

# Awareness and Use of Insecticide-Treated Mosquito Bed Nets (ITNs) among Students in the Second Cycle Institutions in the Tamale Metropolis of Northern Region of Ghana

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

**Introduction:** Insecticide-treated nets (ITNs) are a type of personal protection that has been shown to reduce severe illness and death caused by malaria in endemic areas. Effective malaria prevention reduces mortality and morbidity rates associated with malaria. The use of ITNs have been shown as one of the effective and simplest way of preventing malaria among the general population. Yet, the awareness and utilisation of ITNs are not encouraging in most African countries

including Ghana. This study aimed at assessing students' level of awareness and use of insecticide-treated bed nets in the Tamale Metropolis of Ghana's Northern Region.

**Methods:** A school-based cross-sectional study design was used. The participants were 368 in total from six different schools within the Metropolis. The study participants were recruited using multistage sampling techniques. Data were collected with a pretested questionnaire and the data were analyzed with SPSS version 24. Descriptive and binary logistic regression models were used. The results were presented in the form of frequencies, percentages, and tables.

**Results:** The study revealed a high level of knowledge (92.1%), possession of ITN (74.2%), 87.0% knew the use of ITNs to prevent malaria. Majority (69.8%) of respondents use ITNs, out of those who use ITNs, only 14.4% indicated sleeping under ITN throughout the year while 85.6% use ITNs during the season of mosquitoes. Students who had a good understanding of the purpose of ITNs were 1.39 times more likely to use ITNs (AOR=1.39, 95% CI=0.25-7.56,  $P= .002$ ) and students who did not own ITNs were 0.3% less likely to use ITNs (AOR=0.003, 95% CI=0.007-0.014,  $P>.001$ ).

**Conclusion:** The study reported high awareness about ITNs and ownership. The usage of ITN all year round however was low. The success of ITNs usage in second cycle institutions is dependent on the government's ability to provide adequate infrastructure to allow for some space to enable the students to tie their Nets. The students of the second cycle institutions should be educated more on ITNs usage and its benefits.

*Keywords: ITN; students; awareness; utilization; Ghana.*

## 1. INTRODUCTION

Malaria kills approximately one million people worldwide each year, with more than 80% of these deaths occurring in Sub-Saharan Africa [1,2]. However, there has been a decline in malaria-related deaths over the years resulting in about 655,000 deaths in 2010, to 438,000 in 2015 [3]. Malaria affects all age groups of the population and for many decades malaria has been considered a public health concern in many African countries [4].

Malaria accounts for roughly half of all outpatient visits and in-patient hospital admissions in several African nations, as well as the total economic burden of illness [2]. Many have argued that malaria is the cause of poverty in Africa [5]. It results in a yearly loss of nearly United States Dollars (US\$)12 billion in Gross Domestic Product (GDP) [6], reduced individual productivity as a result of the number of days they stay out of work due to malaria and the cost of treatment of malaria [2,6] and affects teaching and learning in schools [7].

Ghana is one of the world's fifteen (15) malaria-burdening countries. Ghana experienced the greatest increase in absolute case numbers (approximately 500,000 new cases) between 2017 and 2018, representing a 5% increase over 2017 levels (from 213 to 224 per 1000 of the population at risk) [8]. According to reports from Ghana, more than 40% of ITNs accessible in

households are underused [9]. This can bring the country back in her quest to meet the target set for herself. A study conducted in the middle belt of Ghana has shown that the study participants knew how crucial ITNs are to preventing malaria. Some pregnant women due to financial constraint and missed chance during the free distribution of ITN do not own a bed net and does not sleep in same [10].

According to research, where malaria thrives the most, humans thrive the least [11]. This, they presume, is due to a variety of attributes, including the effects on childbearing, growing populations, saving and investment, labour productivity, absenteeism, premature deaths, and medical expenses [12].

In 1998, the World Health Organization (WHO) began the Roll Back Malaria campaign, with the support of G8 heads of state and the Organization of African Unity. The initiative outlined six strategies to address the issue of malaria. Among these strategies were disease transmission control; and cost-effective integrated vector management methods [13]. As a result, in malaria-endemic areas, pregnant mothers and children under the age of five are offered regular insecticide-treated bed nets. The Insecticide-treated bed nets are a cost-effective form of malaria protection, resulting in a reduction in malaria cases and also malaria-related adverse outcomes [14,15].

