IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 11 Ver. I (November 2018), PP 01-07
www.iosrjournals.org

Generic Application on Rabies Entry Assessment with Semi-Quantitative Approach

Amanatin A.[12*], Sudarnika E.[3], Lukman D.W.[3], Wibawan I.W.T.[3]
[1](*Veterinary Public Health, Graduate School of Bogor Agricultural University, Bogor, West Java Indonesia)*
[2](*Indonesia Agricultural Quarantine Agency, Ministry of Agriculture, Jakarta, Indonesia)*
[3](*Department of Animal Disease and Veterinary Public Health, Bogor Agricultural University, Bogor, Indonesia)*
**Corresponding author:Amanatin Amanatin*

Abstract :*Risk assessment is apart of risk analysis but sadly not all personnel associated with the animalhealth are able to do so. Theaim of this study was to develop a generic rabies entry assessment application with semi-quantitativeapproach. Rabies entry assessment used the standard risk analysis in the Terrestrial Animal Health Code, World Organization of Animal Health (OIE) with a semi-quantitative approach following to Biosecurity Australia. Methods of development entry assessment were conducted by literature review, field observation, as well as expert opinion in animal health.This application used Microsoft Excel 2010 with added@RISK software.This application consisted of six (6) nodes with eighteen (18) questions. The result of questionnaires showed that application were helpful the risk assessment (100%), easy to used (87%), would be applied in their institution (70%), and easy to understood the questions and answer (100%).*
Keywords: *Assesment, dog, entry, rabies, semi-quantitative*

Date of Submission: 20-10-2018 Date of acceptance: 05-11-2018

I. Introduction

Rabies is a disease caused by a neurotropic virus in the genus Lyssavirus of family Rhabdoviridae [1]. Rabies is a major zoonotic disease in various countries including Indonesia [2]. Indonesia government declared free from rabies by the year of 2020, but currently only 9 provinces from 33 provinces declared free[3]. The spreading of rabies in Indonesia is caused by the movement of dogs via pets animal, for trade, and military forces[4]. Risk analysis is needed to carry out preventive measures against spreading of rabies to rabies free areas. Risk assessment is a part of the risk analysis, but not all personnel associated with the animal health are able to properly do the assessment.

The current risk assessment guide is still at an outline step with qualitative approach. Qualitative risk assessments are easier to use but they have a high score of subjectivity. Quantitative assessments have not been developed much since they require specialized expertise with complete data support. Frame work of risk assessment on livestock disease qualitatively was developed by de Vos et al. in 2012[5]. A generic rabies risk assessment tool has been developed by Ward and Hernández-Jover in 2015[6]. Applications for rabies control and eradication have been developed under the name The Stepwise Approach towards Rabies Elimination (SARE) [7], but this application does not specifically calculate the risk of rabies entering a region.

A generic aplication of risk assessment can facilitate animal health officers in assessing risks. Semi quantitative approach is used for more objective results with limited data. Dogs are chosen as research object because dogs are the main animal that transmit this disease. The rabies cases in Indonesia are largely due to dog bites. Risk assessment is required to determine appropriate risk management in rabies control and eradication programs. Based on the reason above, the study aim was to develop a generic application of rabies entry assessment through dog movement with a semi-quantitative method.

II. Methods

2.1. Entry Assessment Model

Rabies entry assessment used the standard risk analysis in the Terrestrial Animal Health Code(TAHC), World Organization of Animal Health (OIE)[8] with a semi-quantitative approach following to Biosecurity Australia[9].Entry assessment is the process of describing the pathway (s) needed for an activity to introduce pathogenic agents into a particular environment, and estimating the probability, either qualitatively or quantitatively, of the complete process that occuring [10].

Methods of development entry assessment were conducted by literature review, field observation, as well as expert opinion in animal health. Expert opinions were obtained by interview method, in-depth interview, questionnaire and focus group discussion (FGD).Risk assessment consist of entry assessment, exposureassessment, consequence assessment, and risk estimation. This study consisted of entry assessment and risk estimation. The hazard identification was the rabies virus brought by live dogs not including another rabies carriers. This study only assessed rabies from dog that transported through legal route.

