

# OIE Reference Laboratory Reports Activities

## *Activities in 2021*

**This report has been submitted : 2022-01-19 17:18:08**

<b>Name of disease (or topic) for which you are a designated OIE Reference Laboratory:</b>	Foot and mouth disease
<b>Address of laboratory:</b>	177, Hyeoksin 8-ro Gimcheon-si Gyeongsangbuk-do, 39660 KOREA (REP. OF)
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<b>Name (including Title) of Head of Laboratory (Responsible Official):</b>	Bong-Kyun Park, Commissioner of APQA
<b>Name (including Title and Position) of OIE Reference Expert:</b>	Jong-Hyeon Park, Head of Center for FMD Vaccine Research
<b>Which of the following defines your laboratory? Check all that apply:</b>	Governmental

**ToR 1: To use, promote and disseminate diagnostic methods validated according to OIE Standards**

1. Did your laboratory perform diagnostic tests for the specified disease/topic for purposes such as disease diagnosis, screening of animals for export, surveillance, etc.? (Not for quality control, proficiency testing or staff training)

Yes

Diagnostic Test	Indicated in OIE Manual (Yes/No)	Total number of test performed last year	
		Nationally	Internationally
Indirect diagnostic tests		Nationally	Internationally
ELISA (SP Antibody)	Yes	2,613	0
ELISA (NSP Antibody)	Yes	2,392	0
Direct diagnostic tests		Nationally	Internationally
Virus isolation	Yes	0	0
Antigen ELISA	Yes	0	0
Realtime RT-PCR	Yes	819	0
VP1 gene sequencing	Yes	0	0

**ToR 2: To develop reference material in accordance with OIE requirements, and implement and promote the application of OIE Standards. To store and distribute to national laboratories biological reference products and any other reagents used in the diagnosis and control of the designated pathogens or disease.**

2. Did your laboratory produce or supply imported standard reference reagents officially recognised by the OIE?

No

3. Did your laboratory supply standard reference reagents (non OIE-approved) and/or other diagnostic reagents to OIE Member Countries?

Yes

Type of reagent available	Related diagnostic test	Produced/ provide	Amount supplied nationally (ml, mg)	Amount supplied internationally (ml, mg)	No. of recipient OIE Member Countries	Region of recipients
VDRD FMDV 3Diff/PAN Rapid kit	FMDV Rapid test	Median Diagnositcs/APQA	550tests	150tests	1	<input type="checkbox"/> Africa <input type="checkbox"/> Americ as <input checked="" type="checkbox"/> Asia and Pacific <input type="checkbox"/> Europe <input type="checkbox"/> Middle East
VDx FMDV O/A/Asia1 qRT-PCR	rRT-PCR(serotypeO/A/Asia1)	Median Diagnositcs/APQA	0	192tests	1	<input type="checkbox"/> Africa <input type="checkbox"/> Americ as <input checked="" type="checkbox"/> Asia and Pacific <input type="checkbox"/> Europe <input type="checkbox"/> Middle East
VDx FMDV O genotyping qRT-PCR	rRT-PCR for genotype O/PanAsia,Mya-98,Ind-2001, and CATHAY	Median Diagnositcs/APQA	0	192tests	1	<input type="checkbox"/> Africa <input type="checkbox"/> Americ as <input checked="" type="checkbox"/> Asia and Pacific <input type="checkbox"/> Europe <input type="checkbox"/> Middle East
VDx FMDV A genotyping qRT- PCR	rRT-PCR for genotype A/Sea-97, and G-VI	Median Diagnositcs/APQA	0	192tests	1	<input type="checkbox"/> Africa <input type="checkbox"/> Americ as <input checked="" type="checkbox"/> Asia and Pacific <input type="checkbox"/> Europe <input type="checkbox"/> Middle East

4. Did your laboratory produce vaccines?

No

5. Did your laboratory supply vaccines to OIE Member Countries?

No

**ToR 3: To develop, standardise and validate, according to OIE Standards, new procedures for diagnosis and control of the designated pathogens or diseases**

6. Did your laboratory develop new diagnostic methods validated according to OIE Standards for the designated

pathogen or disease?

