Analysis of Cost Associated with Treatment of Road Traffic Injuries among Victims at the Kenyatta National Hospital Nairobi City Kenya

Zablon.anyenda. Lipule[1]; Dr Andre Yitambe[2]; Dr Kenneth Rucha[3]

[1]Masters of Science health management at Kenyatta University, School of Public health & Applied Sciences department of health management and informatics.
[2]Senior Lecturer Kenyatta University, department of health management and informatics.
[3]Chair department and lecturer Kenyatta University department of health management and informatics.

Background; Previous studies have pointed out that road traffic injuries (RTIs) as a leading cause to fatalities of over one million victims globally per year which bears negative impact on health, economy and development of the society as a whole. Furthermore, young men and women at their most economic age group have been identified as the most vulnerable group to road traffic injuries (RTIs) resulting to mortality and very severe morbidity due disability. However, there is little or no published evidence on healthcare resource allocations and utilization after RTIs, especially in developing countries that include those in Africa.

Objective: The main objective of this study was to analyze the total hospital cost related to RTI (Road traffic injury) victims admitted for a period of 3 months. The study demonstrated effects of direct and indirect medical cost , productivity loss and hospital length of stay on total cost of road traffic injuries of RTI victims at KNH.

Methods: This was a cross sectional study design done at the Kenyatta Hospital Nairobi, surgical wards and Accident & Emergency. A sample (n=124) consisted of new victims admitted to the Hospital due to RTI from January 25th 2019 to 24th April 2019., this was two thirds of the sample size at 74% respondent rate who gave consent and all ethical approvals granted. The data collection of direct and indirect medical cost was by data extraction tool, testing of the tools was done at the surgical ward. Productivity loss of the victims was calculated by use of Work Productivity and Activity Impairment Questionnaire (WPAIQ). SPSS version 22 was applied and descriptive statistics to show frequencies and Percentages for categorical variables (victim's unique individualized characteristics). Multi Linear Regression Model Test was used test the relationship between the independent and dependent variables.

Results: The study results indicated that direct cost factors (laboratory cost, A&E Charges and Diagnostic Cost) $(X_1; \beta_1 =.199, P<.047)$, $(X_3; \beta_3 =.469, P< .037)$, and $(X_4; \beta_4 =.029, P< .048)$ had a significant influence on the overall cost of treatment of RTI victims seeking treatment at the KNH, there was no significant relationship between Bed Charges $(X_2; \beta_2 =.117, P>.689)$ and the cost of treatment of RTI victims seeking treatment at the KNH. The findings of the study also indicated that Y= 7.949+.001X1+0. 458X2+0. .239 X3+ 0. .305X4+e where a .199 change in direct cost, .117 changes in indirect cost, .469 change in total productivity cost and .029 changes in duration of stay in hospital influenced a unit change on the cost of treatment of RTI victims seeking treatment at the KNH. Most distribution of injuries was lower limbs at 51.6%

Conclusion & Recommendation: The study concludes that Road traffic accident is an economic burden to individual, family and country at large. The study recommends, need for an awareness on importance of National Hospital insurance fund (NHIF) as a universal health coverage fund for people at an affordable cost, there is need to reduce the indirect cost of treatment associated indirect cost of treatment, support to from one person or two further increasing productivity time associated with the injury. Further motion study on cost analysis will give a detailed insight on these area of study.

Keywords: Cost Analysis, Road Traffic Injuries, Road Traffic Accidents Direct medical cost, Indirect medical cost, Productivity cost and length of stay.

I. INTRODUCTION.

According to the WHO global road safety report 2021 there is an increase in the number of road traffic related injuries fatality where more than 1.35 million victims annually that greatly affect health and development of the society as a whole. The report further points out, RTIs as the leading cause of death of among children and young adults. Ninety percent of these incidents occur in developing countries. The burden of injuries resulting from RTIs globally is high in developing countries with close to 5% economic loss from the GDP in low and middle income is attributed to RTAs' mortalities and morbidity. World Bank Report (2020) on high toll of road traffic accidents established correlation between reduction in road traffic accidents and the increase in growth GDP per capita. This is attributed to the fact that over 1.3 million victims lose their lives and this on the other hand pose a huge economic loss, so the lesser the loss of lives from accidents. Adeloye *et al* (2016) carried out a meta-analysis study that included 39 studies done from 15 African countries, and concluded an estimated pooled rate for RTIs 65.2 / 100,000 population and a death rate of 16.6 per 100,000 population. Locally on trends demonstrates an increase in, fatalities and injuries by 26% and 46.5%, between January 2015 to January 2020 (NTSA, 2020. WHO (2018) report on global road safety and World Bank (2017) study on high toll of RTAs that

