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## Tourist willingness to update vaccination status as a prerequisite for visiting free-ranging habituated great apes in Uganda

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### Abstract

Since management efforts have greatly reduced threats from habitat loss, disease remains a single-most significant threat to mountain gorillas. Conservation personnel and tourists are potential “vectors” that could pass human diseases to habituated gorillas. Vaccination and treatment of humans visiting the great apes have been strongly advocated but willingness to adopt this by the visitors had not been studied. A self reporting questionnaire was administered in Uganda to tourists visiting Ngamba Island Chimpanzee Sanctuary (NICS) where up-to-date tourist vaccinations are required before visiting, and to tourists and staff of Bwindi-Mgahinga Conservation Area (BMCA) where vaccinations were not a prerequisite to gorilla tracking. Most of tourists visiting BMCA (87%) and NICS (69%) had been vaccinated for most of the diseases. The BMCA staff had mostly been vaccinated against childhood diseases and no updates had been done. The vaccination status for NICS tourists were significantly ( $P < 0.05$ ) more up-to-date than of tourists to BMCA. However 85 % of tourists to BMCA would have willing fully taken up vaccination updates and medical check-ups if this was made a prerequisite for visitors of gorillas. It was shown that laxity of tourists and park staff on vaccination exposes gorillas and other great apes to health risk hence the protected area managers should become strict on requiring up-to-date vaccinations for visitors and park personnel.

**Key words:** Mountain gorillas, chimpanzees, other great apes, park staff, tourists, vaccination.

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### Introduction

A population of 380 mountain gorillas (*Gorilla beringei beringei*) inhabit a marginal high altitude ecosystem of extinct volcanoes shared by Uganda, Democratic Republic of Congo and Rwanda. The other population of mountain gorillas (*Gorilla*

*beringei*) is made up of 320 individuals found in Bwindi Impenetrable National Park (1, 2) inside Uganda. The two sub-populations are separated from each other by only a 25-40 Km wide stretch of agricultural land which is highly populated (800 persons/sq Km) (3). Habituation of wild apes to

provide close range observation of gorillas has been used to satisfy the tourists aesthetic needs. This has made mountain gorilla eco-tourism very popular (4). However, great apes are genetically related to human beings, for instance chimpanzees (*Pan troglodytes Schweinfurthii*) and mountain gorillas (*Gorilla beringei beringei*, are 98% related to humans (5). Their habituation therefore increases the risk of disease transmission between them and the park personnel and tourists (19, 20, 21, 22, 23, 24, and 25). Most of the diseases common to non human primates are zoonotic or potentially so (6, 7, and 8). This situation is made worse by emergence and re-emergence of highly virulent zoonotic and/or anthroozoonotic pathogens with high morbidity and mortality among great ape populations in Africa(13, 14, 15, 16, 17, 18).

It was against the above background that a set of regulations (Table 1) was developed and adopted to govern human/great ape interaction in order to minimize stress, behavioral impact and disease transmissions while enabling safe visits and enhancement of visitor experience. One of the control measures was vaccination of personnel who get close to great apes against common human diseases. Despite instituting these regulations, no studies have been done to assess the extent of compliance by the tourists and park staff to vaccination against the recommended human zoonotic diseases transmitted between humans and apes.

### **Materials and methods**

The study was done at Bwindi-Mgahinga Conservation Area (BMCA) and Ngamba Island Chimpanzee Sanctuary. BMCA consists of two National Parks: Bwindi Impenetrable National Park (BINP) and Mgahinga Gorilla National Park (MGNP)

located in the southwestern part of Uganda. The BINP is a UNESCO world heritage site. The MGNP is located in the far southwestern corner of Uganda in Bufumbira County in Kisoro district. It is part of the 'Virunga Conservation Area' (VCA), which is made up of Parc National des Volcans in Rwanda, Parc National des Virungas in Congo and MGNP in Uganda. VCA is home to about 380 Mountain Gorillas (31). BMCA is managed by Uganda Wildlife Authority (UWA).