Yes

7. Did your laboratory develop new vaccines according to OIE Standards for the designated pathogen or disease?

No

Name of the new test or diagnostic method or vaccine developed	Description and References (Publication, website, etc.)
FMDV O/A/Asia1 serotyping qRT-PCR	rRT-PCR kits for serotype differentiation (O, A, and Asia1), Preparing for publication
FMDV O genotyping qRT-PCR	rRT-PCR kits for genotype differentiation (O/ME-SA/PanAsia, O/ME-SA/Ind-2001, O/SEA/Mya-98, and O/CATHAY), Preparing for publication
FMDV A genotyping qRT-PCR	rRT-PCR kits for genotype differentiation (A/ASIA/Sea-97, and A/ASIA/G-VII), Preparing for publication

***ToR 4: To provide diagnostic testing facilities, and, where appropriate, scientific and technical advice on disease control measures to OIE Member Countries***

8. Did your laboratory carry out diagnostic testing for other OIE Member Countries?

No

9. Did your laboratory provide expert advice in technical consultancies on the request of an OIE Member Country?

No

***ToR 5: To carry out and/or coordinate scientific and technical studies in collaboration with other laboratories, centres or organisations***

10. Did your laboratory participate in international scientific studies in collaboration with OIE Member Countries other than the own?

Yes

Title of the study	Duration	Purpose of the study	Partners (Institutions)	OIE Member Countries involved other than your country
Comparative studies for avian influenza virus and FMD virus between Korea and Vietnam	10 years(2014-2024)	Studies on genetic characterization of foot and mouth disease viruses and avian influenza virus in Vietnam	NCVD (National Center for Veterinary Diagnosis, Depart of Animal health)	VIETNAM
Comparative studies for avian influenza virus and FMD virus between Korea and Cambodia	5 years(2018-2022)	Studies on genetic characterization of foot and mouth disease viruses and avian influenza virus in Cambodia	NAHPRI (National Animal Health and Production Research Institute, Phnom Penh, Cambodia)	CAMBODIA
Comparative studies for avian influenza virus and FMD virus between Korea and LAO PDR	5 years(2018-2022)	Studies on genetic characterization of foot and mouth disease viruses and avian influenza virus in LAO PDR	NAHL (National Animal Health Laboratory, Vientiane, LAO PDR)	LAOS
Research collaboration with NCFAD on FMD Diagnosis	3 years(2019-2021)	Research collaboration with NCFAD on FMD Diagnosis	NCFAD, Canada (FAO FMD Lab)	CANADA
Comparative studies for FMD virus between Korea and Bangladesh	5 years(2020-2024)	Studies on genetic characterization of foot and mouth disease viruses and avian influenza virus in Bangladesh	CDIL(Central Disease Investigation Laboratory)	BANGLADESH
Establishing technology of identifying FMD genes to use molecular epidemiology and building NGS	3 years(2020-2022)	For establishing the leading analytical technology of viral genomic epidemiology that can scientifically support epidemiological studies in response to FMD outbreaks and building NGS platform for rapid pan genome analysis	The Pirbright Institute	UNITED KINGDOM

***ToR 6: To collect, process, analyse, publish and disseminate epizootiological data relevant to the designated pathogens or diseases***

11. Did your Laboratory collect epizootiological data relevant to international disease control?

Yes

If the answer is yes, please provide details of the data collected:
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Epizootiological data(sampling time, location, and species) relating to the samples received for scientific research (see ToR5) was collected
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12. Did your laboratory disseminate epizootiological data that had been processed and analysed?

Yes

If the answer is yes, please provide details of the data collected:
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Sampling time, location, and species
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**13. What method of dissemination of information is most often used by your laboratory?  
(Indicate in the appropriate box the number by category)**

