Study of Risk Factor and Epidemiology Surveillance System of Leptospirosis

Yudied Agung Mirasa[1], Ririh Yudhastuti[2], Chatarina Umbul Wahyuni[3], Mateus Sakundarno Adi[4]

[1]*Doctoral Program, Faculty of Public Health, Airlangga University, Indonesia / Technical Centre for Environmental Health and Disease Control, Surabaya, Indonesia*
[2,3]*Faculty of Public Health, Airlangga University, Indonesia*
[4]*Faculty of Public Health, Diponegoro University, Indonesia*

Abstract

Leptospirosis was a zoonosis disease that was assumed as having the largest spreading in the world. In Indonesia, leptospirosis disease was spread in Java Island, South Sumatera, West Sumatera, Riau, North Sumatera, Bali, West Nusa Teggara, South Sulawesi, North Sulawesi, East Kalimantan, and West Kalimantan. East Java Province was one of the provinces in Indonesia which the people there still reported leptospirosis case until in 2014 and it tended to increase more and more either from the total of the case or the spreading area of the disease. According to Ministry of Health of Republic of Indonesia, in 2013 East Java had been noted that there were 6 occurrences with the total of 243 cases, and the people who died because of it were 25 persons (CFR 20%). Based on the data and the condition above, it showed that the epidemiology surveillance system of leptrospirosis along this time had not been optimal, especially in the early warning system (EWARS) of leptospirosis in Public Health Center level. This research aimed at describing the potential risk factor of leptospirosis and implementing epidemiology surveillance on EWARS of leptospirosis in Public Health Center. The method of this research was by observing scientific articles regarding leptospirosis in human that was published through publication media either in Indonesia or in other countries and the articles were published before 2015. The primary data was obtained from the report of epidemiology surveillance in Health Office in Ponorogo District 2014. The instrument that was used for valuing the implementation of surveillance was handbook of the Directorate General of Disease Control and Environmental Health of the Ministry of Health of the Republic of Indonesia in 2014. The research result of risk factor of potential environment of leptospirosis was there were 16 (53,3%) researches, including the variable of history of flooded area, the puddle around the house, lack of waterways or poor waterways, poor home sanitation, rats around the house, high rainfall, and occupation. The trend situation of case data in Indonesia in 2009-2013, especially in endemic area of leptospirosis showed potency of the increase of case total and the spreading area of the disease also more enlarged. The surveillance system of leptospirosis recently had not been optimal to be conducted and it needed to be conducted an improvement either in program aspect or operational aspect in the field. However, it needed an early warning system of leptospirosis that could know the predictive indicator of leptospirosis in the field in order to reduce case incidence rate and to press the spreading of case to other areas.

Keywords: EWARS , Leptospirosis, Risk factor

I. INTRODUCTION

Leptospirosis was zoonosis disease that was assummed as having the largest spreading in the world. The incident in country that had warm climate was larger rather than in country that had medium climate because the life time of leptospira was longer in warm and humid environment. Zoonosis disease was a disease that naturally could be moved from vertebrate animal to the human or vice versa. Leptospirosis was an infectious disease that was caused by pathogen bakteria which was known as Leptospira[1].

Leptospirosis was infected through a contact with water, mud, polluted water by animal's urine that was infected by Leptospira bacteria that was an infection source or central point of leptospirosis transmission[1,2]. Moreover, the animals which were as infection sources were rodent (rat), pig, cattle, goat, sheep, horse, dog, cat, insect, bird, insectivore (porcupine, bat, squirrel)[3].

Leptospirosis spread widely around the world, such as in Russia, Argentina, Brazilia, Australia, Israel, Spanish, Afghanistan, Malaysia, United States of America, Indonesia. Therefore, leptospirosis was recognized as potential epidemic of disease that had significant impact for health around the world[4]. Global incident of leptospirosis still had not been known, however, the estimation showed that there were around 320.000 leptospirosis cases per year in around the world[5].

