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Final Report

Road Traffic Safety in African Countries – Status, Trend, Contributing Factors, Counter Measures and Challenges

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16. Abstract Road traffic crashes and injuries constitute major health, economic, and developmental challenges to African countries. For its 4 per cent of the world's motor vehicles, the fatalities on African roads exceed 10%. With further motorization, the number of road traffic crashes, injuries and fatalities are expected to continue to grow. The road carnage has severe impact on the human, social and economic development. The present study intends to update the status, trends, causes, existing countermeasure, and issues in traffic safety, facing African countries. It is the hope of the author that the finding could stimulate discussion and to inform policy makers in traffic safety policy formation. The present study reviews reports published in major scientific journals in traffic safety on this significant issue.					
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Road Traffic Safety in African Countries – Status, Trend, Contributing Factors, Counter Measures and Challenges

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Objective. *Road traffic crashes and injuries constitute major health, economic, and developmental challenges to African countries. For its 4 per cent of the world's motor vehicles, the fatalities on African roads exceed 10%. With further motorization, the number of road traffic crashes, injuries and fatalities are expected to continue to grow. The road carnage has severe impact on the human, social and economic development. The present study intends to update the status, trends, causes, existing countermeasure, and issues in traffic safety, facing African countries. It is the hope of the author that the finding could stimulate discussion and to inform policy makers in traffic safety policy formation.*

Methods. *The present study reviews articles published in major scientific journals, internal reports by government and institutions, as well as articles published on the Web. The journals and the internet were searched for the last 12 years, starting from 1998, dovetailing the last comprehensive literature review by Oredo (1997). Key search engines are used in the search, in addition to journal specific investigations. Journals from diverse disciplines, such as traffic safety, injury prevention, medicine, economics, public health and general social science, as well as localized journals in African countries are reviewed, recognizing the multi-disciplinary nature of the field and potential special local issues that are unique to the Continent. The articles are assessed for relevance and validity, although most of identified relevant articles are used, given the limited number of published studies.*

Results. *The study reveals that African countries are facing serious challenges in traffic safety. For example, recent statistics show that more than 100 people die in road traffic crashes per 10,000 vehicles in Tanzania and Ghana, compared to the 1.7 fatalities per 10,000 vehicles in the US. The fatalities will nearly double in two decades between 2000 and 2020 if major action is not undertaken. The review identified a set of factors, similar to those in motorized countries, which contribute to traffic crashes and injury. Human behavior and incapacitation as a group account for more than 85% of the factors reported by police. Not similar to developed countries, traffic casualties are primarily born by vulnerable road users in Africa. Pedestrians alone account for more than 40% of total fatalities on African roads. Limited countermeasures are reported in the literature. The evaluations of these programs are mixed and the research methods used have questionable validity. Many African countries are facing challenges in their effort to improve traffic safety. These include, but not limited to, the lack of data, research, leading agency/organization, in a culture that are somewhat fatalistic and in the economies that are, for the most part, stagnant.*

Conclusion. *Road traffic crashes and injuries are threatening human, social, and economic development in many African countries. Much needs to be done to slow and/or reverse the trend. The recent recognition and initiatives by the United Nations has helped to build an army of alliances and a momentum. The future of African roads is in the hands of African people and in each of the helping hand from the global village wherein we all an inhabitant.*

Keywords Traffic Safety; Road traffic crashes, injuries and fatalities; African countries; contributing factors; counter measures; evaluation.

Introduction

Road traffic crashes and injuries constitute major health, economic, and developmental challenges to developing countries, especially those in Africa. Of the estimated 1.2 million people killed in road traffic crashes in 2002, 90% occurred in low- and middle-income countries (Peden et al., 2004). Africa has the highest fatality rate in relation to her population (28.3 per 100,000 population after adjusting for under reporting), which is substantially higher than motorized countries in the world, such as those in North America (12.1 to 16.2 per 100,000 population) (Peden et al., 2004). Taken into consideration of the lower vehicle ownership, per vehicle traffic fatality rate in African countries is tremendous, varying from tens to more than a hundred folds of those in the USA. (FARS, 2008; Peltzer and Renner, 2004). African crash fatalities are also over represented world wise. For its 4 per cent of the world's motor vehicles, the African road fatality share exceeds 10% of the total fatalities (GRSP, 2009; Jacobs, 2000). With motorization among African countries, road traffic crashes and injuries are expected to grow at a fast rate, threatening the economic and human development of this poor and promising land (Lagarde, 2007; Nantulya and Reich, 2003).

