

# Level of Awareness Regarding Some Zoonotic Diseases, Among Dog Owners of Ithaca, New York

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## ABSTRACT

**Objectives:** Worldwide, dogs and cats are the two most common household companion animals. Because of this, they can be direct or indirect source of many human infections. Fortunately, most of these zoonotic infections can be clinically prevented by appropriate prophylactic interventions. **Materials and Methods:** Present kind of cross-sectional study, for the first time, was conducted in city of Ithaca, New York. People visiting local animal hospitals, dog parks, library and shoppers at Walmart supermarket were personally interviewed and a pre-tested questionnaire was got filled from every individual. The collected data were analyzed for percentage proportions using Microsoft Excel<sup>®</sup> and the results had been presented in graphical as well as tabulated forms. **Results:** Out of 100 participants responding to the request for participation, gender-wise, 45% of the participants were male while 55% of the participants were females. Demographically, 50% participants lived in rural, 35% in urban while 15% participants lived in suburban areas. Educational background of the participants ranged from High school pass-outs to Graduates. **Conclusions:** Participants were aware about the zoonotic potential of leptospirosis, giardiasis, rabies, hookworms, coccidiosis, lyme disease, roundworms, toxoplasma, leishmaniasis, salmonellosis and ringworm disease. Knowledge gaps in the sampled population, in terms of lack of awareness about zoonotic diseases vectored by mosquitoes, ticks and fleas; practice of not doing regular deworming and prophylactic control of fleas and ticks on pet dogs; and lack of practice among physicians to discuss zoonotic canine diseases with their clients were revealed by this study.

**Keywords:** Dogs, deworming, ectoparasites, Ithaca, immunosuppression, leptospirosis, rabies, zoonotic diseases

## Introduction

Worldwide, dogs and cats are the two most common household companion animals. As per American Society for Prevention of Cruelty against Animals (ASPCA), about 78.2 million dogs and about 86.4 million cats are owned in the United States. About 62% of all households in the United States have a pet.<sup>[1]</sup> Since ages, they have contributed to the physical, social and emotional well-being of humans.<sup>[2-4]</sup> Because of their close proximity to humans, they can be direct or indirect source of many zoonotic infections.<sup>[5]</sup>

Wide range of zoonotic infections have been documented which can be transmitted from dogs and cats.<sup>[6-8]</sup> Nationwide, 34% of dogs in USA with up to 54% of dogs living in Southeastern states were found infected with gastrointestinal parasites.<sup>[9]</sup> Toxocara

infection in humans result in visceral larva migrans, sometimes leading to blindness<sup>[10]</sup> while hookworm infection in humans can result in cutaneous larva migrans.<sup>[11]</sup> As per the Centers for Disease Control and Prevention (CDC), worldwide, between 1 and 3 million people are zoonotically infected with toxocara migrans every year.

In addition to endoparasites, dogs and cats also harbor ectoparasites, which are known to vector zoonotic diseases.<sup>[12]</sup> Fleas are known to transmit human plague, rickettsioses, murine typhus and leishmaniasis;<sup>[13]</sup> and serve as intermediate host for dog tapeworm (*Dipylidium caninum*). *Rhipicephalus* ticks have been known to parasitize humans<sup>[14]</sup> and vector rickettsial diseases and visceral leishmaniasis.<sup>[15]</sup> Fortunately, most of these infections can be clinically prevented by appropriate prophylactic interventions.<sup>[16]</sup>

Among the intestinal parasitic diseases, Giardiasis has been reported as a frequent diarrhoeal illness<sup>[17]</sup> caused by the parasite *Giardia intestinalis*. Nevertheless, limited studies have

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been published about risk perception by dog owners; level of knowledge of dog owners regarding canine intestinal parasites and the extent to which they were aware of zoonotic potential of such canine parasitic infections.