2.2. Risk Estimation Calculation

The development of entry assessment applications began with the designation of scenario tree from of the most likely pathways from identified hazard. The scenario tree consisted of several nodes that will be the basefor compiling a list of questions. Each node consisted of several questions with different values and was developed based on factors in the risk assessment which followingthe World Organisation for Animal Health (OIE) methodology for risk analysis [8].The valuefrom all questions in a node is one.The likelihood of each answer choice in each question was converted to a semi-quantitative approach that following to Australian Biosecurity. The qualitative category was quantified into uniform distribution that following to Australian Biosecurity and was presented in Table 1.

Table1. Nomenclature and probability distributions for semi-quantitative likelihoods [9]

Likelihood	Descriptive definition	Probability interval	Probability distribution
High	The event would be very likely to occur	Range = 0.7-1	P ~ Uniform (0.7, 1)
Moderate	The event would occur with an even probability	Range = 0.3-0.7	P ~ Uniform (0.3, 0.7)
Low	The event would be unlikely to occu	Range = 0.05-0.3	P ~ Uniform (0.05, 0.3)
Very Low	The event would be very unlikely to occur	Range = 0.001-0.05	P ~ Uniform (0.001, 0.05)
Extremely Low	The event would be extremely unlikely to occur	Range = 10^{-6}-0.001	P ~ Uniform (10^{-6}, 0.001)
Negligible	The event would almost certainly not occur	Range = 0-10^{-6}	P ~ Uniform (0, 10^{-6})

The probabilityvalue of each node was based on the sum of each probability of the questions in the node. The probability value of the question was obtained from the multiplication of probability value (Risk Uniform) for each answer choice with the value of the question. The estimated risk value was obtained from the multiplication of all the probability values of the node in the risk pathway. Application were developed using Microsoft Excel (PC/Windows 2010) and and probabilities were estimated using Monte Carlo stochastic simulation modelling with @Risk (Palisade Corporation, USA). Each simulation consisted of 1000 iterations sampled using the Latin hypercube method with a fixed random seed of one.

2.3. Sensitivity Analysis

Sensitivity analysis isthe process of examining the impact of the variation in individual model inputs on the model outputs in a quantitative risk assessment[11]. The sensitivity of the outputs of the model to some of the input parameters was evaluated using the @Risk Sensitivity Analysis (Palisade Corporation, USA). Sensitivity analyses were conducted for the overall outputs of the entry assessment models to identify which input parameters were the most influential to the output probabilities.

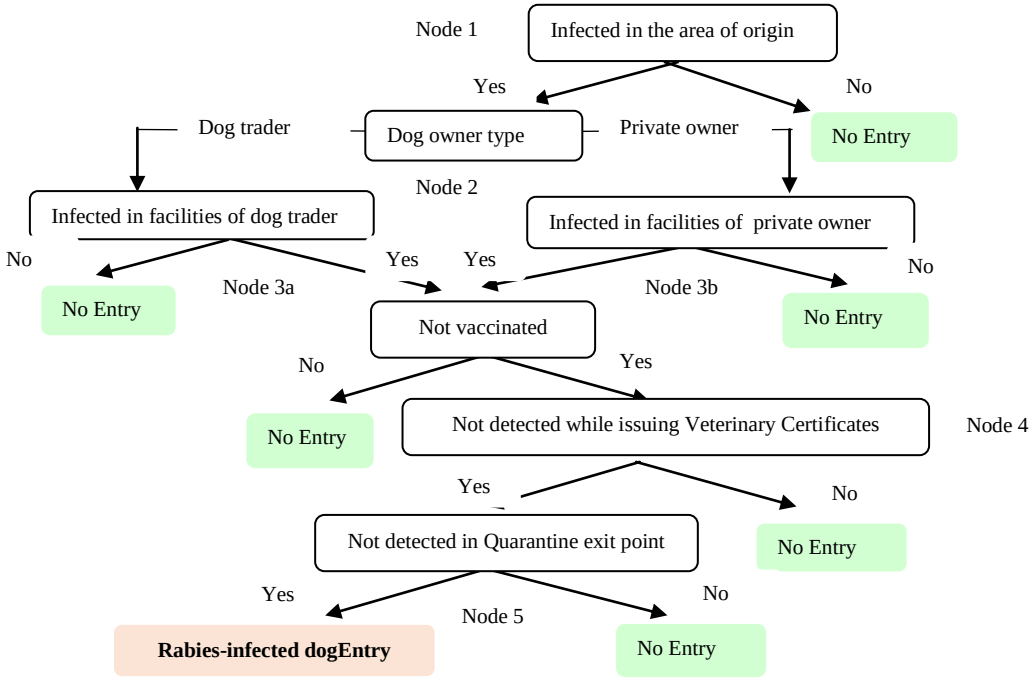
2.4. Trial and Evaluation of Risk Assessment Application

This application was tested on 30 (thirty) respondents. The criteria for respondents are quarantine veterinarians, goverment veterinarians, and veterinarians of Disease Investigation Center. Application improvements were based on evaluation results when applied at the field level.