In Indonesia, since in 1970s, the occurrence in human was reported fresh in South Sumatera, Bangka Island, and some hospitals in Jakarta[6]. Leptospirosis in Indonesia was spread in Java Island, South Sumatera, West Sumatera, Riau, North Sumatera, Bali, West Nusa Tenggara, South Sulawesi, North Sulawesi, East Kalimantan, and West Kalimantan. It was noted that the Extraordinary Incident of Leptospirosis was occurred in Riau (1986), Jakarta

(2002), Bekasi (2002), and Semarang (2003). The provinces that still reported leptospirosis case in which started from 2005 until 2013 were DKI Jakarta Province, Central Java Province, West Java Province, Daerah Istimewa Yogyakarta Province, and East Java Province. the Extraordinary Incident of leptospirosis in East Java was ever occurred in several districts since in 2010-2013. According to the data from Ministry of Health in Republic of Indonesia in 2013, in East Java had been noted that there were 6 occurrences with the total of 243 cases and the 25 persons died (CFR 20%).

In 2008, Health Department made a guidance EWARS of leptospirosis in Public Health Center with the expectation of being able to reduce and find the case as early as possible and it could be reported to local health office. In fact, recently, there were still leptospirosis cases. Hence, it needed an evaluation of epidemiology surveillance system that actually had been conducted recently.

This research aimed at describing the potential risk factor of leptospirosis, evaluating the implementation of epidemiology surveillance in EWARS of leptospirosis in Public Health Center.

II. METHODS

In this research, it was conducted a review of scientific articles regarding leptospirosis in human. The data of leptospirosis research articles were obtained from the journals which were published through publication media either in Indonesia or in other countries. The criteria which were used in selecting the articles as followed:
1. The articles were published before 2015
2. Study regarding leptospirosis in human
3. The purpose of the research was to value the risk factor of leptospirosis in human
4. The power of association was measured and served
5. The location of the research was in the area of Asia – Pacific (the countries in Asia and Pacific)

The review result of the articles was obtained from other countries, including the article of leptospirosis case study in several countries, such as Brazil, Nicaragua, and India. The articles of research result in Indonesia were obtained by searching for the website of either local university or local governmental health office which conducted leptospirosis study. The articles from Indonesia were in accordance with the study of the occurrence of leptospirosis case that was ever occurred in Indonesia, including leptospirosis case in Java Island (in Jakarta, Yogyakarta, Semarang, Ponorogo, Demak, Sleman, Gresik, Madura, and other areas).

In evaluating the epidemiology surveillance system on EWARS of leptospirosis in Public Health Center, it used primary data in the Public Health Center and the report of epidemiology surveillance in Health Office in Ponorogo District, East Java-Indonesia in 2016. The instrument that was used in order to value the implementation of surveillance was handbook of the Directorate General of Disease Control and Environmental Health of the Ministry of Health of the Republic of Indonesia in 2014.

III. RESULTS

From the result of studying of leptospirosis research journal in human was found either the differences or the similarities and were provided in table in order to make easier to analyse.

Table 1. Research Characteristic

Research	Research Design	Characteristic			
		Institution	Research Location	Population	Sample Size
Indonesia					
Murtiningsih, 2003[8]	CC	Gadjah Mada University	Yogyakarta	Cases in Yogyakarta	106
Muhidin, 2011[9]	CS	Research and Development Center (*Balai Litbang*)	Yogyakarta	The houses in area of Yogyakarta	90
Melani, 2010[10]	CS	Diponegoro University	Semarang	Cases in Semarang	171
Nurjanah, 2013[11]	CS	Dian Nuswantoro University	Semarang	Cases in Semarang	60
Okatini, 2007[12]	CC	Indonesia University	Jakarta	Cases in Jakarta	190
Yunianto, 2008[13]	CS	Research and Development Centers (*Loka Litbang*)	Demak	Area of Semarang and Demak	30