## Review of literature

In spite of pets acting as direct as well as indirect source of zoonotic canine infections, very few published studies, conducted among dog owners of USA, documenting their level of awareness with respect to zoonotic canine diseases were found during review of literature. Worldwide, a Brazilian study reported that majority of dog-owners, interviewed in the most developed state of Brazil (Sao Paulo) were not aware about the names of dog's intestinal parasites, their mechanism of transmission, risk associated for zoonotic infection and the prophylactic measures available to tackle them.<sup>[17]</sup>

Another study conducted in De Kalb County of Georgia state, USA, reported that only 63% of the pet owners believed that diseases of their pets can be transmitted to humans.<sup>[18]</sup> When asked further, other than rabies, this proportion of pet owners could not name a single disease, which was zoonotic in nature. Similar lack of awareness among dog owners regarding zoonotic canine diseases was reported from Texas, USA.<sup>[19]</sup> This lack of awareness among dog owners potentially put them at higher risk of contracting zoonotic infections.

In another published study, which was conducted in Netherlands,<sup>[20]</sup> feces and fur of healthy pet dogs and cats were tested for presence of *Toxocara*, *Giardia* and *Cryptosporidium* infection. Eggs/cysts of all of these three zoonotic parasites were detected in this study. This study further reported that frequency of detection of *Toxocara* eggs from fur of both dogs and cats was higher as compared to detection from the faeces. Similarly, two studies conducted in Ilorin city of Nigeria<sup>[8]</sup> and tea growing community of North-eastern part of India<sup>[21]</sup> highlighted lack of awareness among dog owners about the zoonotic threat from their pet dogs.

Since humans share their environment with dogs, it was decided to study the level of awareness among dog owners regarding some of the zoonotic diseases spread by dogs.

## Materials and Methods

For the first time, present cross-sectional study was conducted among dog owners in city of Ithaca, New York. People visiting local animal hospitals, dog parks, city library and shoppers at Walmart supermarket were personally interviewed and a pre-tested questionnaire was got filled from every individual. Total of 100 participants (having recent or past history of dog ownership), belonging to urban, sub-urban and rural demographical locations were interviewed during this study. Before getting the questionnaire filled, every participant was informed about the objective of this study and their verbal consent was taken. In addition to questions related with the

objective of the study, participants were requested to give information about their age, level of education, number of dogs owned and the type of demography where they lived.

## Statistics

The collected data was analysed for percentage proportions using Microsoft Excel<sup>®</sup> software and the results are presented in graphical as well as tabulated forms.

## Results

The age of participants in this study, as depicted in Figure 1, ranged from 19 to 65 years with almost equal representation from both genders (Males: 45%, female: 55%). Out of the total 100 participants interviewed, 50% participants lived in rural, 35% in urban while 15% participants lived in sub-urban demography. Educational background of the participants ranged from High school pass-outs to Graduates (Masters/PhDs) [High school: 10%, Undergrads (UG): 75%, Graduates: 15%]. Number of dogs in the house of participants of this study varied from 0 to 5 dogs per household [Figure 2].

Out of 100 participants interviewed in this study, 65% of the participants were of opinion that humans can catch some diseases from dogs. Similar level of awareness was observed among pet owners of one county of Georgia state, USA.<sup>[18]</sup> When asked to list the name of diseases which are transmitted from dogs to humans, participants mentioned following diseases i.e., leptospirosis, giardiasis, rabies, hookworms, coccidiosis, lyme disease, roundworms, toxoplasmosis, leishmaniasis, salmonellosis, ringworm infection and ticks [Figure 3]. When asked about their primary source of information regarding this knowledge, 40% participants quoted their veterinarian, 20% participants quoted internet while 5% mentioned media.

Seventy percent of the participants were of opinion that diseases spread by dogs are deadly to humans while 95% of these participants were of opinion that spread of these diseases can be effectively avoided by human intervention.

Ninety-five percent of the participants in this study admitted getting their dogs vaccinated against various diseases. But, when asked to list the name of these diseases for which they got their dogs vaccinated, 40% of participants were not able to list the