III. Result

3.1. Rabies Entry Risk Assessment Application

This scenario tree was developed from dog domestic movement process.The scenario tree was made based on of the biological pathways by which rabies might be introduced into dog movement and the pathway of the spreadof rabies in Indonesia.The results of the development of scenario tree for rabies entry assessment in this study consisted of five (5) nodes, are shown in fig. 1.



Figur. 1. Scenario tree for rabies entry assessment.

The nodes and questions used for the development of this generic entry assessment application based on this pathway are:
Node 1. Probability of dogs were infected in the origin area: consisted five questions which are status of rabies disease in the origin area, vaccination program, antibody titer surveillance, rabies case, dog keeping type.
Node 2. Proportion of different types of dog owner: consisted two questions who are dog trader and private owners.
Node 3. 3a. Probability of dogs were infected in facilities of dog trader: consisted two questions which are dog keeping type and the presence of dogs from other areas.
3b. Probability of dogs were infected in facilities of private owners: consisted two questions which dog keeping type and the presence of dogs from other areas.
Node 4. Probability dogs that will be shipment are not vaccinated: consisted two questions which are dog vaccination and identity card.
Node 5. Probability of rabies-infected dogs are not detected while the process of issuing Veterinary Certificates: consisted four questions which are examination of clinical symptoms, vaccination card, serological test for rabies antibodies, and duration of keeping dog.
Node 6. Pobability of rabies-infected dogs are not detected in the Agricultural Quarantine Service exit point: consisted six questions which are documents examination, clinical symptoms examination, results of serological test for rabies antibodies, vaccination time, and pregnancy examinations.

Nodes, questions, values, answers, and probability are presented in Table 2.

Table 2. Nodes, questions,values, answers, and probability in the application

No	Node	Question	Value	Answer	Likelihood & Uniform distribution
1	Probability of dogs were infected in the origin area	What is the status of rabies disease in the origin area (district / city / province)of the dog?	0.2	Infected	High [U(0.7, 1)]
				Free	Very low [U(0.001,0.05)]
				Unknown	High [U(0.7, 1)]
		How is the vaccination program in the origin area of the dog?	0.4	There is no vaccination program	High [U(0.7, 1)]
				There is a vaccination program with coverage less than 70% without an antibody titer test	Moderate [U(0.3,0.7)]
				There is vaccination program with coverage less than 70% with antibody titer test	Moderate [U(0.3,0.7)]
				There is vaccination program with coverage more than 70% without an antibody titer test	Very low [U(0.001,0.05)]
				There is vaccination program with coverage more than 70% with antibody titer test	Extremely low [U(10^{-6}0.001)]
				Unknown	High [U(0.7, 1)]
		- What is the result of antibody titer surveillance or rabies vaccination evaluation in its origin area?	0.1	Protective antibody titer is less than 70%	High [U(0.7, 1)]
				Protective antibody titer is more than 70%	Low [U(0.05, 0.3)]
				Unknown	High [U(0.7, 1)]
		Has rabid dog been found in the area of origin for the past two years?	0.1	Yes	High [U(0.7, 1)]
				No	Low [U(0.05, 0.3)]
				Unknown	High [U(0.7, 1)]
		How does the generally dog keeping system in the origin area?	0.2	Free-roaming	High [U(0.7, 1)]
				Tied at the yard	Moderate [U(0.3,0.7)]
				Kept inside the house	Very low [U(0.001,0.05)]
				Caged in groups	Very low [U(0.001,0.05)]
				Caged individually	Extremely low [U(10^{-6}0.001)]
				Unknown	High [U(0.7, 1)]
2	Proportion of different types of dog owner	How much is the percentage of dogs that are transported by dog traders?		Average percentage	Fill by user = (0-1), Beta
				Minimum percentage	Fill by user = (0-1), Beta
				Maximum percentage	Fill by user = (0-1), Beta
		How much is the percentage of dogs that are transported by privat owners?		Average percentage	Fill by user = (0-1), Beta
				Minimum percentage	Fill by user = (0-1), Beta
				Maximum percentage	Fill by user = (0-1), Beta
3a	Probability of dogs were infected in facilities of dog trader	How is the dog enclosure system being used by dog collector?	0.7	Group	High [U(0.7, 1)]
				Individual	Extremely low
				Tied at the yard	High [U(0.7, 1)]
				Unknown	High [U(0.7, 1)]
		Are there dogs obtained from outside the area / city / district?	0.3	No	Low [U(0.05, 0.3)]
				Yes, from another area with infected status	High [U(0.7, 1)]
				Yes, from another area with not infected status	Low [U(0.05, 0.3)]
				Unknown	High [U(0.7, 1)]
3b	Probability of dogs were infected in facilities of private owner	How is the dog enclosure system being used by dog owner	0.7	Free-roaming	High [U(0.7, 1)]
				Tied at the yard	Moderate [U(0.3,0.7)]
				Kept inside the house	Very low [U(0.001,0.05)]
				Caged in groups	Very low [U(0.001,0.05)]
				Caged individually	Extremely low [U(10^{-6}0.001)]
				Unknown	High [U(0.7, 1)]