Research	Research Design	Characteristic			
		Institution	Research Location	Population	Sample Size
Sunaryo, 2014[14]	CS	Research and Development Center (*Balai Litbang*)	Gresik	Area of Gresik	60
Agustini, 2011[15]	CS	Gadjah Mada University	Yogyakarta	Cases in Sleman	103
Yuliani, 2014[16]	CS	Bogir Agricultural Institute	Bogor	Area of Leptospirosis cases	-
Prastiwi,2012[17]	CC	Research and Development Center	Bantul	Society	70
Ristiyanto,2013[18]	CS	Research and Development Center	Bantul	Society	129
Rahmadani, 2010[19]	CS	Research and Development Centers	Semarang	Society	105
Rejeki,2005[20]	CC	Diponegoro University	Semarang	Patients in hospital	126
Ningsih, 2014[21]	CS	Research and Development Center	Banyumas	Cases Area	-
Anies, 2009[22]	CC	Diponegoro University	Demak	Society	120
Dina, 2014[23]	CC	Airlangga University	Madura	Society	280
Other Countries					
Prabakharan, 2014[24]	CC	Bharathidasan University	India	Sufferer in hospital	621
Kamath, 2014[25]	CC	*Manipal University*	India	Cases in Udupi	116
Allwood, 2014[26]	CS	*University of Minnesota*	*United States*	Family	91
Wasinki, 2013[27]	CS	National Veterinary Research Institute,	Poland	Farmers and Farms	197
Vega, 2014[28]	CS	University of the West Indies, St Augustine	Trinidat	Society	250
Agampodi, 2014[29]	CS	Rajata, University Srilangka	Srilangka	Cases in Srilangka	96
Sarkar, 2002[30]	CC	University of California	Brazil	Neighborhoods	125
Tassinari, 2008[31]	CS	Brazilian ministry of health	Brazil	Neighborhoods	56
Victoriano, 2009[32]	CS	University of the Philippines	Philippines	Neighborhoods	125
Yanagihara, 2006[33]	CS	China Institute of Science Japan	Philippines	Neighborhoods	147
Tubiana, 2013[34]	CC	Institute Pasteur de Nouvelle-Caledonie	New Caledonia	Sufferer in hospital	176
Castellanos, 2003[35]	CS	Mexican Institute Of Social Security	Mexican	Neighboorhoods	160
Gracie, 2014[36]	CS	Pavilhão Haity Moussatché	Bazil	Neighboorhoods	95
Sugunan, 2009[37]	CS	Bharatidasan University	India	Society	79

Note : CS: cross-sectional study; CC, case–control study

Table 1 provided characteristic of 30 researches which were selected and consisted of 16 articles of journal in Indonesia and 14 articles of journal in other countries. The researches in Indonesia were mostly conducted by educational institution in university through lecturer's research and student's thesis (10;62,5), meanwhile, other researches were conducted by the government through Health Research and Development Center in Ministry of Health (6;37,5%). In selected articles, the research design of cross-sectional was more used (20; 66,7%) rather than control cases design (10; 33,3%).

Table 2. The Influence of Environmental Risk Factor on Leptospirosis

Research	Flood	Puddle around the house	Lack of Waterways	Poor Home Sanitation	Rats around the House	Having Pets/ livestock	Rainfall	Altitude	Occupation
Indonesia									
Murtiningsih, 2003[7]	o	o	o	o	xx	y	o	o	o
Muhidin, 2011[8]	o	o	y	xx	xx	o	o	o	y
Melani, 2010[9]	o	o	o	o	o	o	xx	o	o
Nurjanah, 2013[10]	o	o	o	o	o	o	o	o	o
Okatini, 2007[11]	o	o	x	x	y	o	o	o	o
Yunianto, 2008[12]	xx	o	o	o	xx	o	xx	o	o
Sunaryo, 2014[13]	o	o	o	o	xx	o	xx	o	o
Agustini, 2011[14]	o	o	o	xx	xx	o	xx	o	o
Yuliani,2014[15]	o	o	o	o	xx	o	o	o	o
Prastiwi,2012[16]	o	o	o	y	o	y	o	o	x
Ristiyanto,2013[17]	o	o	o	o	xx	o	o	o	o
Rahmadani, 2010[18]	o	o	x	y	xx	o	o	o	o
Rejeki, 2005[19]	o	y	o	o	xx	y	xx	o	o
Ningsih, 2013[20]	x	o	o	o	x	o	x	o	o
Anies, 2009[21]	xx	xx	y	o	y	y	o	o	o
Dina, 2014[22]	xx	xx	y	y	x	y	o	o	y
Other Countries									
Prabakharan, 2014[23]	o	x	o	o	o	xx	o	o	o
Kamath,2014[24]	o	o	xx	x	o	o	o	o	o
Allwood,2014[25]	y	o	o	x	y	y	o	o	o
Wasinki, 2013[26]	xx	o	o	o	xx	xx	o	o	xx
Vega, 2014[27]	o	o	x	o	o	o	xx	xx	o
Agampodi, 2014[28]	o	o	o	o	x	o	o	o	o
Sarkar, 2002[29]	o	o	xx	x	x	o	o	o	x
Tassinari, 2008[30]	o	o	o	o	x	o	xx	o	o
Victoriano, 2009[31]	o	o	o	xx	x	x	o	o	o
Yanagihara, 2006[32]	x	o	xx	x	o	o	x	o	x
Tubiana, 2013[33]	o	x	o	xx	o	o	o	o	y
Castellanos, 2003[34]	o	o	y	y	o	x	o	o	o
Gracie,2014[35]	xx	o	o	o	o	o	o	o	o
Stern, 2005[36]	o	o	o	o	o	xx	o	o	o
The total of significant research result	7/8	4/5	6/10	9/13	16/19	5/11	9/9	1/1	4/7

Note : X = significant ($P < .05$) in the bivariate analysis; XX = significant ($P < .05$) in the multivariate analysis; o = factor was not examined; y = factor was examined, no significant association.