According to research conducted in Ghana's Hohoe Municipality, 81.3 % own ITN, while 66.4 % use it. The majority of survey participants (97.8%) agreed that ITNs are effective in preventing malaria [16]. Most literature has reported that the usage rates of ITNs are between the ranges of 60-80% [17–19], meanwhile World Malaria report targets 90% plus usage (WHO [20]). Factors such as the awareness level about ITNs, environmental and socio-cultural factors as well as how and where people sleep, may ease involvement or non-involvement in ITN campaigns [10,21,22].

Adjah & Panayiotou [23] in a study conducted in Ghana to analyze the impact of malaria-related messages on the usage of insecticide-treated nets for malaria prevention, it was discovered that the general public is increasingly using treated bed nets. Health workers and volunteers who disseminate malaria-related messages, as well as encouraging people to use ITNs, are among those who provide information about the effective use of ITNs.

According to available information in Ghana, a significant number of households that own bed nets do not sleep under them [24,25].

It is reported that malaria contributed to about 40% of outpatient visits in every public health facility and in 2015, 10 million cases of malaria were documented, which is almost 40% of Ghana's population. In the first quarter of 2016, there was a 3.5% increase in the number of cases recorded over the previous year [26]. In Ghana, approximately 8 to 23 significant hotspots of malaria morbidity were identified each year, with more hotspots observed between 2015 and 2017. The hotspots were discovered in the northern belt of Ghana in 2013 and 2014 [27]. The Ghanaian government has worked tirelessly to eradicate malaria, particularly among pregnant women and their families, for decades [28]. The diseases affect everyone, but they are incredibly harmful to pregnant women and children under the age of five [29,30].

Because of their fragility, practically all malaria research focuses on children under the age of five and pregnant women, with the remaining portion of the population receiving less attention. Some of these students miss contact hours with their lecturers as a result of seeking malaria treatment [31]. The student population is often neglected by government targeted programmes, meanwhile, the growth of the country depends on

the youth [32,33]. This study aimed to determine the level of awareness and use of insecticide-treated bed nets among students in second cycle institutions in Ghana's Northern Region's Tamale Metropolis.

This often-neglected part of the population is mostly students in second cycle institutions, who are part of the community hence to eradicate malaria efforts must not be channelled towards only pregnant women and children under five years. It is hoped that the study's findings will serve as the foundation for policy direction aimed at this population segment.

## 2. METHODS AND MATERIALS

### 2.1 Study Setting

The research was carried out in Ghana's Northern Region, in the Tamale Metropolis. "Tamale is located in the Northern Region's central region and is bordered by five other districts: Savelugu-Nanton is to the north, Yendi Municipal Assembly is to the east, Tolon-Kumbungu is to the west, Central Gonja is to the south-west, and East Gonja is to the South" (34). Tamale is situated between the latitudes of 9°16 and 9°34 North and the longitudes of 0°36 and 0°57. It has a population of 264,899 people, according to the Ghana Statistical Service's 2010 Population and Housing Census (GSS, 2010). The proportion of the Metropolis' population residing in urban areas is higher (80.8%) than that of rural communities (19.1%) [34].

Tamale Metropolis has 19 Senior High Schools, 7 of which are public and 12 of which are private, with a total of 14573 students [35].

### 2.2 Study Design

A school-based cross-sectional study design was used for this study and the study was conducted among purposefully selected Second Cycle Institutions in Tamale Metropolis.

### 2.3 Sampling Population

The study included students in selected Senior High schools in the Tamale Metropolis.

### 2.4 Inclusion and Exclusion Criteria

All Senior High School students within the Tamale Metropolis, the mentally sound student,

not severely ill and those who voluntarily consent to participate in the study. All other students outside this category were excluded from the study.