In recent years, the growing traffic safety problem in low income countries has been recognized by public health scholars and institutions alike worldwide. The World Health Organization (WHO) arranged a consultation meeting in April 2001 and prepared a 5-year WHO strategy for road traffic injury prevention (WHO, 2002). The 2003 official statement from United Nations Secretary General emphasized the global public health challenge posed by road traffic injuries and encouraged Member States to address the problem. Studies at the international level, such as the conference held in Cambridge, Massachusetts, provided a forum for scholars and government officials to exchange viewpoints and summarize present practice. The discussion extended to the feasibility and methodology of transferring effective traffic safety interventions in high income countries to Africa (Nantulya 2003). However, in-depth, localized analysis of the magnitude, trend, characteristics, and mechanism of traffic crashes in the systems of human, vehicle, road way, culture and the general environment that combined, and in a complex way, to determine the frequency and severity of traffic collisions, their causes, and effective policy interventions are still in an initial stage. More needs to be done.

Traffic safety research in Africa is in its infancy. Lacking necessary financial, technical and data resources, the studies of road traffic crashes, its causes and impacts on human, social, and economic conditions are sporadic and limited. Some traffic safety programs have been implemented to control and reduce traffic accidents, not necessarily based on evidence based scientific knowledge of the underlying causes of the problem. Few of these implemented programs have been fully evaluated and fewer of recent evaluations have been reported in the literature. Nevertheless, these existing programs and studies can provide invaluable information for future decision making and program development. An early comprehensive review of traffic safety in Africa was compiled by Oredo in the late 1990s (Oredo, 1997), although a more recent and focused review of road safety in Sub Saharan Africa was commissioned by the US Department of Transportation (Jacobs, 2000). Since then, changes have occurred in many fronts, including the renewed political interest and newly implemented programs and studies. An updated review of the practices and outcomes in traffic safety in Africa in this new millennium is therefore contemplated. The results of this review is intended to serve the information needs of researchers, policy makers and the international organizations, such as the United Nation, WHO, Word Bank, and many other international standing committees and institutions that are committed to this cause. It is also the intension of the present author to update the review periodically in the future.

The present study reviews reports published in major scientific journals in traffic safety on this significant issue. Articles are obtained from the published journals electronically or in print. Major search engines, such as PubMed and EBSCO are used for the initial scan for published articles. More detailed search went into key journals in road traffic safety and other related journals in economics and other social science. The journals searched include, but not limited to, Accident Analysis and Prevention, Safety Research, International Journal of Injury Control and Safety Promotion, Injury Prevention, Traffic Injury Prevention, Injury Control and Safety Promotion, and various local safety journals published in Africa. The journals were searched for the last 12 years, starting from 1998, dovetailing with Oredo's last comprehensive review (Oredo, 1997). A search of website was also conducted to glean government

reports and other studies not published in scientific journals. Website of known organizations is specially targeted. This report represents the summary of the most relevant literature found in the search.

This report is organized into six sections. First it reports on the prevalence and trend of the road traffic crash and injuries. Second, it analyzes the pattern of traffic injury involvement and identifies the key issue of pedestrians as a major safety feature in Africa. Third, it compiles causal factors and discusses potential interventions. Fourth, it review and summarize extant evaluation of current policies and counter measures that have been implemented. Fifth, it discusses the hindrance and potential solutions in traffic safety improvement in the present African country context. It concludes by summarizing the findings and commenting on issues facing African countries in improving traffic safety.