Ngamba Island Chimpanzee Sanctuary (NICS) is a part of the Koome group of islands in Lake Victoria, Uganda. The sanctuary is managed by Chimpanzee Sanctuary and Wildlife Conservation Trust (CSWCT). It lies at 0.06'S 32.39'E. It's about 0.5 km<sup>2</sup> in size of which 93% is forested. It is a home to 45 chimpanzees under rehabilitation with the opportunity to interface between the habitat and the captive facility. The island has no resident local people except the staff, and receives about 5,000 visitors per year of which 250 are overnight- visitors on whom health records are enforced like the staff, and the rest being day-visitors for whom health records are not a requirement.

A study was done for six months (August 2007 to January 2008). A questionnaire was administered to every other tourist to ensure randomization of the sampling process. A total of 311 tourists (145 males and 166 females) visiting BMCA were sampled. Questionnaires were administered to tourists after gorilla tracking as they waited to be awarded their tracking certificates and to others when they returned from birding and nature walks. A different questionnaire was also administered to 74 BMCA staff, all of whom were males.

Table 1. Mountain gorilla tourism regulations and their Justification

Rule	J u s t i f i c a t i o n		
	To prevent disease transmission to gorillas	To minimize behavioral disturbance and stress to gorillas	To prevent risk of injury to tourists
Tourists who are ill are refused visits to gorillas	X		
Limit of six/ eight tourists per group	X	X	X
Minimum age of fifteen years for visitors.	X		
Limit of one hour spent with gorilla	X	X	X
No flash photography		X	X
Minimum distance of five metres between gorillas and tourists	X	X	X
Tourists remain in tight group without surrounding gorillas.		X	X
No pointing, sudden movements or loud noises		X	X
Tourists should not clear vegetation them selves.		X	X
Do not run if charged by a gorilla.			X
Eating, drinking and smoking not permitted within 200m	X		
Turn away and cover mouth if you have to sneeze or cough.	X		
Bury faces in hole at least 30cm deep	X		
Remove all trash from the park	X		

At the NICS, a questionnaire similar to that administered to tourists in BMCA was administered to 110 (43 males and 67 females) including both day and overnight tourists. Overnight-visitors are the ones who come in close contact with the chimpanzees during feeding and enrichment activities while in the holding facility and during the forest walk time and for whom vaccination schedules were required. The day visitors were never allowed to leave the island's observatory platform and were not obliged to have vaccination updates. Copies of the questionnaire were given to tourists on arrival by the individuals in charge of

education during a briefing about the Island and the chimpanzees at which time they also explained about the questionnaire.

### Results

Of the total of 412 tourist respondents, 55.3% were females 44.7% were males. The age of the tourists were distributed as shown in Table 2. Europeans constituted 48 %, followed by Americans (27.2%), Australians (8.9%), African (2.9%) and 11.9% did not indicate their country of origin. In both sites of study 98.3% of the visitors were visiting for the first time.

Over all 58.8% of the visitors were planning to visit another primate area during their stay in Uganda (see Table 3). Thirty eight percent of the tourists to NICS were planning to visit BMCA during their stay and also to Kibale National Park and Kyambura Gorge, where there are habituated free-ranging chimpanzees.

Very few BMCA visitors (<10%) had visited NICS but many more had visited other great ape areas like Kibale (> 15%), Queen Elizabeth / Kyambura (>50%) and Murchison (20%) National Parks. Half of the visitors to BMCA had taken only 1 week or less, and 30 % had taken about two weeks to travel from their home of origin. Fewer numbers (<10%) had taken months to arrive at the study sites as they toured other countries before coming to Uganda. The majority (92%) of all visitors to BMCA came to purposely track gorillas.

The majority of the BMCA tourists (79%) had not recently taken a TB test, while in Ngamba about 68% had recently taken the test. The 32% of NICS visitors who had not recently taken the test were day visitors who were not required to comply with health

regulations which were applied to overnight visitors ( see Table 4). Fifty-four percent of the NICS tourists had taken the test less than a year before visiting the chimp island as per the requirements. Most of the BMCA tourists (98%) indicated that they had never suffered from TB and may be wrongly assumed not to be a TB risk to the gorillas but 79% had not recently taken the TB test.

