.
- Henipaviruses criteria for entry into AUSVET plan. Compare with porcine myocarditis guidelines.
- AB-CRC should structure their communication for laypeople, including the public health message that there is a range of modes of transmission, and up to five possible generations of transmission.
- Barriers that need to be overcome - Risk assessment required. Funding issues. More research required.

Group three considered this question in four parts, according to the components of this question. The points raised in discussion of these were summarized and presented to the forum as follows:

- What key information and/or actions are required to enable henipavirus research outcomes to be translated into policy and/or practice?
  - Assessment of existing resources and capacity
  - Risk Analysis - consequences and economics. Will a risk analysis change existing policies?
  - Political will?
- What research outcomes are most relevant to our area of work?
  - Epidemiology – human and animal
  - Bat ecology data – urbanization
  - Town planning, habitat clearing, public response
  - Diagnostics – proof of freedom etc
- What can the AB-CRC do to facilitate use of these research outcomes in our area?

- Adoption forums
- Summary of findings to CDNA
- Tailor specific messages of results to specific groups ie town planners / local govt
- What barriers need to be overcome for these research outcomes to be applied?
  - Political agendas
  - Competing priorities / resources
  - NiV not currently on Australian 'radar'

The authors of this report consider the following points to represent the combined outcomes of groups two and three:

- There is a perceived need for improved risk assessment for henipaviruses and improved risk management policies
- Ongoing research in the area is required that addresses identified research gaps and priorities
- There is a perceived need for continued cross-sector communication of henipavirus research via AB-CRC facilitated adoption forums, and targeted communication of specific AB-CRC research outcomes to specific audiences including the relevant networks (e.g. CDNA) and industries.

## **Concluding Remarks & Summation of Outcomes**

In summing up at the conclusion of the forum, Dr Debby Cousins thanked all delegates on behalf of the AB-CRC for attending the forum and for actively participating in the workshop sessions. The invited speakers were commended for their entertaining and thoughtful presentations, and Dr Daszak and Dr Plowright were acknowledged for organising their schedules to enable them to attend the forum in person.

Dr Cousins noted that one of the highlights of the forum was Dr Luby's presentation from Bangladesh of 'NiV breaking news'. From his intimate knowledge of this region, Dr Luby was able to provide a up-to-date account of NiV emergence, including evidence of human-to-human transmission for up to five generations. This presentation was recorded and, with Dr Luby's permission, has been supplied to delegates who were unable to attend his presentation.

The main outcomes of this forum for the AB-CRC and other interested parties include the accumulated lists of henipavirus knowledge gaps and research priorities. In addition, the adoption forum concept was widely acclaimed as being valuable mechanism for strengthening the interface between policymakers, practitioners and researchers to ensure a coordinated and considered approach to planning and tackling complex challenges. It provided an efficient opportunity to bring people together around an issue, in this instance to

update them on the latest in henipavirus research. The afternoon workshop sessions provided a focus to consider these diseases from a diversity of perspectives, and there was clear agreement about the value of engaging people with a diversity of knowledge, skills and experience, from the animal, public health and environment sectors. The end-users at the forum gained much from being brought together with henipavirus researchers, and vice versa.

It was evident from both the formal and informal feedback that this was a very productive meeting. For the delegates, the forum provided an opportunity to update their understanding of these diseases and the research that has been funded by the AB-CRC. For the AB-CRC, the forum has contributed significantly to the centre's understanding of how current research knowledge can be utilized and how future research may be prioritised. The forum also provided an opportunity for networking between the various sectors. Overall, the adoption forum has developed and strengthened the working relationships between the environment, animal health and public health sectors with respect to henipaviruses.

## Recommendations

A number of key recommendations were generated from the outcomes of the forum. These recommendations, listed below, will be used by the AB-CRC for forward planning in henipavirus research and adoption;

### **Recommendation 1**

That the AB-CRC continues to advance knowledge of henipavirus ecology and diagnostics through its research program. The outcomes of current AB-CRC supported henipavirus research, in combination with the research priorities identified in this forum, should be used to direct further research in this area.

### **Recommendation 2**

That the AB-CRC continues to promote interaction and linkage between end users and researchers using the adoption forum approach. This may include a future adoption forum on henipavirus and/or in other areas of research that are considered relevant.

### **Recommendation 3**

That the AB-CRC target specific groups for the continued communication of relevant henipavirus research related material. These communications are to be tailored to the target audience.

### **Recommendation 4**

That the AB-CRC consider obtaining permission from invited speakers at the adoption forums to disseminate their presentations (powerpoint slides and audio recordings) to interested parties unable to attend in person (as undertaken for Dr Luby's presentation).

## Evaluation

All delegates were provided with an evaluation sheet at the completion of the adoption forum. The delegates were asked to provide their views of their expectations of the forum, how well these expectations were met, and how they feel the forum could have been improved. They were also asked to rate the success of each of the sessions and how they felt the forum had been in achieving its desired outcomes. Responses were obtained from 25 delegates, representing a 60% response rate (minus the AB-CRC forum organisers). The questions asked in the evaluation and a summary of the responses are provided below.