identified key findings on reduction of road traffic accidents having a ripple effect to improving countries national income growth. The finding of the study further observed 2 to 5% of all causes are as a result to RTIs, which is so significant on a long-term economic growth of developing countries. WHO and World bank, reports notes evidence-based action aimed at reduction of road traffic injuries and mortality exist and formulation of the 2030 Agenda for Sustainable Development targets for reducing road traffic injuries as a vital preventive measure. Of key note, there have been researches on cost analysis for treatment the studies but limited to epidemiological content. On the other hand, as researched evidence on diseases' burden and causes, treatment effective and its cost effectiveness, the area has been researched key intervention measures documented especially for communicable and Nutrition science., but such information is limited in cases of injuries. Therefore, this study was a key eye opener on the part costing of road traffic accidents. For the purpose of understanding of the variables used in the study see Table 1

Table 1 list of variables, their definition and measurement used in the study at KNH

S.No	Variable Name	Definition	Measurement
1	Direct medical cost	Independent variable	direct medical expenses.i.e Diagnostic test,Labaraotory cost, Diagnostic cost &length of stay
2	Indirect medical cost	Independent variable	Non-Medical Expenses, Transport to health facility, upkeep of care taker
3	Productivity Loss	Independent variable	Loss of working Hours, Loss of income due to hospitalization
4	Average length of stay	Independent variable	Duration of Hospitalization
5	Treatment of RTI Victims at KNH	Intervening variable	treatment of RTI victims at Kenyatta National Hospital
6	Cost of treatment of Road traffic injury Victims	Dependent variable	Total Cost of Treatment of RTI Victims at Kenyatta National Hospital

II. METHODS

2.1 Study Design and Methods

The study design was cross sectional. The data collection and period of study was undertaken at the KNH casualty and surgical units between January 25th and April 24th 2019.The dependent variable was cost of treatment of road traffic injuries of victims admitted at KNH, independent variables were; Direct medical cost and indirect medical cost, Productivity cost and length of stay.

2.1.1 Location of study

Location of the study was at the KNH; which is the largest public tertiary referral and teaching hospital in the east and central Africa with a patient bed capacity of over 1000. The facility receives at least 216 road traffic victims in 3 weeks,

translating to at least 10 victims daily as per hospital report. KNH is located along the Hospital Road(off Ngong Road) it approximately 4 kilometeres from CBD for Nairobi City. Kenya.

2.1.2 Research questions

a) How does direct medical cost affect the costs of treatment of RTI victims at the KNH?
b) What are the indirect medical costs that affect the costs of treatment of RTI victims at the KNH?
c) What is the relationship between productivity loss and the costs of treatment of RTI victims at the KNH?
d) How does duration stay in hospital contributes to the cost of treatment of RTI victims at the KNH?

2.1.3 Research Objectives

a) Establish how direct medical cost affect the costs of treatment of RTI victims at the KNH.
b) Establish how indirect medical cost affect the costs of treatment of RTI victims at the KNH?
c) Establish the relationship with productivity loss affects the costs of treatment of RTI victims at the KNH.
d) Determine how duration stay in hospital contributes to the cost associated with treatment of RTI victims at the KNH.

2.1.4 Study Hypothesis

Ho: There is no association between direct medical cost and the costs of treatment of RTI victims at the KNH?
Ho: There is no association between indirect medical cost and the costs of treatment of RTI victims at the KNH?
Ho: There is no relationship between productivity loss and the costs of treatment of RTI victims at the KNH?

2.2 Sampling Method

Purposive sampling method was applied to select KNH as study area as the largest referral and teaching Centre, it receives a number of RTI victims for specialized treatment.

Systematic sampling method was applied to select study population, using the admission register as the sampling frame; every second patients was selected for the study only if they qualify the inclusion criteria. In the surgical ward a further review of departmental admission and discharge register was done.

The sample size will be determined through statistical computation formula illustrated in fisher et al (1998). See the flow chart below (**Figure 1) inclusion criteria**; All victims reviewed at KNH or are admitted post road traffic accident at the KNH casualty department and then admitted to the surgical wards level 4, level 5 and level 6. While **Exclusion criteria**; victims involved in road traffic accident seen at the Accident and emergency treated and discharged, victims admitted to the critical care unit, or transferred out of the hospital.

