An overview of brucellosis in animals in the Asia Pacific Region

Monaya Ekgatat
OIE Expert for Brucellosis
National Institute of Animal Health,
Department of Livestock Development
50/2 Kasetklang, Ladyao, Chatuchak
Bangkok 10900, THAILAND
Sharing Topics

- Background
- Regional disease situation
- Regional progress
- Challenges and Way Forward
Infectious and contagious disease due to *Brucella* spp.

Major public health risk and worldwide importance

Causes significant economic losses to livestock production

Causes also important in wildlife, infecting feral pigs, bison, elk, European hares and marine mammals

One disease of *Bioterrorism Agents: Group B*, second highest priority with low infectious doses (10 –100 bacteria)

The infective doses of *Brucella* spp.

- *Brucella melitensis* 1-10
- *Brucella abortus* 100,000
- *Brucella suis* 1000-10,000
- *Brucella canis* 1,000,000

Brucellosis?
Transmission and spread

- Spread to humans: through food borne transmission, occupational and environmental contact with infected animals and their products. It causes a severe debilitating disease in people.
- Complication may affect any system of human.
- Brucellosis is one of travel-associated disease.
- The disease in animals is characterized by abortions or reproductive failure with typically recover, and will be able to have live offspring following the initial abortion, they may continue to shed the bacteria.
- Spread when the animal aborts or gives birth, bacteria are found in the birth fluids.
- Survive outside the animal in the environment for several months, based on the environment condition.
- Infect the other animal by ingesting the bacteria and colonise the udder, then contaminate to the milk.
- Infect animals and humans through wounded skin, or through mucous membranes. One of the acquired laboratory infections.
Clinical signs
- Mild, showing few signs until abortion. In males: swelling of the testicles, and/or arthritis.
- In horses: fistulous withers or poll evil (swelling of the neck or back).
- Infected pregnant mares: abort or give birth to weak and vulnerable foals.
- It results in huge economic losses to dairy, sheep, goat and pig farmers (poor reproductive performance, abortions, infertility, retention of placenta, stillbirth or birth of weak offspring).

Prevention and control
- Surveillance: serological tests, milk testing (milk ring test, ELISA) as screening for campaigns to eliminate brucellosis.
- Individual animal testing: trade and disease control.
- Endemic areas: vaccination is necessary to reduce the incidence of infection.
- Period becomes closer to eliminated: test and stamping-out program is required.
- Human brucellosis is best prevented by controlling the infection in animals.
- Milk: Pasteurisation
<table>
<thead>
<tr>
<th>Species</th>
<th>Biovars</th>
<th>Preferred host</th>
<th>Main geographical area</th>
<th>Pathogenicity for man</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. abortus</td>
<td>1, 2, 3, 4, 5, 6, (7), 9</td>
<td>Cattle and other Bovidae</td>
<td>Europe, Americas, Africa, Asia</td>
<td>Moderate</td>
</tr>
<tr>
<td>B. melitensis</td>
<td>1, 2, 3</td>
<td>Sheep and goats, Wild ongulates, camels</td>
<td>Mediterranean countries, Middle and Near East</td>
<td>High</td>
</tr>
<tr>
<td>B. suis</td>
<td>1, 2, 3</td>
<td>swine, swine, hare</td>
<td>Americas, Asia, Oceania, Central and Western Europe, USA, China, USA, Canada, Russia, Russia</td>
<td>High, Very low, High, Moderate, High</td>
</tr>
<tr>
<td>B. neotomae</td>
<td></td>
<td>Desert wood rat (Neotoma lepida)</td>
<td>USA</td>
<td>Unknown</td>
</tr>
<tr>
<td>B. ovis</td>
<td></td>
<td>Sheep</td>
<td>Mediterranean countries</td>
<td>No</td>
</tr>
<tr>
<td>B. canis</td>
<td></td>
<td>Dogs</td>
<td>USA, South America Europe</td>
<td>Low</td>
</tr>
<tr>
<td>B. ceti</td>
<td></td>
<td>Cetaceans</td>
<td>-</td>
<td>High / Unknown</td>
</tr>
<tr>
<td>B. pinnipedialis</td>
<td></td>
<td>Pinnipeds</td>
<td>-</td>
<td>High / Unknown</td>
</tr>
<tr>
<td>B. microti</td>
<td></td>
<td>Common voles</td>
<td>Central Europe</td>
<td>Unknown</td>
</tr>
<tr>
<td>B. inopinata</td>
<td></td>
<td>Human/Unknown</td>
<td>USA/Oceania</td>
<td>Unknown</td>
</tr>
<tr>
<td>B. papionis</td>
<td></td>
<td>Baboons (Papio spp.)/ Unknown</td>
<td>USA</td>
<td>Unknown</td>
</tr>
<tr>
<td>B. vulpis</td>
<td></td>
<td>Red foxes (Vulpes vulpes)</td>
<td>Central Europe</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