Traffic Crashes, Injuries and Fatalities: Magnitude, Trends and Consequence

Compared to the high income, motorized countries, traffic safety in African countries is poor. Odero (2004) compiled traffic crash and injury statistics of selected African countries, which is shown in Table 1. For example, South Africa, the most industrialized country in Africa, reported 19 fatalities per 100,000 populations, which is higher than that of the USA (15 fatalities per 100,000 populations). Taken into consideration of motorization, Tanzania and Ghana witnessed more than 100 fatalities per 10,000 vehicles, compared to the 1.7 fatalities per 10,000 vehicles in the US. Please see Table 1, page 5.

Table 1. Reported road deaths in selected African countries, by region

Country (year)	Deaths	Fatality rate	
		Per 10,000 vehicles (level of motorization)*	Per 100,000 population
Eastern Africa:			
Kenya (1999)	2,823	73 (14)	10
Ethiopia (1998)	1,693	199 (1)	3
Tanzania (1998)	1,583	161 (5)	5
Uganda (1997)	1,575	122 (7)	8
Eritrea (1996)	129	36 (9)	3
Southern Africa			
S. Africa (1998)	9,068	16 (121)	19
Malawi (1996)	1,382	245 (5)	12
Zimbabwe (1996)	1,205	34 (31)	11
Botswana (1998)	453	55 (56)	31
Lesotho (1993)	326	87 (17)	15
Swaziland (1996)	290	46 (68)	31
Central Africa			
Rwanda (1994)	483	161 (5)	5
Niger (1998)	245	46 (5)	2
Congo	124	23 (20)	5
C. Africa Republic	58	270 (1)	2
West Africa			
Nigeria (1995)	6,185	45 (21)	9
Ghana (1998)	1,646	122 (7)	9
Cameroon (1994)	840	52 (12)	6
Senegal (1995)	791	66 (14)	9
Cote d'Ivoire (1995)	575	13 (28)	4
Guinea (1995)	423	121 (5)	6
Benin (1996)	412	90 (8)	7

Source: Table adapted from (Odero, 2004),

While the road traffic crashes and injuries are slowly improving in past decades in the higher income, motorized countries, traffic safety in most developing countries, including countries in Africa, are worsening in general. For instance, the number of reported crashes increased by 62.8 percent (from 6,850 to 10,715), the number of reported traffic injuries increased by 48.8% (from 7663 to 11,405), and the number of traffic fatality increased by 65.3% (from 824 to 1362) in Ghana between 1994 and 1998 (Afukaar et al, 2003). Between 1965 and 1998, traffic crashes increased by 300 % (from 3,562 to 14,342) and the number of people killed by 430% (from 552 to 2972) in Kenya (Odera et al, 2003). The rate of increase has slowed down somewhat in the 1990 in South Africa after a dramatic increase in traffic casualties in the previous decades along with economic expansion and motorization. In the 10-year period between 1985/86 and 1995/96, road fatalities in South Africa have increased by 5%, a remarkable

improvement from the 120% increase reported over the previous 20-year period. The trend has also reversed course in the 1980-90s in Nigeria, corresponding to economic recession, although it is trending up again since the turn of the new millennium (Nantulya, 2003). Traffic fatality increased from 5,953 in 1999 to 8,672 in 2003, an annual rate of 11% (Osimi et al, 2006). The road traffic crash fatality rate in Africa as a whole is anticipated to increase by 80% between 2000 and 2020, if major change is not taking place (Peden et al. 2004).