a) Articles published in peer-reviewed journals: 14

1. Park MY, Han YJ, Choi EJ, Kim H, Pervin R, Shin W, Kwon D, Kim JM, Pyo HM. Post-vaccination Monitoring to Assess Foot-and-Mouth Disease Immunity at Population Level in Korea. *Front Vet Sci*. 2021 Aug 4;8:673820
2. Ryoo S, Lee H, Lim DR, Lee JW, Bunnary S, Tum S, Lee DS, Hwang H, Jeong S, Nah J, Ku BK, Kim JM, Cha SH. Identification of the O/ME-SA/Ind-2001e Sublineage of Foot-and-Mouth Disease Virus in Cambodia. *Front Vet Sci* 2021 Oct 29;8:749966
3. Hwang JH, Lee G, Kim A, Park JH, Lee MJ, Kim B, Kim SM. A Vaccine Strain of the A/ASIA/Sea-97 Lineage of Foot-and-Mouth Disease Virus with a Single Amino Acid Substitution in the P1 Region That Is Adapted to Suspension Culture Provides High Immunogenicity. *Vaccines (Basel)*. 2021 Mar 24;9(4):308.
4. Choi J, Jo HJ, Jung SS, Choi J, Lee SH, Kim HH, Kim YJ, Kim B, Park JH, Kim J. Evaluation of swine protection with foot-and-mouth disease O1/Campos and O/Primorsky/2014 vaccines against the O Mya-98 lineage virus from East Asia. *Vaccine*. 2021 Mar 19;39(12):1701-1707.
5. Jo H, Kim BY, Park SH, Kim HM, Shin SH, Hwang SY, Kim SM, Kim B, Park JH, Lee MJ. The HSP70-fused foot-and-mouth disease epitope elicits cellular and humoral immunity and drives broad-spectrum protective efficacy. *NPJ Vaccines*. 2021 Mar 26;6(1):42.
6. Kim H, Kim AY, Choi J, Park SY, Park SH, Kim JS, Lee SI, Park JH, Park CK, Ko YJ. Foot-and-Mouth Disease Virus Evades Innate Immune Response by 3C-Targeting of MDA5. *Cells*. 2021 Jan 29;10(2):271.
7. Kim AY, Kim H, Park SY, Park SH, Lee JM, Kim JS, Park JW, Park CK, Park JH, Ko YJ. Investigation of the optimal medium and application strategy for foot-and-mouth disease vaccine antigen production. *J Appl Microbiol*. 2021 Sep;131(3):1113-1122.
8. Kim AY, Kim H, Park SY, Park SH, Kim JS, Park JW, Park JH, Ko YJ. Development of a Potent Stabilizer for Long-Term Storage of Foot-and-Mouth Disease Vaccine Antigens. *Vaccines (Basel)*. 2021 Mar 12;9(3):252.
9. Park SH, Lee SY, Kim JS, Kim AY, Park SY, Lee JH, Lee M, Kim H, Lee SI, Kang NY, Park JW, Kim SM, Park JH, Ko YJ. Scale-Up Production of Type O and A Foot-and-Mouth Disease Bivalent Vaccine and Its Protective Efficacy in Pigs. *Vaccines (Basel)*. 2021 Jun 2;9(6):586.
10. Ko MK, Jo HE, Choi JH, You SH, Shin SH, Hwang SY, Jo H, Kim HM, Lee MJ, Kim SM, Kim B, Park JH. Efficient protection against Asia1 type foot-and-mouth disease using a chimeric vaccine strain suitable for East Asia. *Vet Microbiol*. 2021 Feb;253:108975.
11. Kim AY, Park SY, Park SH, Jin JS, Kim ES, Kim JY, Park JH, Ko YJ. Validation of Pretreatment Methods for the In-Process Quantification of Foot-and-Mouth Disease Vaccine Antigens. *Vaccines (Basel)*. 2021 Nov 19;9(11):1361.
12. Ekanayaka P, Shin SH, Weeratunga P, Lee H, Kim TH, Chathuranga K, Subasinghe A, Park JH, Lee JS. Foot-and-Mouth Disease Virus 3C Protease Antagonizes Interferon Signaling and C142T Substitution Attenuates the FMD Virus. *Front Microbiol*. 2021 Nov 19;12:737031.
13. Ahn YH, Chathuranga WAG, Shim YJ, Haluwana DK, Kim EH, Yoon IJ, Lim YT, Shin SH, Jo H, Hwang SY, Kim HM, Lee MJ, Park JH, Yoo SS, Lee JS. The Potential Adjuvanticity of CAVANT®SOE for Foot-and-Mouth Disease Vaccine. *Vaccines (Basel)*. 2021 Sep 28;9(10):1091.
14. Ekanayaka P, Lee BH, Weerawardhana A, Chathuranga K, Park JH, Lee JS. Inhibition of MAVS Aggregation-Mediated Type-I Interferon Signaling by Foot-and-Mouth Disease Virus VP3. *Viruses*. 2021 Sep 6;13(9):1776.