Geographical distribution

* Highest incidence: Middle East, the Mediterranean region, sub-Saharan Africa, China, India, Peru, and Mexico.

* At present: countries in central and southwest Asia are seeing the greatest increase in cases.

* Western and Northern Europe, Canada, Japan, Australia and New Zealand are believed to be free from the agent.
Regional disease situation of animal brucellosis

Disease status: *Brucella abortus* (2020): Panama, Libya, Botswana, Somalia, Bangladesh, Thailand

Disease status: *Brucella abortus* (2021): Panama, Libya, Botswana (continuing)

Number of new outbreaks: 2019-2020-2021
**Disease status:**
*Brucella melitensis* (2020): Sierra Leone, Croatia, Saudi Arabia, Somalia, Pakistan, Thailand

**Number of new outbreaks:** 2019-2020-2021

**Quantitative Data**
- Deaths
- Cases
- Killed and disposed of
- Susceptible
**Disease status:**

*Brucella suis* (Jul-Dec 2020, Jan-Jun 2021, Jul-Dec 2021): Finland, France

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**Number of new outbreaks**

- **Finland (wild boar)**
- **Finland (wild boar), France (swine)**
- **Somalia-suspected**
**Brucella suis**

**Notification:** 24/6/2021  
**Started on:** 11-05-2021

**Animal Type:** Terrestrial  
**Confirmed on:** 01-06-2021

**Causal Agent:** *Brucella suis*  
**Reported on:** 23-06-2021

**Reason:** Recurrence  
**Last occurrence:** 01-07-2021

**Epidemiological Comment:**
- Outdoor rearing, detection as part of a self-testing
- Culture is underway at national laboratory to identify the serotype of the *Brucella suis* strain

### Source of event or origin of infection
- Contact with wild species
- Unknown or inclusive

### Test Results

<table>
<thead>
<tr>
<th>TEST NAME</th>
<th>CATEGORY</th>
<th>LAB</th>
<th>Species</th>
<th>Outbreak</th>
<th>Tested from</th>
<th>Tested until</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complement fixation test for antibody detection</td>
<td>Antibody detection tests</td>
<td>Local Lab</td>
<td>swine</td>
<td>1</td>
<td>11-05-2021</td>
<td>01-06-2021</td>
</tr>
<tr>
<td>(Ab CFT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect enzyme-linked immunosorbent assay</td>
<td>Antibody detection tests</td>
<td>ANSES</td>
<td>swine</td>
<td>1</td>
<td>11-05-2021</td>
<td>04-06-2021</td>
</tr>
<tr>
<td>(i-ELISA)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Country/Territory Disease-Serotype/ genotype/subtype**