Traffic safety is affected, and reciprocally affecting, the economic growth in Africa (Bishai, 2006; Kopits and Cropper, 2005; Olukoga, 2003). Booming economy with rising motor vehicle ownership is often accompanied by increased traffic collisions and injuries. However, crashes could increase even in an economic stagnation or downturn, given certain conditions. In the last a couple of decades in the 20th century, although the economies in most of developing countries have experienced strong growth, very little has happened in Africa, especially in Sub-Saharan African countries. "Some countries are even poorer today than they were thirty years ago. Sub-Saharan Africa has had the lowest Gross Domestic Product (GDP) for decades" (Ikejiaku, 2009). The lack of economic activities and financial resources means that individuals cannot afford to buy new and safe vehicles; they are more likely to keep the old vehicles and they often defer maintenance. It can also mean that governments forgo transportation funding in terms of building new and upkeep existing infrastructure; they could neglect vehicle and driver regulation and relax enforcement of traffic laws. Road traffic safety can therefore be compromised (Assum, 1998). Reciprocally, the poor road condition and traffic safety has negatively affected the economies, limiting the access and exchange of goods and services with the rest of the world, which is the key engine of economic upsurge in other developing countries.

Crash involvement

One striking feature of road traffic crashes and injuries in Africa is its high involvement of, and impact on, the most vulnerable road users, the pedestrian and the passengers in public transportations, such as buses and minibuses. The literature review shows that pedestrian crashes account for more than 40 percent of crashes in most of Africa countries. For example, pedestrians accounted for 55% of road traffic

deaths in Mozambique between 1993 and 2000 (Romao et al, 2003). Pedestrians account for 46% of road traffic deaths in Ghana between 1994 and 1998 (Afukaar et al, 2003). Pedestrian and passenger crashes represented 80% of all road traffic deaths in Kenya in 1990 (Odero et al, 2003). This creates an overwhelming burden to the most vulnerable road users and their families, which tend to be poor and less educated. It becomes an equity issue, as well as an overall health and economic issue facing African nations.

The majority of Africans use public transportation for daily routine activities. As passengers, they are exposed to the risks of collision and injury involving public buses and matatus. This risk is heightened by poor vehicle design, roadside hazard, and transportation conditions, such as the lack of seat belts, overcrowding, and hazardous road environment. In an epidemiological study of transport-related injuries in Ghana, for example, Mock and colleagues (1999) found that 58% of motor vehicle crashes involved buses and mini-buses among urban residents. Including taxis, cargo trucks, etc., commercial vehicles are involved in 79% of motor vehicle crashes. In rural Kenya, the majority of passengers are transported by small local companies, using matatus (Nafukho, 2002). Most of public transportation related collisions occurs in these mini-buses, with its limited safety measures and unsafe operations.

Two-wheelers are other transportation means used in some African countries and they constitute another group of vulnerable road users. In a study of motorcycle collisions using hospital data from Nigeria, Oluwadiya (2009) reported that motor cyclist involved crashes are the second most common cause of road traffic injuries in Nigeria. Using participating hospital data from December 2005 to November 2006, Oluwadiya (2009) found that among the victims of motorcycle crashes, more than half of the victims are passengers (39.5) and pedestrians (13.8). Lack of protection, drivers, passengers, and the involved pedestrians are more likely to sustain injury or fatality at the impact of traffic collision.

Along the demographic line, road traffic injury and fatalities are mostly concentrated in males at their most productive age (Mock et al, 2003). Using data from South Africa National Injury Mortality Surveillance System (NIMSS), Mabunda and colleagues (2008) conducted an in-depth analysis of the pedestrians

involved in collisions in four cities in South Africa. The study found that among the total of 7,433 pedestrian deaths between 2001 and 2004, more than half (56.7%) were in their prime age, between 20 and 44 years old. Most of the pedestrian deaths are male, with a three to one ratio to female fatalities. The death of the most productive member exerts a devastating impact to the families, pushing many into poverty with long lasting effect to their children and their community at large (Mabunda et al, 2008).

Contributing factors

A number of risk factors contribute to traffic crashes and the resulting human casualties. These factors are often classified into three major categories, human, vehicle, and highway infrastructure, along a pre-crash, crash, and post-crash time dimension, commonly referred to Haddon Matrix, in recognition of Haddon, W Jr. (1980) for his contribution. The present study adopted this framework to organize the contributing factors, as well as their corresponding countermeasures, which are reported in the next section.