## 2.5 Sampling Size and Sampling Method

The Snedecor & Cochran, [36] formula for a point estimate survey was used to select the sample size.  $N$  = sample size,  $z$  =  $z$ - score of a 95% confidence level (5% significance level) of the study equivalent to 1.96,  $p$  = The use of treated mosquito nets in Tamale Metropolis was estimated to be 50% as there was no estimated prevalence of treated mosquito net use in the Metropolis. This is because 50% coverage gives the maximum sample. So that, whether the actual prevalence was less than or more than 50% the needed sample size would have been covered nevertheless,  $q$  = estimated proportion of students who do not use ITN ( $1-p= 0.5$ ), and  $m$  = margin of error of the study thus  $100\%-95\%= 5\% = 0.05$  in this study. The number of study participants recruited for the study were 384.

The study used multistage sampling. Information on all the second-cycle institutions within the Tamale Metropolis was obtained from the Ghana Education Service (Northern Regional Directorate's office) and put into four clusters. Three (3) clusters were chosen using simple random sampling while the remaining cluster was used for the pretesting. For each of the clusters included, two (2) schools were then chosen. This was done by writing the names of schools in each cluster on pieces of paper and folding them individually. The pieces of paper were placed in the palm, shook and then thrown on the floor. Two people were then made to pick one piece of paper each. Whichever schools were picked were included in our study. This was repeated for the rest of the other clusters. For each of the schools visited, systematic sampling was employed. The sample frame was obtained from each school and divided by 64 to get the sampling interval. All the people who were within the inclusion criteria of the classes chosen participated in the study.

## 2.6 Data Collection Instrument and Method

To collect data, a structured questionnaire was designed and used. The questionnaire was used to collect information on respondents' socio-demographic characteristics, awareness and

knowledge, student attitudes toward ITN use, and barriers to effective ITN use.

Students who were part of the study were given the questionnaire to complete and return to the researchers. The data collection was done at their various schools. The teachers and the students determined the time and location for the data to be collected. The questionnaire was designed in line with the literature that was reviewed and general knowledge on the topic. The questionnaires were pretested to clarify ambiguity and to ensure reliability.

Out of 384 questionnaires distributed, 368 questionnaires were complete and hence were considered for data analysis.

## 2.7 Data Analysis and Presentation of Results

Before being exported to IBM Statistical Package for Social Sciences (SPSS 24.0), data was entered and cleaned in Microsoft excel. Data was first checked for completeness and entered on daily basis. Descriptive statistics, inferential statistics, and narratives were used to describe the data. The association between dependent variable (ITNs usage) and independent variables (Sex, Class, Knowledge on ITNs usage, Ownership of ITNs, Beneficiary of ITNs) was determined using Chi-square analysis, and a  $p$ -value of 0.05 was considered statistically significant.

## 2.8 Ethics Consideration

The conduct of the study was approved by the University for Development Studies and the School of Nursing and Midwifery departments Research committee.

Permission was granted by the Regional Directorate of Education to enable us carry out the study. An introduction letter was obtained from the Regional Health Directorate and submitted to all heads of secondary schools. All schools granted permission to carry out the study in their schools. Before issuing the questionnaire, informed consent was sought both verbally and written from all respondents who were involved in this study and they were assured that the aim of the study is purely for academic purposes. All participants were guaranteed anonymity and confidentiality, and their participation was entirely voluntary. They were informed that the findings

would be used solely for academic purposes, so they were free to decline participation in the study at any time.

### 3. RESULTS

#### 3.1 Socio-demographic Characteristics

The response rate for this study was recorded as 95.8%. The majority of participants (67.1%) were between the ages of 17 and 19, with 9.2% being 20 years or older. Males accounted for 53.5% of the participants, over 90% were in grade one or two of their study with 69.4% of them attending public schools. Only 3.5% of the respondents were married (Table 1).

#### 3.2 Awareness and Knowledge of Respondents on ITNs

Out of the 368 participants, 92.1% have ever heard of ITNs, 87% knew the purpose of ITNs in preventing malaria. The majority of respondents (62.8%) have heard about ITNs mainly on the radio. More than half (51.0%) of the respondents aired their ITNs before using them for the first, 69.9% believed that ITN can retreated. Most (32.7%) of the students believed that it could last for 3 to 5 years (Table 2).

