Special Articles

The Rabies Epidemic on Flores Island, Indonesia (1998-2003)

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Flores is an isolated previously rabies-free Indonesian island which has been experiencing a canine rabies outbreak which resulted in at least 113 human deaths. It started with the importation of three dogs from rabies endemic Sulawesi in September of 1997. Local authorities responded with massive killing of dogs starting in early 1998. Approximately 70% of the dogs, in the district where rabies had been introduced, were killed during that year, yet canine rabies still exists on Flores at this time (June 2004). Approximately 50 percent of dog bite cases and human deaths were in children under 15 years of age. Between 1998 and the end of 2002, 3,389 post-exposure rabies treatments were provided and none of the treated subjects died. Almost all patients were given the Thai Red Cross intradermal rabies postexposure treatment regimen using tissue culture rabies vaccine. A small but unknown number of patients with very severe exposures also received equine rabies immune globulin. This occurrence indicates that even massive culling of the dog population, without an intensive vaccination campaign of the survivors, will not arrest an outbreak even if it occurs on a small island.

Keywords : *Rabies, Flores island, Indonesia*

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Geographic, Historical and Social Background

Rabies in Asia is largely transmitted by canines. Asian countries such as Japan, Korea, Taiwan, Malaysia and Singapore, which once harbored rabies but then controlled and immunized their dog population, were eventually able to eradicate this disease. Flores is located west of Bali and east of Timor and belongs to Nusa Tenganara province of Indonesia. It is approximately 350 x 60 Km long and wide, is mountainous, contains several active volcanoes and is covered by lush vegetation. Corn, coconuts, bananas, other tropical fruits, vegetables, coffee, spices and cocoa are grown for local consumption and export. Flores is divided into 6 administrative districts. They are listed from east, where the rabies outbreak originated, to west (Fig. 1).

District	District center	Population in 2002
Sikka:	Maumere	262,600
East Flores:	Larantuka	197,417
Ende:	Ende	231,222
Ngada:	Bajawa	223,222
Manggarai:	Ruteng	607,348
Lenbata (a separate island):	Kalabahi	89,736

Total population: 1,611,588 (year 2000)

Maumere is the largest town. Approximately 70 percent of the population are Catholics and the

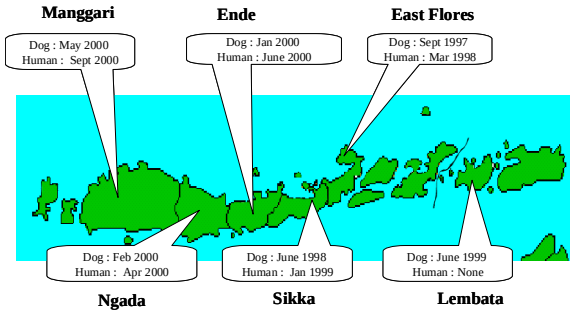

Fig. 1 Dates of First Appearance of Dog and Human Rabies on Flores Island, Indonesia

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rest Moslem, Hindi or Protestant Christians. Before the current rabies outbreak, there were an estimated 600,000-800,000 dogs on the island. Almost all of these were owned and semi-controlled. They had not been vaccinated against rabies since rabies had never been reported previously from Flores. The dogs are of the same mixed breeds seen in Southeast Asia with an average weight of 14-16 Kg. Dog meat has a traditional place in the diet of Flores. They are kept as watchdogs, pets, for food and for trade. The general population is poor and survives largely from subsistence farming. Fishing is an important industry and there is little control over movements of fishermen. Flores has an infrastructure of district and sub-district health centers. They are staffed by health aids, nurses and recently graduated physicians. Hospital services are operated mostly by general practitioners with the help of a few visiting specialists from other parts of Indonesia. Nevertheless, the expanded program of immunization (EPI) functions well. Major endemic diseases include malaria (P.falciparum and P.vivax), tuberculosis and intestinal parasites. Though poor, Flores is a peaceful and beautiful island with a tolerant population, little crime or violence and a great tourism potential.

Arrival of rabies in flores

This island has not known rabies prior to 1997 and had no contingency plan for managing its introduction. Canine rabies cases were first identified in East Flores district in September of 1997. Fisherman had imported three dogs from Butung Island (south-east Sulawesi) which is approximately 500 Km north of Flores and a known canine rabies endemic region. The dogs died shortly after arrival but were not examined. Neighborhood dogs then died with clinical signs suggesting rabies. Several were diagnosed later by Seller staining or fluorescent antibody techniques (FAT) at the regional laboratory of the Lifestock Department at Maros on Sulawesi (Table 1). Soon, the first human rabies cases appeared in East Flores: 10 in 1998, 13 in 1999, 1 in 2000, and 2 in 2001 (Table 2).