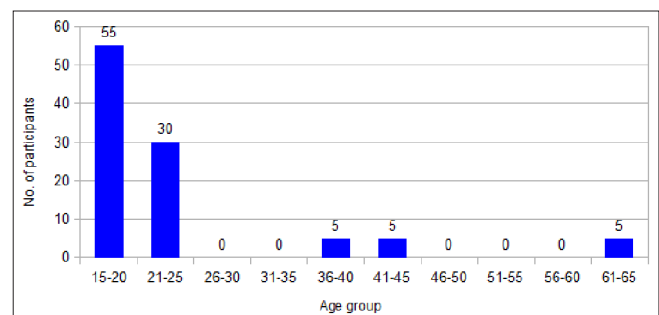


Figure 1: Age distribution of participants

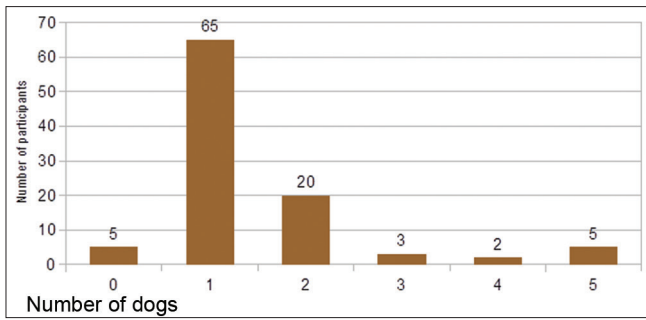


Figure 2: Distribution of number of dogs owned by participants

Table 1: Name of diseases and number of participants getting their dogs vaccinated against them

Name of disease	Number of participants
Rabies	45
Parvo virus	30
Canine distemper	30
Intestinal worms*	5
Ticks*	5
Lyme disease	15
Heartworm*	10
Canine hepatitis	10
Leptospirosis	20
Corona virus	5
Parainfluenza virus	5
Kennel cough ( <i>Bordetella</i> )	15
Do not know	45

\*Participants were under impression that the preventive measures for tick control, heartworm prevention and deworming for intestinal worms were kind of vaccines

name of even a single disease [Table 1]. Maximum number of participants (45%) reported getting their dogs vaccinated against rabies. Gender-wise, 54.54% of these 55 participants in present study, who did not vaccinate their pet dogs for rabies, were males while 45.46% of these participants were females. Demography-wise, majority (63.63%) of these 55 participants lived in sub-urban while 18.18% lived in rural and urban dwellings, each. 72.73% (40/55) of these participants who did not vaccinate their dogs for rabies were having undergrad level of education while 27.27% of these respondents were high-school pass-outs. This higher proportion of undergraduates as well as participants living in sub-urban area, as compared to others, was because of their higher proportion in the sampled population.

Similarly, 80% (80/100) participants reported that they did not vaccinate their dogs for leptospirosis. Forty-five of these 80 participants were male while 35 of these participants were females. 68.75% (55/80) of these respondents were undergraduates while 18.75% (15/80) and 12.5% (10/80) of respondents were high-school pass-outs and graduates, respectively. Higher proportion of undergraduate as compared to others was because of higher proportion of undergraduates in the sampled population.

Total of 75% (75/100) participants reported that they regularly deworm their pet dogs for internal parasites. Remaining 25% (25/100) participants in this study reported that they

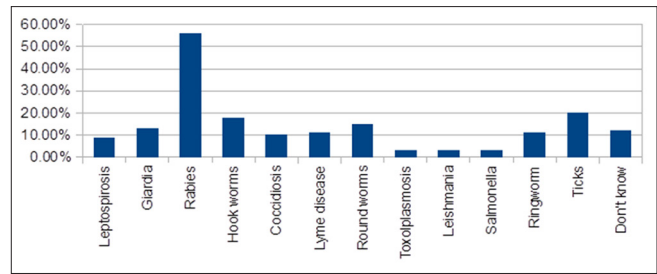


Figure 3: Percentage of participants aware of different zoonotic diseases transmitted by dogs

did not deworm their pet for intestinal worms. Gender-wise these participants were 15 (60%) males and 10 (40%) females. Education-wise, majority of these ignorant participants were undergraduates (68%), with 40% of these living in urban and rural areas each. This observation points toward the need to include public health aspect of zoonotic diseases among the course curriculum of undergraduate studies.

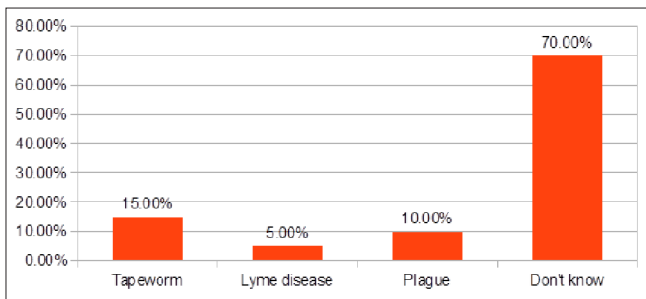
Only 55/100 (55%) participants in this study admitted putting their dog on flea control. Pet owners/public need to be educated on the need/merits of flea control. Gender-wise, this lack of practice was equally distributed among both genders (Males: 55.55%, females: 44.45%). Education-wise, 66.66% of these owners were undergraduates while 44.44% of these owners resided in the rural area.

