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Foot-and-Mouth Disease
Reference Laboratories
Network

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FAO World Reference Laboratory and OIE Reference Laboratory for FMD (WRLFMD or WRL), Institute for Animal Health, Pirbright, UK: David Paton, Yanmin Li, Nigel Ferris, Don King, Nick Knowles, Bob Statham, Jef Hammond.

Centro Panamericano de Fiebre Aftosa (PANAFTOSA) and OIE Reference Laboratory for FMD, Rio de Janeiro, Brazil: Rosanna Allende.

Federal Governmental Institute, Centre for Animal Health (FGI ARRIAH) and OIE Reference Laboratory for FMD, Vladimir, Russia: Vladimir Borisov, Aleksey Scherbakov.

OIE Regional Reference Laboratory for Sub-Saharan Africa (RRLSSA), Gabarone, Botswana: Gaolathe Thobokwe, George Matlho.

OIE Reference Laboratory for Foot and Mouth Disease, Laboratorio de Fiebre Aftosa de la Dirección de Laboratorios y Control Técnico (LFADILAB) SENASA, Argentina: Eduardo Maradei.

FAO/OIE FMD Reference Laboratory, Transboundary Animal Diseases Programme, ARC-Onderstepoort Veterinary Institute (ARC-OVI), South Africa: Rahana Dwarka, Belinda Blignaut.

FAO FMD Reference Laboratory, Foreign Animal Disease Diagnostic Lab, Plum Island Animal Disease Center (PIADC), Greenport, USA: Samia Metwally, Hernando Duque.

OIE collaborating centre for validation, quality assessment and quality control of diagnostic assays and vaccine testing for vesicular diseases in Europe, CODA-CERVA-VAR, Ukkel, Belgium: Kris De Clercq

National FMD Laboratory, Lanzhou Veterinary Research Institute (LVRI), CAAS, Gansu, P. R. China: Xuepeng Cai, Xiangtao Liu.

Project Directorate on FMD (PDFMD), Indian Council of Agricultural Research, Mukteswar, Nainital (Uttarakhand), India: B. Pattnaik, A. Sanyal

Regional Reference Laboratory for Foot and Mouth Disease in the South East (RRLSEA), Department of Livestock Development, Pakchong, Thailand: Wilai Linchongsubongkoch.

Foot-and-mouth disease Laboratory, Embakasi, Kenya: Sabenzia Wekesa.

Introduction to the OIE/FAO FMD Reference Laboratory Network Report

The Network of OIE/FAO FMD Reference Laboratories has been established with two principal goals, namely:

(1) understanding global virus distribution and patterns and making vaccine recommendations,

and

(2) improving the quality of laboratory tests from international and national reference laboratories.

This requires sharing and joint evaluation of surveillance information on laboratory diagnoses, serotyping, genetic characterisations and vaccine matching tests and harmonising standards for diagnostic procedures.

This report is divided into two parts providing an update on progress towards each of these goals.

Additional information about the Network can be found at: http://www.foot-and-mouth.org/

PART 1

Genetic and antigenic diversity and global distribution of foot-and-mouth disease viruses. Information gaps, threats and vaccine recommendations

1.1. Summary of FMD outbreaks and surmised global situation

Figure 1. FMD situation by country according to OIE, Jan-Jun 2009[1]

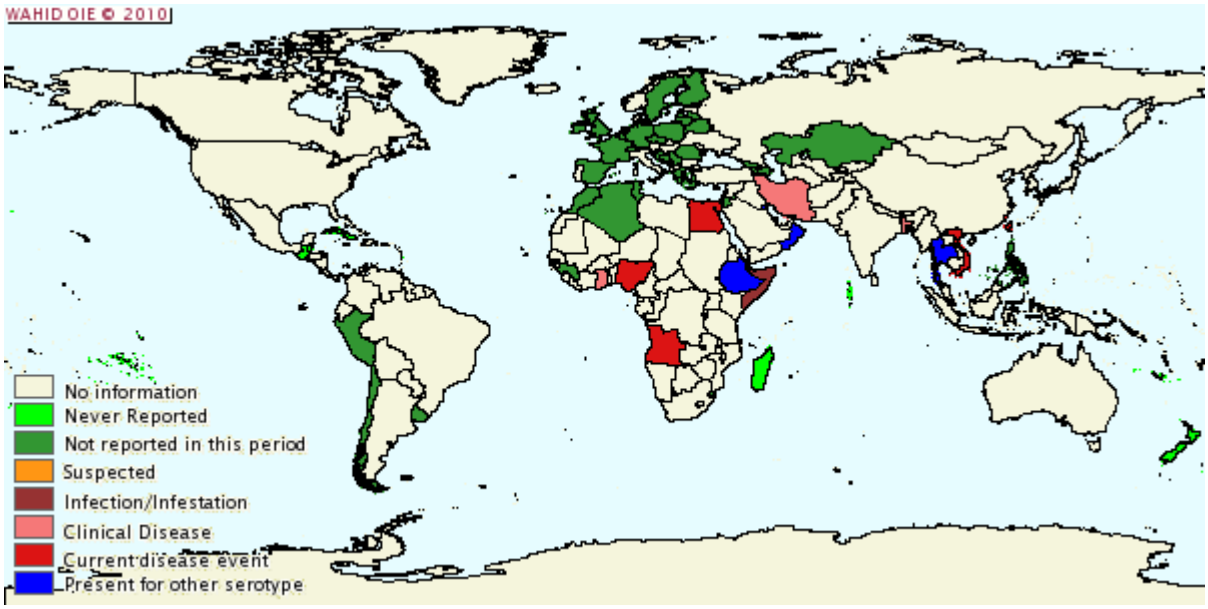
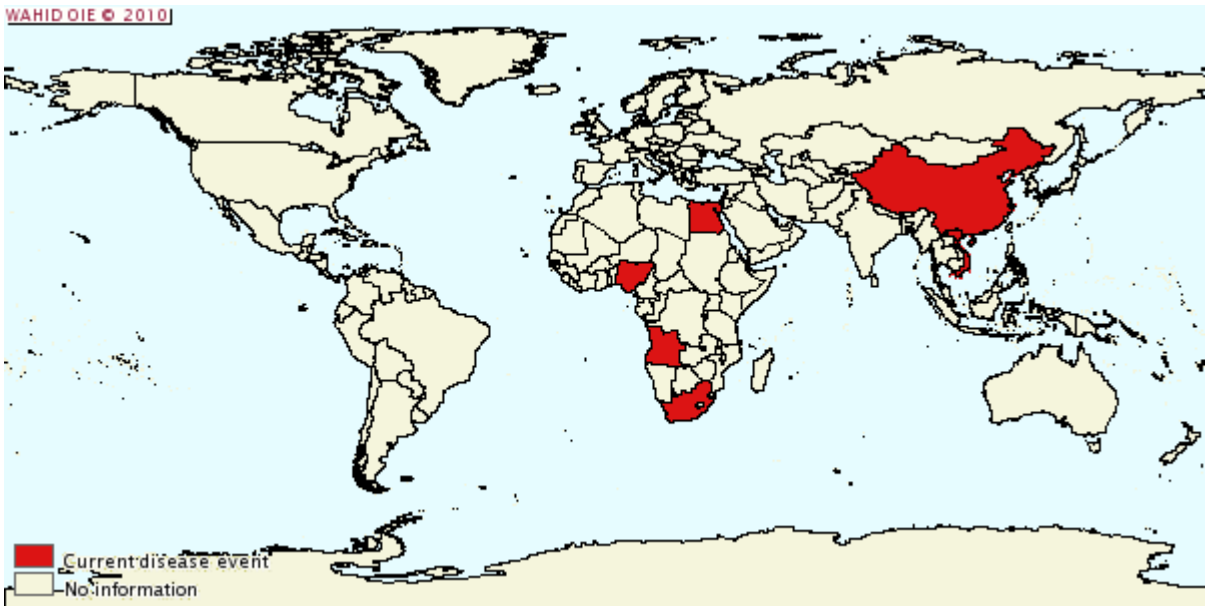
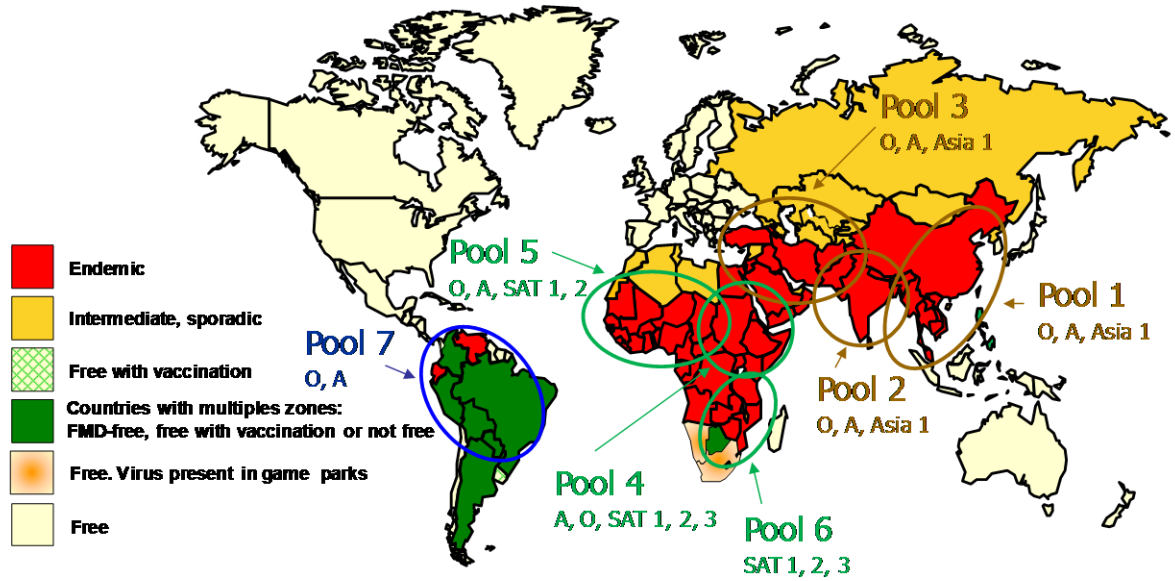


Figure 2. FMD situation by country according to OIE, Jul-Dec 2009



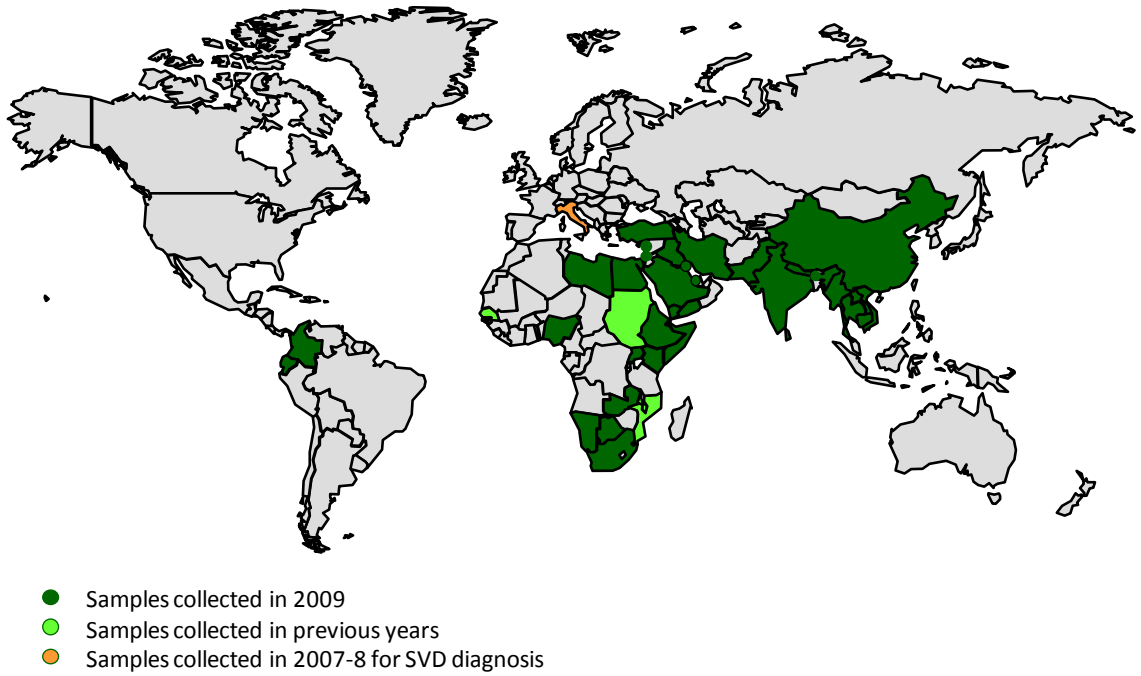
[1] The WAHID Interface provides access to all data held within OIE's new World Animal Health Information System (WAHIS): http://www.oie.int/wahis/public.php?page=disease_status_map&disease_type=Terrestrial&disease_id=1&empty=999999&sta_method=semesterly&selected_start_year=2008&selected_report_period=1&selected_start_month=1&page=disease_status_map

Figure 3.
The conjectured status of FMD in 2009 showing approximate distribution of regional virus pools



Pool positions are approximate and colours indicate that there are three principal pools, two of which can be subdivided into overlapping areas

Figure 4.
Countries submitting samples to the Network Laboratories for FMD diagnosis in 2009



1.2. Introduction

Global surveillance for foot-and-mouth disease (FMD) aims to identify the current hazards and to predict heightened risk so that appropriate diagnostics and vaccines are available for their detection and control. This requires sustained effort directed towards the monitoring of FMD outbreaks and ideally also of FMD virus (FMDV) circulation and persistence, along with collection and characterisation of FMD viruses and integration of findings with associated epidemiological intelligence. Such an extensive effort requires a team approach encompassing national and international disease control services and their laboratories along with commercial vaccine and diagnostic providers.

The work of international FMD reference laboratories in collecting and characterising FMDV isolates has been reviewed (Ferris and Donaldson, 1992; Kitching 2000) and more recently with emphasis on the requirements and methodologies for vaccine selection (Paton et al., 2005). FMDV is unevenly distributed throughout the world reflecting factors such as livestock density and species mix, patterns of husbandry, animal movement and trade, wildlife reservoirs and incentives and capacities for disease control. The virus exists as multiple serotypes and subtypes with absent or incomplete cross-immunity, likely differences in species predilections and modes of persistence and transmission, and with distributions that are partly based on historical and chance events. The situation is dynamic and affected by viral evolution, waxing and waning host immunity and changing ecosystems and trading patterns. Despite the propensity and opportunities for spread of FMDV into new regions, comparisons of VP1 gene sequences of viruses submitted over many years do show a tendency for similar viruses to recur in the same parts of the world (Knowles and Samuel, 2003; Rweyemamu et al., 2008) and this presumably reflects some degree of either ecological isolation or adaptation. On this basis, the global pool of FMD viruses can be subdivided into seven 'regional pools' in which genetically and antigenically distinctive virus strains tend to occur within a defined region.

The seven 'Regional Pools' referred to throughout this report are shown in Figure 4 and represent:

Pool 1 – Eastern Asia	Pool 4 – Eastern Africa	Pool 7 – South America
Pool 2 – Southern Asia	Pool 5 – Western Africa	
Pool 3 – Eur-Asia	Pool 6 – Southern Africa	

Virus circulation and evolution within regional virus pools results in changing priorities for appropriately adapted vaccines. Periodically, viruses spread between pools and to free regions.

Ferris NP, Donaldson AI. (1992) Rev Sci Tech.11(3):657-84.
Kitching RP. (2000) Ann N Y Acad Sci. 916:139-46.
Paton DJ, Valarcher JF, Bergmann I, Matlho OG, Zakharov VM, Palma EL, Thomson GR. (2005) Rev Sci Tech. 24(3):981-93.
Knowles NJ, Samuel AR. (2003) Virus Res.91(1):65-80.
Rweyemamu M, Roeder P, Mackay D, Sumption K, Brownlie J, Leforban Y, Valarcher JF, Knowles NJ, Saraiva V. (2008) Transbound Emerg Dis. 55(1):57-72.

1.3. Overview

FMD remained largely confined to traditionally infected areas between January and December 2009.

No outbreaks were reported in countries listed by OIE as FMD-free without vaccination.

One country and one zone listed by OIE as FMD-free with vaccination lost their status[2]:

(i) Following a report received from the OIE Delegate of Chinese Taipei on two outbreaks of FMD in the states of Yun-Lin and Chang-Hua, the "FMD free Member where vaccination is practised" status for Chinese Taipei as recognised by the International Committee of the OIE in terms of Resolution XX in May 2004, is suspended with effect from 18 February 2009.

(ii) Following a report received from the OIE Delegate of Colombia on FMD cases in a local slaughterhouse located in the municipality of Ipiales (Department of Nariño), the status of the FMD free zone of Colombia where vaccination is practised is suspended with effect from 4 August 2009. The status of Colombia's two FMD free zones where vaccination is not practised is not affected by the suspension of Colombia's FMD free zone where vaccination is practised.

Within endemically and sporadically infected parts of the world there have been upsurges of cases, sometimes leading to the submission of samples to reference laboratories and indicating an enhanced risk of collateral spread.

The majority of viruses have been isolated from samples submitted from Africa and Asia which remain the major reservoirs for the FMD virus. In South America, FMDV circulation has mainly been detected in Ecuador and Venezuela.

Information gaps

Submission of samples from endemic regions has continued to be mainly in response to perceptions of increased number or severity of outbreaks, although in some cases there are proactive projects promoting sample submission. Reactive sampling provides an incomplete survey of the global virus pool and often lacks context in the form of information on the history accompanying the samples. Nevertheless, the bias towards things that are out of the ordinary may be helpful in providing early warning for new epidemics. It is hoped that there will be growing uptake of regional FMD control schemes following the launch of the OIE/FAO Progressive Control Pathway FMD initiative under the Global Framework for eradication of transboundary animal diseases. The starting point for countries that are currently endemically infected with FMDV will be surveillance to identify the types of virus present and the weight of infection.

[2] Current status: http://www.oie.int/eng/Status/FMD/en_fmd_free.htm
Changes of status: http://www.oie.int/eng/Status/FMD/en_fmd_change.htm

The main gaps in knowledge about the global distribution of FMDV come from countries without control schemes, especially in sub-Saharan Africa and in southern and central Asia.

Threats

The greatest diversity of FMD viruses are in Africa and there are relatively few vaccines available that have been developed to protect against current African strains. Vaccines used in Africa may also lack stability and potency contributing to poor protection and increasing the threat of spread of outbreaks in the region and beyond. Historically, FMD viruses have rarely spread out of Africa, apart from sporadic incursions into the Middle East. However, changing patterns of global travel may alter this risk.

Despite growing efforts to control FMD in India and China and the attendant prospect of a reducing incidence of infection within their very large livestock populations, FMD viruses continue to circulate both in these countries and regionally. Therefore, Asia remains an important reservoir for serotypes O, A and Asia 1. FMD viruses have traditionally spread from Southern Asia, threatening FMD-free regions to the north and west in Central Asia and Europe. In fact, Asia has been the main source of outbreaks affecting the Middle East and Europe in the last twenty years (Valarcher et al., 2008). There is also a continued possibility of spread of FMDV through countries of the former Soviet Union into Europe and China and from Indo-China into northern and eastern neighbours. Vaccine strains developed locally to control FMD within Asia are not maintained within European vaccine banks.

The latest incursions into the Middle East (and North Africa) have been of the O PanAsia 2 and A Iran 05 strains and these still present a significant threat for further spread including to the west into Europe, and northwards into countries of the former Soviet Union. Serotype Asia 1 has apparently not been present in the Middle East since 2004, apart from a single incursion into Bahrain, early in 2009 that did not spread. Natural immunity against this serotype will therefore be low in Middle Eastern countries and based on the episodic incursions of the past, a reappearance may be due. Therefore, the risk of a new westward spreading epidemic should be borne in mind. A reservoir of the virus is certainly still present to the east in Southern Asian countries and a recently detected case from Pakistan showed an unusually poor match to the Asia 1 Shamir vaccine that is held in many European vaccine antigen reserves.

In South America, Ecuador and Venezuela are the two countries which remain with FMD endemicity, representing a threat to the cattle population which is in the areas free with or without vaccination from South America. Virus O_1 is still circulating in Ecuador and Venezuela as well as virus A_{24} in Venezuela. Virus C_3 has not be identified since 2004 in the Amazon region from Brazil. In the early 2000, reintroduction of virus O occurred in the common border regions of Paraguay, Bolivia, Argentina and Brasil. As a consequence, a High Surveillance Zone was defined in the area and extensive serosampling for viral activity studies are being implemented in a joint programme between the four countries. The generally improving situation in South America may give rise to a reassessment of strain priorities for vaccine banks held by FMD-free countries elsewhere.

Vaccine recommendations

These take two forms. Regional recommendations are given in section 1.4, whilst the WRLFMD recommendations for FMD free countries are given in section 1.6.

Continuous molecular and antigenic characterisation of field viruses remains of utmost importance to facilitate rapid development of new vaccines that will provide coverage for specific regions. Regional vaccine selection does not always investigate whether vaccines produced elsewhere would be suitable, or conversely whether locally produced vaccines would have a wider application. This underscores the need for greater cooperation between the work of different regional reference laboratories. Commercial restrictions can hamper exchange of vaccine strains between reference laboratories and this lessens opportunities to evaluate the applicability of different vaccines to different regions. Harmonisation of local vaccine selection procedures is a priority so that results obtained in one laboratory can be extrapolated to other situations. Different manufacturing and licensing standards for vaccines also reduce the possibility for sharing of vaccines between regions.

Matching tests to check the antigenic suitability of vaccines to protect against circulating strains continue to reveal gaps in cover, especially against serotype A and SAT 2. There is an urgent need for new SAT vaccine strains with good immunogenicity, adaptation to suspension cultures of BHK-21 cells and post-inactivation stability.

As well as improving the efficacy, stability and safety of production, research on FMD vaccines is needed to establish a better understanding of the vaccine coverage required for protection under different livestock systems and to improve alternatives for potency testing of vaccine batches. Further research is also needed to develop simpler and more reproducible vaccine selection methods.

1.4. Regional situation

Pool 1: EASTERN ASIA

Network labs receiving samples in 2009

Laboratory	Sample Nos.	Countries of origin
WRLFMD	52	Cambodia, Hong Kong, Myanmar, Taiwan, Thailand
RRLSEA	134	Cambodia, Laos, Myanmar, Vietnam, Thailand
LVRI		China

Japan, South Korea, Indonesia, Brunei and the island states of Malaysia remained FMD-free without vaccination.

No outbreaks of FMD have been reported from the Philippines since 2005 and in 2009, the country has applied to OIE for Luzon to be the final region recognised as officially free of FMD.

In China, a small number of outbreaks have been reported in 2009 by LVRI. Eight new outbreaks of Asia 1 serotype were confirmed by LVRI, involving 7 different provinces in 2009. Amongst these, 6 provinces reported an outbreak for the first time.

The most surprising finding has been the introduction of type A FMD at the beginning of this year. The first case confirmed was in Wuhan, Hubei province, followed by cases in Shanghai, Jiangsu, Guangxi, Guizhou and Shandong province. VP1 sequencing showed that the viruses involved have a common source and are different from the historical Chinese strains of type A FMD virus. The VP1 sequences of A/HuB/WH/2009 and A/SH/2009 are related to some published VP1 sequences of A/May/02 (95.9%), A/Tai/07 (95.7%) and A/Lao/8/06 (95.3%), and a comparison with WRLFMD sequence data revealed a strong similarity to A/Tai/08 virus and indicated that the virus may have been introduced from Southeast Asia. This type A virus mainly affects cattle, although pigs can also show clinical signs in some field cases. Under experimental conditions, pigs and sheep showed subclinical infection following contact with diseased cattle. Epidemiological analysis indicates that animal movements associated with trade are the main factors for the spread of this type of FMD outbreak and for transmission between provinces. For FMDV type A, no vaccine is available to date, so control measures have been based on the destruction of infected and suspected infected animals, controlling animal movements, epidemiological surveillance and quarantine measures. For the Asia 1 serotype, monovalent and bivalent (combined with type O) vaccines are available for large-scale vaccination. Details associated with the cases confirmed by LVRI are shown in the Figure and Table below:

Figure 5. Provinces of China with reported outbreaks of FMDV (based on Table 1, serotype A in blue and Asia 1 in red).

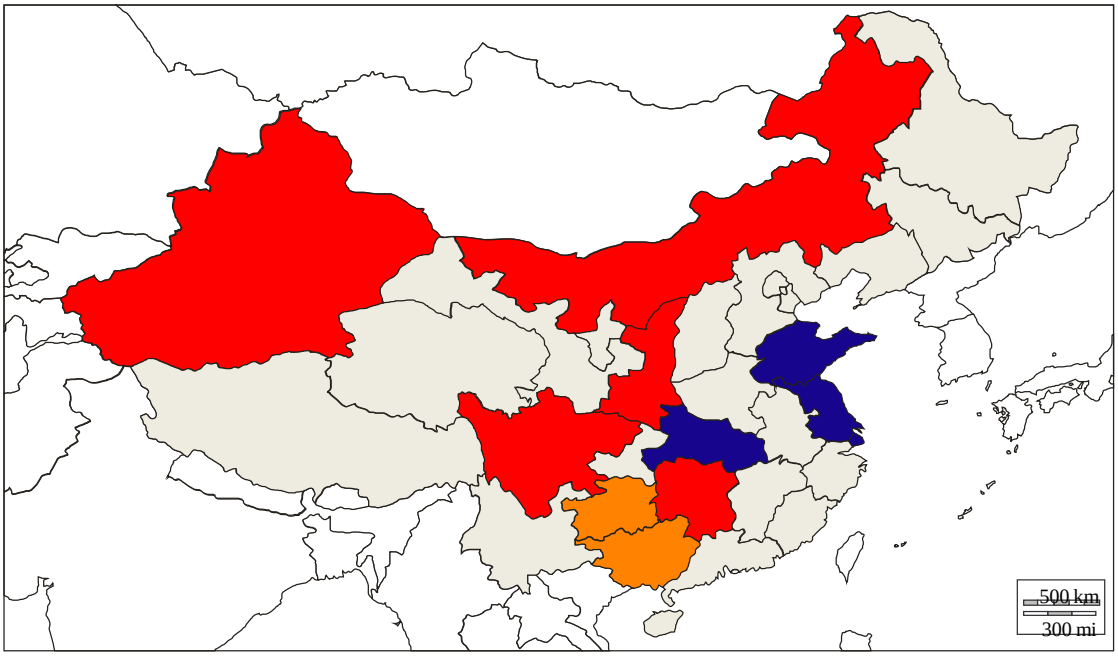


Table 1. FMD Information from LVRI, China

Report date	Location	Outbreak date	Serotype	Confirmation date	Species	Nos. Susceptible	Nos. Cases	Deaths
3/6/2009	Bingcheng District, Bingzhou, SHANDONG	3/6/2009	A	8/6/2009	Cattle	290	33	0
22/5/2009	Haixing chaoyang village, Pan, Liupanshui, GUIZHOU	14/5/2009	A	21/5/2009	Cattle Pigs	78 19	71 19	0 0
22/5/2009	Xi'nan, Lin'gui, Guilin, GUANGXI	25/4/2009	A	21/5/2009	Cattle Pigs	184 570	12 0	0 0
15/5/2009	Huanghualing, Lingchuan, Guilin, GUANGXI	28/4/2009	Asia 1	14/5/2009	Cattle Pigs	40 60	1 0	0 0
7/5/2009	Dengjiayan, Nanzhen, Hanzhong, SHAANXI	21/4/2009	Asia 1	6/5/2009	Cattle	57	15	9
25/4/2009	Dongjiang village, Changning, Hengyang, HUNAN	20/4/2009	Asia 1	24/4/2009	Cattle	170	110	2
25/4/2009	Mazong, Tongzi, Zunyi, GUIZHOU	20/4/2009	Asia 1	24/4/2009	Cattle	71	21	0
30/4/2009	Congcong, Wujing, Changzhou, JIANGSU	15/4/2009	A	30/4/2009	Cattle	413	17	0
16/4/2009	Fuyuan farm, Wusu, Tacheng, XINJIANG	11/4/2009	Asia 1	15/4/2009	Cattle	217	34	0
2/4/2009	Shuigui, Lizhou, Guang yuang, SICHUAN	29/3/2009	Asia 1	2/4/2009	Cattle	35	11	0
25/3/2009	Sumitu Sumu, Etuoke, E'erduosi, INNER MONGOLIA	17/3/2009	Asia 1	20/3/2009	Cattle Sheep Pigs	235 885 1	20 0 0	0 0 0
22/1/2009	Sunwan, Dongxihu, Wuhan, HUBEI	13/1/2009	A	21/1/2009	Cattle	294	58	5
11/2/2009	Wusi , Fen Xian, SHANGHAI	3/2/2009	A	11/2/2009	Cattle	440	41	0
22/1/2009	Erbatai, Kuche, XINJIANG	14/1/2009	Asia 1	21/1/2009	Cattle	34	1	0

In addition to serotypes Asia 1 and A reported from LVRI, after a gap of submissions for several years, WRLFMD received samples from Hong Kong. Analysis of these samples that were collected between 2006 and 2009 confirmed the continued presence in Hong Kong of the Cathay pig-adapted topotype of serotype O. This strain of FMD virus had previously been reported in Hong Kong over many years. Viruses of the Cathay topotype generally show a poor to moderate antigenic match to vaccines such as O Manisa, O India R2/75 and O BFS (see results table in section 1.6.6.).

The virus isolated from a Taiwanese sample submitted to WRLFMD also confirmed the presence of an O Cathay strain of virus that was not closely related to the Hong Kong viruses or to other viruses for which sequence data are available at WRLFMD. It was closest to an earlier isolate from Taiwan (from 1997) though with ~9% nucleotide differences in VP1. The new Taiwanese isolate showed a good antigenic match to O Manisa and O India R2/75 vaccines.

In 2009, 140 samples were sent to the RRLSEA in Pakchong from Myanmar, Cambodia, Vietnam, Laos and Thailand and serotyping revealed mainly types O and A. An overview of outbreaks reported in each country were as follows:

Cambodia: 33 outbreaks affecting 2,277 cattle, 616 buffalo and 600 pigs in 13 provinces. 17 samples were sent to RRLSEA and confirmed as type O.

Laos: 11 outbreaks of type O affecting 804 animals in 2 provinces.

Malaysia: 31 outbreaks of type O and A; no samples submitted to RRLSEA.

Myanmar: 19 outbreaks of type O affecting 1094 cattle and 20 buffaloes.

Philippines: no outbreaks.

Indonesia: no outbreaks.

Vietnam: 74 outbreaks in 18 provinces; the largest in the first quarter of the year. Serotypes O and A were reported.

Thailand: 60 outbreaks in 15 provinces in northern , northeastern and southern parts of the country. The types of animals affected were beef cattle (86%), dairy cattle (6%), buffalo (6%) and pigs (2%). Sixty samples were submitted to RRLSEA for serotype identification, which mainly confirmed type O and A. 62% of outbreaks were attributed to animal movements.

The antigenic and genetic variation of viruses in the Southeast Asia region has been investigated at RRLSEA. The r_1-values for type O isolates from Laos, Vietnam, Myanmar and Thailand showed a match to the Thai vaccine strain O189/87. Type A isolates from Laos, Vietnam and Thailand showed a match to the Thai vaccine strain A118/87. Genetic analysis of type O viruses from Myanmar and Thailand revealed that they were of the SEA topotype, whilst genetic analysis of type A revealed them to be of the Asia topotype.

FMD viruses of serotypes O and A were isolated from samples sent to WRLFMD in 2009 from Cambodia, Myanmar and Thailand. The genetic typing confirmed the

findings from RRLSEA that type O viruses were mainly of the indigenous South East Asian strain known as "Myanmar 98". However, O PanAsia was also identified in samples that had been collected in Cambodia in 2008. VP1 sequencing of samples from Malaysia also confirmed the presence of both PanAsia and Myanmar 98 strains of serotype O. There were no samples submitted from Vietnamese pigs, so the situation regarding continued circulation of the O Cathay topotype is uncertain. The type O viruses from South East Asia that were tested for vaccine matching at WRLFMD showed a generally poor match to O Manisa and a better match to O IND R2/75. The type A viruses recovered at WRLFMD from Thailand and Cambodia were also of indigenous South East Asia lineages and those tested showed a moderate match to the A Malaysia 97 vaccine.

Vaccine strains that may be suitable for use in the region include:

Serotype	Internationally available	Locally produced
O	O_1 Manisa, O 3039	China 1999, Thailand 189/87
A	Malaysia 97	China 1972, Thailand 118/87
Asia 1	Shamir	China 2005, Thailand /85

Serotype O Cathay-like virus vaccines (e.g. O Taiwan 97, O Philippine 97, or O 1685 Russia 95) could also be useful where viruses of this topotype affect pigs.

Pool 2: SOUTHERN ASIA.

Network labs receiving samples in 2009:

Laboratory	Sample Nos.	Countries of origin
WRLFMD	154	Bangladesh, Bhutan, Nepal, Pakistan, Sri Lanka
PDFMD	640*	India
PIADC-FADDL	59	Pakistan

*collected during 2008-2009.

India, Pakistan, Sri Lanka, Bangladesh, Bhutan and Nepal remain endemically infected with FMDV.

In India, serosurveillance has been carried out on 21,526 bovine samples collected in 2008/9 at a rate of 100 per district from 248 districts in 20 states. Tests revealed a 31% seroprevalence for antibodies to non-structural FMDV proteins with a range from 6% in Himachal Pradesh to 46% in Karnataka. During 2008/9, 511 outbreaks were recorded from which 640 samples were submitted for laboratory investigation. The predominant serotype isolated was type O (89% of those typed) and it was found in all regions of India. About 10% of the ~334 isolates made thus far have undergone testing for vaccine matching to O IND R2/75 and 95% have shown a good match. Until this year, the PanAsia-2 strain was the main one, but in 2009, the "India 2001" strain has predominated. Serotype O in India has been associated with significant disease in wildlife during 2005-08. For serotype A, a pattern of genotype/lineage turnover where periodically newer genotypes surface and older genotypes disappear has been observed since 2001. The predominant strain of serotype A is genotype VII which has an amino acid deletion in an antigenic site of VP3 position 59. This virus is distinct from the A Iran 05 strain found throughout the Middle East. Although

antigenically heterogeneous, most of the 26 serotype A isolates have shown a match to A IND 40/00. Serotype A was not recorded in northern India. The Asia 1 serotype is the least prevalent and was not recorded in southern and central regions of India. All of the 16 Asia 1 field isolates matched to Asia 1 63/72. These A and Asia 1 virus lineages seem to be unique to India. The priority vaccine strains are those stipulated in India, namely O IND R2/75, A IND 40/00 and Asia 1 IND 63/72.

Samples received at WRLFMD from Nepal, Bangladesh and Sri Lanka also demonstrate that there are type O viruses of the Middle-East South Asia topotype circulating in southern Asia which are not part of the PanAsia-2 lineage. In Nepal, five phylogenetically distinct clusters of viruses were characterised that included representatives of the India 2001 strain as well as O PanAsia-1 and O PanAsia-2. viruses Closely related India 2001 strain were also identified in Bangladesh. Sri Lankan viruses characterised at WRLFMD had VP1 sequences that did not show a close match to those of strains held on the WRLFMD database. Serological tests on serotype O viruses from Pakistan and Nepal showed the best match against the O Ind R2/75 vaccine strain. For serotype A viruses from Pakistan, the best match was against A Tur 2006 (A Iran 05 strain) vaccine. Several serotype Asia 1 viruses were recovered from Pakistan including one with a poor serological match to Asia1 Shamir vaccine.

From Pakistan, in April 2009, PIADC-FADDL received 28 sera and 59 tissue and oral swab samples from cattle and water buffalo. Oral swab and tissue samples were tested by real-time RT-PCR (22 tissue positive, 23 swab positive) and virus isolation (11 tissue positive, 3 swab positive). Nucleotide sequencing indicated the presence of serotypes O and A which are expected in this region. Based on VP1 nucleotide sequences, 4 different strains of serotype O were identified. An additional 7 samples were serotype A based upon VP1 sequence.

Vaccine strains that may be suitable for use in the region include:

Serotype	Internationally available	Locally produced
O	O_1 Manisa	IND R2/75*
A	A_{22} Iraq	IND 40/2000*, Turkey 1/2006 (A Iran 05 lineage)
Asia 1	Shamir	IND 63/72*

* Trivalent vaccine comprising these three strains is nationally mandated in India

Pool 3: EUR-ASIA

Network labs receiving samples in 2009:

Laboratory	Sample Nos.	Countries of origin
WRLFMD	474	Bahrain, Egypt, Iran, Iraq, Israel, Italy (SVD), Kuwait, Lebanon, Libya, Palestine, Saudi Arabia, Turkey, United Arab Emirates
FGI-ARRIAH	2	Tajikistan
PIADC-FADDL	37	Iraq

FMD viruses continue to circulate in many Middle-Eastern countries, the prevailing serotypes in 2009, being as in 2007-8, O (PanAsia-2 lineage) and A (Iran 05 lineage). In Egypt, which may be considered as part of Africa and the Middle East, an African strain of serotype A continues to be detected following its introduction from the horn of Africa in 2006. The O_1 Shaquia vaccine strain of FMDV was also recovered from Egyptian field samples submitted to WRLFMD. There have been no outbreaks of serotype Asia 1, apart from an apparently isolated incident in Bahrain.

In the Middle East the A-Iran-05 strain continues to evolve and spread to previously unaffected countries. During the present reporting period it has been recognised or appeared for the first time in Iraq, Kuwait, Lebanon, Libya, Israel and the Palestinian Autonomous Territories and has continued to cause outbreaks in Bahrain, Iran, Pakistan and Turkey. During the past two years, four distinct sub-lineages have been recognised and named A-Iran-05^{ARD-07}, A-Iran-05^{EZM-07}, A-Iran-05^{AFG-07} and A-Iran-05^{BAR-08}. The first two have evolved within Turkey and have not spread to the rest of the Middle East. A-Iran-05^{AFG-07} has appeared in Afghanistan (2007), Iran (2008-2009), Pakistan (2008-2009) and Bahrain (2009). A-Iran-05^{BAR-08} has become the most widespread sub-lineage appearing in Bahrain (2008), Iran (2009), Pakistan (2009), Lebanon (2009), Iraq (2009), Kuwait (2009), Libya (2009) and the Palestinian AT (2009).

It seems probable that antigenic changes may have conferred an advantage for the spread of the A Iran 05 strain, but this is less clear for O PanAsia-2 which mostly still matches O Manisa vaccine. The Asia 1 virus detected in Bahrain was most closely matched to earlier Indian sequences held in the WRLFMD database. A type O serotype outbreak in 2009, fatally affecting gazelle in the United Arab Emirates, was caused by viruses of the O "India 2001" strain. Recent isolates sent to WRLFMD from Pakistan show continued evolutionary change, with some A and a single Asia 1 viruses showing a poor match to A Turkey 06 (A Iran 05 strain) and Asia 1 Shamir, respectively. Elsewhere in the region, Egypt continues to submit samples containing unique viruses of serotype O (related to the O Sharquia 72 vaccine strain) and type A (of the A Africa topotype closely related to that introduced into the country in 2006). Homologous A Africa vaccine is produced in Egypt, but there is no tailored vaccine readily available from international vaccine manufacturers for use in neighbouring countries.

In all, about 35 isolates have been matched to a variety of vaccine strains as well as 10 O PanAsia-2 viruses isolated in 2008. The priority vaccines are O Manisa (or similar strains), A Iran 05 strain and Asia 1 Shamir (or similar strains). The major gaps in submission are considered to be from some central Asian Republics, the Caucasus and some Middle East countries concerned about the impact of transparency on trade. The main problems for vaccine selection are an inability to compare vaccine matching results between centres due to the use of different vaccine strains, unstandardised methods and field isolates that are not shared. New vaccine strains tailored to the A Iran 05 viruses threatening EurAsia are becoming available, but their cross-reactivity against other strains is not yet clear. Based on previous experience, it may be expected that serotype O but not A will be sustained within the region. In India, the O India 2001 strain has replaced O PanAsia-2 and it will be interesting to see if this also occurs in neighbouring regions. Initial studies suggest that the Indian vaccine strain O IND R2/75 could be a useful alternative to Manisa in other Asian and EurAsian countries. An Asia 1 epidemic may be due in EurAsia, since cases are occurring in

Pakistan, whilst countries like Iran and Turkey will by now have a low population immunity to this serotype (last seen in 2004). Plans to increase imports of live cattle and small ruminants into the Middle East from Africa and through new trade routes may increase the risk of African strains being introduced.

Samples were sent to PIADC from Iraq where FMD is endemic and the presence of almost every serotype has been recorded since 1952. The estimated total number of animals at risk in Iraq is 36,230 cattle, 22,412 buffalo, 585,075 sheep and 131,228 goats. The majority of the cattle are raised in small confined herds, with restricted movement and local grazing, supplemented with seasonal crops. Buffalo, sheep and goats are in semi-closed conditions, concentrated near rivers and move across borders. Vaccination and surveillance programmes are in place using a once yearly schedule of application of imported Trivalent (O_1, A22, Asia 1) or Monovalent (O_1) oil adjuvant vaccines in cattle/buffalo or sheep/goat populations, respectively. As per the government records, only 18% of total livestock was vaccinated in 2008. Vaccine is imported from India and Turkey without local production. A quarantine system is in place, and legal importation of livestock and fresh meat is not allowed since 1985.

Vaccine strains that may be suitable for use in the region include:

Serotype	Internationally available	Locally produced*
O	O_1 Manisa	Russian O_1 PanAsia
A	A Iran 05, A_{22} Iraq	Turkey 1/2006 (A Iran 05 lineage)
Asia 1	Shamir	Georgia 2000

* Vaccines are also produced locally in Iran, Turkey, Egypt and Jordan

The main differences between vaccine requirements of pools 1-3 relate to serotype A. The serological match between A_{22} Iraq and some A Iran 05 lineage field isolates is poor.

Pool 4: EASTERN AFRICA

Network labs receiving samples in 2009:

Laboratory	Sample Nos.	Countries of origin
WRLFMD	255	Ethiopia, Kenya, Somalia, Sudan, Uganda, Yemen
ARC-OVI	10	Kenya

For this section, the laboratory information supplied from Embakasi and WRLFMD has been complemented by epidemiological insights and local diagnostic findings supplied by the participants at the First Eastern Africa FMD laboratory network meeting held in Nairobi, Feb 8th 2010.

Serotypes O, A, SAT 1 and SAT 2 have all been reported from this area in recent years and all countries are thought to be endemically infected with FMD virus. Type C was last isolated in 2004 in Kenya.

Samples from Kenya have been typed as SAT 1, SAT 2, O and A, with SAT 1 predominating. The samples were also referred to the WRLFMD for genetic and antigenic characterisation. The same four serotypes as in Kenya are believed to be

circulating in Somalia, Ethiopia and Burundi. Type O was isolated from samples from Somalia in 2009 (Embakasi Lab) and evidence of type A, SAT1 and SAT2 was obtained through serology (VNT). Samples collected in 2009 were submitted to the WRLFMD from Uganda and Somalia, but although FMDV was confirmed by PCR, it was not possible to isolate or serotype the viruses involved. Sudanese samples that had been collected in 2008 were confirmed by WRLFMD as belonging to serotypes O and SAT 2.

In Ethiopia, SAT 1 was identified for the first time in 2008 from lowland areas along the border with Sudan, but was not detected in the same area in 2009, instead, SAT 2 was identified. In 2009, SAT 2 was identified from outbreaks in the central highlands, whereas in 2008 and previous years SAT 2 had only been detected along the border with Kenya. Type O outbreaks predominated in the central highlands area in 2009, followed by type A and SAT 2. This complexity affects selection of vaccine for use in animals destined for export from Ethiopia and the domestic dairy sector. Viral and serological surveys are underway in Ethiopia.

Since the collapse of the last Somali government, FMD investigations have only taken place in 2007 and 2008 with submission of samples to the FMD laboratory in Embakasi, Kenya. FMD outbreaks are considered to occur on a yearly or even twice yearly basis – the latter being more likely where the cattle population is high.

In Burundi in 2008, 2115 cases were reported in 13 out of 16 provinces, but there have been no recent serotyping data. Further cases were reported in 2009 into early 2010.

In Tanzania in 2009, type A was detected from outbreaks in the southern highlands close to Malawi and at a holding ground close to Dar-es-Salaam. Type A was first detected (by CVL Tanzania, by ELISA) in Tanzania in 2008; this is the most southerly extension of type A distribution yet known. Further investigations are needed with confirmation by a OIE/FAO reference centre as the finding is new and possibly threatens Southern Africa, where only SATs are known to be present. In 2008, type O was also detected in the southern highlands of Tanzania, following earlier detection in 2002, 2003, and 2004 (CVL Tanzania).

Gaps identified as priorities for sampling/submission include:
- Southern Sudan, Western Sudan (Darfur)
- Burundi
- Rwanda,
- DRC (eastern borders)
- Tanzania (general)
- Eritrea
- Somali ecosystem

FMD vaccination is applied only at a limited scale in 4 countries in the region:
- Kenya (Kevevapi vaccine, Kenya)
- Ethiopia (from NVI Ethiopia, and Indian Immunologicals)
- Uganda (Kevevapi, Kenya)
- Somalia (pre-export at Berbera port, Kevevapi Kenya).

Within the region, there are gaps in laboratory capacity and both in technical capability and ability to interpret results. There is a need to develop a strategic plan and network for the region. It would be helpful to identify a specialist from each country who could act as a local animator to encourage action on FMD control initiatives.

Vaccine strains that may be suitable for use in the region include:

Serotype	Internationally available	Locally produced in 2009
O	O_1 Manisa	Kenya 77/78, Egypt 2/72, Ethiopia O 281
A	Eritrea 98	Kenya 5/80, Egypt 06, Ethiopia A110
SAT 1	See pool 6	Kenya T155/71
SAT 2	Saudi 2000, Eritrea 98, see pool 6	Kenya 52/84

Pool 5: WESTERN AFRICA

Network labs receiving samples in 2009:

Laboratory	Sample Nos.	Countries of origin
WRLFMD	29	Senegal
PIADC	30	Nigeria

Few samples have been submitted from this region to OIE/FAO Reference Laboratories for investigation of FMD outbreaks, although the disease is known to be present. Samples sent to WRLFMD from Nigeria in 2007/8 revealed the presence of serotypes O and SAT 2. Local capability for laboratory investigations including serotyping and characterisation of FMD viruses appears to be also very limited.

Nigeria has the highest human population in Africa and more than 100 million FMD susceptible livestock animals, with small ruminants predominating as well as significant numbers of cattle and pigs. As with several other countries in the region there is a mix of sedentary and pastoral livestock farming, the latter contributing to extensive transboundary animal movements.

In 2008, viruses submitted from Nigeria to WRLFMD were of serotypes O and SAT 2 and revealed a link to other African regions such as Sudan. In 2009, 30 tissue samples and 532 sera were submitted to PIADC-FADDL from Nigeria. Epithelial samples from 29 cattle and one sheep collected from nomadic herds in Kwata, Miango, Bukuru Market and Barkin-Ladi from an outbreak that had lasted from October 2008 to February 2009. Morbidity rate was between 50% and 80% and no mortality reported. Twenty one of 30 samples were positive and typed as serotype A. Phylogenetic analysis of the P1 and VP1 regions revealed close identity to A21 Kenya 1984 virus and Cameroon 2000 virus, respectively.

Three of twenty-nine samples submitted to WRLFMD from Senegal in 2009, were RT-PCR positive for FMDV, but no viruses were isolated for serotyping.

Vaccine strains that may be suitable for use in the region include:

Serotype	Internationally available	Locally produced
O	O_1 Manisa	
A	Eritrea 98, A_{22} Iraq	
SAT 1	See pool 6	
SAT 2	Saudi 2000, Eritrea 98, see pool 6	Nigeria 6/81*

* Current availability of this vaccine is not known

Pool 6: SOUTHERN AFRICA

Network labs receiving samples in 2009:

Laboratory	Sample Nos.*	Countries of origin
WRLFMD	30	Botswana, Malawi, Mozambique, South Africa, Swaziland, Zambia
ARC-OVI	361 (19387)	South Africa
	- (68)	Angola
	- (100)	Lesotho
	- (84)	Malawi
	- (2517)	Mozambique
	4 (225)	Namibia
	- (47)	Sultanate Of Oman
	2 (234)	Swaziland
	- (47)	Uganda
	10 (-)	Kenya
	1 (-)	Zambia
	- (2299)	Zimbabwe
RRLSSA		

* clinical samples except for those in parenthesis that represent serology samples.

In Southern Africa, SAT1 isolates from 2001-2006 belonged to topotypes I, II and III with outbreaks characterised in Mozambique during 2001-2002, Zimbabwe in 2003, Zambia during 2005 and 2006 and Botswana in 2006. The SAT2 isolates were from Botswana 2002 and 2006; Zimbabwe during 2000/2001-2003, and recently from Nambia and Malawi during 2008 and 2009. Recently, SAT 1 had infected domestic cattle in the buffer zone in the Nsikazi magisterial district, Nelspruit SV area, Mbombela local municipality, Ehlanzeni district municipality, Mpumalanga province, South Africa. There has been no official confirmation of outbreaks in Zimbabwe.

Both serotypes SAT 1 and SAT 2 continue to cause problems in Zambia and it is not clear whether these are introductions from neighbouring countries or transmission from indigenous African buffalo populations.

In Botswana, after 20 years with no outbreaks, a series of 9 outbreaks have occurred since 2002. These have been mostly of SAT 2 and attributed either to incursions from neighbouring countries or due to contact between domestic cattle and wildlife. The 2008 outbreaks appeared to have been exacerbated by antigenic mismatch between the field virus and the vaccine strains. To try to address the problems associated with lower vaccine matches, efforts are being made to increase antigen payload, introduce

new vaccine strains and improve the surveillance of buffalo. The priority vaccines are SAT 2 and SAT 1, but there is insufficient information to be more precise about the strains that should be included. For SAT 1, past vaccine matching results have indicated that vaccine strains are relevant. For SAT 2, recent outbreaks have shown some differences. However, viruses with good correlation to vaccine caused outbreaks recently as well.

Vaccine strains that may be suitable for use in the region include:

Serotype	Internationally available	Locally produced
O	O_1 Manisa	Kenya 77/78, Egypt 2/72
A	Eritrea 98	Kenya 5/80, Egypt 06
SAT 1	Rhodesia 12/78, Botswana 1/68,	Botswana 1/77, KNP 196/91, Kenya T155/71, SAR 9/81
SAT 2	Zimbabwe 7/83, Eritrea 98, Saudi 2000	Zimbabwe 11/89, Zimbabwe 5/81, Zambia 3/81, KNP 19/89, Kenya 52/84, Kenya 65/82
SAT 3	Zimbabwe 9/81, Zimbabwe 2/83	KNP 10/90

Not all of the above-mentioned vaccine strains are in production and there are major problems in finding new strains suitable for vaccine production. This is not only due to the lack of availability of field isolates and sera for use in vaccine matching tests, but also the fact that prospective vaccine strain adaptation for production purposes is a cumbersome process and that commercial returns are uncertain on investment to generate new vaccine strains.

Pool 7: SOUTH AMERICA

Network labs receiving samples in 2009:

Laboratory	Sample Nos.	Countries of origin
PANAFTOSA	9	Columbia, Ecuador
SENASA-Arg	19	Ecuador

In South America, an FMD type O outbreak was reported in pigs in a slaughterhouse at Nariño, Colombia near the border with Ecuador causing an emergency situation during the month of July in Colombia. The outbreak was brought under control using a "stamping out" and vaccination (bivalent O and A vaccine) campaign, followed by intensive trace back and trace forward studies that included sero-sampling. Elsewhere, outbreaks of serotype O were reported in Ecuador (107) and, in addition Venezuela continues to have outbreaks and reported to the Continental Surveillance System FMDV serotype O (3) and A (8) during 2009. Genetic and antigenic typing results obtained for isolates studied in South America in 2009 (causing the emergency in Colombia and from endemic regions in Ecuador) showed that isolates belong to the endogenous Euro-SA strains and were related to viruses circulating in endemic areas of the Andean region. Vaccine matching studies suggest that vaccines that are currently in use should protect against clinical disease when applied under systematic vaccination and revaccination schemes.

As a consequence of the outbreak, Colombia had its status of free with vaccination granted in May, suspended until the authorities send the OIE proper documentation to request reinstatement. Currently the Urabá Chocoano and the San Andrés and Providencia islands remain free without vaccination in the country.

The second sero-sampling of the longitudinal surveillance scheme based on geographic risk characterization (farm level) was conducted during 2009 in the high surveillance zone (HSZ) created in the common borders of Argentina, Bolivia, Brazil and Paraguay. The NSP tests on sera collected (~9,000 samples) were conducted at PANAFTOSA.

The vaccines used in the region are all single oil emulsions. O Campos and A24 Cruzeiro are used throughout the region, whilst C3 Indaial is included in Bolivia, Brazil and Paraguay. The justification has been the Amazonas outbreak in 2004. In Argentina, a tetravalent vaccine is used incorporating A ARG 2001 in addition to O Campos and A24 Cruzeiro and C3 Indaial. The role of the OIE reference Laboratories in advising on methodology and standards for vaccine control is considered extremely important. Cattle up to 2 years old are vaccinated every 6 months and thereafter annually, aiming for 100% coverage. For vaccine matching, r_1 values of 0.25 or greater are considered acceptable and the 2009 type O viruses gave values over this threshold when tested at two OIE Reference Laboratories. In some cases r_1 values from Ecuador strains were close to the threshold. Considering the importance of vaccine potency, expectancy of protection (EPP) is also used to gauge antigenic match rather than relying on r_1 values alone.

Vaccine strains recommended for use in the region*:

Serotype	Internationally available	Locally produced
O	O_1 Campos,	O_1 Campos
A	A_{24} Cruzeiro, Argentina 2001	A_{24} Cruzeiro, Argentina 2001
C	C_3 Indaial	C_3 Indaial

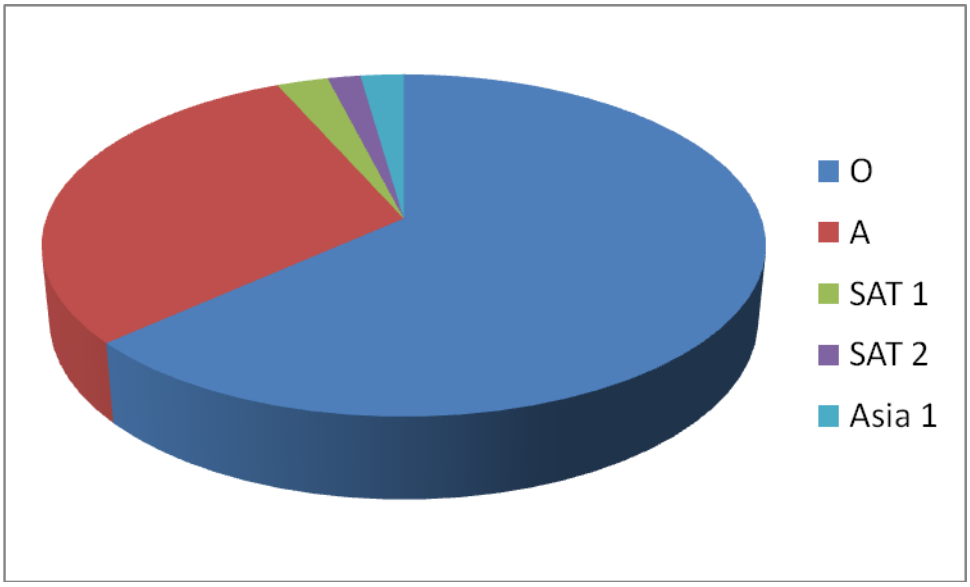
* PANAFTOSA recommendation is as High Priority: O_1 Campos, A_{24} Cruzeiro, C_3 Indaial, and as medium priority: A Argentina 2001

1.5. Clinical samples and FMDV isolates submitted to reference laboratories of the FMD network during the year in question.

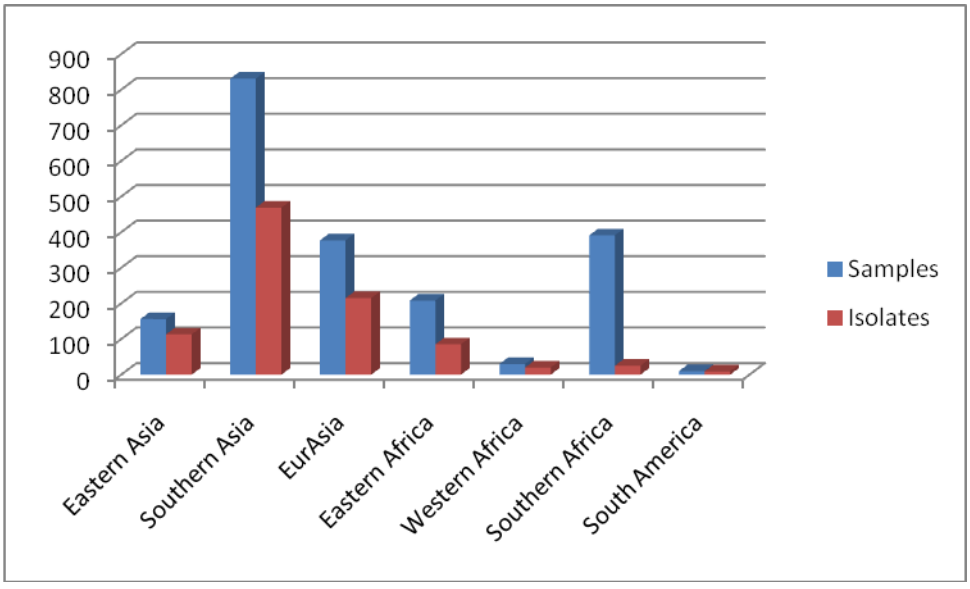
1.5.1. Overview of samples received and serotyping results

The network laboratories received and characterised approximately 2,400 samples in 2009 from 42 countries, of which approximately 400 had been collected in earlier years.

Of samples collected in 2009, the proportion of the different serotypes detected is shown below (serotypes C and SAT 3 were not detected):



The approximate number of samples and number of virus isolates made by region is shown below for samples collected in 2009:



The approximate numbers of samples received for FMDV detection and characterised in 2009 by the different network laboratories is tabulated below:

	Collected in 2009		Collected earlier	
Laboratory	Samples	Countries	Samples	Countries
WRLFMD	710	28	284	23
PANAFTOSA	10	2		
FGI-ARRIAH	2	2		
RRLSSA				
ARC-OVI	377	5	24	1
PIADC-FADDL	126	3		
LVRI				
PDFMD	640*	1		
RRLSEA	140	5	111 **	4
SENASA-Arg	19	1		

* some samples collected in 2008; **samples collected in year 2008

A searchable on-line database of samples is available via the Reference Laboratories Information System (ReLaIS) for the OIE/FAO FMD Reference Laboratories Network http://www.foot-and-mouth.org/.

Characterisation results obtained on samples received by WRLFMD and PANAFTOSA can be found respectively at: http://www.wrlfmd.org/ and at: http://www.panaftosa.org.br.

The report of the Fifth Annual Meeting of the OIE/FAO FMD Laboratory Network that was held in Delhi, India from 23rd – 27th November 2009, can be found at:

http://www.wrlfmd.org/ref_labs/fmd_ref_lab_reports.htm

1.5.2. Details of serotyping and molecular detection results of samples collected and received in 2009

Country	No. of samples	Virus isolation in cell culture/ELISA FMD virus serotypes							SVD virus	NVD	RT-PCR for FMD (or SVD) virus		Laboratory
		O	A	C	SAT 1	SAT 2	SAT 3	Asia 1			Positive	Negative	
EASTERN ASIA													
Cambodia	7	1	-	-	-	-	-	-	-	6			RRLSEA
Hong Kong	3	2	-	-	-	-	-	-	-	1	2	1	WRLFMD
Laos	22	17	4	-	-	-	-	-	-	1			RRLSEA
Malaysia	21										12	9	WRLFMD
Myanmar	8	4	-	-	-	-	-	-	-	4	8	-	WRLFMD
Myanmar	4	4	-	-	-	-	-	-	-	-			RRLSEA
Taiwan	1	1	-	-	-	-	-	-	-	-	1	-	WRLFMD
Thailand	4	4	-	-	-	-	-	-	-	-	4	-	WRLFMD
Thailand	60	27	13	-	-	-	-	-	-	-	20		RRLSEA
Vietnam	47	2	34	-	-	-	-	-	-	-	11		RRLSEA
SOUTHERN ASIA													
Bangladesh	31	17	-	-	-	-	-	-	-	14			WRLFMD
Bhutan	48	19	-	-	-		-	-	-	29	34	12	WRLFMD
India[1]	640	334	26	-	-	-	-	16	-	197			PDFMD
Nepal	15	8	-	-	-	-	-	-	-	7	13	2	WRLFMD
Pakistan	36	-	16	-	-	-	-	3	-	17	33	3	WRLFMD
Pakistan	59	20	9	-	-	-	-	-		-	41	18	FADDL
Sri Lanka	2	1	-	-	-	-	-	-	-	1	2	-	WRLFMD

Country	No. of samples	Virus isolation in cell culture/ELISA FMD virus serotypes							SVD virus	NVD	RT-PCR for FMD (or SVD) virus		Laboratory
		O	A	C	SAT 1	SAT 2	SAT 3	Asia 1			Positive	Negative	
EURASIA													
Bahrain	9	-	3	-	-	-	-	2	-	2	7	2	WRLFMD
Egypt[2]	32	20	11	-	-	-	-	-	-	3	30	2	WRLFMD
Iran	77	29	40	-	-	-	-	-	-	8	73	3	WRLFMD
Iraq	25	-	11	-	-	-	-	-	-	14	15	10	WRLFMD
Iraq	37	-	18	-	-	-	-	-		0	18	9	FADDL
Israel	21	-	20	-	-	-	-	-	-	1	19	1	WRLFMD
Kuwait	6	-	6	-	-	-	-	-	-	-	6	-	WRLFMD
Lebanon	7	-	4	-	-	-	-	-	-	3	5	2	WRLFMD
Libya	117	-	37	-	-	-	-	-	-	80	34	81	WRLFMD
Palestine	34	-	5	-	-	-	-	-	-	4	9	-	WRLFMD
Saudi Arabia	2	2	-	-	-	-	-	-	-	-	2	-	WRLFMD
Turkey	7	5	1	-	-	-	-	-	-	1	3	-	WRLFMD
United Arab Emirates	3	1	-	-	-	-	-	-	-	2	2	1	WRLFMD
EASTERN AFRICA													
Ethiopia	49	23	2	-	-	2	-	-	-	22	35	14	WRLFMD
Kenya	78	6	1	-	12	2	-	-	-	46	38	36	WRLFMD
Kenya	10	-	-	-	-	-	-	-	-	10		10	ARC-OVI
Somalia	4	-	-	-	-	-	-	-	-	4	-	4	WRLFMD
Uganda	3	-	-	-	-	-	-	-	-	3	2	1	WRLFMD
Yemen	64	37	-	-	-	-	-	-	-	27	47	17	WRLFMD
WESTERN AFRICA													
Nigeria	30	-	20	-	-	-	-	-		1	20	10	FADDL

Country	No. of samples	Virus isolation in cell culture/ELISA FMD virus serotypes O	A	C	SAT 1	SAT 2	SAT 3	Asia 1	SVD virus	NVD	RT-PCR for FMD (or SVD) virus Positive	Negative	Laboratory
SOUTHERN AFRICA													
Botswana	8	-	-	-	-	8	-	-	-	-	8	-	WRLFMD
Namibia	3	-	-	-	-	-	-	-	-	3	-	3	ARC-OVI
South Africa	361	-	-	-	7	-	-	-	-	354	11	350	ARC-OVI
Swaziland	2	-	-	-	-	-	-	-	-	2	-	2	ARC-OVI
Zambia	16	-	-	-	6	4	-	-	-	6	14	2	WRLFMD
Zambia	1	-	-	-	-	-	-	-	-	1	-	1	ARC-OVI
SOUTH AMERICA													
Columbia	3	3	-	-	-	-	-	-	-	-	3	-	PANAFTOSA
Ecuador	7	6	-	-	-	-	-	-	-	1	6	1	PANAFTOSA
Ecuador	19	19									19	0	SENASA
TOTAL[3]	**2043**	**612**	**281**	**0**	**25**	**16**	**0**	**21**	**0**	**875**	**607**	**607**	

[1] samples from 2008/9

[2] two samples from Egypt contained a mixture of type O and A FMDVs

[3] some samples may have been sent to more than one laboratory

1.5.3. Details of serotyping and molecular detection results of samples collected prior to 2009 and received in 2009

Region and Country	No. of samples	Virus isolation in cell culture/ELISA FMD virus serotypes O	A	C	SAT 1	SAT 2	SAT 3	Asia 1	SVD virus	NVD	RT-PCR for FMD (or SVD) virus Positive	Negative	Laboratory	Year collected
EASTERN ASIA														
Cambodia	4	3	1	-	-	-	-	-	-	-	4	-	WRLFMD	2004-8
Cambodia	17	10	1	-	-	-	-	-	-	6			RRLSEA	2008
Hong Kong	10	10	-	-	-	-	-	-	-	-	10	-	WRLFMD	2006-8
Laos	11	11	-	-	-	-	-	-	-	-			RRLSEA	2008
Myanmar	4	3	-	-	-	-	-	-	-	1	4	-	WRLFMD	2006-8
Myanmar	4	3	-	-	-	-	-	-	-	1			RRLSEA	2008
Thailand	18	6	12	-	-	-	-	-	-	-	18	-	WRLFMD	2008
Thailand	79	31	25	-	-	-	-	-	-	23			RRLSEA	2008
SOUTHERN ASIA														
Nepal	12	4	-	-	-	-	-	-	-	8	9	3	WRLFMD	2007-8
Pakistan	8	1	5	-	-	-	-	2	-	-	7	1	WRLFMD	2008
Sri Lanka	2	-	-	-	-	-	-	-	-	2	1	1	WRLFMD	2008
EURASIA														
Egypt	9	7	-	-	-	-	-	-	-	2	9	-	WRLFMD	2006-8
Israel	42	29	-	-	-	-	-	-	-	13	23	7	WRLFMD	2007-8
Italy	32	-	-	-	-	-	-	-	32	-	-	-	WRLFMD	2007-8
Palestine	25	20	-	-	-	-	-	-	-	5	23	2	WRLFMD	2007
Turkey	7	3	4	-	-	-	-	-	-	-			WRLFMD	2008
United Arab Emirates	19	8	-	-	-	-	-	-	-	11	14	5	WRLFMD	2008

Region and Country	No. of samples	Virus isolation in cell culture/ELISA: FMD virus serotypes O	A	C	SAT 1	SAT 2	SAT 3	Asia 1	SVD virus	NVD	RT-PCR for FMD (or SVD) virus: Positive	Negative	Laboratory	Year collected
EASTERN AFRICA														
Ethiopia	9	4	-	-	-	-	-	-	-	5	5	4	WRLFMD	2008
Kenya[1]	21	4	1	-	7	4	-	-	-	6	21	-	WRLFMD	2008
Sudan	8	5	-	-	-	2	-	-	-	1	7	1	WRLFMD	2008
Uganda	1	-	-	-	-	-	1	-	-	-	1	-	WRLFMD	1997
Yemen	18	6	-	-	-	-	-	-	-	12	11	7	WRLFMD	2007-8
WESTERN AFRICA														
Senegal	29	-	-	-	-	-	-	-	-	29	3	26	WRLFMD	2008
SOUTHERN AFRICA														
Malawi	1	-	-	-	-	1	-	-	-	-	1	-	WRLFMD	2008
Mozambique	1	-	-	-	1	-	-	-	-	-	1	-	WRLFMD	2002
South Africa	2	-	-	-	-	-	2	-	-	-	2	-	WRLFMD	2006
South Africa[2]	24	-	-	-	11	5	8	-	-	-	24	-	ARC-OVI	2008
Swaziland	2	-	-	-	2	-	-	-	-	-	2	-	WRLFMD	2000
TOTAL[3]	**419**	**168**	**49**	**0**	**21**	**12**	**11**	**2**	**32**	**125**	**200**	**57**		1997-2008

[1] one sample from Kenya contained a mixture of type O and SAT 1 FMDVs

[2] buffalo isolates

[3] some samples may have been sent to more than one laboratory

1.6. Genetic and antigenic typing of FMD virus isolates submitted to the Reference Laboratories

The table below lists FMDV isolates for which VP1 gene sequences (639 nucleotides) have been obtained by some of the Network Laboratories during 2009.

Phylogenetic trees and observations on them can be found at http://www.wrlfmd.org/ for all of the viruses that were analysed at WRLFMD. The VP1 gene sequences of a selection of virus isolates representative of all of the topotypes of FMDV can also be found at this website.

FMDV ID	Country of origin	Topotype	Lineage/strain	Sub-lineage	Laboratory	Date received	Comments
Serotype O							
TAJ/2009	Tajikistan	ME-SA	PanAsia-2		ARRIAH		
09A	Ecuador	EURO-SA			LFADLCT		
09B	Ecuador	EURO-SA			LFADLCT		
09C	Ecuador	EURO-SA			LFADLCT		
UAE/1/2008	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/2/2008	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/3/2008	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/4/2008	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/1/2009	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/3/2009	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/4/2009	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/5/2009	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
UAE/9/2009	United Arab Emirates	ME-SA	Ind-2001	-	WRLFMD	11/02/2009	
IRN/7/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	26/02/2009	
IRN/14/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	26/02/2009	
ETH/29/2008	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009	
ETH/31/2008	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009	

ETH/32/2008	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/1/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/3/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/4/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/5/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/6/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/7/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/8/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/9/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/10/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
ETH/11/2009	Ethiopia	EA-3	-	-	WRLFMD	26/02/2009
TUR/34/2008	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/35/2008	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/36/2008	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/38/2008	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/2/2009	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/3/2009	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/4/2009	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/5/2009	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
TUR/6/2009	Turkey	ME-SA	PanAsia-2	-	WRLFMD	09/03/2009
EGY/10/2006	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/11/2006	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/1/2008	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/3/2008	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/4/2008	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/5/2008	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/7/2008	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/1/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/6/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009
EGY/8/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	19/03/2009

PAK/14/2008	Pakistan	ME-SA	PanAsia-2	-	WRLFMD	27/03/2009
YEM/4/2008	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/5/2008	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/6/2008	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/7/2008	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/8/2008	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/10/2008	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/5/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/6/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/7/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/8/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/9/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/11/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/12/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/16/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/17/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/18/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/19/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/20/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/21/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/22/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/23/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/24/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/29/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/30/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/33/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/34/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/35/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/36/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009
YEM/37/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009

YEM/41/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/42/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/43/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/44/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/45/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/46/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/50/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/53/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
YEM/56/2009	Yemen	EA-3	-	-	WRLFMD	16/03/2009	
ETH/24/2009	Ethiopia	EA-3	-	-	WRLFMD	14/04/2009	
ETH/25/2009	Ethiopia	EA-3	-	-	WRLFMD	14/04/2009	
ETH/26/2009	Ethiopia	EA-3	-	-	WRLFMD	14/04/2009	
ETH/27/2009	Ethiopia	EA-3	-	-	WRLFMD	14/04/2009	
ETH/28/2009	Ethiopia	EA-3	-	-	WRLFMD	14/04/2009	
MYA/3/2009	Myanmar	SEA	Mya-98	-	WRLFMD	20/04/2009	
MYA/1/2006	Myanmar	SEA	Mya-98	-	WRLFMD	20/04/2009	
MYA/1/2009	Myanmar	SEA	Mya-98	-	WRLFMD	20/04/2009	
HKN/6/2006	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/1/2007	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/2/2007	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/3/2007	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/4/2007	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/1/2008	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/2/2008	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/3/2008	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/4/2008	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/1/2009	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
HKN/2/2009	Hong Kong	CATHAY	-	-	WRLFMD	23/04/2009	
KEN/22/2008	Kenya	in progress			WRLFMD	30/04/2009	O + SAT 1

KEN/24/2008	Kenya	EA-2	-	-	WRLFMD	30/04/2009
KEN/36/2008	Kenya	EA-2	-	-	WRLFMD	30/04/2009
KEN/37/2008	Kenya	EA-1	-	-	WRLFMD	30/04/2009
KEN/6/2009	Kenya	EA-2	-	-	WRLFMD	30/04/2009
KEN/10/2009	Kenya	EA-2	-	-	WRLFMD	30/04/2009
TAI/2/2008	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/3/2008	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/5/2008	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/6/2008	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/7/2008	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/12/2008	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/40/2008(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	29/07/2008
TAI/42/2008(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	31/07/2008
TAI/44/2008(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	15/08/2008
TAI/55/2008(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	08/09/2008
TAI/60/2008(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	07/11/2008
TAI/66/2008(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	04/12/2008
TAI/75/2008(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	18/12/2008
TAI/1/2009	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/2/2009	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/3/2009	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/4/2009	Thailand	SEA	Mya-98	-	WRLFMD	01/05/2009
TAI/8/2009(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	19/01/2009
TAI/9/2009(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	12/01/2009
TAI/11/2009(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	23/01/2009
TAI/14/2009(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	23/01/2009
TAI/27/2009(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	24/02/2009
TAI/P25/2009(*RRL)	Thailand	SEA	Mya-98	-	RRLSEA	26/08/2009
LAO/5/2009(*RRL)	Laos	SEA	Mya-98	-	RRLSEA	04/06/2009
MYA/1/2009(*RRL)	Myanmar	SEA	Mya-98	-	RRLSEA	15/06/2009

MYA/2/2009(*RRL)	Myanmar	SEA	Mya-98	-	RRLSEA	15/06/2009
MYA/3/2009(*RRL)	Myanmar	SEA	Mya-98	-	RRLSEA	15/06/2009
CAM/1/2004	Cambodia	ME-SA	PanAsia	-	WRLFMD	01/05/2009
CAM/5/2006	Cambodia	ME-SA	PanAsia	-	WRLFMD	01/05/2009
CAM/1/2008	Cambodia	ME-SA	PanAsia	-	WRLFMD	01/05/2009
MYA/2/2006	Myanmar	SEA	Mya-98	-	WRLFMD	01/05/2009
MYA/2/2008	Myanmar	SEA	Mya-98	-	WRLFMD	01/05/2009
EGY/17/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/18/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/19/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/20/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/21/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/22/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/23/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/24/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/25/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/26/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/27/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/28/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/29/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/30/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/31/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
EGY/32/2009	Egypt	ME-SA	Sharquia-72	-	WRLFMD	28/05/2009
ISR/11/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/13/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/14/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/15/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/17/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/19/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/20/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009

ISR/21/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/24/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/25/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/29/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/30/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/31/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/32/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/34/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/36/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/37/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/38/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/39/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/40/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/42/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/43/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/44/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/46/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/50/2007	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
ISR/1/2008	Israel	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/1/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/2/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/3/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/4/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/5/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/6/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/7/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/8/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/11/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/12/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/13/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009

PAT/15/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/16/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/17/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/18/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/19/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/21/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/22/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/23/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
PAT/24/2007	Palestinian A.T.	ME-SA	PanAsia-2	-	WRLFMD	02/06/2009
NEP/2/2007	Nepal	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
NEP/4/2008	Nepal	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
NEP/5/2008	Nepal	ME-SA	Ind-2001	-	WRLFMD	22/06/2009
NEP/7/2008	Nepal	ME-SA	Ind-2001	-	WRLFMD	22/06/2009
NEP/2/2009	Nepal	ME-SA	Ind-2001	-	WRLFMD	22/06/2009
NEP/3/2009	Nepal	ME-SA	Ind-2001	-	WRLFMD	22/06/2009
NEP/6/2009	Nepal	ME-SA	-	-	WRLFMD	22/06/2009
NEP/10/2009	Nepal	ME-SA	-	-	WRLFMD	22/06/2009
NEP/11/2009	Nepal	ME-SA	-	-	WRLFMD	22/06/2009
NEP/13/2009	Nepal	ME-SA	-	-	WRLFMD	22/06/2009
NEP/14/2009	Nepal	ME-SA	-	-	WRLFMD	22/06/2009
NEP/15/2009	Nepal	ME-SA	-	-	WRLFMD	22/06/2009
IRN/31/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
IRN/34/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
IRN/35/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
IRN/38/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
IRN/40/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
IRN/41/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
IRN/42/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
IRN/43/2009	Iran	ME-SA	PanAsia-2	-	WRLFMD	22/06/2009
TAW/1/2009	Taiwan	CATHAY	-	-	WRLFMD	22/06/2009

SAU/1/2009	Saudi Arabia	ME-SA	PanAsia-2	-	WRLFMD	19/08/2009	
SAU/2/2009	Saudi Arabia	ME-SA	PanAsia-2	-	WRLFMD	19/08/2009	
SRL/1/2009	Sri Lanka	ME-SA	-	-	WRLFMD	24/08/2009	
YEM/57/2009	Yemen	EA-3	-	-	WRLFMD	03/09/2009	
YEM/58/2009	Yemen	EA-3	-	-	WRLFMD	03/09/2009	
YEM/59/2009	Yemen	EA-3	-	-	WRLFMD	03/09/2009	
YEM/63/2009	Yemen	EA-3	-	-	WRLFMD	03/09/2009	
YEM/64/2009	Yemen	EA-3	-	-	WRLFMD	03/09/2009	
ETH/39/2009	Ethiopia	EA-3	-	-	WRLFMD	03/09/2009	
ETH/44/2009	Ethiopia	EA-3	-	-	WRLFMD	03/09/2009	
ETH/45/2009	Ethiopia	EA-3	-	-	WRLFMD	03/09/2009	
ETH/46/2009	Ethiopia	EA-3	-	-	WRLFMD	03/09/2009	
ETH/47/2009	Ethiopia	EA-3	-	-	WRLFMD	03/09/2009	
ETH/49/2009	Ethiopia	EA-3	-	-	WRLFMD	03/09/2009	
MAY/5/2009	Malaysia	SEA	Mya-98	-	WRLFMD	26/10/2009	FMDV-GD[1]
MAY/6/2009	Malaysia	SEA	Mya-98	-	WRLFMD	26/10/2009	FMDV-GD
MAY/7/2009	Malaysia	SEA	Mya-98	-	WRLFMD	26/10/2009	FMDV-GD
MAY/8/2009	Malaysia	SEA	Mya-98	-	WRLFMD	26/10/2009	FMDV-GD
MAY/11/2009	Malaysia	ME-SA	PanAsia	-	WRLFMD	26/10/2009	FMDV-GD
MAY/20/2009	Malaysia	SEA	Mya-98	-	WRLFMD	26/10/2009	FMDV-GD
MAY/21/2009	Malaysia	SEA	Mya-98	-	WRLFMD	26/10/2009	FMDV-GD
KEN/62/2009	Kenya	EA-1	-	-	WRLFMD	06/11/2009	
KEN/63/2009	Kenya	EA-1	-	-	WRLFMD	06/11/2009	
KEN/64/2009	Kenya	EA-1	-	-	WRLFMD	06/11/2009	
KEN/65/2009	Kenya	EA-1	-	-	WRLFMD	06/11/2009	
KEN/66/2009	Kenya	EA-1	-	-	WRLFMD	06/11/2009	
KEN/67/2009	Kenya	EA-1	-	-	WRLFMD	06/11/2009	
MYA/5/2009	Myanmar	SEA	Mya-98	-	WRLFMD	19/11/2009	
MYA/6/2009	Myanmar	SEA	Mya-98	-	WRLFMD	19/11/2009	
BAN/1/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	

BAN/2/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/3/2009	Bangladesh	ME-SA	not designated	-	WRLFMD	27/11/2009	
BAN/4/2009	Bangladesh	ME-SA	not designated	-	WRLFMD	27/11/2009	
BAN/5/2009	Bangladesh	ME-SA	not designated	-	WRLFMD	27/11/2009	
BAN/9/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/11/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/20/2009	Bangladesh	ME-SA	not designated	-	WRLFMD	27/11/2009	
BAN/23/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/24/2009	Bangladesh	ME-SA	not designated	-	WRLFMD	27/11/2009	
BAN/25/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/26/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	FMDV-GD
BAN/27/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/28/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/29/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/30/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
BAN/31/2009	Bangladesh	ME-SA	Ind-2001	-	WRLFMD	27/11/2009	
Serotype A							
LEB/2009	Lebanon	ASIA	Iran-05		ARRIAH		
BAR/2/2009	Bahrain	ASIA	Iran-05	AFG-07	WRLFMD	21/01/2009	
BAR/4/2009	Bahrain	ASIA	Iran-05	AFG-07	WRLFMD	21/01/2009	
IRQ/9/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	28/01/2009	
IRQ/10/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	28/01/2009	
IRQ/11/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	28/01/2009	
IRQ/12/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	28/01/2009	
IRQ/15/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	28/01/2009	

IRQ/17/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	28/01/2009
IRQ/19/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	28/01/2009
KUW/1/2009	Kuwait	ASIA	Iran-05	BAR-08	WRLFMD	11/02/2009
KUW/2/2009	Kuwait	ASIA	Iran-05	BAR-08	WRLFMD	11/02/2009
KUW/3/2009	Kuwait	ASIA	Iran-05	BAR-08	WRLFMD	11/02/2009
KUW/4/2009	Kuwait	ASIA	Iran-05	BAR-08	WRLFMD	11/02/2009
KUW/5/2009	Kuwait	ASIA	Iran-05	BAR-08	WRLFMD	11/02/2009
KUW/6/2009	Kuwait	ASIA	Iran-05	BAR-08	WRLFMD	11/02/2009
IRQ/21/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	15/02/2009
IRQ/22/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	15/02/2009
IRQ/23/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	15/02/2009
IRQ/24/2009	Iraq	ASIA	Iran-05	BAR-08	WRLFMD	15/02/2009
IRN/1/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/2/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/3/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/4/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/5/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/6/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/8/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/9/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/10/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/11/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/12/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/13/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/15/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/16/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/17/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/18/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/19/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/20/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009

IRN/21/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/22/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/23/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/24/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/25/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/26/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/27/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/28/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
IRN/29/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	26/02/2009
ETH/12/2009	Ethiopia	AFRICA	G-VII	-	WRLFMD	26/02/2009
ETH/13/2009	Ethiopia	AFRICA	G-VII	-	WRLFMD	26/02/2009
TUR/37/2008	Turkey	ASIA	Iran-05	ARD-07	WRLFMD	09/03/2009
TUR/39/2008	Turkey	ASIA	Iran-05	ARD-07	WRLFMD	09/03/2009
TUR/40/2008	Turkey	ASIA	Iran-05	EZM-07	WRLFMD	09/03/2009
TUR/7/2009	Turkey	ASIA	Iran-05	ARD-07	WRLFMD	09/03/2009
LIB/1/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/2/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/3/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/4/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/5/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/6/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/7/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/8/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/9/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/10/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/11/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/12/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/13/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/14/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/15/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009

LIB/16/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/17/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/18/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/19/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/20/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/21/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/42/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/43/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/44/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/47/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/48/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/50/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/51/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/54/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/55/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/56/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/57/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/91/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/92/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/93/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/94/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
LIB/117/2009	Libya	ASIA	Iran-05	BAR-08	WRLFMD	12/03/2009
EGY/3/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
EGY/4/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
EGY/7/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
EGY/9/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
EGY/12/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
EGY/13/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
EGY/14/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
EGY/15/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009

EGY/16/2009	Egypt	AFRICA	G-VII	-	WRLFMD	19/03/2009
LEB/1/2009	Lebanon	ASIA	Iran-05	BAR-08	WRLFMD	24/03/2009
LEB/4/2009	Lebanon	ASIA	Iran-05	BAR-08	WRLFMD	24/03/2009
LEB/5/2009	Lebanon	ASIA	Iran-05	BAR-08	WRLFMD	24/03/2009
LEB/7/2009	Lebanon	ASIA	Iran-05	BAR-08	WRLFMD	24/03/2009
PAK/7/2008	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	27/03/2009
PAK/9/2008	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	27/03/2009
PAK/10/2008	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	27/03/2009
PAK/12/2008	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	27/03/2009
PAK/13/2008	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	27/03/2009
PAK/1/2009	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	27/03/2009
PAK/2/2009	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	27/03/2009
PAK/4/2009	Pakistan	ASIA	Iran-05	BAR-08	WRLFMD	27/03/2009
BAR/6/2009	Bahrain	ASIA	Iran-05	BAR-08	WRLFMD	01/05/2009
KEN/28/2008	Kenya	AFRICA	G-I	-	WRLFMD	30/04/2009
KEN/22/2009	Kenya	AFRICA	G-I	-	WRLFMD	30/04/2009
TAI/4/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/8/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/9/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/10/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/11/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/13/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/14/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/15/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/16/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/17/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/18/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/19/2008	Thailand	ASIA	-	-	WRLFMD	01/05/2009
TAI/16/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	20/04/2008
TAI/20/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	06/05/2008

TAI/23/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	05/06/2008
TAI/34/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	10/07/2008
TAI/53/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	08/08/2008
TAI/63/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	17/11/2008
TAI/65/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	04/12/2008
TAI/68/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	09/12/2008
TAI/77/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	22/12/2008
TAI/78/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	22/12/2008
TAI/12/2009(*RRL)	Thailand	ASIA	-	-	RRLSEA	26/01/2009
TAI/19/2009(*RRL)	Thailand	ASIA	-	-	RRLSEA	05/02/2009
TAI/20/2009(*RRL)	Thailand	ASIA	-	-	RRLSEA	06/02/2009
TAI/22/2009(*RRL)	Thailand	ASIA	-	-	RRLSEA	17/02/2009
TAI/25/2009(*RRL)	Thailand	ASIA	-	-	RRLSEA	19/02/2009
VIT/2/2009(*RRL)	Thailand	ASIA	-	-	RRLSEA	08/06/2009
VIT/2/2009(*RRL)	Thailand	ASIA	-	-	RRLSEA	08/06/2009
CAM/4/2008(*RRL)	Thailand	ASIA	-	-	RRLSEA	29/10/2008
CAM/2/2008	Cambodia	ASIA	-	-	WRLFMD	01/05/2009
ISR/1/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/2/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/3/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/4/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/5/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/6/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/7/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/8/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/9/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/10/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/11/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/12/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/13/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009

ISR/14/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/15/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/16/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/17/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
ISR/18/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
PAT/1/2009	Palestinian A.T.	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
PAT/2/2009	Palestinian A.T.	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
PAT/5/2009	Palestinian A.T.	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
PAT/6/2009	Palestinian A.T.	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
PAT/8/2009	Palestinian A.T.	ASIA	Iran-05	BAR-08	WRLFMD	02/06/2009
IRN/30/2009	Iran	ASIA	Iran-05	AFG-07	WRLFMD	22/06/2009
IRN/32/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	22/06/2009
IRN/36/2009	Iran	ASIA	Iran-05	AFG-07	WRLFMD	22/06/2009
IRN/37/2009	Iran	ASIA	Iran-05	BAR-08	WRLFMD	22/06/2009
IRN/39/2009	Iran	ASIA	Iran-05	AFG-07	WRLFMD	22/06/2009
IRN/44/2009	Iran	ASIA	Iran-05	AFG-07	WRLFMD	22/06/2009
PAK/6/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/7/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/8/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/9/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/10/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/13/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/15/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/17/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
PAK/18/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	15/06/2009
ISR/20/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	13/07/2009
ISR/21/2009	Israel	ASIA	Iran-05	BAR-08	WRLFMD	27/07/2009
PAK/23/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	28/09/2009
PAK/23/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	28/09/2009
PAK/24/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	28/09/2009

PAK/24/2009	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	28/09/2009	
PAK/25/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	28/09/2009	
PAK/25/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	28/09/2009	
PAK/31/2009	Pakistan	ASIA	Iran-05	-	WRLFMD	28/09/2009	
PAK/31/2009	Pakistan	ASIA	Iran-05	AFG-07	WRLFMD	28/09/2009	
MAY/2/2009	Malaysia	ASIA	-	-	WRLFMD	26/10/2009	FMDV-GD
MAY/9/2009	Malaysia	ASIA	-	-	WRLFMD	26/10/2009	FMDV-GD
Type Asia 1							
PAK/8/2008	Pakistan	-	-	-	WRLFMD	27/03/2009	
PAK/11/2008	Pakistan	-	-	-	WRLFMD	27/03/2009	
BAR/9/2009	Pakistan	-	-	-	WRLFMD	01/05/2009	
BAR/8/2009	Pakistan	-	-	-	WRLFMD	01/05/2009	
PAK/29/2009	Pakistan	-	-	-	WRLFMD	28/09/2009	
PAK/26/2009	Pakistan	-	-	-	WRLFMD	28/09/2009	
PAK/27/2009	Pakistan	-	-	-	WRLFMD	28/09/2009	
Type SAT 1							
ZAM/1/2009	Zambia	I (NWZ)	-	-	WRLFMD	30/03/2009	
ZAM/3/2009	Zambia	I (NWZ)	-	-	WRLFMD	30/03/2009	
ZAM/6/2009	Zambia	I (NWZ)	-	-	WRLFMD	30/03/2009	
ZAM/7/2009	Zambia	I (NWZ)	-	-	WRLFMD	30/03/2009	
ZAM/8/2009	Zambia	I (NWZ)	-	-	WRLFMD	30/03/2009	
ZAM/9/2009	Zambia	I (NWZ)	-	-	WRLFMD	30/03/2009	
KEN/16/2009	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009	
KEN/22/2008	Kenya	in progress	-	-	WRLFMD	30/04/2009	O + SAT 1
KEN/23/2008	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009	
KEN/25/2008	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009	
KEN/26/2008	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009	

KEN/32/2008	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/34/2008	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/35/2008	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/2/2009	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/8/2009	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/9/2009	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/12/2009	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/14/2009	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
KEN/15/2009	Kenya	I (NWZ)	-	-	WRLFMD	30/04/2009
SWZ/1/2000	Swaziland	II (SEZ)	-	-	WRLFMD	18/09/2009
SWZ/2/2000	Swaziland	II (SEZ)	-	-	WRLFMD	18/09/2009
MOZ/2/2002	Mozambique	I (NWZ)	-	-	WRLFMD	18/09/2009
KEN/55/2009	Kenya	I (NWZ)	-		WRLFMD	06/11/2009
KEN/104/2009	Kenya	I (NWZ)	-		WRLFMD	06/11/2009
KEN/109/2009	Kenya	I (NWZ)	-		WRLFMD	06/11/2009
KEN/117/2009	Kenya	I (NWZ)	-		WRLFMD	06/11/2009
KEN/119/2009	Kenya	I (NWZ)	-		WRLFMD	06/11/2009
SAR/1/09	South Africa	I (SEZ)	-		ARC-OVI	07/09/2009
SAR/2/09	South Africa	I (SEZ)	-		ARC-OVI	07/09/2009
SAR/3/09	South Africa	I (SEZ)	-		ARC-OVI	07/09/2009
SAR/4/09	South Africa	I (SEZ)	-		ARC-OVI	07/09/2009
SAR/5/09	South Africa	I (SEZ)	-		ARC-OVI	18/09/2009
SAR/6/09	South Africa	I (SEZ)	-		ARC-OVI	18/09/2009
SAR/7/09	South Africa	I (SEZ)	-		ARC-OVI	18/09/2009
Type SAT 2						
ZAM/12/2009	Zambia	III	-	-	WRLFMD	30/03/2009
ZAM/13/2009	Zambia	III	-	-	WRLFMD	30/03/2009
ZAM/14/2009	Zambia	III	-	-	WRLFMD	30/03/2009

ZAM/16/2009	Zambia	III	-	-	WRLFMD	30/03/2009	
KEN/18/2008	Kenya	IV	-	-	WRLFMD	30/04/2009	
KEN/19/2008	Kenya	IV	-	-	WRLFMD	30/04/2009	
KEN/21/2008	Kenya	IV	-	-	WRLFMD	30/04/2009	
KEN/31/2008	Kenya	IV	-	-	WRLFMD	30/04/2009	
KEN/11/2009	Kenya	IV	-	-	WRLFMD	30/04/2009	
KEN/13/2009	Kenya	IV	-	-	WRLFMD	30/04/2009	
BOT/2/2009	Botswana	III	-	-	WRLFMD	08/06/2009	
BOT/3/2009	Botswana	III	-	-	WRLFMD	08/06/2009	
BOT/4/2009	Botswana	III	-	-	WRLFMD	08/06/2009	
BOT/5/2009	Botswana	III	-	-	WRLFMD	31/07/2009	
BOT/6/2009	Botswana	III	-	-	WRLFMD	31/07/2009	
BOT/7/2009	Botswana	III	-	-	WRLFMD	31/07/2009	
BOT/8/2009	Botswana	III	-	-	WRLFMD	31/07/2009	
ETH/42/2009	Ethiopia	XIII	-	-	WRLFMD	03/09/2009	
ETH/48/2009	Ethiopia	XIII	-	-	WRLFMD	03/09/2009	
MAL/1/2008	Malawi	I	-	-	WRLFMD	18/09/2009	
Type SAT 3							
SAR/1/2006	South Africa	I (SEZ)	-	-	WRLFMD	18/09/2009	
SAR/2/2006	South Africa	I (SEZ)	-	-	WRLFMD	18/09/2009	
UGA/10/97	Uganda	V (EA)	-	-	WRLFMD	18/09/2009	aka UGA/2/97/3

[1]FMDV-GD = originally reported as FMDV genome detected by RT-PCR, but serotype unknown and subsequently sequenced directly from RT-PCR without virus isolation.

1.6.2. Summary of antigenic typing

Vaccine efficacy is influenced by both vaccine potency and vaccine match and poor match may to some extent be compensated by high potency. Thus, a vaccine with a weak antigenic match to a field isolate, as determined by serology, may nevertheless afford some protection if it is of sufficiently high potency. Therefore, in the absence of a good match, or where the match is unknown, vaccines of high potency should preferably be used. Potency can be augmented by booster vaccination. The r_1 values shown below, represent the one way serological match between vaccine strain and field isolate, calculated from the comparative reactivity of an antiserum, raised against the vaccine in question, to the vaccine virus and the field isolate.

1.6.3. Antigenic characterisation of field isolates by matching with vaccine strains at FGI-ARRIAH

Antigenic characterisation of FMD field isolates by matching with vaccine strains
r_1 values were obtained by VNT **(ARRIAH)**

FMDV Serotype A

Isolates	**VNT**			
	A_{22} №550	A Turkey /06	A Iran/97	A_{22} Iraq 24/64
A/Lebanon/09	0,2	0,4	0,06	0,38

Interpretation of r_1 values

In the case of VNT:

$r_1 = \geq 0.3$ suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.
$r_1 = < 0.3$ suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect.

1.6.4. Antigenic characterisation of field isolates from Ecuador by matching with vaccine strain O1 Campos- r_1 values obtained by VNT and CFT at SENASA Laboratory.

Test	r_1 value	EPP
VNT	0.27	Post-vaccination O1 Campos: 81.78% O Ecuador: 38.31% Post re-vaccination O1 Campos: ≥95.33% O Ecuador: 78.19%
CFT	0.27	

1.6.5. Antigenic characterization of field isolates from Ecuador by matching with vaccine strain O1 Campos- r_1 values obtained by CFT at PANAFTOSA Laboratory.

Test	sample	"r_1" value *
CFT	18	0,40
	25	0,78
	39	0,77
	57	0,81
	128	0,84
	164	0,79
	O1 Campos	1,00

* values ≥ 0.25 indicates that field sample belong to the same subtype than vaccine strain

Vaccine matching studies by LP-ELISA using a panel of 30 bovine sera 30 days post vaccination and 30 bovine sera 30 days post re vaccination (*)

	EPP by LP-ELISA O1 Campos*	
Viral strain	**30 dpv**	**30 dpR**
O1 Ecuador 018/2009	73,30	98,46

* EPP values ≥ 70 (panels of 30 sera) or ≥ 75 (panels of 16 sera) in revaccinated animals suggest that the vaccine strain protect against field virus

1.6.6. Antigenic characterisation of field isolates by matching with vaccine strains
r_1 values were obtained by VNT or ELISA at WRLFMD

Jan-Mar 2009

Five FMDV type O isolates (O ETH 15 and 24/2008; and O SUD 3, 4 and 8/2008) from Ethiopia and Sudan collected in 2008. O ETH 15 and 24/2008 and O SUD 4 and 8/2008 were antigenically close to O Manisa, O BFS 1860, O Ind R2/75 and O Kaufbeuren (not O ETH 24/2008) but did not match with O 4174 vaccine strains. Two isolates from Ethiopia and two isolates from Sudan were also matched with O 3039 and O Tunisa vaccine strains by LPBE, respectively. Isolate O SUD 3/2008 was only tested against O 4174 and the result showed no match between the two viruses.

Twelve FMDV type A viruses (A BAR 2, 6 and 7/2008; A ETH 7 and 9/2008; A KUW 3 and 4/2008; A IRQ 9, 10, 17, 21 and 24/2009) from Bahrain, Ethiopia, Kuwait and Iraq collected in 2008 and 2009. All isolates tested showed close match to the A TUR 06 vaccine strain while failed to match with all of A IRN87, A IRN96, A SAU95 and A IND 17/82 vaccine strains. Isolates from Kuwait, Iraq and one (A BAR 2/2009) from Bahrain showed close match with A MAY97 by LPBE. Two isolates from Bahrain and one isolate from Ethiopia showed a match with A Ertrea98 vaccine strain by LPBE.

Three viruses from Bahrain, 1 from Kuwait and 3 from Iraq showed a match with the A_{22} Iraq vaccine strain by either 2dmVNT or LPBE.

Two field isolates from Botswana (SAT2 BOT 16 and 18/2008) gave no antigenic match with SAT2 Eritrea98 vaccine strain by LPBE.

Apr-Jun 2009

Four FMDV type O isolates (O IRN 7 and 14/2009; and O TUR 3 and 35/2009) from Iran and Turkey collected in 2009 were further characterised by two dimensional virus neutralisation test (2dmVNT) and/or LPBE. The results showed that two isolates from Iran were antigenically matched with O Manisa if a high potency vaccine was used but there was not a close match to O BFS or O IND R2/75. O TUR 35/2009 was antigenically relatively close to O 4174 if a high potency vaccine was used. O TUR 3/2009 showed no match with O Manisa, O BFS and O 4174.

Six FMDV type A viruses (A TUR 7, 14 and 40/2009; A ETH 12 and 13/2009; and A LIB 14 and 117/2009) from Turkey, Ethiopia and Libya collected in 2009. All isolates tested showed close match to the A TUR 06 vaccine strain but failed to match with A_{22} IRQ except A LIB 14/2009 which showed a relative match with A_{22}. Two viruses isolated from Ethiopia were antigenically close to A Eritrea 98 vaccine but not to A SAU 41/91, A IRN 99 and A IRN 87. Two viruses from Turkey showed no antigenic match with A SAU 41/91, A IRN 99 and A IRN 87 while A TUR 40/2009 showed a low match to A Eritrea 98 by LPBE. A LIB 14/2009 gave a match with A SAU 41/91 but not with A Eritrea 98 while A LIB 117/2009 showed no antigenic relationship with either A Eritrea 98 or A SAU 41/91.

Jul-Aug 2009

Eighteen FMDV type O isolates from Pakistan, Turkey, Ethiopia, Myanmar, Yemen, Israel, Hong Kong, Taiwan, Kenya and Saudi Arabia collected in 2007, 2008 and 2009. The majority of isolates were matched with O IND R2/75 vaccine strain by VNT. Fifteen out of seventeen tested viruses were close to O1 Manisa either by VNT or LPBE. Only six out of 17 tested virus showed an antigenic match with O BFS. O 3039 and O 4625 vaccines also gave relatively good coverage to 5 out of six and 9 out of 11 tested viruses, respectively.

Seven FMDV type A viruses from Lebanon, Pakistan and Israel collected in 2008 and 2009. All isolates tested showed close match to the A TUR 06 and A SAU 41/91 (except A PAK 4/2009) vaccine strains and almost all failed to match with A_{22} IRQ. The exceptions were A PAK 13/2008 and A PAK 2/2009 which showed a relative match with A_{22} by VNT. Vaccines A Eritrea 98, A IRN 87 and A IRN 99 did not provide antigenic coverage to the tested isolates .

Five FMDV SAT 2 viruses from Zambia, Kenya and Botswana collected in 2009. SAT 2 KEN 11/2009 and SAT 2 BOT 4/2009 showed an antigenic match with SAT 2 Eritrea vaccine virus. Neither SAT 2 ZIM nor SAT 2 K65/82 vaccine showed coverage to the tested field isolates by either VNT or LPBE.

Sep-Dec 2009

Two FMDV type O isolates (O SRL 1/2009 and O IRN 40/2009) from Sri Lanka and Iran collected in 2009: both matched with O Manisa, O BFS, O IND R2/75, O 4171 vaccine strain by VNT and/or LPBE.

Six FMDV type A viruses from Iran, Pakistan and Palestinian Autonomous Territories collected in 2009. Two isolates from Iran and one isolate from Palestinian Autonomous Territories showed antigenic match with A22 Irq and A Turkey 06 vaccine strains. Virus A PAK 23/2009 and A PAT 1/2009 failed to match any of vaccine strains tested.

Four FMDV SAT 1 viruses from Kenya and Zambia, collected in 2009. All except SAT 1 KEN 12/2009 showed an antigenic match with SAT 1 Rho.

Five FMDV SAT 2 viruses from Botswana, Ethiopia and Kenya collected in 2009. All except SAT 2 BOT 6/2009 showed a good match with SAT 2 Eritrea vaccine and all except SAT 2 ETH 42/2009 (not tested) scores as matching with SAT 2 ZIM vaccine.

Serotype O

Field isolate	Date received	Vaccine ID: O Manisa vnt	O Ind R2/75 vnt	O BFS vnt	O Kaufbeuren vnt
Egy 04/2008	10.7.09			0.46	
Egy 10/2006	10.7.09	>1.0	>1.0	0.29	
Egy 21/2009	10.7.09	>1.0	>1.0	>1.0	
Egy 27/2009	10.7.09	>1.0	>1.0	>1.0	
Eth 15/2008	16.12.08	0.46	0.69	0.7	0.58
Eth 24/2008	16.12.08	0.44	0.65	0.7	0.23
Eth 24/2009	30.4.09	0.32	>1.0	0.43	
Eth 28/2009	30.4.09	0.32	>1.0	0.74	
Eth 39/2009	11.9.09	0.16	0.86	0.51	
Eth 49/2009	11.9.09	0.34	>1.0	0.56	
Hkn 01/2009	30.7.09	0.24	0.46	0.08	
Hkn 02/2009	30.7.09	0.29	0.32	0.07	
Irn 07/2009	11.3.09	0.17	0.18	0.06	
Irn 14/2009	11.3.09	0.26		0.16	
Irn 40/2009	28.8.09	0.44	>1.0	>0.76	
Isr 43/2007	23.7.09	0.36	>0.74	0.17	
Isr 50/2007	23.7.09	0.21	>1.0	0.20	
Ken 10/09	31.7.09	0.92	0.63	0.82	
Mya 03/2009	30.4.09	0.20	0.27	0.19	
Mya 05/09	27.11.09	0.12	0.64	0.24	
Mya 06/09	27.11.09	0.32	>1.0	0.52	
Nep 02/2007	17.9.09	0.28	>1.0	0.6	
Nep 07/2008	17.9.09	0.29	>1.0	0.47	
Nep 06/2009	17.9.09	0.15	>1.0	0.6	
Nep 15/2009	17.9.09	0.17	>0.94	0.4	
Pak 14/2008	7.7.09	0.69	0.79	0.21	
PAT 01/2007	14.10.09	0.29	>1.0	0.44	
PAT 24/2007	14.10.09	0.3	>1.0	0.45	
Sau 01/2009	26.8.09	0.74	0.46	0.72	
Sau 02/2009	26.8.09	0.72	0.35	0.66	
Sud 04/2008	22.1.09	0.68	0.78	0.49	0.36
Sud 08/2008	22.1.09	0.49	0.9	0.35	0.37
Srl 01/2009	28.8.09	0.28	>1.0	0.59	
Tai 07/2008	16.9.09	0.06	0.13	0.09	
Tai 01/2009	16.9.09	0.24	0.67	0.34	
Tai 02/2009	16.9.09	0.28	0.79	0.43	
Tai 04/2009	16.9.09	0.45	>0.83	0.65	
Taw 01/2009	31.7.09	>0.76	0.66	0.25	
Tur 03/2009	28.3.09	>0.86	>1.0	0.25	
Tur 35/2009	28.3.09	0.24	0.43	0.28	
UAE 03/2008	26.2.09	0.73	0.79	0.7	0.38
UAE 04/2009	26.2.09	0.20	0.83	0.11	
Yem 05/2009	14.7.09	0.08	>0.63	0.15	
Yem 42/2009	14.7.09	0.04	0.65	0.05	
Yem 56/2009	14.7.09	0.21	>1.0	0.36	
Yem 58/2009	11.9.09	0.13	0.62	0.41	
Yem 64/2009	11.9.09	0.12	>0.81	0.41	

Serotype A

Field isolate	Date received	Vaccine ID										
		A_{22} Iraq vnt	Tur06 vnt	Ind 17/82 vnt	SAU91 vnt	Eri98 vnt	Irn 87 vnt	IRN96 vnt	May-97 vnt	IRN99 vnt	SAU95 vnt	A15 vnt
Bar 02/2009	06.02.09	0.38	0.72	0.13	0.20	0.04						
Bar 04/2009	06.02.09											
Bar 06/2008	16.12.08	0.23	0.6		0.4	0.04	0.12	0.06			0.11	
Egy04/2009	10.07.09	0.06	0.22		0.02	0.17	0.29		0.27			
Egy16/2009	10.07.09	0.06	0.45		0.03	0.32	0.41		0.18			
Eth 09/2008	16.12.08	0.07	0.46		0.04	0.12	0.04	0.07			0.3	
Eth 12/2009	30.04.09	0.16	0.46		0.06	0.35						
Eth 13/2009	30.04.09	0.2	0.34		0.09	0.37						
Irn 02/2009	11.03.09	0.35	0.93				0.13		0.09	0.14		
Irn 06/2009	11.03.09	0.1	0.38				0.31		0.29	0.24		
Irn 23/2009	11.03.09	0.07	0.35							0.11		
Irn 25/2009	11.03.09	0.08	0.35							0.10		
Irn 39/2009	28.08.09	0.34	0.52	0.1	0.21		0.09		0.09	0.08		
Irn 44/2009	28.08.09	0.35	>0.72	0.11	0.3		0.07		0.09	0.09		
Irq 10/2009	06.02.09	0.27	0.74		0.32		0.12	0.05	0.12			
Irq 17/2009	06.02.09	0.32	>0.83		0.35		<0.13	0.05	0.13			
Irq 21/2009	26.02.09	0.11	0.6		0.19							
Irq 24/2009	26.02.09	0.53	0.81	0.22	0.24	0.04						
Isr 02/2009	24.07.09	0.28	0.86	0.28	0.51	0.08	0.12		0.05			
Isr 18/2009	24.07.09	0.23	>1.0	0.31	0.6	0.08	0.11		0.07			
Ken22/2009	31.07.09	0.06	0.07	0.19	0.05	failx2	0.34		0.15	failx2		
Kuw03/2009	26.02.09	0.17	0.65	0.16	0.13	0.06						
Kuw04/2009	26.02.09	0.21	0.61	0.20	0.13	0.04						
Leb 01/2009	16.07.09	0.25	0.58	0.29	0.37	0.05	0.08		0.03			
Leb 05/2009	16.07.09	0.12	0.47	0.20	0.35	0.04	0.05		0.01			
Lib117/2009	28.03.09	0.18	0.61		0.23	0.03						
Lib 14/2009	28.03.09	0.37	0.83		0.36	0.04						
Pak02/2009	07.07.09	0.63	>1.0	0.08	>1.0							
Pak04/2009	07.07.09	0.09	0.46	0.35	0.08							
Pak13/2008	07.07.09	0.45	>1.0	0.08	0.42							

Pak23/2009	08.10.09	0.07	0.23	0.18	0.04		0.11	0.06	0.08	
Pak24/2009	19.10.09	0.10	0.32	0.17	0.04		0.10	0.09	0.10	
PAT01/2009	14.10.09	0.09	0.24	0.26	0.08		0.08	0.08	<0.09	
PAT06/2009	14.10.09	0.19	0.75	0.43	0.36		0.08	0.13	0.09	
Tai 04/2008	16.09.09	0.15						0.31		0.24
Tai 09/2008	16.09.09	0.16						0.23		0.22
Tai 10/2008	16.09.09	0.19						0.37		0.33
Tai 15/2008	16.09.09	0.14						0.31		0.20
Tai 19/2008	16.09.09	0.13						0.41		0.23
Tur 07/2009	28.03.09	0.13	0.44		0.03	0.05				
Tur 40/2009	28.03.09	0.06	0.79		0.01	0.10				

Serotype Asia 1

Field isolate	Date received	Vaccine ID		
		Ind 8/79	Shamir	WBN
Bar 8/2009	07.07.2009	0.14	0.80	0.12
Bar 9/2009	07.07.2009	0.12	0.78	0.08
Pak 29/2009	08.10.2009	0.12	0.14	0.43

Serotype SAT 1

Field isolate	Date received	Vaccine ID Rho 12/78 VNT
Ken 12/2009	31.07.09	0.13
Ken 15/2009	31.07.09	0.31
Ken 55/2009	27.11.09	0.51
Ken 119/2009	27.11.09	0.93
Zam 07/2009	21.07.09	>0.99
Zam 08/2009	21.07.09	0.70

Serotype SAT 2

Field isolate	Date received	Vaccine ID Eri 3218 VNT	Zim 7/83 VNT
Bot 02/2009	31.07.09	0.23	0.09
Bot 04/2009	31.07.09	0.32	0.07
Bot 06/2009	26.08.09	0.11	0.37
Bot 16/2008	21.11.08	fail	fail
Bot 18/2008	21.11.08	fail	fail
Eth 42/2009	09.09.09	0.52	0.35
Eth 48/2009	09.09.09	0.5	0.32
Ken 11/2009	31.07.09	0.35	0.28
Ken 13/2009		1	>1.0
Sud 01/2008	22.01.09	0.27	<0.13
Sud 02/2008	22.01.09	0.18	0.15
Zam 14/2009	21.07.09	0.22	0.04
Zam 16/2009	21.07.09	0.17	0.08

Acknowledgement
For the work carried out at Pirbright, the majority of the vaccine strains and vaccine antisera used for these tests have been supplied to the WRLFMD by Merial. Some strains and/or antisera were supplied to WRLFMD by Intervet, ARRIAH and the Thai Regional Reference Laboratory at Pakchong

Interpretation of r_1 values

In the case of VNT:

r_1 = ≥ 0.3 suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.

r_1 = < 0.3 suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect unless a vaccine of very high potency is used or animals are vaccinated more than once.

In the case of ELISA:

r_1 = 0.4-1.0 suggests that there is a close relationship between field isolate and vaccine strain. A potent vaccine containing the vaccine strain is likely to confer protection.

r_1 = 0.2-0.39 suggests that the field isolate is antigenically related to the vaccine strain. The vaccine strain might be suitable for use if no closer match can be found provided that a potent vaccine is used and animals are preferably immunised more than once.

r_1 = <0.2 suggests that the field isolate is so different from the vaccine strain that the vaccine is unlikely to protect

1.6.7. WRLFMD Vaccine Recommendations

The recommendations made by the WRLFMD are principally a list of vaccine strains for which master seed vaccine viruses are believed to be available within the portfolios of vaccine suppliers able to fulfill the quality requirements for use in Europe. The ranking of the utility of the viruses is based on the results obtained by the WRLFMD from in vitro serological tests to match these vaccine viruses to recent field isolates. As such, the WRLFMD can only recommend vaccine virus strains for which it has received supplies of both the vaccine virus and the homologous antiserum. Since these vaccine strains are chosen to protect against threats from outside of Europe, it can be anticipated that the vaccines should also be useful to counter such threats at source. However, other vaccine viruses may have been produced, for example by vaccine manufacturers located in the regions from which the threats arise, that would also provide an equivalent or even better antigenic match to the field isolates that pose the threat (see Regional Recommendations at section 1.4).

HIGH PRIORITY

O Manisa
O BFS or O Campos
A24 Cruzeiro
Asia 1 Shamir
A Iran 05
A22 Iraq
SAT 2 Saudi Arabia or equivalent

MEDIUM PRIORITY

A Eritrea
A Iran 96
SAT 2 Zimbabwe
A Iran 87 or A Saudi 23/86
SAT 1 South Africa
A Malaysia 97
A Argentina 2001
O Taiwan 97 (or equivalent pig-adapted strain)
A Iran 99

LOW PRIORITY

A15 Bangkok related strain
A87 Argentina related strain
C Noville
SAT 2 Kenya
SAT 1 Kenya
SAT 3 Zimbabwe
A Kenya

NB Strains are not listed in order of importance within each priority grouping.

PART 2

Improving the quality of laboratory tests from international and national reference laboratories

2.1. Inter-laboratory comparative testing exercises

2.1.1. Vaccine Matching by serology

Last year's vaccine matching inter-laboratory comparative test (ILCT) trial had involved distribution of an A22 vaccine strain along with five bovine anti-A22 antisera and five field isolates. Guinea-pig and rabbit antisera were also distributed for ELISA testing. Eight laboratories were invited to participate. Some laboratories achieved reproducible results but others did not. Using the five antisera in a pool gave very similar results to the mean of using them individually and was considered the best approach. Full methodologies and raw test data were not received from all participants. For 2009, it was decided to extend the study by supplying additional viruses to be matched and by using the pooled BVS only. Four more (twelve in total) laboratories were invited to participate and eleven agreed to do so. All were encouraged to carry out the tests using their own methodology as well as that supplied by WRLFMD. Great difficulties were experienced with the processing of documents and the sending of samples and this greatly delayed the progress of the work. More documents including various certificates and contracts than previous years were required from WRLFMD for some countries to obtain the import permits from their authorities. Also, some airlines which were available in the past have refused to take on board biological infectious materials or shipments containing dry ice since the beginning of 2009. Three laboratories had still not received the panels by the time of the Network Meeting in December 2009. Results from eight participants were received by the end of 2009 and they were decoded and summarised in the following tables (Table 1 and Table 2). A preliminary analysis suggested that the correlation between different labs has improved compared to the results observed last year, where no lab showed comparable results for all 5 samples (Figure 1). For the results from the 2009 exercise, comparable results for all nine samples were observed in four out of six labs testing live virus panels using LPBE and/or VNT, and three out of four labs testing inactivated samples using LPBE, respectively. The overall interpretations were consistent from seven out of eight laboratories. This reduction of discrepancy between different labs could be due to the distribution of detailed protocols for both VNT and LPBE from WRLFMD to all the participants at the time of sending the samples. Two labs (6 and 7) showed a great improvement in VNT (compare Figure 1 and Table 1). The methodology from different labs has been harmonised to some extent by this exercise. Participating laboratories have been requested to send details of their methodologies as well as the raw data of their test results including titre values as well as calculated r values from both the 2008 and 2009 testing exercises.

Figure 1. r_1 values using pooled BVS generated by participants from FMD vaccine matching ILCT 2008 (VNT). 1a and 1b are duplicate results obtained from the same lab retesting the samples using the same methodology after an interval of several months.

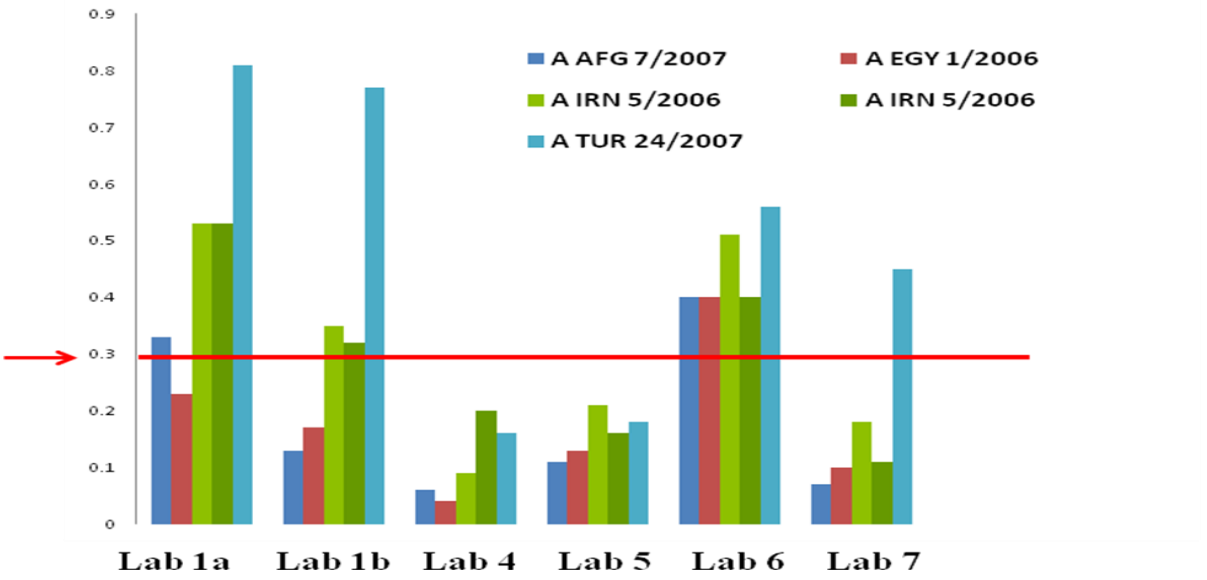


Table 1. r_1 values using pooled BVS generated by participants from FMD vaccine matching ILCT 2009 for live virus panel (VNT and LPBE).

Sample	"r1" values by VNT							"r1" values by LPBE				Overall Interpretation					
	Lab code							Lab code				Lab code					
	1	6	6	4	7	10	12	1	6	7	12	1	6	4	7	10	12
1	0.14	0.13	0.06	0.08	0.17	0.13	0.15	0.01	0.1	<0.2	0.01	no match	no match	no match	not macth	not macth	no match
2	0.14	0.13	0.06	0.1	0.125	0	0.23	<0.03	0.1	<0.2	0.71	no match	no match	no match	not macth	not macth	acceptable match
3	0.34	0.39	0.38	0.08	0.35	0	0.37	0.25	0.2	<0.2	0.35	close match	close match	no match	good match	not macth	close match
4	0.36	0.39	0.38	0.16	0.5	0.18	0.38	0.36	0.25	0.36	0.35	close match	close match	no match	good match	not macth	close match
5	0.36	0.31	0.25	0.3	0.35	0.24	0.43	0.08	0.25	0.36	0.5	close match	acceptable match	acceptable match	good match	not macth	close match
6	0.44	0.31	0.32	0.11	0.5	0.51	0.58	0.32	0.25	0.5	0.5	close match	acceptable match	no match	good match	good match	close match
7	0.08	0.13	0.06	0.06	0.07	0.18	0.17	<0.03	0.13	0.35	0.03	no match	no match	no match	not macth	not macth	no match
8	0.08	n/a	n/a	0.07	0.07	0.18	0.05	0.02	0.08	0.35	0.03	no match	no match	no match	not macth	not macth	no match
9	0.10	0.13	0.1	0.05	0.08	0	0.1	<0.03	0.06	<0.2	n.a.	no match	no match	no match	not macth	not macth	no match
Protocol	in-house	in-house	Pirbright	in-house	in-house	in-house	in-house	in-house	in-house	in-house	in-house						

Table 2. r_1 values using pooled BVS generated by participants from FMD vaccine matching ILCT 2009 for BEI inactivated virus panel (LPBE)

Sample	r1 values by LPBE				Interpretation			
	Lab code				Lab code			
	1	2	10	3	1	2	10	3
1	0.05	0.2	0.15	0.1	no match	moderate match	no match	no match
2	0.00	<0.016	0.1	0.08	no match	no match	no match	no match
3	0.00	<0.031	0.32	0.18	no match	no match	moderate match	no match
4	0.00	<0.044	0.42	0.2	no match	no match	good match	no match
5	1.00	1.4	0.58	1.1	close match	close match	good match	close match
6	1.00	0.925	0.62	0.93	close match	close match	good match	close match
7	0.00	<0.044	0.17	0.08	no match	no match	no match	no match
8	0.00	<0.033	0.26	0.08	no match	no match	moderate match	no match
9	0.00	0.065	0.14	0.14	no match	no match	no match	no match
Protoco	in-house	in-house	in-house	in-house				

2.1.2. Virus isolation and serology

2.1.2.1. Proficiency testing study (PTS) organised by WRLFMD/CRLFMD-SVD

During 2009, the European Community Reference Laboratories for FMD and SVD, in association with WRLFMD, organised a round of inter-laboratory proficiency testing to help quality assure FMD and SVD diagnosis. The first priority was to supply proficiency panels to member states of the EU and of the EUFMD, but the panels were also made available more widely, including targeting of the OIE/FAO FMD Network Laboratories.

The test purposes evaluated in this PTS were outbreak detection by virus detection and serology. The serology panel therefore involved samples for testing after both vaccination and non-vaccination. All samples were analysed sufficiently prior to selection to ensure that they would give consistent results in tests by index methods. One panel included live virus so that virus isolation testing could be evaluated. Virus in other panels was inactivated so that they can be evaluated in laboratories that do not work at the highest containment levels.

Seventy one countries were invited to take part. Of the 45 labs that agreed to participate, 26 were from EU member countries; 19 from Non-EU countries. Participants were sent a package containing uniquely coded and labelled samples as described below. Particular tests were not specified, but labs were invited to select tests and interpret results based upon:

a. Virus detection – as if samples were from suspect outbreaks.
b. Serology - as if serum samples were from suspect FMDV infection cases with vaccination or non-vaccination history or SVDV infection.