Figure 1 Systematic Sampling of Post RTI victims at KNH

SYSTEMATIC SAMPLING FLOW CHART
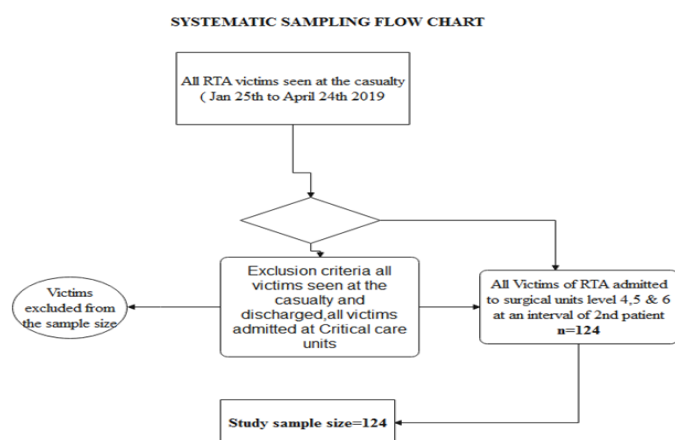
2.3. Data collection and Analysis

The Data extraction tool was tested at the KNH Level 6 surgical department on long stay patients' key adjustment made to improve the validity and reliability of the data collection tool, expert opinion was sort.

SPSS version 22 was applied and descriptive statistics to show frequencies and Percentages for categorical variables (victim's unique individualized characteristics). Analysis of variance (ANOVA) was used to determine regression output of variable and Multi Linear Regression Model Test was used test the relationship between the independent and dependent variables.

III. RESULTS

1. Social demographic characteristics

Table 2: It demonstrates majority of respondents road users were of male gender at 77% and 23% female of the respondents, Findings of the study the age group at the highest risk was 18-39 at 75% and the least was 60+ years The level of education was slightly over 50% of the road users who responded in the study had secondary education and the least post graduate. To understand the awareness on the insurance as pillar to move the agenda on sustainable goals on development 3 "Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all., the study found out only 27% of the respondents had insurance cover and 73% did not have insurance cover.

Table 2. Demographic Factors of RTI victims at KNH during Jan-April 2019 study period

Variables	Frequency	Percentages
Gender		
Male	95	76.6
Female	29	23.4
	124	100
Age group in years		
< 18	4	3.2
18-39	93	75
40-59	25	20.2
60+	2	1.6
	124	100
Education level		
Primary education	42	33.9
Secondary education	64	51.6
College education	9	7.3
University	9	7.3
Post graduate	0	0
	124	100
Insurance cover		
Yes	33	26.6
No	91	73.4
Total	124	100

Table 3 Mode of Transport of RTI Victims at KNH

Mode of Transport	Frequency (n)	Percentages (%)
Car	17	13.7
Lorry	1	.8
Motor cycle	54	43.5
Others	1	.8
Pedestrian	29	23.4
Public	22	17.7
Total	**124**	**100.0**

From table 3 above among the respondents, the vulnerable road user was motorcycle, pedestrian and public. this group represents mode of transport mostly used in the city.

The findings of the study established that most of the principal injuries among the RTI victims who were admitted at Kenyatta National Hospital were in the lower limbs or part of the body and comprised of 50% followed by 12.9% who had injuries in the Lower and Upper parts of the body while patients with injuries on the spine and lower; upper area, Thorax, lower and others and Head and Spine injuries. See table 4.

Table 4 Principle injured area and the severity of the injury

Principle Injured Area	Severity of the Injury			Total
	Severe	Moderate	Mild	
	%	%	%	%
Lower	53.8	51.7	41.7	51.6%
Lower and Upper	7.7	13.8	20.8	14.5%
Face and Head	7.7	1.1	4.2	2.4%
Abdomen	0.0	3.4	0.0	2.4%
Thorax	0.0	1.1	0.0	0.8%
Lower and others	7.7	0.0	0.0	0.8%
Head	0.0	9.2	25.0	11.3%
Face and Lower	7.7	3.4	0.0	3.2%
Spine	7.7	3.4	0.0	3.2%
Neck and Lower	0.0	2.3	0.0	1.6%