Contributing factors as identified by investigating police in African countries are similar to those in the US and other motorized countries. Human factors, including road user behavior and incapacitation, are the most common factors, accounting for more than 85% of all traffic crashes (Odero et al, 2003). Among them, the two key known contributing factors are speeding and drinking and driving. Please see Table 2, page 9.

TABLE 2. Causes of road accidents as determined by the police in selected African countries, Main Cause of Accident (%)

	Road-user Error	Vehicle defect	Adverse road conditions or environment	Other
Botswana	94	2	1	3
Cyprus	94	1	6	-
Ethiopia	81	5	-	14
Kenya	85.5	5.1	1.3	5.4
Zimbabwe	89	5	1	5

* In about 30% of accidents, multiple factors were identified

** Source:

1) Baguley and Jacobs, 1999, Traffic Safety Issues for The Next Millennium, Transport Research Laboratory

2) Oreo et al, 2003, Road traffic injuries in Kenya: Magnitude, causes and status of intervention.

Speeding is a key contributing factor in traffic collisions and injuries in Africa, regardless of the variation of policy investigation and reporting in different countries (Afukaar, 2003; Butchart et al, 2000). Speeding is a contributing factor in 75% of the traffic fatal crashes in South Africa (Satchwell, 2002). Speeding is a contributing factor in more than 25% of all traffic crashes in Dar-es-Salam in Tanzania between 1999 and 2001 (Barengo et al, 2006). Higher speed reduces the response time of the drivers of the motor vehicles and increases the severity of the injury, due to the larger amount of energy to be dissipated at contact/impact. Arguably, every traffic crash is speed related, and speed management is apparently one of the top issues for safety improvement in African countries.

Drinking driving is another key factors contributing to traffic crashes and injuries (Pluddemann et al, 2004).

Alcohol influence has been found in 50% of the police reported accident in a study in Nigeria between 1996 and 2000 (Mondong et al, 2006). However, even this number is likely to underreport alcohol as a contributing factor in traffic crashes and injuries in many African countries. Lack of detection and enforcement has been cited in the literature as the reason for concern. In Tanzania, for example, the lack of identification of drinking and driving as a contributing factor has been specifically attributed to the lack of technology, logistics and culture, as well as reluctant in enforcing drinking and driving laws (Museru et al, 2002). Lack of devices on the road side, the police has to take the drivers to medical centers, where doctors may or may not be available for blood concentration test in the name of law enforcement (Bekibele et al, 2007).

Human incapacitation has been reported in the literature as contributing factors in road traffic crashes. This factor is rendered somewhat heightened status in transportation in present Africa, where private vehicle ownership is still low and most people take public transportation, i.e., buses and mini-buses, operated primarily by private companies. Two key issues stand out in this concern, the driver visual acuteness and driver fatigue. A study of drivers in public institutions found that older drivers with lower level of eye sight tend to have higher likelihood to be involved in traffic collisions. Lack of examination of eye sight, especially for older drivers who drive buses or trucks, is therefore of policy relevance for decision makers, given the significant role that commercial transportation plays in these nations and economies (Adeoti, 2007).

Driver fatigue, especially truck and bus driver fatigue is considered a major issue, threatening transportation safety in the world, including Africa (Adams-Guppy & Guppy, 2003; Davis et al, 2003). This issue is exacerbated by the overcrowding of passengers and the lack of maintenance of the buses and trucks. In Kenya, for example, most crashes in rural areas involve public transportation vehicles, including buses and matatus, a smaller vehicle used for personal transportation often owned and operated by private companies in Africa. The long distance driving and the lack of effective management of fatigues contribute to the crashes and the resulting injuries and fatalities (Odero et al, 2003). Fatigue affects road users who lack protection specifically. A Nigerian study shows that rider fatigue contributes to 13% of motorcycle crashes in Nigeria (Oginni et al, 2009).