		Are there dogs obtained from outside the area / city / district?	0.3	No Yes, from another area with infected status Yes, from another area with not infected status Unknown	Low [U(0.05, 0.3)] High [U(0.7, 1)] Low [U(0.05, 0.3)] High [U(0.7, 1)]
4	Probability dogs that will be shipment are not vaccinated	Is every dog that will be transported vaccinated?	0.8	Yes, all dogs are vaccinated for at least 14 days and a maximum of 1 year before departure Yes, all dogs are vaccinated and the time is less than 14 days or more than 1 year before departure Yes, some dogs are vaccinated for at least 14 days and a maximum of 1 year before departure Yes, some dogs are vaccinated and the time is less than 14 days or more than 1 year before departure No Unknown	Extremely low [U(10^{-6}0.001)] Low [U(0.05, 0.3)] Moderate [U(0.3,0.7)] Moderate [U(0.3,0.7)] High [U(0.7, 1)] High [U(0.7, 1)]
		Does every dog that has been given vaccination must be labeled or identified?	0.2	Yes No Unknown	High [U(0.7, 1)] Low [U(0.05, 0.3)] High [U(0.7, 1)]
5	Probability of rabies-infected dogs is not detected while the process of issuing Veterinary Certificates (VC)	Does every dog to be issued VC has to be examined for clinical symptoms?	0.2	Yes, all dogs Yes, some dogs No Unknown	Low [U(0.05, 0.3)] Low [U(0.05, 0.3)] High [U(0.7, 1)] High [U(0.7, 1)]
		Does every dog to be issued VC has to enclosea vaccination book legalized by the veterinarian?	0.1	Yes, without the legalization of veterinarian Yes, with the legalization of veterinarian No Unknown	High [U(0.7, 1)] Very low [U(0.001,0.05)] High [U(0.7, 1)] High [U(0.7, 1)]
		Does every dog to be issued VC has to befor rabies antibodies?	0.5	Yes No Unknown	Very low [U(0.001,0.05)] High [U(0.7, 1)] High [U(0.7, 1)]
		Does every dog to be issued VC has to be kept from birth or at least 6 months in the area of origin?	0.2	Yes No Unknown	Very low [U(0.001,0.05)] High [U(0.7, 1)] High [U(0.7, 1)]
6	Pobability of rabies-infected dogs are not detected in the Agricultural Quarantine Service exit point	Does inspection being carried out to check the completeness, truth and validity of the document?	0.1	Yes No Unknown	Very low [U(0.001,0.05)] High [U(0.7, 1)] High [U(0.7, 1)]
		Does clinical checkups is conduct inAgricultural Quarantine Service exit point?	0.1	Yes, all dogs Yes, some dogs No Unknown	Low [U(0.05, 0.3)] Moderate [U(0.3,0.7)] High [U(0.7, 1)] High [U(0.7, 1)]
		What action is taken if the dog did not have a protective antibody titer test result?	0.3	Antibody titer test is carried out for all dogs, if the result didn't reach protective level, then vaccination is carried out Antibody titer test is carried out by sampling, if the result didn't reach protective level, vaccination is carried out on all dogs Not permitted to get through and antibody titer requested to be tested	Extremely low [U(10^{-6}0.001)] Very low [U(0.001,0.05)]