When asked to name any zoonotic disease transmitted by fleas, 75/100 (75%) of participants were ignorant about such disease. Figure 4 depicts that 5/100 (5%) participants wrongly mentioned that fleas transmit lyme disease to humans, while 15/100 (15%) participants were of opinion that fleas transmit tapeworms to humans. Only 10/100 (10%) participants were able to mention that fleas transmit plague to humans but all these participants mentioned dogs, instead of rodents, as reservoir of plague. 53.33% of these participants who could not list a single zoonotic disease transmitted by fleas were females while 46.67% of these participants were male. Majority (73.33%) of these participants were undergraduates followed by graduates and high school (13.33% each). 66.67% of these ignorant participants resided in rural area. This was because of higher proportion of undergraduates in the sampled population.

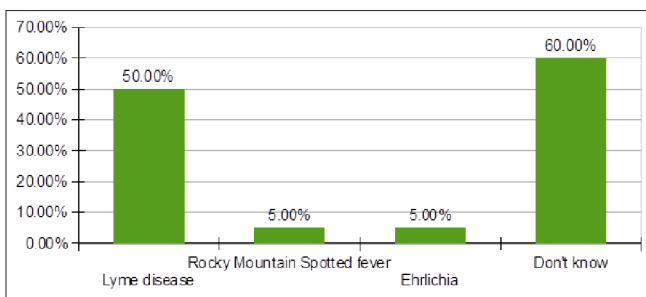
When asked to list any zoonotic canine disease transmitted by ticks, 60/100 (60%) participants were ignorant about any such disease. Out of 100 participants, 50 (50%) participants mentioned lyme disease, five (5%) participants mentioned Rocky Mountain Spotted fever and Ehrlichiosis each, as the diseases transmitted by ticks [Figure 5]. 66.67% of the ignorant participants, who did not know a single zoonotic disease transmitted by ticks were females. Majority (58.33%) of these participants resided in the Rural area followed by 25% residing in Urban and 16.67% in Suburban area. Seventy-five percent of these ignorant participants were undergraduates, 16.66% were graduates while 8.33% were high school pass-outs. This was because of higher proportion of undergraduates in the samples population.

Regarding zoonotic diseases transmitted by mosquitoes, only 10/100 (10%) participants correctly mentioned West Nile virus [Figure 6] while 60/100 (60%) participants could not name a single disease which is transmitted by mosquitoes, not even the heartworm. Furthermore, 25/100 (25%) of the participants, who were aware about the heartworm disease, mentioned that mosquitoes transmit heartworm to human also. 58.33% (35/60) of these ignorant participants, who could not name a single disease transmitted by mosquitoes, were males while rest of 41.67% of participants were females. Majority (75%) of these ignorant participants resided in rural area, followed by 16.66% living in the urban and 8.33% in suburban area. Seventy-five percent of these ignorant participants were undergraduate, followed by 16.67% high-school pass-outs. This evidence of knowledge gap demands focussing of vector-borne disease-related awareness programs on this segment of population.

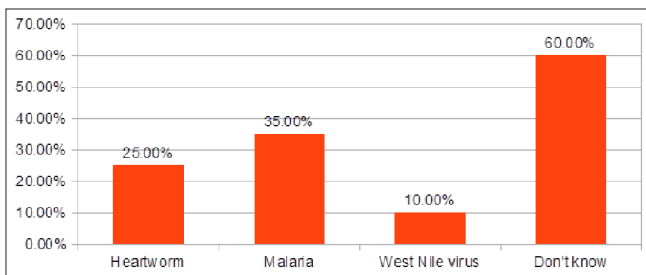
It was found that half of the participants admitted to share their bed with their dogs. Gender-wise, males and females were



**Figure 4:** Percentage of participants listing some zoonotic diseases from dogs, transmitted by fleas



**Figure 5:** Percentage of participants listing some zoonotic diseases from dogs, transmitted by ticks



**Figure 6:** Percentage of participants listing some zoonotic diseases from dogs, transmitted by mosquitoes

equally represented among the participants sharing their bed with their dogs. Fifty percent of these participants resided in the rural area, while 60% of these participants were undergraduates. Fifteen percent (15/100) participants admitted that they have kids (<10 years age) in their homes.