b) International conferences: 13

1. Sang-Ho Cha, Darae Lim, Soyoon Ryoo, Hyeonjeong Kang, Dongsook Lee, Hye-Jin Park, TaeYoon Eom,

- SomGyeol Jeong, HyeonWoo Hwang, JunSeong Lim, Jae-Myung Kim, Rapid detection and serotyping of FMDV using a multiplex qRT-PCR for Serotype O, A and Asia1 in Pool 1 and 2 regions, (GFRA 2021 Scientific Meeting, Nov. 2021)
2. Mi-Young Park, You Jin Han, Sang Ho Jang, Bo Kyu Kang, Hyun-Ji Seo, Gyeong Min Lee, Jae Hyeon Shin, Jae Myoung Kim, Eun-Jin Choi. Validation of a novel solid-phase blocking ELISA for the detection of antibodies to foot-and-mouth disease virus serotype A (GFRA 2021 Scientific Meeting, Nov. 2021)
  3. Soyoon Ryoo, Da-Rae Lim, Hyeonjeong Kang, Dongsook Lee, Hye-jin Park, Golan Azam Chowdhury (Tulu), HyeonWoo Hwang, SomGyeol Jeong, Jae-Myung Kim, Sang-Ho Cha. Phylogenetic analysis of foot-and-mouth disease virus circulating in Bangladesh, 2020 (GFRA 2021 Scientific Meeting, Nov. 2021)
  4. Soyoon Ryoo, Da-Rae Lim, Hyeonjeong Kang, Dongsook Lee, Hye-jin Park, Seng Bunnary, Sothyra Tum, HyeonWoo Hwang, SomGyeol Jeong, Jae-Myung Kim, Sang-Ho Cha. First detection of foot-and-mouth disease virus O/ME-SA/Ind-2001 lineage in Cambodia (GFRA 2021 Scientific Meeting, Nov. 2021)
  5. Hyeonjeong Kang, Soyoon Ryoo, Da-Rae Lim, Hyeonwoo Hwang, Somgyeol Jeong, Nguyen Dang Tho, SothyraTum, Watthana Theppangna, Jae-Myung Kim, Sang-Ho Cha. Phylogenetic analysis of Foot-and-Mouth Disease Viruses circulating in Southeast Asia in 2020 (GFRA 2021 Scientific Meeting, Nov. 2021)
  6. Hyeonjeong Kang, Soyoon Ryoo, Da-Rae Lim, Dongsook Lee, Hye-jin Park, Nguyen Dang Tho, Sothyra Tum, Watthana Theppangna, Jae-Myung Kim, Sang-Ho Cha. Identification of Foot-and-mouth disease virus(FMDV) genotype circulating in Southeast Asia between 2017 and 2019 (GFRA 2021 Scientific Meeting, Nov. 2021)
  7. Darae Lim, Soyoon Ryoo, Hyeonjeong Kang, Dongsook Lee, Hye-jin Park, TaeYoon Eom, SomGyeol Jeong, HyeonWoo Hwang, JunSeong Lim, Jae-Myung Kim, Sang-Ho Cha. Development of a sensitive and specific genotyping multiplex qRT-PCR for FMDV serotype O and A (GFRA 2021 Scientific Meeting, Nov. 2021)
  8. Dong-Wan Kim, Jong-Hyeon Park, Sung-han Park. Optimizing adjuvant suitable for intradermal delivery of foot-and-mouth disease vaccine. (GFRA 2021 Scientific Meeting, Nov. 2021)
  9. Seong Yun Hwang, Sung Ho Shin, Hyun-Mi Kim, Se Hee Shin, Min Ja Lee, Su-Mi Kim , Jong-Hyeon Park. Evaluation of chimeric vaccine virus with broad antigenicity against foot-and-mouth disease type O. (GFRA 2021 Scientific Meeting, Nov. 2021)
  10. Aro Kim, Ji-Hyeon Hwang, Gyeongmin Lee, Jong-Hyeon Park, Min Ja Lee, Byoungan Kim and Su-Mi Kim. A Vaccine Strain of the A/ASIA/Sea-97 Lineage of Foot-and-Mouth Disease Virus with a Single Amino Acid Substitution in the P1 Region That Is Adapted to Suspension Culture Provides High Immunogenicity. (GFRA 2021 Scientific Meeting, Nov. 2021)
  11. Sung Ho Shin, Seong Yun Hwang, Hyun-Mi Kim, Se Hee Shin, Min Ja Lee, Su-Mi Kim, Jong-Hyeon Park. Type A chimeric vaccine strain for broad antigenic coverage shows complete protection in the pigs against three different lineages of foot-and-mouth disease virus. (GFRA 2021 Scientific Meeting, Nov. 2021)
  12. Sang Hyun Park, Seo-Young Lee, Jae Young Kim, Ji-Hye Lee, Ah-Young Kim, Sun Young Park, Jong-Sook Jin, Eun-Sol Kim, Jong-Hyeon Park and Young-Joon Ko. Development of type O and A FMD bivalent vaccine in pilot-scale and assessment of its efficacy. (GFRA 2021 Scientific Meeting, Nov. 2021)
  13. Ha-Hyun Kim, Seo Young Moon, Seung Heon Lee, Min Young Kim, Seon Woo Kim, Jong-Hyeon Park, and Jaejo Kim. in vitro vaccine matching for field foot-and-mouth disease viruses recently circulating in Southern East Asia. (GFRA 2021 Scientific Meeting, Nov. 2021)