Research regarding risk factor of leptospirosis in 16 researches was obtained environmental factor, including history of flooded area, puddle around the house, lack of waterways or poor waterways, poor home sanitation, rats around the house, high rainfall, altitude, and occupation. Among 16 researches in Indonesia, there were 4 researches that stated that there was a significant correlation between the history of flooded area and the occurrence of leptospirosis[13,21,22,23]. Among 14 researches in other countries, there were only 3 researches that used variable of flood[27,33,36]. In the researches in other countries, it was obtained the similar result which was in Poland and Brazil, which they stated that there was a significant correlation between flood and the occurrence of leptospirosis. Nevertheless, a conducted research from United States of America stated that there was no significant correlation between the flood and the occurrence of leptospirosis.

In the variable of the puddle around the house, among 5 researches that used the variable was obtained 4 results which showed that there was a significant correlation with the occurrence of leptospirosis cases [22,23,24,34]. In other countries, among 5 researches that used the variable, it was obtained that 4 researches stated that there was a significant correlation between the waterways and the occurrence of leptospirosis[25,28,30,33].

In the variable of poor home sanitation, among 6 researches in Indonesia, it was obtained that 3 researches stated that there was a significant correlation between home sanitation and the occurrence of leptospirosis[9,12,15].

Meanwhile, in other countries showed that among 7 researches, the 6 researches stated that there was a significant correlation between home sanitation and the occurrence of leptospirosis [25,26,30,32,33,34].

In the variable of the rats around the house, among 13 researches in Indonesia that used the variable, the 11 researches stated that there was a significant correlation between the rats around the house and the occurrence of leptospirosis. Meanwhile, the researches in other countries stated that there were 5 researches of 6 researches which stated that there was a significant correlation between the rats around the house and the occurrence of leptospirosis.

In the variable of having either farm animal or pets, among 5 researches in Indonesia, all of them stated that there was no significant correlation between having either farm animal or pets and the occurrence of leptospirosis. However, it was different with the researches in other countries which were among 6 researches, the 5 researches stated that there was a significant correlation between having either farm animal or pets and the occurrence of leptospirosis.

In the variable of rainfall, among 9 selected researches, all of them stated that the rainfall correlated significantly with the occurrence of leptospirosis in several areas. In the variable of altitude, among the selected researches, there was only one research that used the variable and it was obtained that there was a significant correlation between altitude and the occurrence of leptospirosis.

In the variable of occupation, among 3 researches in Indonesia, it was obtained that only 1 research that stated that there was a significant correlation between the type of occupation and the occurrence of leptospirosis[17]. In other countries, the selected research that used occupation variable were 4 researches and the 3 researches of the 4 researches stated that there was a significant correlation between the type of occupation and the occurrence of leptospirosis[27,30,33].

Table 3. The Influence of Potential Risk Factor on the Occurrence of Leptospirosis in Human