## Discussion

Worldwide, dogs and cats make the most common household pet companions. Since, USA is having one of the highest population of domesticated dogs in the world, it was decided to evaluate the level of awareness regarding some of zoonotic disease among US dog owners. For the first time, present kind of cross-sectional study was conducted among the dog owners of Ithaca, New York.

Overall, participants listed zoonotic diseases like leptospirosis, giardiasis, rabies, hookworms, coccidiosis, lyme disease, roundworms, toxoplasmosis, leishmaniasis, salmonellosis, ringworm infection and ticks on their filled questionnaires. Infestation with ticks was wrongly mentioned by some participants as a disease. Nineteen percent participants were of the opinion that dogs do not transmit any disease to humans. Seventy percent of the participants were of opinion that diseases spread by dogs are deadly to humans while 95% of these participants were of opinion that spread of these diseases can be effectively avoided by human interventions. This observation suggests the need for public outreach programs for spreading proper awareness about various zoonotic diseases transmitted by dogs.

Forty percent of participants quoted their veterinarian as their primary source of information regarding zoonotic diseases, which was higher as compared to 33% in a similar study conducted in Zimbabwe,<sup>[22]</sup> This higher proportion was because sampled population in this study was from a developed nation as compared to sampled population by Pfukenyi and his team. Followed by family veterinarian, 35% participants quoted their family member/friend as their source of information about zoonotic diseases. Not a single participant mentioned their primary physician as his/her source of information for zoonotic diseases. Such observation regarding the primary source of information about zoonotic canine diseases has been recorded for the first time in USA. Similar finding was reported in studies conducted in Nigeria<sup>[8]</sup> and Brazil.<sup>[17]</sup> Physicians, not only in developing countries, but also in the developed countries need to educate their patients on the zoonotic aspect of diseases. For a layman, the effect of such information regarding awareness about zoonotic diseases, when delivered by a physician is more profound as compared to other sources. Due to time constraints, physicians are too focussed on the presenting complaint of the client and tend to skip discussing merits of prophylactic zoonotic disease prevention from their pets. Liberal availability of zoonotic diseases related client education material in the client waiting area should be encouraged.

Around 20% participants were found quoting internet as their source of information, which was lower (32%) as compared to findings from a similar study conducted in Southern Canada.<sup>[23]</sup> This observation strengthened the need for a reliable website/online database, which can be freely accessed by public to get accurate information regarding zoonotic diseases. CDC has developed a very comprehensive website ([www.cdc.gov](http://www.cdc.gov)) to disseminate such information regarding various zoonotic diseases. More such websites/free apps for smartphones, tablets, etc., should be promoted. Only 5% of the participants mentioned that they got their information/knowledge from media which was four times low as compared to findings of similar study conducted in Southern Canada.<sup>[23]</sup> From this observation, it is evident that media also need to strengthen up its role of spreading awareness among public about zoonotic diseases. All the participants were of the opinion that spread of zoonotic diseases from dogs can be avoided by human intervention.

Ninety-five percent the participants in this study admitted vaccinating their dogs against certain diseases. But when asked to list the name of diseases for which they got their dogs vaccinated, 40% of participants were not able to list even a single disease. In this study, dogs were most frequently (45%) reported to be vaccinated against rabies. This was because of combination of two factors: To satisfy legal requirement by local city/county laws and due to wide publicity given by media regarding the deadly nature of rabies. In spite of local laws and the wide publicity in media, still out of total 100 participants interviewed, 55% participants said that they did not vaccinate their dogs against rabies. This observation demands further study to elicit the factors which are still forbidding the dog owners to get their dogs vaccinated for this deadly disease. Similar lack of knowledge with respect to rabies vaccination was also reported from Texas, USA.<sup>[19]</sup>