c) National conferences: 37

1. Eun-Jin Choi, Mi-Young Park, Hyun-Ji Seo, YouJin Han, Gyeongmin Lee, JaeHyeon Shin, TaeEun Kim, Sung Suk Jung, Geun Hwa Park, Jae Myoung Kim. Establishment of serum bank system to support research and development related to foot-and-mouth disease diagnosis (National conference for the Korean Society of Veterinary Science, Oct 2021)
2. Mi-Young Park, Jae Hyeon Shin, You Jin Han, Hyun-Ji Seo, Gyeong Min Lee, Sung Suk Jung, Jae Myoung Kim, Eun-Jin Choi. Improvement for the detection of nonstructural proteins antibody to foot-and-mouth disease virus in cattle under intensive vaccination policy in South Korea (National conference for the Korean Society of Veterinary Science, Oct 2021)
3. Jae Ho Lee, Geun Hwa Park, Eun-Jin Choi, Jae Myoung Kim, Mi-Young Park. Post-vaccination monitoring for evaluation of food-and-mouth disease immunity at population level in Korea in 2021 (National conference for the Korean Society of Veterinary Science, Oct 2021)
4. Geun Hwa Park, You Jin Han, Gyeong Min Lee, Jae Hyeon Shin, Eun-Jin Choi, Hyun-Ji Seo, Jae Myoung Kim, Mi-Young Park. Development of Goat serum panel to validate nonstructural protein antibody kit of foot-and-mouth disease virus (National conference for the Korean Society of Veterinary Science, Oct 2021)
5. Taeyoon Eom, Hyeonjeong Kang, Soyoon Ryoo, Da-Rae Lim, Dongsook Lee, Hye-jin Park, Nguyen Dang Tho, Sothyra Tum, Watthana Theppangna, Jae-Myung Kim, Sang-Ho Cha. Phylogenetic analysis of Foot-and-mouth disease virus (FMDV) genotype circulating in Southeast Asia between 2017 and 2019 (National conference for the Korean Society of Veterinary Science, Oct 2021)
6. Dongsook Lee, Hyun-ji Lee, Hye-jin Park, Som-Gyeol Jung, Hyeon Woo Hwang, Soyoon Ryoo, Da-Rae Lim, Jae Myoung Kim, Bok Kyung Ku, Sang-Ho Cha. Genetic characterization of foot-and-mouth disease virus (FMDV) O/ME-SA/Ind2001e sublineage detected in South Korea in 2017 and the O1 Campos vaccine efficacy (National

conference for the Korean Society of Veterinary Science, Oct 2021)

7. Junseong Lim, Soyoon Ryoo, Da-Rae Lim, Hyeonjeong Kang, Dongsook Lee, Hye-jin Park, Golan Azam Chowdhury (Tulu), HyeonWoo Hwang, SomGyeol Jeong, Jae -Myung Kim, Sang-Ho Cha. Identification of foot-and-mouth disease virus circulating in Bangladesh, 2020 (National conference for the Korean Society of Veterinary Science, Oct 2021)

8. Da-Rae Lim, Soyoon Ryoo, Sang-Ho Cha. Development of a sensitive and specific genotyping multiplex qRT-PCR for FMDV A/ASIA/GVII and A/ASIA/Sea-97 (National conference for the Korean Society of Veterinary Science, Oct 2021)

9. Da-Rae Lim, Soyoon Ryoo, Sang-Ho Cha. Rapid detection method of FMDV genotyping multiplex qRT-PCR for ME-SA/PanAsia, ME-SA/Ind-2001, SEA/Mya-98 and Cathay (National conference for the Korean Society of Veterinary Science, Oct 2021)