- United Kingdom: Contagious agalactia infections  
  - Date: 24/06/21
- China (PRC): Highly pathogenic influenza A virus (H1N1)  
  - Date: 25/06/21
- Malaysia: Highly pathogenic influenza A virus (H1N1)  
  - Date: 25/06/21
- France: *Brucella suis* (ref. wild)  
  - Date: 24/06/21
- Poland: SARS-COV-2 in animals (ref. wild)  
  - Date: 24/06/21
- Russia: Highly pathogenic influenza A viruses (H9N2)  
  - Date: 24/06/21

**Outbreaks from the most recent events**

[Map showing recent outbreaks]
## Regional progress

### Asia-Pacific Bovine Brucellosis Inter-laboratory Proficiency Test (ILPT)

<table>
<thead>
<tr>
<th>2013</th>
<th>2014</th>
<th>2016</th>
<th>2018</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh</td>
<td>Bangladesh</td>
<td>Bhutan</td>
<td>Bhutan</td>
<td>China</td>
</tr>
<tr>
<td>Bhutan</td>
<td>Fiji</td>
<td>Fiji</td>
<td>Fiji</td>
<td>Fiji</td>
</tr>
<tr>
<td>Fiji</td>
<td>Indonesia</td>
<td>India</td>
<td>Indonesia</td>
<td>Japan (4 labs)</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Lao PDR</td>
<td>Indonesia</td>
<td>Malaysia</td>
<td>Malaysia (4 labs)</td>
</tr>
<tr>
<td>Iran</td>
<td>Malaysia</td>
<td>Mongolia</td>
<td>Mongolia</td>
<td>Mongolia</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>Mongolia</td>
<td>New Caledonia</td>
<td>Myanmar (2 labs)</td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td>Nepal</td>
<td>Papua New Guinea</td>
<td>Nepal</td>
<td></td>
</tr>
<tr>
<td>Mongolia</td>
<td>Pakistan</td>
<td>Philippines</td>
<td>New Caledonia</td>
<td></td>
</tr>
<tr>
<td>Nepal</td>
<td>Papua New Guinea</td>
<td>Philippines</td>
<td>Papua New Guinea</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>Philippines</td>
<td>Sri Lanka</td>
<td>Philippines (3 labs)</td>
<td></td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>Vietnam</td>
<td>Thailand* (14 Labs)</td>
<td>Thailand* (26 Labs)</td>
<td></td>
</tr>
<tr>
<td>Philippines</td>
<td>Uganda</td>
<td>Vietnam</td>
<td>Vietnam (2 Lab)</td>
<td></td>
</tr>
<tr>
<td>Samoa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sri Lanka</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand* (14 Labs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>France</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* indicates multiple labs.
# Summary of ILPT results 2013-2020

<table>
<thead>
<tr>
<th>Information</th>
<th>2013</th>
<th>2014</th>
<th>2016</th>
<th>2018</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of accepted labs</td>
<td>33</td>
<td>31</td>
<td>39</td>
<td>55</td>
<td>56</td>
</tr>
<tr>
<td>Participating Labs</td>
<td>32</td>
<td>26</td>
<td>37</td>
<td>54</td>
<td>48</td>
</tr>
<tr>
<td>Not report (labs)</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Results in due time (%)</td>
<td>27/32 (84.4)</td>
<td>25/26 (96.2)</td>
<td>36/37 (97.3)</td>
<td>47/54 (87.04)</td>
<td>36/48 (75.0)</td>
</tr>
</tbody>
</table>