	Having Contact with Puddle	Having Contact with Flooded/ River Water	Swimming in the River	Taking Bath in the River	Washing in the River	Having contact with Rat's Urine	Having Contact with the Farm Animal	Using no Personal Protective Equipment	Walking in Barefeet only	River Water as Drinking Water	Know-ledge
Indonesia											
Murtiningsih, 2003[8]	o	xx	o	y	o	o	y	y	o	o	o
Muhidin, 2011[9]	o	o	o	o	o	o	o	o	o	o	o
Melani, 2010[10]	o	o	o	o	o	o	o	o	o	o	o
Nurjanah, 2013[11]	o	o	o	o	o	o	o	o	o	o	y
Okatini, 2007[12]	y	o	o	o	o	o	o	o	o	o	o
Yunianto, 2008[13]	o	o	o	o	o	o	o	o	o	o	o
Sunaryo, 2014[14]	o	o	o	o	o	x	o	o	o	o	o
Agustini, 2011[15]	o	x	o	x	x	o	o	o	o	o	o
Yuliani, 2014[16]	o	o	o	o	o	o	o	o	o	o	o
Prastiwi, 2012[17]	o	o	xx	x	o	o	y	o	y	o	o
Ristiyanto, 2013[18]	o	o	o	o	o	o	o	o	o	o	xx
Ramadhani, 2010[19]	o	o	o	o	o	o	o	o	o	o	o
Rejeki, 2005[20]	o	o	o	o	o	o	o	y	o	o	o
Ningsih, 2014[21]	o	o	o	o	o	o	o	o	o	o	o
Anies, 2009[22]	x	y	o	xx	xx	o	y	y	o	o	o
Dina, 2014[23]	x	x	o	o	x	x	y	xx	y	o	o
Others											
Prabakharan, 2014[24]	o	o	xx	xx	xx	o	o	xx	o	o	o
Kamath, 2014[25]	xx	o	o	xx	o	xx	o	o	o	y	o
Allwood, 2014[26]	xx	y	y	o	o	o	y	o	o	xx	y
Wasinki, 2013[27]	xx	o	xx	o	o	o	xx	o	o	o	y
Vega, 2014[28]	o	o	o	o	o	o	o	o	o	o	o
Agampodi, 2014[29]	o	o	o	o	o	xx	y	o	o	o	o
Sarkar, 2002[30]	o	o	o	o	o	xx	o	x	o	o	o
Tassinari, 2008[31]	o	o	o	o	o	o	o	o	o	o	o
Victoriano, 2009[32]	o	o	o	o	o	o	x	o	o	o	o

	Having Contact with Puddle	Having Contact with Flooded/ River Water	Swimming in the River	Taking Bath in the River	Washing in the River	Having contact with Rat's Urine	Having Contact with the Farm Animal	Using no Personal Protective Equipment	Walking in Barefeet only	River Water as Drinking Water	Know-ledge
Yanagihara, 2006[33]	o	o	o	o	o	o	o	o	o	o	o
Tubiana, 2013[34]	o	o	o	o	o	o	o	o	o	o	o
Castellanos, 2003[35]	o	o	o	o	o	o	xx	x	o	o	o
Gracie, 2014[36]	o	x	x	o	o	o	o	o	o	o	o
Sugunan, 2009[37]	xx	o	o	o	o	o	o	xx	o	o	o
The Total of Significant Research Result	6/7	4/6	4/5	5/6	4/4	5/5	3/9	5/8	0	1/2	¼

Note: X = significant ($P < .05$) in the bivariate analysis; XX = significant ($P < .05$) in the multivariate analysis; o = factor was not examined; y = factor was examined, no significant association.

In the variable of having contact with the puddle around the house, among 3 researches in Indonesia that used the variable, there were 2 researches that stated that there was a significant correlation between having contact with the puddle around the house and the occurrence of leptospirosis. Among 4 researches which were conducted in other countries, all of them stated that there was a significant correlation between having contact with the puddle around the house and the occurrence of leptospirosis.

In the variable of having contact with flooded water/ river water, the 3 researches of 4 selected researches in Indonesia stated that there was a significant correlation between having contact with flooded water/river water and the occurrence of leptospirosis. Meanwhile, there were only 2 researches in other countries which used the variable and only one of them stated that there was a significant correlation between them.

In the variable of swimming in the river from the research in Indonesia, only one research used the variable and it stated that there was a significant correlation between between the variable of swimming in the river and the occurrence of leptospirosis. Meanwhile, there were 4 researches in other countries which used the variable and the 3 researches of the 4 researches stated that there was a significant correlation between them.

In the variable of taking bath in the river, among 16 researches in Indonesia which were selected based on the criteria of journal review, there were 4 researches which used the variable. It was obtained that 3 researches of them stated that there was a significant correlation between the variable of taking bath in the river and the occurrence of leptospirosis. Meanwhile, there were 2 researches in other countries which used the variable of taking bath in the river and both of them stated that there was a significant correlation too with the occurrence of leptospirosis.

In the variable of washing in the river, among 16 selected researches in Indonesia, there were 3 researches which used the variable that stated that there was a significant correlation between the variable of washing in the river and the occurrence of leptospirosis. In the selected researches in other countries, there was only one research that used the variable and the result was there was a significant correlation between them.