		in its origin region	Low [U(0.05, 0.3)]
		Will be Issued a health certificate by requesting an antibody titer test and / or vaccinations to the Agricultural Quarantine Service entry point	Low [U(0.05, 0.3)]
		Permitted to get through	High [U(0.7, 1)]
		Unknown	High [U(0.7, 1)]
What action is taken if the dog did not have history of vaccination?	0.3	Permitted to get through	High [U(0.7, 1)]
		Not permitted to get through and acquired vaccination in its origin region	Low [U(0.05, 0.3)]
		Vaccination is carried out without antibody titer test	Very low [U(0.001,0.05)]
		Antibody titer test is carried out. If the result indicates protective antibody level, the dog are permitted to get through, whereas if the result didn't reach protective level, then vaccination is carried out	Extremely low [U(10^{-6}0.001)]
		Provide a health certificate by requesting in Agricultural Quarantine Service entry point for vaccinations	Moderate [U(0.3,0.7)]
		Unknown	High [U(0.7, 1)]
What action is taken if the dog had been vaccinated less than 30 days or more than one year?	0.1	Not permitted to get through	Low [U(0.05, 0.3)]
		Permitted to get through	High [U(0.7, 1)]
		Revaccinated	Extremely low [U(10^{-6}0.001)]
		Unknown	High [U(0.7, 1)]
What action is taken if there is a dog with pregnancy around 6 week and above or dog that is breastfeeding?	0.1	Not permitted to get through	Low [U(0.05, 0.3)]
		Permitted to get through	High [U(0.7, 1)]
		Examination of gestation not performed	High [U(0.7, 1)]
		Unknown	High [U(0.7, 1)]

3.2. **Trial and Evaluation of Risk Assessment Application**

The respondents were answered all questions in Table 2 and evaluated of this application. Selection of answers should be based on the data and conditions that occur in the field, so it was necessary to prepare the completeness of data that related to the questions. The result of questionnaires showed that application were helpful the risk assessment (100%), easy to used (87%), would be applied in their institution (70%), and easy to understood the questions and answer (100%).

IV. Discussion

Respondents stated this application were not easy, because this application requires several answer from other relevant agencies. This application was designed for a teamwork, which consists of quarantine veterinarians, goverment veterinarians, and veterinarians of Disease Investigation Center.Respondents who did not want to apply this application in their institution, said because there was no dog movement in their institution.

The list of questions and answers were developed based on biological factors, countries, and commodities in the entry assessment that following to import risk analysis [8]. It is also followingthe rabies carrier animals traffic regulations in the Decree of the Minister of Agriculture[12].The value of the question in each node was based on the amount of contribution to the possible risk compared to the other questions in the same node. The likelihood and probability of each answer were based on how much the risk of them.

The status of rabies vaccination, contact with other dog, condition of dog, and veterinary care are factors that associate with rabid dog [13]. Rabies is closely related to the keeping system, which the highest incidence rate of rabies was found in semi free-ranging dogs and the lowest in home dogs. The high incidence rate of rabies in semi free-ranging dogs may due to high level of contact among dog in this group as compared to the home dogs, and efforts to do vaccination by injection to this group of dog is not easy, and as such the rabies transmission cycle continue in this population[14]. The rabies control programmes can be successful if vaccination coverage can reach 70% in all parts of region, district, province, or country[15][16].

Semi-quantitative likelihood evaluation is an evaluation in which likelihoods assigned to steps in scenarios have been given numeric 'scores', or probabilities and/or probability intervals. The advantage of this

assessment approach is that determining the probability interval can describe and interpret estimates of likelihood consistently. Semi-quantitative likelihood evaluations can consider the volume of dog traffic which is an important issue in risk analysis which is not easy with a simpler qualitative approach. This scenario-based approach to likelihood evaluation is considered more transparent than a simple narrative description of relevant factors or events, and enables the relative importance of particular steps to be evaluated. The simulation-based approach provides a very simple and robust means by which the 'uncertainty' inherent in most risk analysis can be represented and included in the assessment process with a uniform distribution at random many times [9].