## Qualitative results

<table>
<thead>
<tr>
<th>Test</th>
<th>2013 (%)</th>
<th>2014 (%)</th>
<th>2016 (%)</th>
<th>2018 (%)</th>
<th>2020 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RBT Satisfactory</td>
<td>29/32 (90.6)</td>
<td>23/26 (88.5)</td>
<td>33/37 (89.2)</td>
<td>49/54 (90.7)</td>
<td>40/45 (88.9)</td>
</tr>
<tr>
<td>CFT Satisfactory</td>
<td>14/15 (93.3)</td>
<td>12/12 (100)</td>
<td>15/16 (93.8)</td>
<td>15/15 (100)</td>
<td>12/12 (100)</td>
</tr>
<tr>
<td>I-ELISA Satisfactory</td>
<td>8/9 (88.9)</td>
<td>6/6 (100)</td>
<td>11/14 (78.6)</td>
<td>10/11 (90.9)</td>
<td>13/16 (81.3)</td>
</tr>
<tr>
<td>Overall Satisfactory</td>
<td>27/32 (84.4)</td>
<td>23/26 (88.5)</td>
<td>33/37 (89.2)</td>
<td>49/54 (90.7)</td>
<td>43/48 (89.6)</td>
</tr>
</tbody>
</table>

![Graph showing Participating Labs and Overall Satisfactory % over years]

- **Participating Labs**
  - 2012: 32
  - 2013: 26
  - 2014: 37
  - 2015: 54
  - 2016: 48

- **Overall Satisfactory %**
  - 2012: 84.4
  - 2013: 88.5
  - 2014: 89.2
  - 2015: 90.74
  - 2016: 89.6
A systematic four step process has been outlined by the Food and Agriculture Organisation (FAO) to assist controlling Brucellosis in human and animal populations. (5 March 2013)

**Figure 2**

Roadmap for progressive control of brucellosis

1. **Situation**
   - Unknown situation of the disease
   - No structured control activities

   **Outcome**
   - Better understanding of the disease situation

   **Activities**
   - Carry out a baseline survey and epidemiological investigations
   - Develop an appropriate control strategy and action plan
   - Inform stakeholders

2. **Situation**
   - Known situation of the disease with a control programme under way

   **Outcome**
   - Brucellosis infection rates falling in livestock

   **Activities**
   - Implement the agreed control plan
   - Monitor the plan for quality and progress
   - Facilitate public health and animal health collaboration

3. **Situation**
   - Brucellosis at low levels within susceptible livestock population

   **Outcome**
   - Reduced impact of brucellosis in livestock and humans

   **Activities**
   - Carry out risk analysis to revise the control strategy as appropriate
   - Implement revised control plan
   - Enhance surveillance and monitoring

4. **Situation**
   - No evidence of brucellosis in livestock
   - No human cases

   **Outcome**
   - Self-declared freedom from brucellosis with or without vaccination

   **Activities**
   - Provide data to support brucellosis-free status according to OIE standards
   - Investigate and clear all suspected brucellosis cases
   - Monitor and maintain disease-free status

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Level of brucellosis declining in livestock and humans

Capacity of national veterinary services improving

*Source: FAO 2013a.*
### Situation

**Stage 0**
- Unknown situation of the disease
- No information/ No infrastructure available
- No control activities in place

**Stage 1**
- Brucellosis disease situation not clear or only limited information available
- Initiation of control activities

**Stage 2**
- Known situation of the disease
- Control program endorsed and financed

**Stage 3**
- Brucellosis continuously reduced in domestic animals and humans
- Less than 5% prevalence in target livestock herds and less than 0.2 cases per 100,000 humans/year

**Stage 4**
- No domestically acquired human cases
- No outbreaks or evidence of brucellosis in livestock

**Stage 5**
- Self-declared freedom from brucellosis with or without vaccination.
- Maintenance of the free status

### Goal/Outcome

**Stage 0**
- Establish basic epidemiological information on brucellosis for decision making

**Stage 1**
- Better understanding of the disease situation (situation & risk factor)
- Commitment from ministries to address brucellosis
- Develop control plan

**Stage 2**
- Control program implemented and monitored
- Infection rates falling
  - Less than 5% in livestock target herds and/or humans to less than 0.2 cases per 100,000/year

**Stage 3**
- Continuous reduction to no domestically acquired human cases
- No outbreaks or evidence of brucellosis in livestock