In variable of having contact with rat's urine among the researches from either Indonesia or other countries, there were 5 researches which used the variable. All of the 5 researches stated that there was a significant correlation between the variable of having contact with rat's urine and the occurrence of leptospirosis.

In the variable of having contact with pets among 16 selected researches in Indonesia, there were 4 researches which used the variable. The 4 researches stated that there was no significant correlation between the variable of having contact with pets or farm animals and the occurrence of leptospirosis. That result was different from the 5 selected researches in other countries which used the variable in which the majority of the researches stated that there was a significant correlation between the variable of having contact with pets or farm animals and the occurrence of leptospirosis.

In the variable of using no personal protective equipment, among 16 selected researches in Indonesia, there were 4 researches that used the variable. The result was there was only one research that stated that there was a significant correlation between the use of personal protective equipment while doing activity and the occurrence of leptospirosis. Other selected researches in other countries were 4 researches that used the variable and all of

their result were there was a significant correlation between the variable of the use of personal protective equipment and the occurrence of leptospirosis.

In the variable of walking in barefeet only among the total of selected researches, there were only 2 researches that used the variable. The result of both researches, there was no significant correlation between the use of footwear and the occurrence of leptospirosis.

In the variable of river water as drinking water among several selected researches, there were 2 researches which used the variable. The result of one of the researches showed that there was a significant correlation between them, meanwhile, the result of another research showed that there was no significant correlation between them.

In the variable of knowledge, among several selected researches, there were 4 researches that used the variable. As the result, the 3 researches stated that there was no significant correlation between the knowledge and the occurrence of leptospirosis.

However, the leptospirosis cases in Indonesia in 2009-2013 were 2466 cases (CFR 9,6%). In endemic area of leptospirosis, there were the cases in almost every year and the cases were occurred an increase either from the total of the case sector or the spreading area of the case sector[37]. In East Java, there were 305 cases in 2009-2013 (CFR 9,3%). Since, it was reported leptospirosis case in 2009 in East Java, the total of leptospirosis case increased more and more.

The data from the research result in Ponorogo district, it was obtained from Health Office and there were 92 cases (CFR 5,4%)[38]. The case data was obtained from passive data, which meant that it was obtained from the report of Public Health Centers and hospitals. The case data that was obtained from active surveillance in the field was nothing. From the interview result from the workers in Public Health Center, the logistical limitation of RDT (Rapid Diagnostic Test) of leptospirosis was one of its obstacles. The implementation of epidemiology surveillance in the field was conducted if it was reported that there was new case from the local health facility and the health worker would handle it in order to look for the possibility of another sufferer around the case. Besides, they also looked at the potential risk factor of leptospirosis around the sufferer. The activity of this epidemiology surveillance was conducted awhile when there was a case and it was not conducted periodically.

From the total of 92 cases until in 2015, there were 74 cases (80%) which were occurred in highland (>500 meter of sea level), were spread in 10 subdistricts and the subdistrict that had the most of number of this case was in Ngrayun Subdistrict (with the altitude of 920m) which had 56 cases. This data showed that leptospirosis for this time was occurred in lowland, flooded area, seashore, and tended in urban area. In fact, it could be occurred in highland area and in the mountains. The guidance of epidemiology surveillance that was made by Ministry of Health recently needed a revision or additional supportive variable that was able to accommodate the risk factor of leptospirosis transmission in either highland area or mountains.

IV. DISCUSSION

From the study of several selected researches in either Indonesia or other countries, particularly in India and Srilanka, it could be known the similarity of risk factors, such as the puddle, having history of flooded area, and poor sanitation. In area of having history of flooded area would enlarge the possibility of being mixed by the dirt or rat's urine with flooded water, and later, it was occurred a contact with the skin that had wound or in the layer of human's mucosal skin, hence, the human could be infected by leptospirosis.

By knowing the risk factor of leptospirosis in several areas, particularly in Indonesia such as in Yogyakarta, Demak, Semarang, Jakarta, and Madura (Java Island), it could be known the tendency of leptospirosis cause in rainy season (high rainfall) and in several areas which were occurred flood, many puddles around the house, poor environmental sanitation, people's unhealthy behavior, and having no willing for the people to use personal protective equipment while working. Therefore, it would be easier to have contact with the water that was contaminated by rat's urine that was positive leptospirosis. Furthermore, the Leptospira entered into the human body through mucous membrane (mucosa) of eye, nose, or skin that had wound or healthy skin but being exposed for long time by the water that was contaminated by rat's urine which was infected by Leptospira.[2,39]