The vaccination history shows that the tourists of BMCA had been vaccinated against most of the diseases but with a large percentage of vaccinations having been taken 3 or more years ago. The diseases with the highest and more recent vaccination rates included yellow fever, tetanus, hepatitis A and B, polio and typhoid (see Table 5) and this may be a reflection of pro-human protection instructions and guidelines given to tourists from travel advisories.

Most of the visitors to BMCA (85%) and NICS (86%) indicated that up-to-date vaccinations be made a prerequisite by management before anybody is allowed to visit great apes and other primate areas ( See Table 6).

Table 2. The age group of the visitors (numbers & %)

Years	BMCA	NICS	Total
5 – 20	12 (3.9%)	3 (2.7%)	15 (3.6%)
21 – 30	71 (22.8%)	32 (29.1%)	103 (24.4%)
31 – 40	76 (24.4%)	25 (22.7%)	101 (24.4%)
41 – 50	59 (19%)	13 (11.8%)	72 (17.1%)
Above 51	93 (29.9%)	37 (33.7%)	130 (30.9%)
Total	311 (100%)	110 (100%)	421 (100%)

Table 3. Number of visitors who would visit other primate habitats

	BMCA	NICS	Total
To Visit other primate habitats	193 (62.3%)	54 (49.1%)	247 (58.8%)
Not to visit any other primate habitat	117 (37.7%)	56 (50.9%)	173 (41.2%)
Total	310 (100%)	110 (100%)	420 (100%)

Table 4. Percentage of tourists who have ever taken a TB test

TB Test status	BMCA (N=311)	NICS (N=110)	Over all (N=421)
Never tested for TB	79	32	67
Tested within 1 year ago	7	54	19
Tested 5 years ago	7	7	7
Tested 10 years ago	3	3	3
Tested over 10 years ago	4	4	4

Table 5. Comparison of percentage vaccination history of BMCA and NICS visitors for each disease

Vaccine and booster rates (years)	1-6 month (%)		>6 months – 3 years (%)		>5 years (%)		Total vaccination rates (%)	
	BMCA	NICS	BMCA	NICS	BMCA	NICS	BMCA	NICS
Polio (10)	26	54	29	23	34	19	89	96
Rabies (2-3)	14	23	10	11	8	5	32	39
Hepatitis A (10)	37	56	36	30	15	10	88	96
Hepatitis B (5)	31	58	30	28	18	6	79	92
Measles (10)	7	44	12	10	38	30	61	84
Meningitis (3-5)	25	63	15	16	10	5	50	84
Tetanus (10)	33	51	38	29	20	16	91	96
Yellow Fever (10)	57	53	24	30	14	17	95	100
Influenza (1)	15	32	19	19	4	3	38	54
Streptococcal pneumonia (life long)	4	10	5	4	2	1	11	15
Cholera (3 months)	20	27	13	11	10	2	43	40
Typhoid (2 - 5)	39	63	31	27	8	2	78	92

Table 6: Percentage of visitors who preferred that up to date vaccinations be a requirement before visiting habituated great apes

	BMCA (N=311)	NICS ( N=110)	Overall (N=421)
Study areas	85	86	85
Other Primate Area	79	72	78

The majority of BMCA staff that responded were between the age of 21 and 40 with about 47% being between the ages of 21 and 30 and about 37% between the ages of 31 to 40. A large percentage (96% and 86%) indicated that they come in close contact with gorillas and yet they have never taken a TB test respectively.

The vaccination history shows that the staff are only vaccinated against childhood diseases (polio, measles and tetanus) which are endemic to Uganda. Details were as shown in Table 7. No particular effort had been made in boosting immunity of these diseases or taking up other vaccinations deemed necessary for working closely with the highly endangered mountain gorillas and other primates.