*What was your main reason(s) for attending the workshop? Did the workshop fulfill your main reason(s) for attending?*

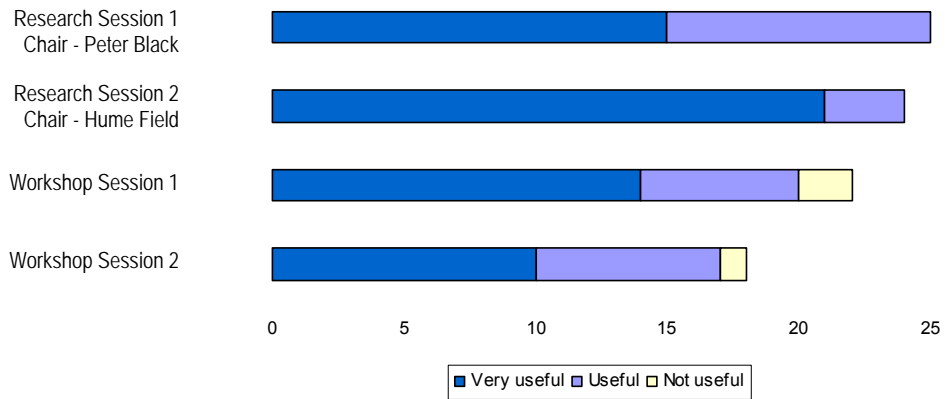
Many indicated they were interested in updating their knowledge of the henipaviruses and research in this area, and a number had a more general interest in emerging infectious disease. Some had a specific interest in disease emergence, others were more interested specifically in NiV in the region, the risk of NiV introduction into Australia, and its public health implications. Two of the delegates indicated they were interested in henipavirus infection in Australian wildlife.

A number of delegates expressed an interest in using the forum to prioritise research in the area and apply research outcomes to consideration of disease management and disease surveillance strategy design. Four delegates were interested in end user perspectives of current henipavirus research.

Twenty four of the 25 delegates (96%) felt the workshop met their reason for attending. They commented that the forum was useful, well organised and provided them a broad overview of research in the area.

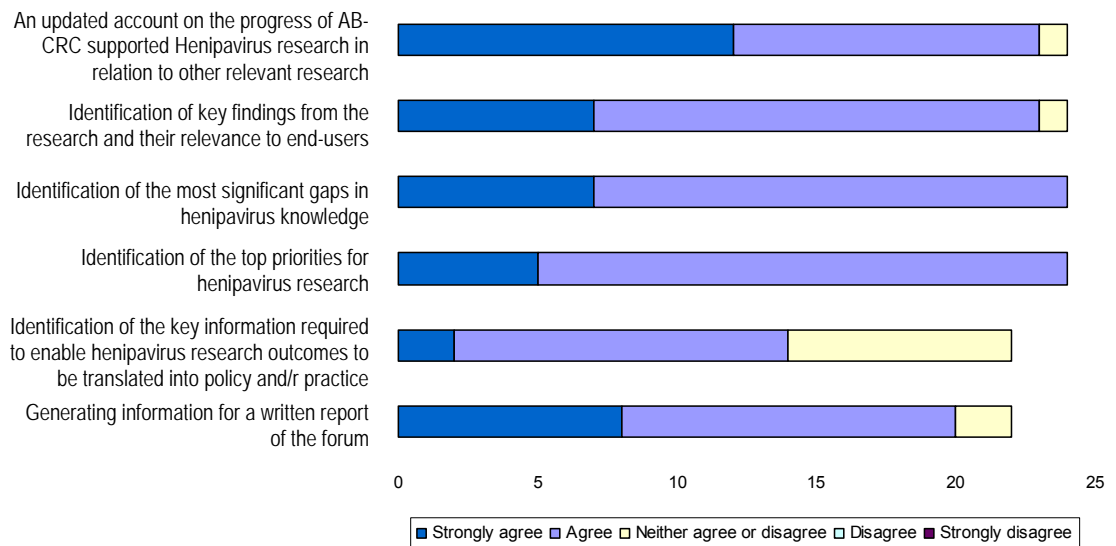
*How useful do you feel the following sessions were in fulfilling your reason(s) for attendance?*

The majority of delegates felt all of the forum sessions were useful or very useful, and met their reasons for attendance. Of all sessions, the second research session (which provided updates of AB-CRC funded henipavirus research and other research in the region), was rated most useful by the delegates.



*Rate the extent to which the workshop achieved the desired outcomes of the meeting.*

Overall the responses to these items were positive, with the majority of respondents agreeing that the workshop was successful in achieving the planned outcomes. The item related to how research outcomes can be translated into policy and/or practice, was considered the most difficult question to answer by the delegates, and this is reflected in their evaluation of this item.



*Do you have any suggestions for how the forum could be improved?*

Seven delegates provided suggestions for how the organisers could improve the forum. Some felt they would have benefited from more research presentations, and one felt the forum could have focussed more on animal and human interactions. Two delegates felt they would have preferred to have had the full forum papers prior to the forum. All efforts were made by the forum organisers to provide the delegates with as much information as possible prior to the day of the forum, however, it is not always possible to obtain abstracts and powerpoint presentations from all presenters in time for collation and distribution prior to the forum. A wildlife representative at the forum felt other bat ecologists may benefit from attending AB-CRC forums, and suggested the organisers may wish to consider greater representation from this sector in the future.

Five delegates used the space provided on the evaluation form to indicate they felt the forum was well run and did not need improving.