V. Conclusion

This application consisted of six (6) nodes with eighteen (18) questions.The result of questionnaires showed that application were helpful the risk assessment (100%), easy to used (87%), would be applied in their institution (70%), and easy to understood the questions and answer (100%).The principal constraint of the semi-quantitative approach is the need to place likelihoods confidently in one or other category. This application is still limited to assessing rabies through live dog movement, so it is necessary to developed another applications for risk assessment related to other diseases or other types of animals.

Acknowledgements

This research is funded by Indonesia Agricultural Quarantine Agency, Ministry of Agriculture, Republic of Indonesia. The authors thank to The Agricultural Quarantine Service Class I of Lampung, The Agricultural Quarantine Service Class II of Cilegon, Directorate General of Animal Husbandry and Animal Health, Disease Investigation Center of Lampung, and Department of Animal Husbandry and Animal Health of Lampung Province.

References

[1]. World Organization of Animal Health (OIE), Rabies :Infection With Rabies Virus And Other Lyssaviruses,2018.
[2]. D. K. Nugroho, D. Ik, S. Tum, and L. Schoonman, Analysis of Rabies Surveillance Data (2008-2011) in Bali Province , Indonesia,Osir, 6(2), 2013, 8–12.
[3]. Directorate general of Animal Husbandry and Animal Health, National Policy and Roadmap for the Eradication of Rabies, 2018.
[4]. M. P. Ward, Rabies in the Dutch East Indies a century ago – A spatio-temporal case study in disease emergence,Prev. Vet. Med., 114(1), 2014, 11-20.
[5]. C. J. de Vos, M. Hoek, E. Fischer, A. De Koeijer, and J. Bremmer, Risk Assessment Framework for Emerging Vector-Borne Livestock Diseases,2011.
[6]. M. P. Ward and M. Hernández-Jover, A generic rabies risk assessment tool to support surveillance, Prev. Vet. Med., 120(1), 2015, 4-11.
[7]. A. Coetzer, A. H. Kidane, M. Bekele, A. D. Hundera, E. G. Pieracci, M. L. Shiferaw, R. Wallace, and L. H. Nel, The SARE tool for rabies control: Current experience in Ethiopia,Antiviral Res., 35, 2016, 74–80.
[8]. World Organization of Animal Healt (OIE), Risk Analysis, Threat Assess. Risk Anal., 2017, 25–36.
[9]. Biosecurity Australia, Guidelines for Import Risk Analysis, 2001,2–119.
[10]. W. D. Murray N, McDiarmid M, Wooldridge B, Gummow RS, Morley SE, Weber A, Giovanni D, Handbook on Import Risk Analysis for Animal and Animal Product: Qualitative Risk Assessment. Vol: 1. (Paris: Office International des Epizooties, 2004).
[11]. M. Z. Murray N, MacDiarmid S, Woldridge M, Gummow B, Morley RS, Weber SE, Giovannini A, Wilson D, Conte AM, Handbook on Import Risk Analysis for Animal and Animal Product: Quantitative Risk Assessment. Vol. 2.(Paris: Office International des Epizooties, 2004).
[12]. Ministry of Agriculture, Republic of Indonesian, "Decree of the Minister of Agriculture 1999 No. 1096 about rabies carrying animal traffic," 1999.
[13]. I. N. Dibia, B. Sumiarto, H. Susetya, A. Agung, G. Putra, H. Scott-orr, B. B. Veteriner, F. K. Hewan, G. Mada, and U. Sydney, Risk Factors Analysis for Rabies in Dogs in Bali Jurnal Veteriner September 2015. Journal Vet, 16(3), 2015, 389-398.
[14]. A. A. G. Putra, Epidemiology of Rabies in Bali: The Analysis of Rabies in Semi Free- ranging Dogs and Their Significance on Transmission Cycle, An Ecosystem Approaches. Bul. Veterines, 18(78), 2011, 45–55.
[15]. World Health Organization (WHO), Rabies,2018.
[16]. L. Touihri, I. Zaouia, K. Elhili, K. Dellagi, and C. Bahloul, Evaluation of Mass Vaccination Campaign Coverage Against Rabies in Dogs in Tunisia,58, 2011, 110–118.

Amanatin A "Generic Applicationon Rabies Entry Assessment with Semi-Quantitative Approach "IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.11 (2018):