Table 7. Vaccination status of the BMCA staff

Vaccine and booster rates (years)	1 month (%)	6 month (%)	1 year (%)	3 yrs (%)	>5 yrs (%)	Total vac (%)
Polio (10)	0	3	1	5	91	100
Rabies (2-3)	0	0	0	0	8	8
Hepatitis A (10)	0	0	0	0	4	4
Hepatitis B (5)	0	0	0	0	8	8
Measles (10)	3	1	1	0	93	98
Meningitis (3-5)	0	0	0	0	20	20
Tetanus (10)	1	3	0	1	85	90
Yellow fever (10)	1	1	1	1	11	15
Influenza(Flu 1) -	8	0	0	0	7	15
Streptococcal Pneumonia(life long)	0	0	0	0	0	0
Cholera(3 month)	0	0	0	0	8	8
Typhoid (3)	1	0	3	0	12	16

## Discussion

Though tourism, research and park management activities were known to reduce encroachment on natural resources and thereby discourage the practice of other illegal activities like poaching (25), they were increasingly being viewed as a risk for ape survival since they can be sources of infections or simply acting as “pathogen traffickers”.

This study (see Table 7) had revealed that the staff of BMCA were mainly vaccinated only against childhood diseases, and no effort had been made to boost these or at least take other vaccinations which were recommended for working with great apes and other primates in a setting where close contact between human and non-human primates was inevitable. There was a need to update these vaccinations as re-emergence of these diseases could occur. For example, at the beginning of this study in 2007, there were University students (above 22 years old) who had been admitted at Makerere University Hospital due to measles (Maureen, persona communication). There was a high possibility that this could also occur among the park staff. Earlier on a high prevalence of acute infectious diseases in the local population surrounding Bwindi had been reported (32). The vaccination status of the local people surrounding the park has also not been documented. Given that childhood immunization coverage in Uganda has been decreasing, from 47% in 1995 to the current coverage of 39% (33), there was a high potential disease risk to the great apes posed by local humans interacting with them.

A similar potential disease risk to chimpanzees from the communities around

Kibale National Park in Uganda has been observed (22). In May of 2008 there was an outbreak of a respiratory infection in one group of the habituated gorillas for the first time in Bwindi Impenetrable National Park since 1993 when gorilla tourism was introduced, but the source of the infection had not yet been established (Ssebide personal communication).

UWA could work with its partners concerned with ape conservation in updating and monitoring the health of its staff. For example the Mountain Gorilla Veterinary Project (MGVP) was running a successful Employee Health Care Program that involved routine health monitoring and disease prevention by carrying out measures like vaccination in Rwanda and DRC (25). It had also introduced a new program which involved working with local veterinarians in routine vaccinations of the dogs in the vicinity of the park against rabies (34).

Although park staff were potentially a health risk to apes, they could present a lower risk as compared to the tourists since most of them stay around the park and don't usually travel to distant areas where they could pick foreign pathogens. However, possibilities do exist where the park staff could a foreign disease from tourists and subsequently transmit the infections to gorillas long after the tourists have left.

It was found that the vaccinations of tourists to NICS were significantly more up-to-date than for those of visitors to BMCA for the diseases investigated (Table 5). The difference must have come about because NICS's management was not silent on the need for vaccination updates for both the overnight visitors and its staff. Information regarding this regulation was supplied on

the website to assist visitors plan their journeys appropriately. But this was a case with BMCA. This was an oversight which could end up costing the lives of the gorillas and hence a grave impact on gorilla tourism. Most of BMCA tourists were due for booster vaccination for rabies, hepatitis B, meningitis, cholera and typhoid. This was in agreement to what was observed with tourists visiting Kibale National Park (22). UWA park management could be taking it for granted that since most tourists come from developed countries then their vaccination coverage and boosts were not questionable. But it has been proved not so, because measles had become endemic in United Kingdom after 14 years of eradication (35). Also in Germany, incidence of measles was on a rise in Germany prior to the 2006 world soccer tournament, causing a heightened alert to the risk of contracting the disease by soccer fans and players from the world over (36; 37).