10. Da-Rae Lim, Soyoon Ryoo, Sang-Ho Cha. Evaluation of serotyping multiplex qRT-PCR for FMDV serotype O, A and Asia 1 using pig experiments (National conference for the Korean Society of Veterinary Science, Oct 2021)

11. Da-Rae Lim, Soyoon Ryoo, Sang-Ho Cha. Development of sensitive and specific serotyping multiplex qRT-PCR for serotype O, A and Asia 1 circulating in Pool1 and 2 regions (National conference for the Korean Society of Veterinary Science, Oct 2021)

12. Seoyoung Moon, Minyoung Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jaejo Kim. Avidity and isotype response of specific antibodies for estimation of protection against challenge with the foot-and-mouth disease O/SKR/Jincheon/2014 virus in vaccinated pigs. (National conference for the Korean Society of Veterinary Science, May 2021)

13. Minyoung Kim, Seoyoung Moon, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jaejo Kim. Alternative serological assessment of protective immunity against challenge with the Foot-and-Mouth disease A/SKR/Yeoncheon/2017 virus in vaccinated pigs. (National conference for the Korean Society of Veterinary Science, May 2021)

14. Sim-In Lee, Ah-Young Kim, Hyejin Kim, Sun Young Park, Sang Hyun Park, Jong-Hyeon Park, and Young-Joon Ko. Optimization of pretreatment methods for the quantification of foot-and-mouth disease virus particle. (National conference for the Korean Society of Veterinary Science, May 2021)

15. Sim-In Lee, Sang Hyun Park, Seo-Yong Lee, Hyejin Kim, Ah-Young Kim, Sun Young Park, Su-Mi Kim, Jong-Hyeon Park, and Young-Joon Ko. Development of foot-and-mouth disease vaccine antigen production process using pilot-scale equipment and its protective efficacy in pigs. (National conference for the Korean Society of Veterinary Science, May 2021)

16. Jong-Hyeon Park. Selection of modified vaccine strain with broad range for protection of Eastern Asia against foot-and-mouth disease. (National conference for the Korean Society of Veterinary Science, May 2021)

17. Jong-Hyeon Park. Vaccine strains designed for broad protection of Foot-and-Mouth Disease. (The Korean Society for Microbiology and Biotechnology, Aug 2021)

18. Seo Young Moon, Min Young Kim, Seon Woo Kim, Ha Hyun Kim, Seung Heon Lee, Jong Hyun Park, and Jae Jo Kim. Determination of antigenic relatedness between foot-and-mouth disease (FMD) serotype O vaccine strains and currently circulating serotype O viruses in Southern East Asia. (International Meeting of the Microbiological Society of Korea, Aug 2021)

19. Seo Young Moon, Min Young Kim, Seon Woo Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jae Jo Kim. Assessment of cross-reactivity between foot-and-mouth disease (FMD) serotype A vaccine strains and currently circulating A/Asia/Sea-97 lineage FMD viruses in Southern East Asia. (International Meeting of the Microbiological Society of Korea, Aug 2021)

20. Min Young Kim, Seo Young Moon, Seon Woo Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jae Jo Kim. Post-vaccination monitoring: The foot-and-mouth disease (FMD) antibody profiles in pigs following the heterologous prime-boost vaccination with commercial vaccines used for the disease control in South Korea. (International Meeting of the Microbiological Society of Korea, Aug 2021)

21. Seon Woo Kim, Seoyoung Moon, Minyoung Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jaejo Kim. Comparative analysis of serological estimate the protective immunity against challenge with the Foot-and-Mouth disease virus in vaccinated pigs. (International Meeting of the Microbiological Society of Korea, Aug 2021)

22. Dong-Wan Kim, Jong-Hyeon Park, and Sung-han Park. Comparison of intradermal (ID) and intramuscular (IM) vaccination of foot-and-mouth disease vaccine (FMDV) in swine. (International Meeting of the Microbiological Society of Korea, Aug 2021)

23. Dong-Wan Kim, Jong-Hyeon Park, and Sung-han Park. Research on adjuvant with high immune response from early to late stage in intradermal foot-and-mouth disease vaccine (ID FMDV). (International Meeting of the Microbiological Society of Korea, Aug 2021)

24. Dong-Wan Kim, Jong-Hyeon Park, and Sung-han Park. Selection of effective adjuvants for research of intradermal foot-and-mouth disease vaccine (ID FMDV) with high immunity. (International Meeting of the Microbiological Society of Korea, Aug 2021)

25. Jong-Hyeon Park. Selection of rational vaccine strain for foot-and-mouth disease. (The Korean Society of Virology, Aug 2021)