Innitial response

An emergency decision to combat the epidemic among dogs was made in East Flores district, the original site, in early 1998. It was to kill as many if not all the dogs in the district. 53,204 dogs were then killed in East Flores that year and this was followed by 3,167 in 1999, 5,649 in 2,000, 20 in 2001 and an unknown number in 2002. The killing of dogs was implemented after consultation with political, religious and health care leaders and an educational campaign of the public. Citizens were encouraged to kill their own dogs. Alternately, teams of locally hired men caught and killed the dogs. This was generally accepted by the public as many residents had lost friends or neighbors to rabies.

Table 1. Dog rabies control efforts at Flores 1998-2002

District	Dog Population					Dogs Vaccinated					
	1998	1999	2000	2001	2002	1998	1999	2000	2001	2002	Total
EastFlores	76,171	37,701	20,528	20,528	5,314	-	-	-	2,117	-	2,117
Sikka	124,311	108,644	46,075	46,075	6,999	-	-	-	-	5,881	5,811
Ende	67,278	67,278	67,899	65,278	13,124	-	-	-	7,926	-	7,928
Ngada	72,522	72,522	82,366	72,522	8,769	-	-	5,157	-	-	5,157
Manggarai	234,046	234,046	234,046	233,125	69,276	-	-	6,469	-	-	6,469
Lembata	43,223	28,318	13,990	13,659	24,000	-	-	13,428	18,000	-	31,428
Total	617,551	548,509	464,904	451,187	127,482	-	-	25,054	28,043	5,881	58,980

District	Dogs Killed					Dogs Examined					Dogs Lab Positive				
	1998	1999	2000	2001	2002	1998	1999	2000	2001	2002	1998	1999	2000	2001	2002
EastFlores	53,204	3,167	5,649	20	-	469	116	45	122	-	377	93	36	98	-
Sikka	15,667	61,561	10,741	-	-	121	287	58	-	-	97	231	47	-	-
Ende	-	-	42,334	4,605	-	-	4	62	197	-	-	4	50	158	-
Ngada	-	-	78,263	-	-	-	-	1,549	54	-	-	-	1,246	43	-
Manggarai	-	-	93	-	-	-	-	221	565	-	-	-	179	455	-
Lembata	-	-	10,496	9,769	-	36	3	-	8	-	29	2	-	6	-
Total	68,871	64,728	147,576	14,394	-	626	410	1,935	946	-	503	330	1,550	760	-

Note: Blank spaces represent none or not known.
Dog populations are estimates. A total of 18 dog brain samples were found to be positive for rabies in 2003.

Table 2. Human rabies in Flores Island 1998-2002

District	1998			1999			2000			2001			2002		
	AB	PET	HD	AB	PET	HD	AB	PET	HD	AB	PET	HD	AB	PET	HD
EastFlores	582	281	10	151	34	13	70	66	1	145	137	2	156	35	0
Sikka	141	60	0	386	62	13	151	60	2	60	-	1	25	25	0
Ende	0	0	0	5	0	0	445	63	3	226	224	2	41	40	1
Ngada	0	0	0	0	0	0	1770	1306	50	62	58	4	55	55	0
Manggari	0	0	0	0	0	0	124	326	2	650	-	2	466	459	7
Lembata	0	0	0	44	0	0	5	2	0	9	-	-	0	0	0
Total	723	341	10	586	96	26	2565	1823	58	1152	419	11	718	710	8

Note: AB: Animal Bites, PEP: Post Exposure Prophylaxis, HD: Human Deaths
Four more human rabies deaths occurred in 2003. One in Ende and 3 in Manggarai districts.

Spread of rabies

Some citizens did not kill their dogs and moved them to the next, as yet rabies free district, and sold them in markets. Some of these dogs incubated rabies and this contributed to the spread to other districts (Table 1, Fig. 1). Human rabies appeared in Sikka District next to East Flores in 1999 with 13 human deaths, followed by 2 deaths in 2000 and 1 in 2001. Ngada District, further to the west, had a severe outbreak with 50 human cases in 2000 (22.5 per 100,000 people). Manggarai, the furthest district to the west, had 2 human cases in 2000, 2 in 2001 and 7 in 2002. Only the Komodos and Lambata, separate islands, reported no human rabies deaths but Lambata did report dog rabies starting in 1998 (Table 2, Fig 1). There were a total of 113 reported human deaths from rabies on Flores between 1998 and the end of 2002. All except one, had encephalitic rabies and all were diagnosed on clinical grounds only. Worldwide, approximately 30% of human rabies is of the atypical Guillain-Barre paralytic form. This presentation can be difficult to diagnose on clinical grounds alone[1]. We assume that there may have been 20-30% additional undiagnosed human cases of rabies on Flores.