It was found that most visitors who arrived in BMCA were from 7 to 30 days prior to leaving their home countries. This duration was within the range of incubation period of most diseases. This could be an indication that tourists could potentially facilitate in trafficking infectious pathogens to the apes. For instance, nine measles cases were reported in Arizona, USA, in 2008, and the source was reported to be an adult traveler from Switzerland. Another case of measles of the strain which was circulating in an outbreak in Israel was also confirmed in New York, USA around the same time (38). There was also a Hepatitis A outbreak in Germany brought in by tourists from Egypt (39). These cases exemplify the risk of disease importation from endemic populations to susceptible populations

facilitated by tourism. Some of these infections may be emerging pathogens beginning to circulate in tourist destinations among animals and local populations. For example some ape carcasses found near the sites of the Human Ebola Epidemics in 1994 in Gabon tested positive for the virus (40) suggesting a co-current outbreak of the disease in the wild primates in which up to 98% of the affected ape population was killed.

Some medical professionals usually argue that the vaccinations should be enforced mainly to protect humans since it is thought that the apes were the only ones passing on diseases to the humans but not the other way round. Usually Foreign Travel Advisory Agencies encourage tourists to take vaccinations of diseases endemic to the areas they were traveling to for their own protection. In addition yellow fever vaccination was a legal requirement for travelers. Such pro-human guidelines could explain why in the current study there was up to date vaccinations against yellow fever, tetanus and typhoid which were endemic in the tropical countries like Uganda. Nevertheless it was well established fact that also apes have contracted diseases from humans when in captivity (41). It was observed there were environmental, animal and human factors that lead up to closer contact between the gorillas and people creating similar interactions seen with animals in captivity. In Tai National Park, Ivory Coast outbreak of respiratory diseases has occurred among habituated chimpanzees during seasons of high food availability when the local people don't usually go into the forest at that time (18). Respiratory infections like influenza (42) are easily spread by tourists in crowded in airports, hotels and in dry aircraft cabins and could

quickly be trafficked to popular tourist destinations.

Ape vaccination could be seen as an option of reducing disease risk transmission, but there are no vaccines commercially available for use. Also vaccination campaigns carried are few. Measles vaccination was done in mountain gorillas in Parc Nationale des Volcans (Rwanda) (43, 13), but the resultant immunogenicity and the ability to offer long-term protection remains questionable.. The use of candidate vaccines developed against Ebola are faced with the dilemma on how to effectively inoculate target animals (44, 45). There are also obstacles to mounting massive vaccination campaigns of apes as they are very evasive and had being highly developed brains that enables them to associate man with his actions. The Great Apes-Human Health Working Group (a part of the World Conservation Society's Animal Health for the Environment and Development (AHEAD) initiative) therefore advocates that efforts must be directed at “*critical control point*” in protecting the health of wildlife (46) which in this case was that vaccination should better be done at the human level.

Though there are gorilla tracking regulations meant to control close human-gorilla interaction in order to minimize disease transmission from park personnel and tourists, compliance has been shown to be low due to human, animal and environment/vegetation factors (12). For instance gorillas, particularly the juveniles, usually do come closer to the tourists out of curiosity or when moving from one location to another during foraging, and the seven

meter distance was not being observed. Also when tourists reach the great ape destination sites feeling unhealthy, they are supposed to declare it to management. But unless there is evidence of clinical disease, usually visitors that they are suffering from transient stress from travel. However, such persons could be carrying and shedding pathogens inactive to the apes.