26. Jong-Hyeon Park. Evaluation of New Foot-and-Mouth Disease Vaccine. (The Korean Vaccine Society, Sep 2021)

27. Jong Sook Jin, Ah-Young Kim, Sun Young Park, Sang Hyun Park, Jong-Hyeon Park, and Young-Joon Ko. Development of optimal pretreatment methods for the quantification of foot-and-mouth disease virus particles using high performance liquid chromatography (HPLC). (The Korean Society for Biotechnology and Bioengineering, Oct 2021)
28. Eun-Sol Kim, Sun Young Park, Ah-Young Kim, Sang Hyun Park, Jong-Hyeon Park, Young-Joon Ko. Scale-up study of the non-structural protein removal method using chloroform for foot-and-mouth disease vaccine production. (The Korean Society for Biotechnology and Bioengineering, Oct 2021)
29. Jae Young Kim, Sang Hyun Park, Seo-Yong Lee, Ah-Young Kim, Sun Young Park, Su-Mi Kim, Jong-Hyeon Park, and Young-Joon Ko. Pilot-scale production of foot-and-mouth disease vaccine antigen and its protective efficacy in pigs. (The Korean Society for Biotechnology and Bioengineering, Oct 2021)
30. Hyun Mi Kim, Sehee Shin, Jong-Hyeon Park, Su-Mi Kim, Min Ja Lee. The C3d-fused foot-and-mouth disease vaccine platform elicits the effect of overcoming the maternally-derived antibody interference by inducing a potent adaptive immunity. National conference for the Korean Society of Veterinary Science, Oct 2021.
31. Sehee Shin, Hyun Mi Kim, Jong-Hyeon Park, Su-Mi Kim, Min Ja Lee. Characterization of maternally-derived antibodies (MDA) and understanding MDA-mediated immune tolerance in foot-and-mouth disease (FMD)-vaccinated pigs. (National conference for the Korean Society of Veterinary Science, Oct 2021)
32. Aro Kim, Gyeongmin Lee, Ji-Hyeon Hwang, Jong-Hyeon Park, Min Ja Lee, Byoungan Kim, and Su-Mi Kim. BacMam expressing highly glycosylated porcine IFN- $\alpha$  induces robust antiviral and adjuvant effects against foot and mouth disease virus in pigs. (National conference for the Korean Society of Veterinary Science, Oct 2021)
33. Min Young Kim, Seo Young Moon, Seon Woo Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jae Jo Kim. Pathogenic evaluation of the A/Asia/G-VII lineage of foot-and-mouth disease virus isolated from Bhutan in pigs. (National conference for the Korean Society of Veterinary Science, Oct 2021)
34. Min Young Kim, Seo Young Moon, Seon Woo Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jae Jo Kim. Experimental infection of pigs with the A/Asia/G-VII lineage of foot-and-mouth disease virus isolated from Middle East region. (National conference for the Korean Society of Veterinary Science, Oct 2021)
35. Min Young Kim, Seo Young Moon, Seon Woo Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jae Jo Kim. Evaluation of pathogenic potential of O/CATHAY topotype of foot-and-mouth disease virus O/VN/30/2017 strain in pigs. (National conference for the Korean Society of Veterinary Science, Oct 2021)
36. Min Young Kim, Seo Young Moon, Seon Woo Kim, Seung Heon Lee, Ha-Hyun Kim, Jong-Hyeon Park, and Jae Jo Kim. The pathogenesis of O/ME-SA/PanAsia lineage of foot-and-mouth disease virus O/VN/08/2018 strain in pigs. (National conference for the Korean Society of Veterinary Science, Oct 2021)
37. Seon Woo Kim, Seo Young Moon, Min Young Kim, Ha-Hyun Kim, Seung Heon Lee, Jong-Hyeon Park, and Jae Jo Kim. Serological relationship between recent field isolates and vaccine viruses of foot-and-mouth disease. (National conference for the Korean Society of Veterinary Science, Oct 2021)

d) Other:

(Provide website address or link to appropriate information) 1

Monthly National sero-surveillance results for overall population immunity and prevalence of infection surveillance (in Korean, [www.qia.go.kr](http://www.qia.go.kr))

**ToR 7: To provide scientific and technical training for personnel from OIE Member Countries**

**To recommend the prescribed and alternative tests or vaccines as OIE Standards**

14. Did your laboratory provide scientific and technical training to laboratory personnel from other OIE Member Countries?