Head, Face and lower	0.0	2.3	0.0	1.6%
Head and Spine	0.0	0.0	4.2	0.8%
Face	0.0	3.4	4.2	3.2%
Face and Lower	0.0	1.1	0.0	0.8%
Spine and Lower	0.0	1.1	0.0	0.8%
Upper	7.7	0.0	0.0	0.8%
Total	**100.0**	**100.0**	**100.0**	**100.0%**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.673	3	1.224	1.052	.521 b
	Residual	2.327	2	1.164		
	Total	6.000	5			

a. Dependent Variable: Total Cost of Treatment for RTI victims

b. Predictors: (Constant), A&E Charges, Laboratory cost, Bed Charge, Diagnostic Cos

The table 5 above that shows a regression output of direct medical expenses factors as valid (F (3, 2) = 1.052, $P<.041$). This means that direct medical expenses factors can be used as predictors explaining the variation in the costs of treatment of RTI victims at the KNH. The $P<0.041$ which is less than the critical value of 0.05 leads us to reject the null hypothesis and accepting the alternative hypothesis that direct medical expenses have a significant influence on the costs of treatment of RTI victims at the KNH

Table 6, Multi Linear Regression of study variable among respondents of RTI victims at KNH

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	7.949	2.648		3.002	.095
	Laboratory cost	.199	.288	.353	.691	.047
	Bed Charge	.117	.252	.275	-463	.689
	A&E Charges	.469	.271	.693	.156	.037
	Diagnostic Cost	.029	.171	.027	.167	.048

a. Dependent Variable: Total Cost of Treatment

From the multi-regression results above it indicated that direct cost factors (laboratory cost, A & E Charges and Diagnostic Cost) ($X_{1:}$ β_1 =.199, $P<.$ 047), ($X_{3:}$ β_3 =.469, $P<$ .037), and ($X_{4:}$ β_4 =.029, $P<$ .048), would have a significant influence on the overall cost of treatment of RTI victims seeking treatment at the KNH. The findings of the study also indicated Bed Charges ($X_{2:}$ β_2 =.117, $P>.689$), would not have any significant influence on the cost of treatment of RTI victims

seeking treatment at the KNH. The findings of the study also indicated that Y= 7.949+.199X1+0.117X2+0.469 X3+ 0.029 X4+e where a .199 change in laboratory cost, .117 changes in A &E Charges, .469 change in Diagnostic Cost and .029 changes in Diagnostic Cost will influence a unit change on the cost of treatment of RTI victims seeking treatment at the KNH.

Effect of Indirect Medical Expenses on costs of treatment of RTI victims at the KNH

The second objective was to establish how indirect medical expenses affect the costs of treatment of RTI victims at the KNH.

Table 7 Total Indirect Cost

Total Indirect Cost in Ksh	Frequency (n)	Percentage (%)
Less than 2000	14	11.3
11,000 -20,000	43	34.7
2000-5000	24	19.3
5100-10000	31	25.0
20,000 and Above	12	9.7
Total	**124**	**100**

The findings of the study established that 34.7% of the RTI victims at the KNH incurred an indirect cost of 11,000 - 20,000 Kenya Shillings, 25.0% of the of the RTI victims at the KNH incurred an indirect cost of 5100-10000 Kenya Shillings while 19.3% of them incurred an indirect cost of 11,000 -20,000 Kenya Shillings while another 9.7% of the respondents had incurred an indirect cost of 20,000 and Above Kenya Shillings. This indicated that most of the indirect cost for all the RTI victims at the KNH was between 11,000 -100,000 (USD 95.24-856.4)

Table 8 Lost working time due to Road Transport Injuries

Category	Day / Hour lost due to the injury (%)		
	8-10 Days	5-7 Days	Less than 5
Employed and Working for pay	33.3	65.00	0.8
Not Employed and not Working for pay	66.3	35.00	99.2
Total	**100.0**	**100.00**	**100.00**

The study while evaluating the day and hour lost as an indirect cost of treatment of the RTI victims who were admitted at Kenyatta National Hospital, the findings of the study established that the highest number of Employed RTI victims at the KNH and worked for pay lost between 5-7 days compared to only 35% in the same category. The highest percentage in the lost days and hours of work was 99.2% of RTI victims who were not employed and did not work for pay compared to only .8% of the RTI victims who were employed and worked for pay that lost less than 5 days.