**Stage 4**
- No domestically acquired human cases
- No outbreaks or evidence of brucellosis in livestock

**Stage 5**
- Lower the frequency of checking the herds
- In depth human case investigations
- Maintain the protection of the country
- Sharing the lesson learnt with other countries
- International regional collaboration

### Activities and indicators

Activities and indicators are implemented and evaluated in each stage

- Level of brucellosis declining in livestock and humans
- Capacity of national veterinary services improving
<table>
<thead>
<tr>
<th>Stage</th>
<th>Area</th>
<th>Stage 0</th>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
<td>Coordination</td>
<td>Identify and engage participation of stakeholders • Set up a brucellosis or zoonoses working group/task force • Establish coordination mechanism among different ministries/organizations One Health</td>
<td>Establish mechanisms for public health and animal health collaboration and information sharing and with stakeholders</td>
<td>Maintain networking and financial resources • Communication and commitment of stakeholders (stimulate networking between farmers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific research and study</td>
<td>Conduct capacity and needs assessment</td>
<td>Conduct Socio-economic study • Develop and implement KAP surveys</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laboratory Diagnostics</td>
<td>Having laboratory capacity to test brucellosis in both human and animal health sectors</td>
<td>Strengthen laboratory capacity</td>
<td>Systematic isolation and typing • Lab accreditation (ISO) • Proficiency testing</td>
<td>Maintain lab capacity • Quality assurance in lab and strong lab network.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease prevention and control</td>
<td>Draft a brucellosis control plan</td>
<td>Establish/review law and regulations if needed • Establish an animal identification system • Establish compensation • Further strengthen veterinary and human health services in surveillance control and prevention (case def, treatmen, recom., etc) • Mass or replacement vaccination if prev. is high or resources are limited and/or test and slaughter if the prevalence is low • Implement and monitor control program</td>
<td>Evaluate control program • Maintain or revise the control program and budget targeting elimination of the dis. • Establish animal identification and database • Control animal movement • Active case finding with One Health approach • Investigation of outbreaks (incl. trace back and forward of infected herds)</td>
<td>Maintain training • Appropriate regulations (revision) • Movement control from risk area and neighboring countries (if infected) • Increase farm biosecurity • Strengthen the elimination (depopulation of farms in case of any outbreak) • Sero-survey in abattoirs. • Increase sero-surveys in risk areas. • Increased movement control in risk areas (consider maintaining vaccination)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surveillance/survey</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring and Evaluation of brucellosis disease programmes</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awareness</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Indicators: all stages**
**Recommendations:**

1. Countries are encouraged to establish collaborations between public and animal health sectors to enhance communication, cooperation and coordination. Development of MoUs and/or ToRs as well as regular meetings and an annual One Health conference to include brucellosis are recommended.

2. Countries are encouraged to develop a 5-year brucellosis control plan based on sound epidemiological information which includes disease distribution in animals and humans.
   a. Countries in the region are encouraged to develop a national program within the framework of stepwise approach for the progressive control of brucellosis utilizing the STEB tool.
   b. An outline of the plan of action by countries is to be developed within the next three to six months with full involvement of the public and animal health sectors.
   c. A national review and revision of the existing regulations and laws should be initiated in support to the regional stepwise approach.
One Health Approach

Review

- Unsuccessful control programmes,
- Limited budget: One Health Concept
- Key issue: global preventive strategies

Challenge of future research

(1) Novel diagnostics
(2) Develop vaccines
(3) Develop genomic-based typing method

Preparedness measures

- Strengthening information dissemination and education on brucellosis
- Improving veterinary and public health surveillance
- Collaboration through One Heath framework

Brucella seropositivity in chicken and risk factors for Brucella infection at the animal-human interface in Anambra State, Nigeria

Joseph Onuchukwu, Emmanuel Okechukwu Njigba, Onochie Amedo Njigba, Emmanuel Ezeokwu and Samuel Okezie Ekezie

- Reservoirs of Brucella infection in Anambra State may be Chicken.
- Need a coordinated One Health approach

Brucellosis in China: history, progress and challenge

Hai Jiang, David O'Cullagh and Jun-Bo Ding

- Emergence of brucellosis in new areas, transmission from wild and domestic animals (new epidemiological dimensions)
- Advancement in diagnostic strategies: promising markers to diagnose brucellos

Research results encourage: the use of bacteriophage lysates in treatment of bovine brucellosis.