The current study has shown that most of the tourists were willing to take up new or update current vaccinations provided it is made mandatory to all visitors to habituated gorillas and other great apes. This approach is highly advocated (18; 22; 20; 25) due to the difficulties involved in vaccinating the great apes, strict human vaccination remains a viable option of curbing down “pathogen trafficking” to and from the great apes. The observed tourists’ willingness to follow vaccination regulation should take advantage of by the park management of BMCA and other conservation areas with great apes. This will require rigorous and efficient preparations in order to handle data from about 12,000 tourists who visit gorilla parks in Uganda per year with almost all of them (98.3%) being first-time visitors. The Mountain Gorilla Veterinary Project Employee Health Care Program instituted in Rwanda and DRC presents a comprehensive approach to control disease transmission to and from park staff and researchers and should be extended to BMCA and emulated in other ape conservation areas. The potential disease risk to the gorillas and other great apes should be significantly reduced if both strict vaccination update for tourists and the Employee Health Program were combined.

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## References

1. **McNeilage, A., Plumptre, A. J., Brock-Doyle, A., Vedder, A. 2001.** Bwindi Impenetrable National Park Uganda: gorilla census 1997. *Oryx*, **35**: 39-47
2. **McNeilage, A., Robbins, M. M., Gushanski, K., Gray, M., Kagoda, E. 2006.** Census of the mountain gorilla population in Bwindi Impenetrable National Park, Uganda. *Oryx* **40**: 419-427
3. **Ministry of Planning and Economic Development, 1997.** The Republic of Uganda Statistical Abstract.
4. **Butynski, J. M., Kalina, J. 1998.** Gorilla Tourism : A critical look. E. J. Miller Gulland and Mace (eds.) *Conservation of Biological Resources, Oxford, UK : Blackwell Science*
5. **Wildman, E. D., Grossman, J. L., Goodman, M. 2000.** Human and chimpanzees functional DNA shows that they are more similar to each other than either is to other apes: [www.uchicago.edu](http://www.uchicago.edu) retrieved 9<sup>th</sup>/09/08
6. **Acha, P. N., Szyfres, B. 1987.** Zoonoses and Communicable Diseases Common to Man and Animals. Second Ed. Pan AM Health Organization, *Scientific publication* No. 503.
7. **Jones, E. E., Alford, P. L., Reingold, A. L., Russel, H., Keeling, M. E., Broome, C. V. 1984.** Predisposition to invasive pneumococcal illness following Parainfluenza Type 3 infection in chimpanzees. *Journal of American Veterinary and Medical Association*, **185(11)**: 1351 – 1353.
8. **Clarke, C. J., Watt, N. J, Meredith, A., McIntyre, N., Burns, S. M. 1994.** Respiratory Syncytial Viruse -associated bronchopneumonia in young chimpanzee. *Journal of Comparative Pathology*, **110**: 207 – 212.
9. **Vedder, A., Webber, W. 1990.** The Mountain Gorilla Project, Volcanoes National Park. In; Living with wild resources management with local participation in Africa (Ed. A. Kiss) pp. 83-60. *World Bank Technical Report Paper* No. 30, World Bank, Washington DC, USA.
10. **Aveling, C., Aveling, R. 1989.** Gorilla Conservation in Zaire. *Oryx*, **23(4)**: 64-70.
11. **Uganda National Parks, 1993.** National Parks Annual Report of 1992.
12. **Muyambi, F. 2005.** The Impact of Tourism on the Behaviour of Mountain Gorillas. *Gorilla Journal* **30**, June 2005