#### 3.3 Utilisation of ITNs among Respondents

Over 70% of the participants owned a net, 65.2% got their nets from the free ITN distribution program while 34.2% had to purchase them. However, 69.8% of those who owned ITNs used them, 45.7% slept under a net a night before the interview while 14.4% used their nets throughout the year (Table 3).

#### 3.4 Association between sex, class, knowledge on ITN, ownership of ITN, beneficiary of ITNs and Usage of ITN among Senior High Schools

Table 4 as shown below represent the factors influencing the use of Insecticide Treated Mosquito Nets in Senior High Schools. The study revealed that students who knew a lot about insecticide-treated mosquito nets were 1.39 times more likely to use them than their peers who knew nothing about them (AOR=1.39, 95% CI=0.25-7.56,  $P= .002$ ). In addition to the foregoing, students who did not own Insecticide Treated Mosquito Nets were 0.3% less likely to use Insecticide Treated Mosquito Nets compared to their peers who did (AOR=0.003, 95% CI=0.007-0.014,  $P>.001$ ).

**Table 1. Socio-demographic characteristics of respondents (N=368)**

Variables	Categories	Frequency (%)
<b>Age</b>	14-16	63(17.2)
	17-19	247(67.1)
	20+	34(9.2)
	Non-Response	24(6.5)
<b>Sex</b>	Male	197 (53.5)
	Female	171(46.5)
<b>Level of study</b>	Form 1	137(37.3)
	Form 2	176 (47.8)
	Form 3	55(14.9)
<b>Type of School</b>	Private	113(30.6)
	Public	256(69.4)
<b>Marital status</b>	Single/co-habiting	355(96.5)
	Married	13(3.5)

**Table 2. Awareness and Knowledge of respondents on ITN (N=339)**

<b>Variables</b>	<b>Categories</b>	<b>Frequency (%)</b>
<b>Ever heard of ITN (N=368)</b>	Yes	339(92.1)
	No	29(7.9)
<b>Ever seen or handled ITN(368)</b>	Yes	336(91.3)
	No	32(8.7)
<b>Uses of ITN</b>	Prevent Mosquito bite/malaria	295(87.0)
	Sound sleep	13(3.8)
	Others	1(0.3)
	None Response	30(8.9)
<b>Source of information</b>	Radio	213(62.8)
	TV	92(27.1)
	Health workers	16 (4.8)
	Others (books, journal, etc)	18 (5.3)
<b>Where ITN can be obtained</b>	Health centres	311(91.7)
	Chemical stores	8(2.4)
	Market	3(0.9)
	Others	5(1.5)
	None response	12(3.5)
<b>Before the first usage of ITN</b>	Airing it	173(51.0)
	Wash it	103(30.4)
	Add chemical	2(0.6)
	Others	12(3.5)
	None response	49(14.5)
<b>Can ITN be retreated?</b>	Yes	237(69.9)
	No	102(30.1)
<b>When should ITN retreated? (N=237)</b>	After washing once	61(25.7)
	After you have had a bite despite using ITN properly	89(37.6)
	After 3-5 years of usage	39(16.5)
	After washing 3 times	26(11.0)
	When it is dirty	22(9.2)
<b>How long can ITN effectiveness last?</b>	1-7 days	17(5.1)
	weeks	2(0.6)
	1-3 months	62(18.3)
	4-12 months	24(7.1)
	1-2 years	43(12.7)
	3-5 years	111(32.7)
	6 years and above	10(2.9)
	Non Response	70(20.6)

**Table 3. Utilisation of ITNs among Respondents (N=368)**

Variables	Categories	Frequency (%)
<b>Do you have a mosquito net?</b>	Yes	273(74.2)
	No	95(25.8)
<b>Have you been a beneficiary of the free distribution of ITN?</b>	Yes	240(65.2)
	No	126(34.2)
	None Response	2(0.6)
<b>Do you use ITNs?</b>	Yes	257(69.8)
	No	68(18.5)
	None Response	43(11.7)
<b>Reasons for not using ITNs(N=68)</b>	No reason	9(13.2)
	Am not comfortable	13(19.1)
	Adverse effect	3(4.4)
	Cost	17(25.0)
	Others	10(14.7)
	None Response	16(23.6)
<b>Did you sleep under ITNs last night?</b>	Yes	168(45.7)
	No	192(52.2)
	None Response	8(2.1)
<b>How often do you use ITNs (N=257)</b>	During the season of mosquitoes	220(85.6)
	All year round	37(14.4)