Risk factor of environment and behavior, which regarding with the occurrence of leptospirosis in several areas of a country, had several similarities and differences. From the variable of risk factor that regarded with environmental factor, there was one selected research that showed that there was a significant correlation between the factor of altitude of an area and the occurrence of leptospirosis in Trinidat.[28] This condition was similar with the case in Ponorogo District, East Java, which there was occurred leptospirosis case in highland area in 2010-

2013.[40] In the area with the altitude, the risk factors which were potential were such as there was the puddle around the house, the house floor was the ground, there was cattle and goats near the house, the existence of rats in the house, having occupation as farmers and cattleman who did not use any personal protective equipment such as footwear.[7]

The epidemiology surveillance of leptospirosis in Indonesia was an analysis activity that was conducted systematically and continuously against leptospira disease or health problem and condition that influenced the increase and transmission of leptopsira disease or the health problem so that we could conduct prevention action effectively and efficiently through the process of data collection, data analysis, and distribution information of epidemiology to the health program organizers[41].

The early warning system of leptospirosis had not been able to be conducted well because the monitoring was only in limited if there was a case that was reported from health center agency. Hence, recently, it was still only in stage of waiting for the occurred case in the field, then, it would be conducted epidemiology investigation of leptospirosis either for the sufferer or risk factor in around the case. The obtained data was mostly passive data. Along this time, it still minimally obtained the report from health office, including active data that was obtained from epidemiological surveillance to the field directly. The Early Warning System had not monitored the situation of tendency of leptospirosis from time to time (weekly period or monthly period) and given an alert to the organizer of disease controlling program if it would be occurred threat of leptospirosis case. This condition made leptospirosis control became late, thus, it tended to occur Extraordinary Incident of leptospirosis.

In chart of The Early Warning System of Leptospirosis in Public Health Center in 2014 showed that in implementing EWARS activity, firstly it was conducted an observation of supportive variable of the transmission of leptospirosis. The health workers conducted an observation more intensively in health service facility in either Public Health Centers or hospitals. By the condition like this, the health workers who conducted it were only the paramedics who worked in health facility. If it was found a sufferer who was diagnosed positive leptospirosis by laboratory, on that time, the health workers would conduct epidemiology investigation to the field where the sufferer lived. Surveillance approach was divided by two, which were passive surveillance and active surveillance[42]. EWARS was constructed by data of passive surveillance, which used special workers of surveillance for visitation to the field, villages, doctor's private practice, other medical personnels, Public Health Center, Clinic, and hospital by the aim of identifying new disease case or death which was known as case finding[43]. The dynamics of surveillance system showed that EWARS of leptospirosis recently had not been able to be conducted optimally and integrated from either resources or workers.

Therefore, it needed to be constructed a system of early warning that could give an alert before it was occurred leptospirosis case in society, could minimize pain/death, could monitor a tendency of infectious disease, and could value the success of controlling program of leptospirosis disease, which made the guidance of health worker as a basic in implementing the standard EWARS of Extraordinary Incident program.

By having not yet optimal EWARS of leptospirosis recently, in order to minimize the obstacles, it needed to be created model approach or regional vulnerability model that could predict the pattern of disease occurrences and know the incident that would be occurred if it was implemented several actions of alternative controlling strategy[44]. This regional vulnerability model had similar pattern with the real problem. The accurate model could be used as guidance for controlling disease efficiently and effectively, and or for increasing the comprehension regarding life cycle of the cause of disease or infection agent[45].

V.   CONCLUSION

Among the articles in Indonesia which were published were more conducted by educational institutions in University (62,5%). This showed that the role of educational institution in research was in superior health field.

The researches regarding environmental risk factor against leptospirosis were 16 researches (53,3%), which there were the variable of history of flooded area, the puddle around the house, poor sewerage, the house floor from the ground, the rats aound the house, cattle and goat corral near the house, and the occupation that had risk of it. The situation of tendency of case data in Indonesia in 2009-2015, particularly in endemic area of leptospirosis showed potency of the increase of case total. Besides, the spreading area of the disease also more enlarged.

However, it needed regional vulnerability model as an indicator of EWARS of leptospirosis that could predict the pattern of disease occurrence and know the incident that would be occurred if it was implemented several actions of alternative controlling strategy. By constructing the regional vulnerability model of leptospirosis, it was expected that it could reduce the case incidence rate and it could press the spreading case to other areas.

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