13. **Sholley, C., Hastings, B. 1989.** Outbreak of illness among Rwanda's gorillas. *Gorilla Conservation news*, 3: 7.
14. **Byers, A.C., Hastings, B. 1991.** Mountain Gorilla mortality and climatic factors in the Parc National des Volcans, Ruhengeri Prefecture, Rwanda, 1988. *Mountain Research and Development*, 2: 145-151
15. **Leendertz, F. H. 2008.** Pandemic human viruses cause decline of endangered. *American Journal of Primatology*.
16. **Leendertz, F. H.; Florian Zirkel; Emmanuel Couacy-Hymann; Heinz Ellerbrok; Vladimir A Morozov; Georg Pauli; Claudia Hedemann; Pierre Formenty; Siv Aina Jensen; Christophe Boesch, Sandra Junglen. 2008.** Interspecies transmission of simian foamy virus in a natural predator-prey system. *Journal of Virology*
17. **Krief, S.; Alette Jamart; Sandrine Mahé; Leendertz, F.H.; Kerstin Mätz-Rensing; François Crespeau; Odile Bain, Jacques Guillot. 2008.** Clinical and pathologic manifestation of oesophagostomosis in African great apes: does self-medication in wild apes influence disease progression?. *Journal of Medical Primatology*.
18. **Köndgen, S.; Hjalmar Kühl; N'goran, P.K.; Walsh, P. D.; Svenja Schenk; Nancy Ernst; Roman Biek; Pierre Formenty; Kerstin Mätz-Rensing; Brunhilde Schweiger; Sandra Junglen; Heinz Ellerbrok; Andreas Nitsche; Thomas Briese; W Ian Lipkin; Georg Pauli; Christophe Boesch., Leendertz, F. H. 2008.** Pandemic Human Viruses Cause Decline of Endangered great apes. *Current Biology*. 26: 260-4
19. **Wolfe, N.D., Escalante, A.A., Karesh, W.B., Kilbourn, A., Spielman, A., Lal, A.A. 1998.** Wild Primate Populations in emerging infectious disease research: the missing link?. *Emerging Infectious Diseases*, 4: 149 -158.
20. **Homsy, J. 1999.** Ape tourism and human diseases: How close should we get? A critical of rules and regulations governing park management and tourism for mountain gorilla (*Gorilla gorilla beringei*). Un published report, *International Gorilla Conservation Programme, Nairobi, Kenya*.
21. **Adams, H.R., Sleeman, J., New, J.C. 1999.** A medical survey of tourists visiting Kibale National Park, Uganda to determine the potential risk for disease transmission to chimpanzees (*Pan troglodytes*) from eco-tourism. In proceedings of the American association of Zoo Veterinarians 1999 (Ed. C.K. Baer), pp 279 -271. *American Association of Zoo Veterinarians, Media, Philadelphia, USA*.
22. **Adams, H.R., Sleeman, J., Rwego, I., New, J.C. 2001.** Self-reported medical history survey of humans as a measure of health risk to chimpanzees (*Pan troglodytes schweinfurthii*) of Kibale National Park, Uganda. *Oryx*, 35: 308-312.
23. **Wallis, J., Lee, D. R. 1999.** Primate conservation: The prevention of disease transmission. *International Journal of Primatology*, 20: 803-826.