**Table 4. Association between sex, class, knowledge on ITN, ownership of ITN, beneficiary of ITNs and Usage of ITN among Senior High Schools**

Variables	Categories	AOR (95% CI)	P-value
<b>Sex</b>	Female	Ref*	
	Male	0.65(0.26-1.65)	.37
<b>Class</b>	Form 2	Ref*	
	Form 1	0.41(0.15-1.18)	.08
	Form 3	0.46(0.12-1.68)	.24
<b>Knowledge on ITN</b>	No	Ref*	
	Yes	1.39(0.25-7.56)	<b>.002</b>
<b>Ownership of ITN</b>	Yes	Ref*	
	No	0.003(0.0007-0.014)	<b>p&gt;.001</b>
<b>Beneficiary of free distribution of ITN</b>	No	Ref*	
	Yes	2.9(1.5-9.6)	0.71

*LR chi2=171.46, Pseudo R2=0.534, Prob>Chi2=0.000, Observations (N)=318, -75.38 log probability, AOR stands for adjusted odds ratio, and CI stands for confidence interval. Ref\* = Reference*

#### 4. DISCUSSION

The current study evaluated Senior High School students' knowledge and use of Insecticide Treated Mosquito Nets (ITN) in Tamale, Ghana. Students' knowledge on the importance and purpose of ITNs use was generally high, but their reported use of ITN was low.

One significant finding of this study was that the majority of students have already heard of ITN and were aware of its intended use. This finding corroborated with those of previous reports from Ghana [37–39]. The study revealed that radio was the main source of information for the participants with health workers being the least source. In one study conducted in Ethiopia, radio

was found to play an important role in the dissemination of information about ITNs; however, the role of health workers was found to be minimal in providing health education about the use of ITNs [40]. In Ghana, Health education programs on mass media are the mandate of the health ministry and are always carried out by health professionals. This, therefore, makes radio an important medium for other health promotion programs.

On the uses of ITN, the majority of the respondents said it was used to prevent mosquito bites. This is consistent with a study by Talipouo et al. [41] in pregnant women, which recorded a higher level of respondents stating they use ITN in preventing malaria. This could be due to the aggressive promotion of insecticide bed nets as means of preventing malaria and the growing impact of other malaria prevention interventions in Africa.

In this study, it was discovered that cost, adverse effects, comfortability, and insufficient knowledge were reasons for which people do not use ITNs. This is consistent with a qualitative study of low use of Insecticide-Treated Bed Net among Expecting Mothers in Ghana's Middle Belt, which revealed discomfort, extreme heat, the odour of the net, and difficulty hanging the net as reasons for the declining use of the ITN [10]. Though the study participants are different, these people are all in the same geographical location and could have been affected by the same or similar perceptions.

There is a significant association between knowledge (Have you seen or handled bed nets) and possession (Do you have a bed net) ( $X^2=17.161$ ,  $P<0.001$ ). The participants showed high knowledge about ITN which correlated with possession of these nets. However, researchers suggest that possession necessarily does not translate into usage. Mosquito net ownership in itself does not preclude utilization [10]. Also, ownership of ITN was reported to be higher (80.7%) than its utilization (41.7%) in a study conducted in Ho, Ghana [42]. The reasons that could be attributed to the high percentage of mosquito net possession but low utilization included adverse effects and discomfort [43–45]. More importantly, secondary school students are unable to use the items in their dormitories because of inadequate accommodation facilities. Aside from the space not being enough, most students do not have beds to tie their nets even if they possessed ITNs [46]. This poses a serious

challenge to the use of ITNs among most students.

It is believed that, if individuals get to understand the benefits derived from using the ITNs, they would effectively utilize them [47–50]. In the case of this study, participants were considered to be largely knowledgeable as 87% of respondents in the present study know about the importance of ITNs in preventing malaria. This could be explained by the fact that education on malaria is topical and a lot of campaigns have been lodged to educate the general population on the prevention of malaria. Thus, these malaria messages on various audio-visual systems, such as television, radio, newspapers, and the internet, could reach youths.