Another deadly zoonotic disease for which very low level of dog owners got their dogs vaccinated was leptospirosis. Awareness steps need to be stepped up to highlight the zoonotic aspect as well as the availability of vaccine for this disease. With the progress of level of education, level of awareness about various pet-borne diseases was also found to be elevated. Majority of these respondents, who did not vaccinate their dogs against leptospirosis, were teenagers between the age of 15–20 years. Probably, young age and lack of exposure to information regarding this zoonotic disease is the reason for this gap of knowledge among this age group. Similar low level of awareness, about leptospirosis, was also recently reported from western states of USA.<sup>[24]</sup> Like sex education, public health aspect of the zoonotic diseases transmitted from pets should also be taught in schools/colleges as part of their course curriculum.

Total of 75% participants reported that they regularly deworm their pet dogs for internal parasites, which was higher as compared to findings of Palmer and his team.<sup>[25]</sup> All of these participants preferred pills over syrup formulation of dewormers. When asked about the reason for their preference, they mentioned the

ease of use. Moreover spilled liquid preparation is lost forever as compared to spitted out pill, which can be easily picked up and re-administered to the pet.

Only 55% participants admitted putting their dog on flea control, which is slightly higher as compared to findings of a similar study conducted in Hungary.<sup>[26]</sup> Only 10/100 (10%) participants were able to mention that fleas transmit plague to humans but all these participants mentioned dogs, instead of rodents, as reservoir of plague. This observation points towards wide knowledge gap among dog owners with respect to role played by fleas in the transmission cycle of human plague, which need to be addressed appropriately. This knowledge gap was found equally among both genders of participants. This is significant from public health viewpoint. Seventy five percent of the pet owners were found equally ignorant about the zoonotic diseases transmitted by fleas and ticks. This proportion is higher than findings of other studies conducted in different parts of world,<sup>[8]</sup> is significant from public health viewpoint as fleas transmit plague, rickettsioses and leishmaniasis<sup>[13]</sup> and can serve as intermediate host for dog tapeworm. Appropriate public awareness measures need to be deployed to educate the masses on this aspect of public health. Pet owners/public need to be educated on the need/merits of prophylactic flea and tick control.

Sixty percent participants were ignorant about diseases transmitted by ticks. This observation highlighted the need for enhancing public education regarding the zoonotic diseases (e.g. RMSF, Ehrlichiosis, etc.) transmitted by ticks. Regarding zoonotic diseases transmitted by mosquitoes, 60% participants could not name a single disease which is transmitted by mosquitoes, not even heartworm. Fifty percent participants admitted to share their bed with their dogs. Similar habit had been reported by Overgaauw and his team from Netherland.<sup>[20]</sup> Although, our proportion is lower, as compared to findings of that study conducted in Netherlands, still this number is very high and it increases the risk of transmission of zoonotic intestinal parasites many fold.

Fifteen percent participants admitted that they have kids (<10 years age) in their homes. As kids do not have fully developed immune system, this zoonotic potential of transmission of intestinal parasites becomes even more alarming in such households where kids share their environment with the dogs. This fact has been highlighted on the CDC website also. On their website, CDC has also posted public information literature/brochures with respect to this increased risk. Since physicians, and not the veterinarians, are aware about the immune status of their clients, they should educate them regarding the increased level of risk related with zoonotic diseases from their pets.

Present study, for the first time, revealed zoonotic disease-related knowledge gaps in the sampled population of USA. These knowledge gaps were in terms of lack of awareness about zoonotic diseases vectored by mosquitoes, ticks and fleas; practice of not

doing regular deworming of their pet dogs and vaccinations; prophylactic control of fleas and ticks on their dogs; and lack of interest by physicians in dissemination of information, related with transmission and prevention of zoonotic diseases, among their patients. It is further concluded that veterinarians can play a pivotal role in disseminating public health information regarding canine zoonotic diseases, to the pet owners. Since present study was conducted in the City of Ithaca, where a veterinary college is located, it is possible that the knowledge level of the participants might be elevated from repeated ongoing public education programs of the veterinary college. Additionally, participants residing in rural demography represented 50% of the sampled population versus 50% of the remaining participants residing in combined urban and semi-urban areas. Seventy-five percent of the participants were undergraduates versus remaining 25% representing the high school and graduates.

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