By early 2000, it became apparent that the disease had spread widely throughout the entire Island and that the initial extensive dog culling in East Flores district was not successful in stopping the outbreak from spreading westwards. District health authorities now recognized that they were confronted by a major and ongoing island-wide emergency. The situation was complicated by the fact that Indonesia was undergoing a severe crisis with social instability, currency devaluation and rapid decentralization of administrative power. As a result, decisions were mostly made by each of the six district authorities independently. Three options were considered:

1) To initiate an immediate massive mandatory island-wide dog vaccination campaign. This was impossible because there was not enough rabies vaccine on hand and no trained vaccinators or logistic facilities (transport, coolers etc) to implement such a massive effort in a timely manner. Furthermore, it was felt that many dogs had already been infected, moved to other districts and that some were already incubating rabies. Vaccination alone would thus be unable to arrest further spread.

2) To expand the initial dog killing effort to the entire island and to eradicate most if not all dogs. This could be done by owners and locally hired workers. It was assumed that most of the healthy-appearing dogs would be butchered and eaten since dog meat has always been consumed on Flores. It was initially thought that this alone would stop the outbreak.

3) To ask for international assistance to help stop the outbreak and control rabies in dogs by a combination of culling and vaccination.

Option 2 was selected and culling of dogs was expanded to other districts but at different levels of intensity. Option 3 was later also invoked and this resulted in the dispatch of a veterinary public health officer from South Africa and of a human rabies researcher from Thailand. Both arrived in Flores under auspices of the World Health Organization (WHO) during the latter half of 2000. They initiated training seminars for canine surveillance and vaccination programs and introduced WHO-standard human post-exposure prophylaxis (PEP) using biologicals donated by Italy. Human PEP recommendations were then implemented and this may have saved lives. No island-wide dog vaccination campaign was implemented as had been recommended by the two WHO consultants[2,3].

An additional 226,698 or more dogs were killed after 1999. Nevertheless, canine rabies was not

eliminated. Out of 2,881 dogs laboratory tested for rabies, 2,318 were found positive (80%). Accurate numbers could not be obtained but it is thought that most tests were done using the insensitive Seller's staining method rather than fluorescent antibody technology. There were no veterinary rabies diagnostic facility on Flores and specimens had to be sent to Maros at Sulawesi for laboratory diagnosis. It took over 2 weeks for laboratory reports to come back. They may have been of some epidemiological value but could not influence individual human PEP management decisions.

The current estimate of the dog population of Flores is at least 400,000. Approximately 30% of dog specimens sent to Sulawesi for laboratory examination (carried out by either Seller's method or Flourescent antibody microscopy) are currently (4004) positive for rabies.

Management of humans exposed to rabies

Local health officials set up post-exposure rabies treatment centers in the district hospitals and some health centers starting in 1998 and purchased a small amount of imported tissue culture rabies vaccine. More vaccines came in the year 2,000 as a donation from Italy. A very limited quantity of human and equine rabies immune globulin was also obtained and used in an unknown but small number of severely exposed patients. Table II shows the reported animal bites and post-exposure treatments (PEP). It is noteworthy that 47.3% of the bites and over half of reported human rabies deaths were in children under 15 years (Fig. 2). These ratios are similar to experiences elsewhere[4,5]. Only 58.7 % of the reported animal bite patients received PEP and most without RIG. However, it is not known how many of these had actually been bitten by rabid dogs. Nevertheless, it is noteworthy that none of the treated subjects had died of rabies; suggesting that vaccine alone will save most rabies exposed subjects[6]. The economical Thai Red Cross intradermal post-exposure regimen was used[7,8] as used in almost all subjects that received PEP. Many persons presented after possible rabies exposures that had occurred weeks to months earlier. Most were vaccinated in spite of the delay in presentation and none of them died of rabies. However, it is not known how many of these subjects had actually been bitten by rabid dogs.

Discussion

The chief health officers and their lay advisors in each of the six districts approached rabies control differently. Decisions were greatly influenced by local political and religious leaders and influential persons. East Flores and Sikka districts continued with the culling of dogs up to 2001. They were not successful in eliminating the disease. Ende and Ngada started massive killing of dogs in 2000 but made only meek efforts to follow this with a vaccination campaign for the remaining canine population. Both districts still experienced canine and human rabies cases in 2001. Only Lembata, an isolated adjacent island district, remained free of human rabies but did report 37 cases of canine rabies and probably had more. However, Lembata was the only district that had vaccinated over 50% of their dog population and managed to control movements of animals by 2000. Flores contains jungle and mountainous areas which harbor a significant wildlife population including many bat species and terrestrial mammals. There has been no evidence of spread of rabies into wildlife to this date.