24. **Butynski, T.M. 2001.** Africa's great apes. In Great apes and humans: The ethics of coexistence (Eds. B.B.Beck, T.S. Stoinski, M. Hutchins, T.L. Maple, B. Norton, A. Rowan, E.F. Stevens & A. Arluke), pp. 3-56. *Smithsonian Institution Press, Washington DC, USA.*
25. **Woodford, H.; Butynski, M., Thomas, M.; Karesh .B. W. 2002.** Habituating the great apes: the disease risks: *Oryx*, **36(2)**:
26. **Cranfield, R.M., Minnis, R. 2004.** Risk of Disease Transmission between Conservation Personnel and the Mountain Gorillas: Results from an Employee Health Program in Rwanda. *EcoHealth*, Volume 1, Number 4, December 2004 , 351-361(11)
27. **Cranfield, M., Gaffikin, L., Minnis, R., Nutter, F., Rwego, I., Travis, D., Whittier, W. 2006.** Clinical response decision tree for the mountain gorilla (*Gorilla beringei*) as a model for great apes. *American Journal of Primatology*. **68**:909-927
28. **Rwego, I. 2004.** Prevalence of observed clinical signs in Mountain gorillas (*Gorilla gorilla beringei*) of Bwindi Impenetrable national Park, Uganda. A Dissertation submitted to the Graduate School in Partial Fulfillment for the Award of Master of Science of Wildlife Health and Management Degree of Makerere University, Uganda.
29. **Ssebide, B. J. 2008.** Daily Ranger-based symptom observations and health monitoring of habituated mountain gorillas (*Gorilla beringei beringei*) in Bwindi Impenetrable national Park, Uganda. A Dissertation submitted to the Graduate School in Partial Fulfillment for the Award of Master of Science of Wildlife Health and Management Degree of Makerere University, Uganda.
30. **Pastoret, P.P.; Schudel, A.A., Lombard, M. 2007.** Obstacles to veterinary vaccinology. *Scientific and Technical Review of the World Organisation for Animal Health (OIE)*, **26 (2)**: 489-494
31. **Gray, M., McNeilage, A., Fawcett, K., Robbins, M.M., Ssebide, B., Mbula, D. Uwingeli, P. 2005.** Virunga Volcano Range mountain gorilla census, 2003. Joint organiser's report, UWA/ORTPN/ICCN (unpublished)
32. **Guerrera, W., Sleeman, J.M., Ssebide, B.J., Pace, L.B., Ichinose, T.Y., Reif, J.S. 2003.** Medical survey of local human population to determine possible health risks to mountain gorillas (*Gorilla gorilla beringei*) of Bwindi Impenetrable Forest National Park, Uganda. *International Journal of Primatology*. **24 (1)**: 197-207.
33. **Ministry of Health, UNICEF, WHO, USAID. 2002.** Promotion of Immunization in Uganda. *Booklet for Leaders. Kampala, Uganda.*
34. **Nolen, R.S. 2006.** Gorillas Conservation Project takes 'one health' approach, Benefits extend beyond the endangered apes. *American Veterinary Medical Association: Javma News.*
35. **Toronto Public Health, 2008.** Information about Measles (Rubeola), [www.toronto.ca](http://www.toronto.ca) ret August 2008.

36. **Charbonneau, L. 2006.** Germany warns of alarming rise to measles infections, *Reuters* of May 2006
37. **Reuters. 2006.** Centre for Disease Control (CDC) warns of measles risk with travel to world cup. *Reuters* of June 2006
38. **CDC (Centre for Disease Control). 2008.** Measles outbreaks in USA: Public Health preparedness, control and response in health care settings and the community in Health Alert Network. CDC HAN-00273-2008-04-02 ADV-N
39. **Frank, C., Walter, J., Muehlen, M., Jansen, A. 2007.** Emerging Infectious Diseases. Volume 13, No 1, [www.cdc.gov/eid](http://www.cdc.gov/eid)
40. **Walsh, D.P., Abernethy, A.K., Bermejo, M., Beyers, R. 2003.** Catastrophic ape decline in western equatorial Africa; *Nature*; Pp 1-3, doi:10.1038/nature 01566, Nature Publishing group
41. **Klos-Heinz, G. and Lang, M .E. 1982.** The handbook of zoo medicine. Pp 56-59, *Van Reinholit Co.*
42. **The Travel Doctor. 2005.** Respiratory infections are second only to travelers' diarrhea among tourists. Retrieved from [www.traveldoctor.co.uk](http://www.traveldoctor.co.uk); accessed in July 2008.
43. **Hastings, B.E., Kenny, D., Lowenstine, L.J. and Foster, J.W. 1991.** Mountain gorillas and measles: Ontogen of wildlife vaccination program. In proceedings of the *American Association of Zoo Veterinarians* annual meeting (ed. R.E. Jungle), pp 198-205. AAZU, Philadelphia, PA.
44. **Cameron K. 2007.** Scientists say Ebola has pushed Western gorillas to the brink. *Science*, 317: (5844) pp. 14841. 4<sup>th</sup> September 2007
45. **Grady, D. 2006.** Ebola Imperils Gorilla Species in Congo Republic: *The New York times*, 6<sup>th</sup>/12/06.
46. **AHEAD (Animal Health for the Environment and Development). 2005.** Consensus Document Outlining Practical Considerations for Reducing Health Risks to African Great Apes and Conservation Employees Through an Occupational Health Program. [www.wcs-ahead.org](http://www.wcs-ahead.org)