Suggestion: One Health approach

Conclusion and future perspective

- Nation-wide comprehensive monitoring, surveillance programs with adequate funding in different geographical areas.
- Public awareness campaigns
Australia has been free from *B. abortus* for 27 years. During this time, no cases of Brucellosis have occurred in Australia.

National Brucellosis and Tuberculosis Eradication Campaign (BTEC)

How did Australia achieve freedom?
- Vaccination
- Test and slaughter program
- Traceback
- Herd monitoring Milk Ring testing

What does Australia do to maintain brucellosis freedom?
- Abattoir monitoring
- Abortion investigations
- National Livestock Identification System (NLIS)
- Data collection
- National Animal Health Information System
- Border security
- Australian Veterinary Plan Emergency (AUSVETPLAN)
- Legal responsibilities
- Australian Laboratory Capabilities

Finding
- Incidence of human Brucellosis in Korea decreased
- This finding indicates that a comprehensive surveillance programme targeting all cattle is required for effective brucellosis morbidity reduction in the human population.
Brucellosis knowledge, attitudes and practices of a South African communal cattle keeper group

- Poor knowledge
- Poor to average practices
- Average to good attitude
- Address the community’s high-risk practices by increasing their knowledge
- Suggest for establishing KAP in local context

Addressed important knowledge gaps on C. burnetii and Brucella spp.
Seroprevalence in Lao goats, C. burnetii was 4.1% and Brucella spp. was 1.4%.

Urgent need to determine human health risks and economic losses caused by Q fever and Brucellosis.
Challenges and Way Forward

- Vaccine development? - New effective vaccine (many projects are on going)
- One Health Approach?
  - work together with livestock holders
  - develop programme (inform and education)
  - strong implication of political decision makers
  - implement surveillance of animal and human
  - establish an One Health Framework (sustainable)

- Socio-economic and epidemiology?
- Strain identification and molecular epidemiology? (future control programme)
- Diagnosis? (MicroRNAs...... promising to diagnosis brucellosis?)
- Knowledge-Attitude-Practice?
- Researches/specific topics (wildlife-domestic-environment interface)
- Awareness, education and communication?
- Consider for low budget- surveillance at slaughter house?

Need cooperation, collaboration, teams and legal framework for moving........
Way forward

- Develop the **road map with stepwise approach** for the progressive control of brucellosis utilizing the STEB tool. (for Asia and the Pacific may be launched later)
- Strengthening cooperation and networking for brucellosis control
- Encourage for **national ILPT in each country** (National Reference Laboratory and regional laboratories)
- Encourage to establish collaborations between public and animal health sectors and sharing information
- Review and update prevention and control programme
- Researches: Food-borne diseases, wildlife - domestic animal interface
- Strengthening, encourage and support FETPV as a key person in the field for disease control (set up **network of Epi. team and Lab team**, including all relevant stakeholders)

Possibility of moving at current situation
Announcement

Asia-Pacific Bovine Brucellosis Inter-laboratory Proficiency Test (ILPT) 2022

- Invite National Reference Laboratory (NRL) and Regional laboratory of member countries
- Shipment: requests for assistance in preparation of import permit application for ILPT panel *(Need/No Need)*
- Information and invitation will be available in *February 2022* through OIE RRAP

Email: niah6@dld.go.th
THANK YOU FOR YOUR ATTENTION

Monaya Ekgatat
monayae@dld.go.th
monayae@gmail.com