Table 9 Effects of productivity loss on the costs of treatment of RTI victims at the KNH: ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.026	8	28.026	15.455	.000 b
	Residual	184.965	116	1.813		
	Total	212.990	124			
a. Dependent Variable: Total Cost of treatment per of RTI victim						
b. Predictors: (Constant), Total Productivity Cost						

The table 9 above that shows a regression output of indirect medical expenses factors as valid (F (8, 116) = 15.455, P<.000). This means that total productivity loss can be used as predictors explaining the variation in the total cost of treatment for RTI victims at the KNH. The P<0.000 which is less than the critical value of 0.05 leads us to reject the null hypothesis and accepting the alternative hypothesis that productivity loss has a significant influence on the costs of treatment of RTI victims at the KNH.

Determine how duration stay in hospital contributes to the cost associated with treatment of RTI victims at the KNH.

The findings of the study indicated that 55.6% of RTI victims at the KNH had stayed in the facility with at least 10.5% stating that they stayed in hospital for more than 50 days while another 1.6% of the had RTI victims at the KNH had stayed hospital for between 41-50 Days seeking treatment for various injuries. The findings of the study also established that total productivity loss (X_1; β_1 =.296, P<.000), would have a significant influence on the overall cost of treatment of RTI victims seeking treatment at the KNH.

V. DISCUSSION

From the study **Table 2**, it demonstrates majority of the road users were of male gender at 77% and 23% female of the respondents. The findings are consistent with many previous studies. According WHO 2015 report on road safety concluded 3 out of 4 deaths occurs in men. Male young adults are the most vulnerable road users at increased risk of RTAs. The WHO (2018) report identifies young male at the highest risk to sustain mortality or morbidity from road accidents. Of key note males are the primary source of income of families and society at large. However this is contrary to study by woyasse et al 2019) which identifies the ratio of male: female similar. A study on analysis of direct medical expenses on RTI in Tabriz City in iran (Shadkam et al ,2017) males were at 68% and female 32%. Another study on Magnitude of road traffic accident related injuries and fatalities in Ethiopia (Narges Shadkam, 2019) concludes Male young adults are vulnerable road users at highest risk of RTAs. In another study in south africa (Matiwane & Mahomed, 2018) The majority of admissions were young males (72%) and those aged 20–34 years (53%). The average age of fatalities was 32 years and 82% were male. (Schlottmann, 2017) a study

in Malawi identifies the average age and gender at the highest risk of road traffic accident injuries. Locally 76% of road accidents victims admitted in Kenyatta National Hospital were between the ages 15 to 44 years. In Moi Teaching and Referral Hospital the study observed average age of the admitted for road traffic casualties was 30.3 (Zedekia, 2017). From the study the age group at the highest risk was 18-39 at 75% and the least was 60+ years, however the WHO report 2018 points out age group 15-29 years as the vulnerable group involved in road traffic accidents resulting to injuries and death. This finding is consistent with this study, as age group is within the group, similarly above 19 years old are mostly injured for entire period with a statistically significant difference (p = 0.000) (ramadan et al, 2017) in a study on public profile of road traffic accidents in kosovo 2010-2015.

When the study sought to the respondent's road user mode of transport, the findings of the study indicated that motorcycle was the leading mode of transports with 43.5 percent of the total respondents, followed by pedestrian and public transport at 23.4 and 17.7% respectively. This supports a study by Kinyanjui (2016) that identified the group with highest risk of involvement in road traffic accident injuries. The study is consistent with WHO global report, (2018, 2019) and KNBS report 2018 and 2020. This is also supported by previous studies

The findings of the study established that most of the principal injuries among the RTI victims who were admitted at Kenyatta National Hospital were in the lower limbs or part of the body and comprised of 50% followed by 12.9% who had injuries in the Lower and Upper parts of the body while patients with injuries on the spine and lower; upper area, Thorax, lower and others and Head and Spine injuries. This consistent to study by Matheka D.M et al. (2015). and contrary to (Matiwane & Mahomed, 2018) who pointed out head injury as the highest region of injury.