The Flores rabies epidemic killed over 113 humans among a population of 1.6 million in 5 years. Local public health authorities were unprepared for this crisis and elected to respond by killing as many

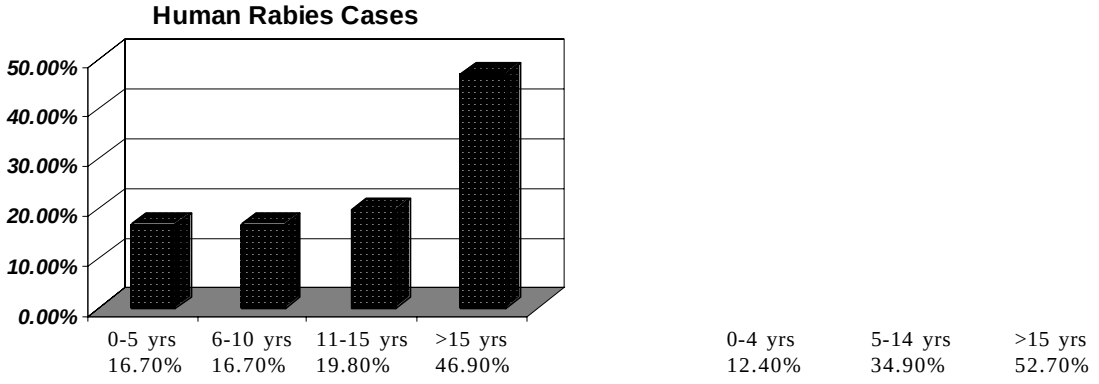

Fig. 2 Ages of Human Rabies Cases and of Animal Bite victims on Flores Island

dogs as possible in the district where rabies first appeared. In spite of the fact that 53,204 of the 76,171 (69.8%) dogs in East Flores had been culled in the remaining months of 1998, rabies was neither contained nor eliminated and managed to spread across the entire island, even though a total of 48% of all dogs in Flores had been killed. The disease is now (in May 2004) still present among the dogs of this relatively small and isolated island.

A new rabies outbreak on Ambon Island, part of the Moluccas in the Banda Sea East of Sulawesi and some 900 Km north-east of Flores, started early in 2003. It also resulted from importation of dogs from Sulawesi and has caused at least 22 human deaths by the end of 2003. Fortunately, a more aggressive effort to control the disease has been implemented. Fishing is an important industry throughout southeast Asia and the Pacific islands. Fisherman often take their dogs on extended trips interrupted by visits to several islands. It is clear that even relatively isolated rabies free islands with a large stray or community dog population are at risk and should develop contingency plans in the event of the introduction of rabies[9].

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การระบาดของโรคพิษสุนัขบ้าในอำเภอฟลอริด ประเทศอินโดเนเซีย (2541-2546)

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มีการแพร่ระบาดของโรคพิษสุนัขบ้าในอำเภอฟลอริด ซึ่งมีประชากรประมาณ 1.6 ล้านคน พบว่ามีคนถึงแก่กรรมจากโรคนี้ 113 ราย ระยะแรกในปี พ.ศ. 2540 ในหมู่บ้านแห่งหนึ่งชื่อ สุลาเวสี มีสุนัขเป็นโรคพิษสุนัขบ้า 3 ตัว ส่งผลให้ในปีถัดมามีการกำจัดสุนัขทั้งอำเภอฟลอริด ไปถึงร้อยละ 70 ของสุนัขทั้งหมด อย่างไรก็ดีจนถึงปัจจุบันในปี พ.ศ. 2547 ก็ยังพบทั้งคนและสุนัขเป็นโรคพิษสุนัขบ้า และประมาณร้อยละ 50 ของคนที่ตายจากโรคพิษสุนัขบ้าเป็นเด็กอายุน้อยกว่า 15 ปี ใครก็ตามในระหว่างปี พ.ศ. 2541-2545 ถ้าถูกสุนัขกัดและได้รับการรักษาถูกต้องจะไม่ตายด้วยพิษสุนัขบ้าเลย ซึ่งคนเหล่านี้เกือบทั้งหมดได้รับการฉีดวัคซีนของสภากาชาดไทย และมีเพียงไม่กี่คนที่ต้องให้ immune globulin ด้วย รายงานนี้ทำให้เชื่อได้ว่าการกำจัดสุนัขร่วมกับการใช้วัคซีนน่าจะได้ผลดี ในการควบคุมการระบาดของโรคพิษสุนัขบ้า

อนึ่งอำเภอฟลอริดนี้มีของโบราณล้ำค่าเป็นมนุษย์หินอยู่ในถ้ำ มีความสูงเพียง 3 ฟุต รูปร่างนอกนั้นเหมือนคนในปัจจุบันทุกอย่าง เชื่อว่าอาจมีอายุ 3 ล้านปีมาแล้ว เป็นเรื่องน่าตื่นเต้นที่มนุษย์หินมามีความสัมพันธ์กับโรคพิษสุนัขบ้าอย่างบังเอิญ