Furthermore, the study's findings revealed that ITN distribution benefited the vast majority of respondents. This is consistent with the findings of a study that examined the ownership, usage, and knowledge of Insecticide Treated Nets (ITNs) in Prevention Strategies in the Hohoe Municipality, Ghana, using the WHO 30-cluster system, which revealed that perhaps the majority of respondents had benefited from free distribution of ITNs [16]. The study participants indicated that some of them had ITNs from their parents and other relatives. In Ghana, there is no mass distribution of ITN in Senior High School. Manu et al. [10] argue that mostly when ITNs are given to mothers, they assemble them and either sell to others to be used to make gardens or used to make gardens themselves. This is because some of these targeted populations (i.e pregnant women and postnatal mothers) have benefited from ITN free distribution more than once. Although some of the schools visited had school gardens, none of them used ITN to fence them. In line with this, Oppong, [51] assessed the insecticide-treated bed net usage pattern in Ashaiman municipality, Accra and concluded that free distribution of ITNs is not a guarantee of bed net use, but rather, other factors such as house structures and sleeping arrangements can affect ITN use.

The study also found a statistically significant relationship between ITN knowledge and use ( $P=0.002$ ; AOR=1.39, 95% CI=0.25-7.56). Those who were knowledgeable about ITNs were found to be more likely to use them than those who were not. This finding was in line with Teklemariam et al. [52] finding that households with a secondary school education (AOR: 1.775 (1.047, 3.009), knowledge about ITN use (AOR:

2.400 (1.593, 3.615)), and knowledge of malaria transmission by a mosquito (AOR: 1.653 (1.156, 2.365) are much more likely to own and use it [52].

Contrary to the argument by Biadgilign et al. [53] that the low utilization rate of ITN is due to its unavailability, the majority of the students owned ITNs but few reported using it all year round. The findings of the present study are consistent with previous studies that reported high ownership of ITN but low utilization [54,55]. In Ghana, ITN is a part of the list of items that prospective students are expected to acquire before they report to any second-cycle institution. Among rural dwellers, ITN ownership is reported to continually remain low [56,57] therefore, this could explain the high ownership of ITN among the students. Reasons provided by the students for non-use of the ITN included lack of space to tie the net, discomfort, and side effects of the chemicals used in the treatment of the nets. Our findings are consistent with those of [58] who concluded that most public boarding schools in Ghana are overcrowded and poorly ventilated. It is worth noting that not every student has access to a bed due to the aforementioned problems. This can be problematic if one has to use a bed net.

Another significant finding of this study was that 85.6% of those who revealed ever using their mosquito nets did so during the “mosquito season,” which runs from May to September. This is consistent with the health models that state that perceived susceptibility to a particular disease yields the desired change in health behaviour if other factors such as knowledge, personality, age, and socio-economic are controlled [59,60]. The participants of this study knew much about the benefits of ITN utilization but did not use them for the rest of the season because they did not perceive any susceptibility to malaria in these seasons.

## 5. CONCLUSION

This study assessed students' knowledge and use of insecticide-treated bed nets in some selected second cycle institutions in the Tamale Metropolis of Ghana's Northern Region. The findings from the study showed that participants in the study had a high level of knowledge about ITN. This, however, did not result in the use of the ITN. The non-use of ITNs was attributed to a variety of factors. ITN Information

gotten from the Radio was also discovered to be the participants' most important source of information. Stakeholders such as the Ghana Education Service and the Ghana Health Service may be required to educate pupils on the importance of using the ITN so that students in second-cycle institutions would be better informed on the use, importance, and advantages of ITNs. The District Health Management Team (DHMT) must ensure that all students in second cycle colleges receive ITNs through proper planning and lobbying with relevant NGOs. Thus, the use of ITNs should be included in the school health program to protect students from malaria-associated morbidity and mortality.

## DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge.

## CONSENT

Each research participant signed a written informed consent form and agreed to remain anonymous.

## ETHICAL APPROVAL

The conduct of the study was approved by the University for Development Studies and the School of Nursing and Midwifery departments Research committee.

## DATA ACCESSIBILITY

The corresponding will give all data upon reasonable request.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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