Yes

- a) Technical visits: 0  
 b) Seminars: 35  
 c) Hands-on training courses: 0  
 d) Internships (>1 month): 0

Type of technical training provided (a, b, c or d)	Country of origin of the expert(s) provided with training	No. participants from the corresponding country
b	Malaysia	9
b	Vietnam	9
b	Indonesia	8
b	Kazakhstan	5
b	Philippines	3
b	Sri Lanka	1

**ToR 8: To maintain a system of quality assurance, biosafety and biosecurity relevant for the pathogen and the disease concerned**

15. Does your laboratory have a Quality Management System?

Yes

Quality management system adopted	Certificate scan (PDF, JPG, PNG format)
KS Q ISO/IEC 17025	2020.10.20 KOLAS.jpg

16. Is your quality management system accredited?

Yes

Test for which your laboratory is accredited	Accreditation body
Antigen detection(Realtime RT-PCR, RT-PCR, Antigen ELISA)	KOLAS(Korean Laboratory Accrediation)
Antibody detection(SP ELISA, NSP ELISA)	KOLAS(Korean Laboratory Accrediation)

17. Does your laboratory maintain a “biorisk management system” for the pathogen and the disease concerned?

Yes

(See *Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, Chapter 1.1.4*)

**ToR 9: To organise and participate in scientific meetings on behalf of the OIE**

18. Did your laboratory organise scientific meetings on behalf of the OIE?

No

19. Did your laboratory participate in scientific meetings on behalf of the OIE?

Yes

Title of event	Date (mm/yy)	Location	Role (speaker, presenting poster, short communications)	Title of the work presented
OIE/FAO Reference Laboratory Network Annual Meeting	12/2021	virtual	speaker	FMD-related activities in 2021 of Animal and Plant Quarantine Agency

**ToR 10: To establish and maintain a network with other OIE Reference Laboratories designated for the same pathogen or disease and organise regular inter-laboratory proficiency testing to ensure comparability of results**

20. Did your laboratory exchange information with other OIE Reference Laboratories designated for the same pathogen or disease?

No

21. Was your laboratory involved in maintaining a network with OIE Reference Laboratories designated for the same pathogen or disease by organising or participating in proficiency tests?

Yes

Purpose of the proficiency tests: <sup>1</sup>	Role of your Reference Laboratory (organiser/participant)	No. participants	Participating OIE Ref. Labs/organising OIE Ref. Lab.
FMD Proficiency Testing	Participant	1	The Pirbright Insitutue, UK

<sup>1</sup> validation of a diagnostic protocol: specify the test; quality control of vaccines: specify the vaccine type, etc.

22. Did your laboratory collaborate with other OIE Reference Laboratories for the same disease on scientific research projects for the diagnosis or control of the pathogen of interest?

Yes

Title of the project or contract	Scope	Name(s) of relevant OIE Reference Laboratories
Establishing technology of identifying FMD genes to use molecular epidemiology and building NGS	To carry out a collaborative research project on Molecular epidemiology and NGS platform studies on foot and mouth disease virus (FMDV) between APQA, Korea and WRLFMD, United Kingdom, for establishing the leading analytical technology of viral genomic epidemiology that can scientifically support epidemiological studies in response to FMD outbreaks and building NGS platform for rapid pan genome analysis	The Pirbright Institute, UK

**ToR 11: To organise inter-laboratory proficiency testing with laboratories other than OIE Reference Laboratories for the same pathogens and diseases to ensure equivalence of results**

23. Did your laboratory organise or participate in inter-laboratory proficiency tests with laboratories other than OIE Reference Laboratories for the same disease?

Yes

Note: See Interlaboratory test comparisons in: Laboratory Proficiency Testing at: <http://www.oie.int/en/our-scientific-expertise/reference-laboratories/proficiency-testing> see point 1.3

Purpose for inter-laboratory test comparisons <sup>1</sup>	No. participating laboratories	Region(s) of participating OIE Member Countries
National Proficiency test for Diagnosis of FMD(Organiser)	46	<input type="checkbox"/> Africa <input type="checkbox"/> Americas <input checked="" type="checkbox"/> Asia and Pacific <input type="checkbox"/> Europe <input type="checkbox"/> Middle East

**ToR 12: To place expert consultants at the disposal of the OIE**

24. Did your laboratory place expert consultants at the disposal of the OIE?

No

25. Additional comments regarding your report:

