GEOGRAPHICAL MAPPING ON SEROPOSITIVE STATUS OF MELIOIDOSIS AMONG LIVESTOCK IN MALAYSIA FROM 2012 TO 2016

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ABSTRACT. A total of 145,347 samples (4,322 cases) were received for the passive surveillance of melioidosis in the Serology Laboratory of Veterinary Research Institute (VRI) from the year 2012 to 2016. From the samples received, 0.63% were positive and 99.37% were negative. The objective of this study is to determine the seropositive rate and distribution of melioidosis in livestock based on cases received which comprise of sheep (37.24%, n=54,130), goat (54.01%, n=78,500), cattle (8.12%, n=11,804) and buffalo (0.63%, n=913) within the period of 5 years. A geographical mapping of seropositive cases was designed using the data from the passive surveillance and the results were visualized in a geographical mapping which provides a clear visual description on the distribution of the diseases. By 2016, positive cases were found to be concentrated in the states on the east coast of Peninsular Malaysia and Sabah. To sum up, the percentage of seropositive cases of melioidosis in 5 years has increased from 1.79% in 2012 to 12.17% in 2015 and decreased to 1.04% in 2016. From the findings, this study can provide the data needed as the indicator for the evaluation of surveillance and vaccination programmes, disease eradication planning and to monitor the distribution of seropositive cases of melioidosis in Malaysia.

Keywords: seroprevalence, melioidosis, livestock, GIS

INTRODUCTION

Melioidosis is an infectious disease of humans and animals caused by *Burkholderia pseudomallei* (Naama T. *et al.,* 2012) and reported endemic in South East Asia and in Malaysia (J. Vadivelu *et al.,* 1995). The common symptoms of melioidosis in animals are anorexia, pyrexia, hyperthermia and cough; and skin dehydration. During the early stages of infection, the disease may progress silently for a considerable period of time and often results in death but symptoms and disease progression is variable among species (Oudah A., 2006).

This disease is endemic in Southeast Asia and northern Australia, mostly in areas within latitudes 20°N and 20°S (Currie *et al.,* 2008). The disease is also a significant animal health problem leading to chronic debility that reduces the productivity in animals and loss of valuable animal protein due to the condemnation of carcasses at the abbatoir.

In Malaysia, the disease was first reported in 1913 by Fletcher in laboratory

animals at the Institute for Medical Research, Kuala Lumpur and since then cases have been continuously reported in both human and animals such as sheep, buffalo, deer, monkey, gibbon, orang utan, kangaroo, camel, parrot, hamster, zebra and crocodile for several years (Strauss *et al.,* 1969; Puthucheary *et al.,* 1992; Vadivelu *et al.,* 1995; Norazah *et al.,* 1996; Azizi *et al.*, 2005; Putchucheary, 2009; Deris *et al.,* 2010; Musa H.I. *et al.,* 2012 and Naama T. *et al.,* 2012).

It is crucial to monitor the occurrence of this disease so that early detection can be made and disease prevention activities can be planned and implemented well. Geomapping is one of the methods of monitoring, tracking and verifying the location of the disease occurrence which can facilitate disease monitoring activities. The geomapping approach provides a clear visual description on the distribution of the diseases. (Masrin A., 2012).

Disease mapping provides information on the measure of disease occurrence across a geographic space. Disease maps are able to provide a rapid visual summary of complex geographic information (Jerry Asaana A., 2012). These maps may also identify subtle patterns in epidemic and health data that are sometimes missed in tubular presentation (P. Elliot, 2004).

The main objective of this study is to determine the seropositive prevalence and spatial distribution of melioidosis in livestock, based on samples received in the Veterinary Research Institute, Ipoh from year 2012 to 2016 by using geographical information system (GIS).

MATERIALS AND METHOD

Datasets

Based on the generated data from VRI Laboratory Information Management System, a total of 145,347 samples were received by the Serology Laboratory, VRI, Ipoh from 2012 to 2016 for the testing of melioidosis. The test which is used to determine the presence of antibodies against *Burkholderia pseudomallei* is the complement fixation test (CFT) and the protocol was as described by OIE (OIE Manual, 2016). An animal was considered to be positive of the disease if it had antibody titre of 1:8 or more. Data on continuous surveillance monitoring of melioidosis in animals for a period of 5 years from year 2012 to year 2016 were summarized according to animal species, years of occurrence and states.

Geographical Information System (GIS)

When used correctly, a GIS can help identify the distribution of diseases, predict disease outbreaks, identify risk factors and provides a powerful means of managing data related to disease outbreak, especially in designing surveillance strategies and monitoring spatial-temporal trends as diseases cases are reported.

Statplanet Desktop™ was used to map the distribution of seropositive cases according to states. It consists of a powerful set of tools for automatically importing and visualizing your data within minutes. With a click of a button, we can select and seamlessly transition between data sets, time periods, map regions, graph and map types.

Users can dynamically customize the view according to their needs for better analysis and decision making. A key strength is its integration of graphs and maps into a single view. This enables users to simultaneously explore and filter the data through multiple, interconnected visualizations. Summarized data were entered to Statplanet and disease map were generated according to years.

RESULTS AND DISCUSSION

A total of 145,347 samples (4,322 cases) were received for the passive surveillance of melioidosis in Serology Laboratory of Veterinary Research Institute (VRI) from the year 2012 to 2016. From the samples received, a total of 910 samples (0.62%) were reported positive for melioidosis. Table 1 shows the species-spesific seroprevalence of melioidosis in livestock in Malaysia. The seroprevalence was observed to be lowest among the goats (0.42%) and highest in buffaloes (0.99%). However, note that the number of buffaloes tested during this study period was small.

Table 2 shows the seroprevalence of melioidosis in livestock in Malaysia based on states during the period of review. The lowest seroprevalence of 0.00% was observed in cattle in Kedah, Kelantan, Melaka, Negeri Sembilan, Perlis, Penang, Sarawak, Selangor and Terengganu while the highest seroprevalence of 10.00% was observed in sheep in Sabah during the study period. It should be noted that not all species were tested with melioidosis in Kuala Lumpur and Labuan during the study period.

Figure 1 shows the overall yearly seroprevalence of melioidosis in Malaysia for the period of year 2012 to 2016. The prevalence varies from as low as 0% in buffalo in year 2015 to high of 1.65% in cattle in year 2016. The average yearly prevalence during the period was 0.75%.

Figure 2, generated from Statplanet™, shows the overall yearly seroprevalence of melioidosis in livestock in Malaysia from year 2012 to 2016 based on states. As shown, Pahang has the highest seroprevalence reported and the rate was increasing every year compared to the seroprevalence rate for Perak state which was decreasing yearly. Other states had prevalence rates which was within the same pace over the years.

Figures 3 to 7 is a percentile map of melioidosis seroprevalence in livestock in Malaysia from year 2012 to 2016. The figures give an indication of spatial association, states with nearly similar colour shades tended to be near each other. Six legend categories of seroprevalence rates were created, corresponding to No Data, 0-0.02, 0.02-0.04, 0.04-0.06, 0.06-0.08, and >0.08. There were 13 states on the map.

CONCLUSION

The relatively high seroprevalence in buffaloes may partly be as a result of the management system, whereby animals have more contact with soil and therefore at a higher risk for infection. However, the number of buffaloes in this study is extremely low and this may not be truly representative of the situation in buffaloes. Therefore, more buffaloes need to be tested to obtain a more accurate prevalence in the species.

Table 1: Seroprevalence of melioidosis in livestock for the period of 2012 to 2016. (n = the number of samples tested)

SPECIES	POSITIVE (n)	NEGATIVE (n)	TOTAL (n)	PREVALENCE (%)
Sheep	487	53,643	54,130	0.90%
Goats	331	78,169	78,500	0.42%
Buffalo	9	904	913	0.99%
Cattle	83	11,721	11,804	0.70%

Table 2: Seroprevalence of melioidosis in livestock for the period of 2012 to 2016 according to states. (n = the number of samples tested)

STATE	SPECIES (n)	POSITIVE (n)	NEGATIVE (n)	TOTAL (n)	%
JOHOR	Bebiri	25	6,019	6,044	0.41%
	Kambing	8	3,521	3,529	0.23%
	Kerbau	1	131	132	0.76%
	Lembu	12	1,825	1,837	0.65%
KEDAH	Bebiri	27	2,402	2,429	1.11%
	Kambing	16	5,961	5,977	0.27%
	Lembu	0	289	289	0.00%
KELANTAN	Bebiri	16	1,602	1,618	0.99%
	Kambing	14	3,903	3,917	0.36%
	Lembu	0	105	105	0.00%
MELAKA	Bebiri	2	268	270	0.74%
	Kambing	5	1,360	1,365	0.37%
	Lembu	0	31	31	0.00%
NEGERI SEMBILAN	Bebiri	11	1,306	1,317	0.84%
	Kambing	12	2,485	2,497	0.48%
	Lembu	0	134	134	0.00%
PAHANG	Bebiri	303	29,313	29,616	1.02%
	Kambing	31	4,263	4,294	0.72%
	Kerbau	1	33	34	2.94%
	Lembu	9	604	613	1.47%

STATE	SPECIES (n)	POSITIVE (n)	NEGATIVE (n)	TOTAL (n)	%
PERAK	Bebiri	39	3,531	3,570	1.09%
	Kambing	109	22,623	22,732	0.48%
	Kerbau	6	641	647	0.93%
	Lembu	55	7,325	7,380	0.75%
PERLIS	Bebiri	16	1,330	1,346	1.19%
	Kambing	15	2,136	2,151	0.70%
	Lembu	0	1	1	0.00%
PENANG	Bebiri	6	1,383	1,389	0.43%
	Kambing	6	3,174	3,180	0.19%
	Lembu	0	18	18	0.00%
SABAH	Bebiri	1	10	11	9.09%
	Kambing	85	19,306	19,391	0.44%
	Kerbau	1	60	61	1.64%
	Lembu	7	1,315	1,322	0.53%
SARAWAK	Bebiri	12	1,412	1,424	0.84%
	Kambing	19	3,941	3,960	0.48%
	Kerbau	0	34	34	0.00%
	Lembu	0	32	32	0.00%
SELANGOR	Bebiri	4	963	967	0.41%
	Kambing	5	995	1,000	0.50%
	Kerbau	0	5	5	0.00%
	Lembu	0	16	16	0.00%
TERENGGANU	Bebiri	25	4,104	4,129	0.61%
	Kambing	5	4,362	4,367	0.11%
	Lembu	0	26	26	0.00%
KL	Kambing	0	96	96	0.00%
LABUAN	Kambing	1	43	44	2.27%
TOTAL		910	144,437	145,347	0.63%

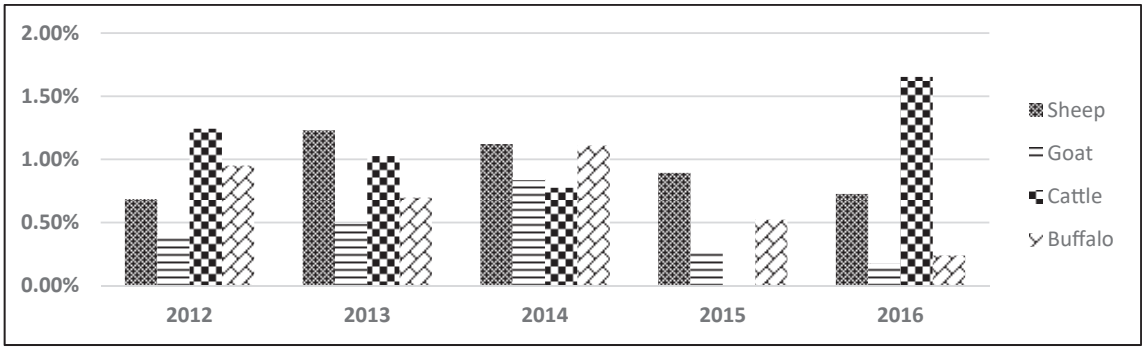

Figure 1. Yearly seroprevalence of melioidosis in livestock in Malaysia from 2012-2016.

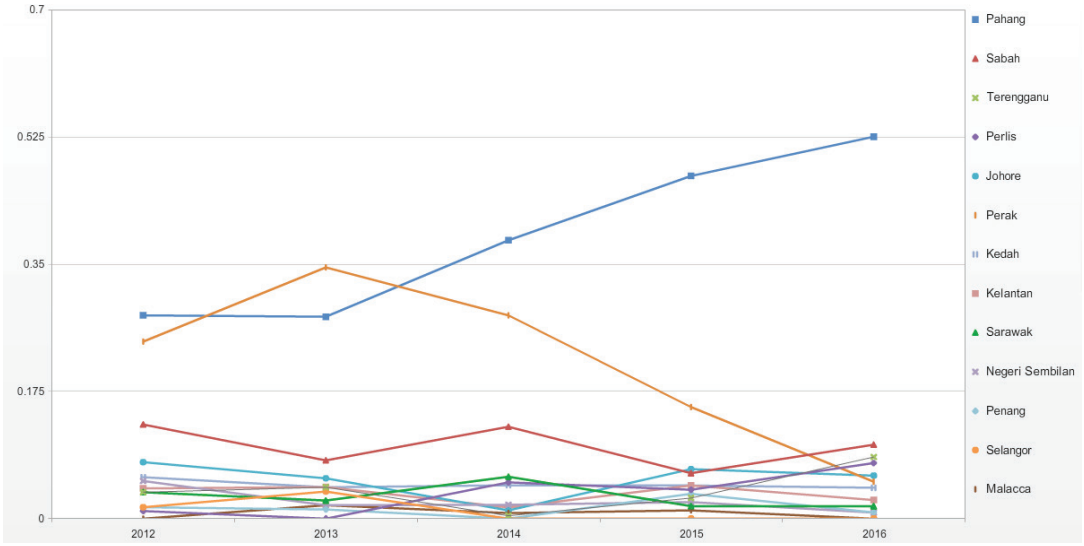

Figure 2. STATPLANET – Yearly seroprevalence of melioidosis in livestock in Malaysia from 2012-2016 according to states.

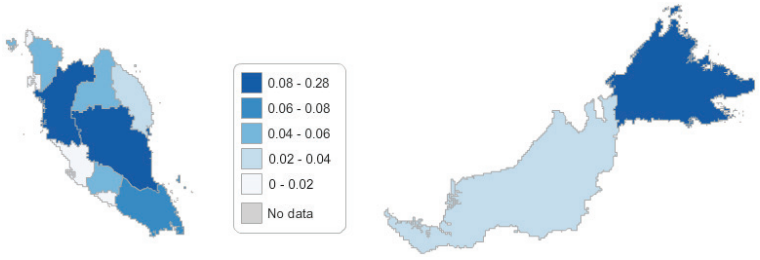

Figure 3. STATPLANET – Map of percentage seropositive melioidosis in Malaysia for year 2012

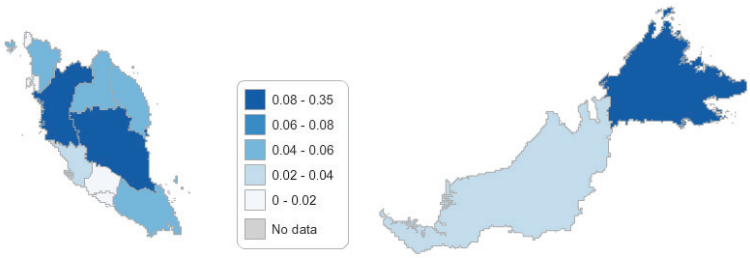

Figure 4. STATPLANET – Map of percentage seropositive melioidosis in Malaysia for year 2013

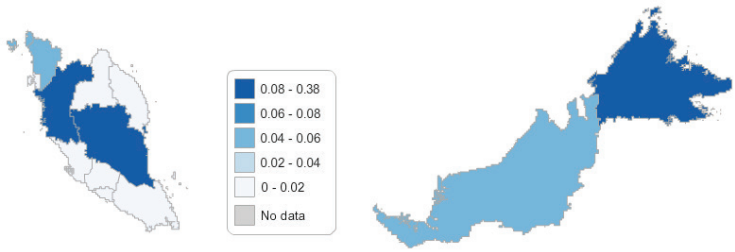

Figure 5. STATPLANET – Map of percentage seropositive melioidosis in Malaysia for year 2014

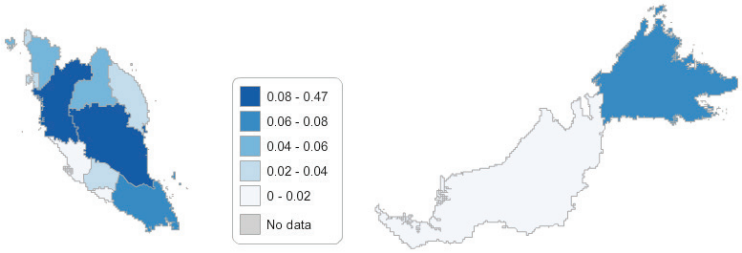

Figure 6. STATPLANET – Map of percentage seropositive melioidosis in Malaysia for year 2015.

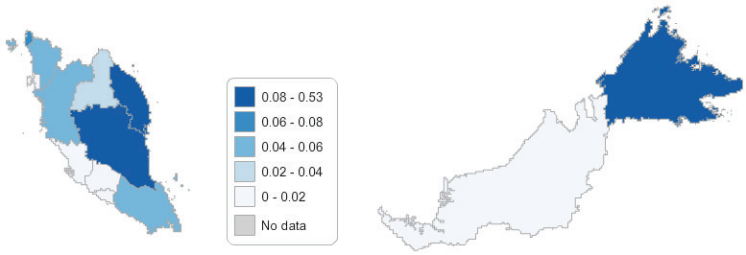

Figure 7. STATPLANET – Map of percentage seropositive melioidosis in Malaysia for year 2016

An earlier study conducted covering a ten year period (1994-2003) in Sabah (Oudah *et.al,* 2007) detected melioidosis in 0.2 and 0.08 in cattle and goats respectively from post-mortem cases. Another study from year 2000 to 2009 by Musa in 2012 found that the seroprevalence of 10.0 and 0.042 among cattle and goats respectively based on livestock sample in Malaysia. The present study, based on cases and samples from VRI, however found the seroprevalence rate of 0.9 and 0.4 among cattle and goats respectively. These findings may suggest that goats are relatively more susceptible to *Burkholderia pseudomallei* infection leading to higher fatality as compared to cattle (Musa H.I. *et al*., 2012).

Based on the mapping of the disease in 2012, the seropositive distribution of melioidosis was reported to be high in the state of Perak, Pahang and Sabah while moderate distribution was seen in Kedah, Kelantan, Terengganu, Negeri Sembilan, Johor and Sarawak. Low distribution was reported to be concentrated in the states of Selangor and Melaka. The seropositive distribution of melioidosis was found to change in the year of 2013 with most positive cases concentrated in the north and east coast of Peninsular Malaysia. In 2014, the high distribution was only in Pahang, Perak and Sabah. In 2015 and 2016 it can be seen that the distribution of disease is only concentrated in the east coast area of Peninsular Malaysia.

The relative increase in prevalence of the disease may be associated with the weather condition during the respective years. However, further investigation of this data will reveal the cause since there were no other risk factors were investigated to explain the differences observed. However, based on findings from other studies, differences in the environmental factors, temperature, rainfall, soil type and composition that influence survival of the agent in the major reservoirs which were soil and water, which may explain the variation in seroprevalence in space and time (Dance, 2000). The intensity of rainfall during the respective years may also play a role as the intensity of rainfall has been reported to correlate with increase in melioidosis cases (Currie and Jacups, 2003).

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