The table 5 above, with the application of ANOVA, it demonstrates a regression output of direct medical expenses factors as valid (F (3, 2) = 1.052, P<.041). This means that direct medical expenses factors can be used as predictors explaining the variation in the costs of treatment of RTI victims at the KNH. The P<0.041 which is less than the critical value of 0.05 leads us to reject the null hypothesis and accepting the alternative hypothesis that direct medical expenses have a significant influence on the costs of treatment of RTI victims at the KNH

The multi linear regression of study variables, it indicates Bed Charges (X_2; β_2 =.117, P>.689), would not have any significant influence on the cost of treatment of RTI victims seeking treatment at the KNH. The findings of the study also indicated that Y= 7.949+.199X1+0.117X2+0.469 X3+ 0.029 X4+e where a .199 change in laboratory cost, .117 changes in A &E Charges, .469 change in Diagnostic Cost and .029 changes in Diagnostic Cost will influence a unit change on the

cost of treatment of RTI victims seeking treatment at the KNH.

In addition, the findings of the study established that total productivity loss (X_1: β_1 =.296, P<.000), would have a significant influence on the overall cost of treatment of RTI victims seeking treatment at the KNH. The productivity loss would not only affect the victim's income but also to the total national income and supports findings by World Bank Report (2020) that highlighted that 5% economic loss from the GDP in low and middle income is attributed to RTAs' mortalities and morbidity. From the study the average length of stay was 24.1, which closer with (Matiwane & Mahomed,2018) who found out the orthopaedic ward the mean LOS was 22.7 days (SD: 20.3). Of note 45% to 60% all admissions in surgical wards are victims of RTIs. (Zedekia, 2017) They also account for 75% of the patients in the spinal injury hospital. At the KNH over 90% of patient admitted at Level 6 ward were as a result of RTIs. On the other hand, in Iran the national standard length of stay in hospital was 4.1 days, this could be attributed to the fact of limited resources, findings show 55.6% respondents of RTI victims at the KNH had stayed in the facility with at least 10.5% stating that they stayed in hospital for more than 50 days while another 1.6% of the had RTI victims at the KNH had stayed hospital for between 41-50 Days seeking treatment for various injuries.

VI. LIMITATION OF STUDY

The study was undertaken in national referral hospital and therefore the applicability of findings may not be generalized to other healthcare institution for instance, private and faith-based hospitals. There was missing information on selected cost components and hence extracted from the study. There is limited research done on costing of RTI in LMICs to include our region and Kenya, much has been done in the developed world. The purposes of the productivity assessment tool, was not maximized as it needed a lot of time, and therefore the need for further motions study to explore the injury and effects to activities of victims. The institution was using both manual and computer system at the Accident and emergency registry and hence resulting to missing information.

VII. CONCLUSION

Road traffic accident is a global public health concern.of key note is a high percentage of male victims in their productive economic ages were the most affected. Them being the key support of the families and society large. Motorcylist, pedestrian and public transport came out as the leading vulnerable group to sustain road traffic injuries, with asignificant group verbalising long term recovery period. The burden to the KNH was evidenced by the large number of road traffic accident victims admitted in the surgical unit especially the level 5 and level 6 wards. The findings of the study direct cost factors laboratory cost, A&E Charges and diagnostic cost had significant influence on the **overall** cost of treatment of RTI victims seeking treatment at the KNH while Bed Charges did not have any significant influence on the

cost of treatment of RTI victims seeking treatment at the KNH. Also, the total productivity loss would have a significant influence on the overall cost of treatment of RTI victims seeking treatment at the KNH.

VIII. RECOMMENDATION.

Study recommends a motion study on the cost analysis with an expanded study location and population to create more insight. Thre is need of the facility to reduce the overall direct cost of treament fo the RTI victims that seek treatment at the hospital. Hospital administration to find ways of improving efficiency, invest more resources in expansion vital equipment used in traction. It also identifies NHIF as a key pillar in the promotion of universal health care, therefore creation of awareness to the public is to be considered and reinforced.

Ethical approval:

All stages of approval were done as per Kenyatta University graduate school, Nairobi City and Kenya National research requirement

Abbreviations

DALYs	Disability adjusted life years
GDP	Gross domestic product
HAIs	Hospital acquired infection
KNBS	Kenya national bureau of statistics
KNH	Kenyatta national hospital
KSH	Kenyan shillings
LMICs	Lower- and middle-income countries
NHIF	National Hospital Insurance Fund
NTSA	National transport service authority
USD	United states dollars
RTAs	Road traffic accidents
RTIs	Road traffic injuries
SSPS	Statistical Package for the Social Sciences
WHO	World health organization
WPAIQ	Productivity loss of the victims was

calculated by use of Work Productivity and Activity Impairment Questionnaire

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Appendix 1 MAP SHOWING THE LOCATION OF KENYATTA NATIONAL HOSPITAL NAIROBI CITY KENYA