Participants were asked to give results for individual tests on each sample and where multiple tests were used, an overall result for each sample. Overall interpretation for each suspect case under investigation for panels 1 and 3 was also requested. Participants were also requested to

provide information on national surveillance for FMD and SVD. This was to enable a clear picture of the scale of activities, the state of QA accreditation and the tests actually being used by participants during 2008/2009 to be compiled.

Details of panels:
Panel 1: infectious material from 2 cases of suspected vesicular disease for virus detection

- 4 epithelial suspensions samples from cattle in a herd affected with a vesicular condition.
- 2 epithelial and 2 faecal suspension samples from pigs in a herd affected with a vesicular condition.

Panel 2: non-infectious material[1] from cattle or pigs for virus genome/antigen detection by RT-PCR and/or Ag-ELISA

- 10 samples from cattle or pigs, each originating from a different case from a herd with a vesicular condition.

Panel 3: non-infectious material[2] for FMD serology

- 4 bovine sera from a suspected FMDV infection case in UK. The cattle showed no vaccination history.
- 4 bovine sera from a suspected FMDV infection case in Africa. The cattle were vaccinated against FMDV O1 Manisa and SAT 2 Eritrea.

Panel 4: non-infectious material[2] for SVD serology

- 8 sera from pigs from a suspected SVDV historical infection case.

[1] Samples were inactivated using Binary ethyleneimine and inocuity tested by two passages in primary bovine thyroid cells (for FMDV) or RS cells (for SVDV) with negative results. [2] Sera were inocuity tested by two passages in primary bovine thyroid cells (for FMDV) or RS cells (for SVDV) with negative results and then inactivated using Binary ethyleneimine to kill any live virus not detected by inocuity testing.

22, 39, 45 and 35 labs required and received panel 1, panel 2, panel 3 and panel 4, respectively. Results of this study were presented at the joint meeting of FMD/SVD national reference laboratory's in Brussels, Belgium in January 2010 and will be incorporated into the Proceedings of the meeting.

Principal conclusions of the exercise

1. Seventy one laboratories from sixty eight countries were invited to participate and forty five labs did so.
2. Information was collected on tests in use, strains of virus used in tests, extent of ongoing testing, and quality accreditation status of tests.
3. In general, although some discrepancies were identified in results for individual samples, most labs gave the correct overall interpretation for each case for panel 1. Panel 2 showed more problems in antigen ELISA than panel 1. Overall results were good for RT-PCR. A consistent result for each sample were observed in most labs for panel 3 and from all participants for panel 4.

2.1.2.2. South American initiatives on laboratory testing harmonization

During 2009, PANAFTOSA organized its annual rounds of inter-laboratory test for FMD diagnosis and sero-surveillance. This year the rounds involved panels of materials for testing by NSP-serology (I-ELISA 3ABC/EITB System) and antigen detection and typing (ELISA and/or Complement Fixation test). All samples were analyzed sufficiently prior to selection

to ensure that they would give consistent results in tests in use in the laboratories of the region. Non infectious viruses were sent so that they can be evaluated in laboratories that do not work at the FMDV required containment levels. Laboratories from 10 countries participated in the exercises. Laboratories were given individual feedback on their results including observations and non-conformities according to predefined criteria. Laboratories with non-conformities received technical cooperation to identify and correct potential problems.

2.1.2.3. North American initiatives on diagnostic harmonization

North American Animal Health Laboratory Network (NAAHLN): the NAAHLN between the US, Canada and Mexico was established in 2007 to harmonize test used for the diagnosis of animal diseases. This initiative addresses a key objective of the security and prosperity partnership of North America towards creating a safer and more reliable food supply while facilitating agriculture trade. Initial harmonization effort is to focus on vesicular diseases, tuberculosis and avian influenza. The main objective is to ensuring an equivalency of diagnostic test results between the laboratories regardless of protocol practiced by each country.

For each disease category, a working group was assembled to include subject matter experts, a coordinator and a statistician. The basic approach is to develop harmonization panels to address performance of each method utilized for specific analyte. A number of assays namely AgELISA, 3ABC ELISA, cell sensitivity for FMDV isolation, realtime RT-PCR and virus neutralization test were harmonized among the three laboratories. Further, cross training is supported to expand and enhance diagnostic capability.

National Animal Health Laboratory Network (NAHLN): PIADC-FADDL supplies support to the NAHLN. The NAHLN is a group of State funded veterinary diagnostic labs that deal with endemic, exotic, zoonotic, and emerging animal diseases and consists of a partnership between animal and plant health inspection service (APHIS)-USDA, -US Cooperative State Research, Education, and Extension Service , USDA, and the state laboratories. The purpose of the network is early detection through targeted surveillance, rapid response; surge capacity to test outbreak samples and appropriate recovery by testing large numbers to show freedom of foreign and domestic animal diseases.

In cooperation with FADDL, the NAHLN laboratories are trained and then practice standardized, rapid diagnostic techniques, secure communications and reporting system, with modern equipment and systems.

For 2009, FADDL provided FMD proficiency panels for 178 participants in 38 laboratories covering 34 states.. FADDL supports the NAHLN by setting quality standards which are followed in the laboratories along with adequate facility biosafety and biosecurity levels. These premises are then reinforced with scenario testing. In addition, FADDL and the NAHLN work together to provide input on methods validation and approval for animal testing, review of available methods and associated gaps and identifying potential new technologies. FADDL participates with the NAHLN in determining equivalency of modified methods or platforms, monitoring performance of implemented assays, and development of performance characteristic summary documents.

FADDL develops and may share training materials with other national laboratory networks in a move to standardize training practices across agencies.

2.1.2.4. Inter-laboratory comparative exercise, organised by RRLSEA, Pakchong and OIE-Regional Coordination Unit, Bangkok

In 2009, an inter-laboratory comparative exercise was conducted for FMD antigen capture ELISA and serology as a part of the 4th Meeting of SEAFMD Laboratories Network meeting, during 1-2 October 2009 at Regional Reference Laboratory for FMD in South East Asia (RRL), Pakchong, Thailand. Sixteen FMD laboratories participated; eight from South East Asian countries (Thailand, Cambodia, Lao PDR, Malaysia, Myanmar, Philippines, Vietnam: both Hanoi and Ho chi Minh), and eight Regional Veterinary Diagnostic Centers within Thailand including the National Institute of Animal health (NIAH), Bangkok. The objectives were (1) to evaluate the performance of individual operators or laboratory staff to ensure that they have competence in performance of FMD diagnostic and serological tests. (2) to evaluate laboratory capability to conduct specific diagnostic tests by comparing the testing results among participating laboratories after providing ELISA reagents and unknown samples. The inter-laboratory comparative programme was a requirement of ISO/IEC 17025:2005 on the laboratory quality standard of veterinary testing for applying accreditation or upgrading the laboratory. In this regard, the RRL was the provider of reference materials and prepared for all reagents, samples, questionnaires, data sheets, record forms and standard operating procedures (SOPs) which were distributed to all participating laboratories:

- Questionnaire - 1 set
- Unknown antigen - 10 samples
- Unknown serum or EQAP samples - 5 samples
- Reagents for LP ELISA type O, A and Asia1 consisting of
  - Rabbit anti FMDV type O, A, Asia1
  - Guinea pig anti FMDV type O, A, Asia1
  - Concentrated inactivated FMD antigen type O, A ,Asia1
- Tracing sheet, record form and ELISA data sheet
- SOP for ELISA typing (RRL-T-001), LP ELISA (RRL-T-002)
- NS test (PrioCheck (RRL-T-004) and NS test (UBI) (RRL-T-003)

2.1.2.5. Harmonisation of tests in the SADC region

A workshop was hosted by the SADC FMD project to address the need for serological monitoring of FMD vaccine. The workshop, held in Gaborone, Botswana was hosted by the technical expert of the FMD project, Dr Gavin Thomson. The countries that participated in the workshop were:

- Botswana (BVI & NVL),
- South Africa (OVI),
- Mozambique,
- Zimbabwe
- Malawi
- Lesotho
- Swaziland

Four main recommendations were decided upon by the attendees of the workshop:

- **Recommendation 1:** Adoption of the WRL protocol for the LPBE (consistent with the recommendations of the OIE [Manual for Diagnostic Tests and Vaccines for terrestrial Animals, FMD chapter]) as the SADC Regional standard.

- Driven by the two Regional Reference Laboratories (in the persons of Drs. G. Thobokwe & R. Dwarka) who will jointly draft a letter to all the relevant laboratories of the Region containing this recommendation to be signed by the heads of the two Reference Laboratories. The letter was drafted and sent to all 15 SADC countries. No response was received to the initial call and a second call was forwarded to all countries. Namibia, Mozambique, Botswana, Zambia and Zimbabwe have indicated their interest in PVM.

- **Recommendation 2**: Production, validation & distribution of a panel of control bovine anti-sera (SAT1, SAT2 & SAT3 and negative control), i.e. for use in testing associated with PVM in the SADC Region.

- The SFMDP undertook to investigate the possibility of contracting the production, preparation and distribution of a large number of small aliquots of control anti-sera to strains of SAT virus currently being used by the BVI. This will enable all laboratories conducting PVM to use the same control anti-sera for a number of years. In this way both within-laboratory and between-laboratory comparison of serological test results will be made possible and practical.

- **Recommendation 3:** Continuous technical support to regional laboratories involved in PVM to be provided by Regional Reference Laboratories.

- **Recommendation 4:** Suppliers of reagents for PVM testing must provide validation data, ideally a certificate defining performance characteristics of the reagents supplied

- Recommendations 3 and 4 are tasks normally expected of reference laboratories and the BVI and ARC-OVI undertook to devote renewed attention to these issues on request from SADC countries.

  The SADC FMD project has since closed and the recommendations will be carried forward by the SADC diagnostic sub committee under the guidance of the 2 regional reference laboratories

2.2. Training

2.2.1. WRLFMD. During May 2009, a two week training course on FMD Diagnostic Techniques was provided at Pirbright for scientists from other diagnostic laboratories. There were 8 participants comprising 4 from Egypt, 2 from Iraq and 1 each from Ethiopia and Jordan. A scientist from the SAP Institute, Turkey visited WRLFMD for 6 months during 2009 for training and collaborative studies on FMDV full genome sequencing. Another scientist from the NRL Zagreb, Croatia visited for 2 weeks training in FMD diagnosis in November 2009. Other training is ongoing through regular visits of laboratory staff from around the world.

2.2.2. South American activities on building human capacities

LFADLCT. In October 2009, a Regional Workshop on the use of LP:-ELISA for vaccine potency control was carried out at SENASA Laboratory. There were nine from Argentina, Brazil, Colombia, Paraguay, Uruguay and Venezuela. A two weeks Individual training was provided for one specialist from Ecuador in FMD diagnosis and virus characterization. A two weeks individual training was provided to one specialist from Paraguay in Quality Assurance and implementation of ISO 17025.

Within the intramural human resources training offered annually by PANAFTOSA for countries in the region, five courses were offered during 2009 comprising monoclonal antibodies production, cell culture and maintenance, virus typing, use of Lp-ELISA for antibody detection and vesicular stomatitis antibody detection by virus neutralization test.

2.2.3. PIADC-FADDL provides, on a regular basis, training courses (5 courses per year) on foreign animal diseases to veterinary students, university professors and veterinarians from all over the United States and other countries. These two week courses include lectures, clinical rounds and necropsy of animals that are experimentally infected with various foreign animal diseases. This year, there were participants from Chile, Panama, Mexico, Peru, Haiti, Honduras, Argentina and Brazil. PIADC-FADDL also provided online training session to the Iraqi Veterinarians on FMD diagnostics and complexity to control. This training was supported by the US Department of States.

2.2.4. RRLSEA provided the following training to OIE member countries: In May 2009, a 2 weeks training course on FMD diagnosis, virus isolation and cell culture technique was provided at RRL, Pakchong to one participant from Myanmar, the training was supported by IAEA. In June 2009, 3 participants from Laos were received for training on FMD diagnosis for 2 weeks, this training was supported by TICA-Lao Project. In October-December 2009, 4 participants from Myanmar were received for training on FMD diagnosis, RT-PCR, concentration and purification of 146S antigen , this training course was supported by IAEA.

2.2.5. ARC-OVI-TADP offers bench training in foot-and-mouth disease diagnostic methods. Ms Tebogo Kgotlele from Botswana National Veterinary Laboratory was awarded an IAEA scholarship to receive training in FMD diagnostic techniques. She spent one month in the TADP diagnostic laboratories receiving training in culture, serological and molecular techniques used in the diagnosis of FMD

2.3. Reagent and test kit supply

2.3.1. WRLFMD. For the period January-March 2009, reagents or kits have been sent to.Iran, Kenya, Rwanda, United Arab Emirates, Zambia, Belgium, Vietnam, Bhutan, Ethiopia, Uzbekistan and the Netherlands.

For the period April-June 2009, reagents or kits have been sent to Romania, Turkey, Japan, Georgia, Qatar, Vietnam, Netherlands, Eritrea, Hong Kong, Taiwan, China, Belgium, Korea, USA, Spain, France, Slovenia, Libya, UAE, Macedonia, Oman and Uzbekistan.

For the period July-September, viruses, reagents or kits have been sent to Vietnam, Pakistan, Poland, Korea, Egypt, Saudi Arabia, Turkey, Mongolia, Indonesia, Romania, Uzbekistan, Denmark, Austria, Thailand, Serbia, Lithuania, Latvia, Slovenia, Malta, Slovakia, Greece, Finland, Estonia, Ireland, Czech Republic, Norway, Croatia, Cyprus, Chile, Morocco, Switzerland, Korea, Spain, USA, South Africa, Canada, Brazil, Macedonia, Azerbaijan, Italy,

Netherlands, Hungary, Belgium, France, Sweden, Argentina, Iraq, Qatar, Japan, Armenia and Israel.

2.3.2 South American reagents supply

LFADLCT. SENASA Laboratory supplied reference reagents as hyper-inmune serum, reference virus vaccine strains, 3D antigen, reagents for LP-ELISA for vaccine potency control and Monoclonal ELISA typing to Argentina, Brazil, Paraguay, Uruguay.

PANAFTOSA's laboratory collaborates with the National Laboratories of the South American countries by producing, controlling and distributing reference reagents for their diagnosis, sero-surveillance and vaccine control activities. Reagents and kits supplied to the countries during 2009 are summarized in Table 3 and 4.

Additionally a panel of 38 bovine sera for use in vaccine matching test was send to SENASA/Argentina and cell lines for viral isolation and vaccine production have been distributed to countries in the region.

Table 3. Complete kits from PANAFTOSA for the number os indicated tests

Tests	Argentina	Bolivia	Brasil	Chile	Colombia	Paraguay	Peru	Uruguay	Venezuela	Total
I-ELISA 3ABC	61.600	13.200	165.440	2.640	18.480	44.880	6.160	4.400	1.760	**318.560**
EITB	5.000	0	18.000	200	1.400	5.000	800	1.000	200	**31.600**

Table 4. Sets of reagents from PANAFTOSA for the number of indicated tests

Test ↓ Country →	Argentina	Brasil	Chile	Colombia	Paraguay	Perú	Uruguay	Venezuela	Total
Typing ELISA-IS (FMDV/VSV)	1.400	3.150	0	1.750	0	350	0	700	**7.350**
CFT 50% (FMDV/VSV)	15.500	0	0	15.500	2.500	0	0	6.000	**39.500**
LP-ELISA Seroepidemiology FMD	0	20.000	0	2.000	2.000	4.000	0	0	**28.000**
LP-ELISA Seroepidemiology VSV	17.000	3.000	4.000	2.000	2.000	0	0	0	**28.000**
LP-ELISA FMD Vaccine control	8.000	257.000	0	25.000	23.000	0	0	6.000	**319.000**
LP-ELISA VSV Vaccine control	0		0	4.000	0	0	0	0	**4.000**
SP-ELISA BT	0	3.000	0	2.000	3.000	0	1.000	0	**9.000**
SP-ELISA IBR	0		0		3.000	0	0	0	**3.000**

2.3.3 RRLSEA, Pakchong supplied diagnostic reagents such as rabbit trapping antibody, guinea pig detecting antibody, inactivated antigen for FMDV type O, A and Asia1 to Laos, Myanmar, and Cambodia.

2.4. Collaborative Research

2.4.1. WRLFMD is a founder member of the Global FMD Research Alliance (GFRA) that seeks to bring together FMD researchers from around the world with the aim of developing recommendations on research priorities and collaborative research projects. A major initiative in 2009 has been to broaden membership of GFRA. The Institute for Animal Health, where WRLFMD is located, maintains close research links with a wide range of partner laboratories worldwide. OVI joined the GEFRA in 2009.

2.4.2. LFADLCT. (1) Argentine Inter-Institutional Network for Research and Development in FMD (RIIDFA) : SENASA- INTA – CEVAN - BIOGENESIS BAGO S.A. (2) PAE -2007 "Coordinated research and development actions in FMD to grant the status of country without FMD" (3) 7th FRAMEWORK PROGRAMME (UE) "Development, enhancement and complementation of animal-sparing, foot-and-mouth disease vaccine-based control strategies for free and endemic regions" (FMD-DISCONVAC).

2.5 South American initiatives on FMDV biosafety and biosecurity

Technical cooperation was delivered by PANAFTOSA in the area of designing, building and/or maintenance of BSL 3 Ag premises for FMDV diagnostic and/or vaccine production to Colombia and Ecuador. Additionally PANAFTOSA coordinates the South American FMDV Biosafety Commission and also is an active member of the Brazilian Commission for FMDV Biosafety that audits periodically government and private's laboratories that handled FMDV.

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