Another major category of contributing factors relates to vehicles. Vehicle road-worthiness is a concern in Africa, although it accounts for a smaller percentage of crashes, between 5% and 6% of the total traffic crashes as the sole contributing factor (Odero et al, 2003). However, combined with other factors, human and roads, vehicle are involved in more than 10% of all road traffic crashes (van Schoor et al, 2001). Given the present economic condition and the lack of car manufacturers in this region, many African countries import older, second hand vehicles. Lack of regulation and inspections at the boarder entry point, the imported vehicle may have varying road worthiness in the first place. This is furthered by the lack of maintenance, in terms of neglect and replacement using low quality substitute, especially for

safety components, such as tires and brakes. This issue may not be improved without economic recovery, coupled with policy initiatives to control imports and regulate fleets on public roads.

Highway infrastructure is another category of factors that contribute to traffic crashes in African countries. Although bad roads account for less than 5 percent of the causes that contribute to traffic crashes, the consequence in human and economic terms is equally devastating (Baguley and Jacobs, 1999). Specific factors include potholes and sharp/steep bends (Odero et al, 2003). A number of reasons have been advanced as explanations for the current road conditions in the African context. Impacted by war, political instability and economic stagnation, roads in many African countries are often badly maintained. More often than not, safety was not been considered in the design of new highways nor safety was not being considered as priorities in highway maintenance. Not being cited as the key contributing factors in the majorities of traffic crashes, unsafe road in combination with human error and vehicle malfunction does in fact increase the frequency and severity of traffic crashes, injuries and fatalities (Baguley and Jacobs, 1999).

Upon and after the impact of collision, mitigating measures in vehicle and road design, as well as emergency medical services and trauma care facilities, play a defining role in reducing the damage of collision and save lives. Safer vehicle and forgivable roads can reduce the severity of injury when collision did occur. Prompt provision of emergency care and rapid movement of the injured from the scene of injury to a health-care facility can save lives, reduce the incidence of short-term disability and dramatically improve long-term outcomes. Although no study have been found in this literature review that focusing on the issue of vehicle and road design in protecting crash victims, a number of studies have documented the lack of resources of emergency and medical services in African countries, especially when the collision occurs in rural areas (Forjough et al, 1999; Lett, 2004; Mock, 2003). In a recent study, Bellagio Essential Surgery group (2008) in Uganda conducted an analysis of the current status in delivering trauma care in that country. They reported inconsistent pre-hospital care in the capital city of Kampala. While some patients were treated by paramedics and transported by ambulance to the nearest hospital, the vast majority of injury victims received minimal or no treatment in the field and

were transported by taxi, private car, police or whatever transportation they could find. Outside of the capital city, crash victims were supposedly covered at the regional hospitals. However, these hospitals were not equipped to provide adequate care for trauma patients, given the lack of surgeon, or no surgeon at all (Bellagio Essential Surgery group, 2008). Similar situation can be generalized to other poor countries in Africa. For instance, there are no emergency services along rural highways to transport victims to trauma facilities in Ghana either (Quansah, 2001).

Interventions and evaluations

To address the risk factors so as to improve road traffic safety, many African countries have initiated intervention through education, engineering and enforcement. For example, Ghana government has launched an information campaign using TV programs (Blantari et al, 2005) to educate professional drivers and to promote road traffic safety. A survey was conducted to gauge the perceptions of 50 professional drivers as to the reach and penetration of the information campaign. The study indicates that TV program has reasonable coverage, clarity, and acceptance from the target populations' viewpoint. The study however failed to detect driver behavior change, which was the major aim of the TV program.

Speed control can save lives, especially for those vulnerable road users in African country. An engineering approach was found in Ghana, which recognize the danger to law enforcement officers to enforce speed laws, the limited police resources including police vehicles, and the low public support of speed law enforcement. The Ghana program installed speed bumps and rumble strips. An initial evaluation reported promising results. Through a simple before and after comparison study, an evaluation revealed a reduction in fatality by 55% (Afukaar, 2003). It should be noted that the report did not provide detailed study design therefore no information is available as to the factors that were controlled through research design. The change of fatalities could be caused primarily by regression to the mean if the sites were selected based on simple counts of collisions, with or without the program. More studies are required to evaluate the effect of a traffic safety program, especially when small area (specific site, such as an intersection or a highway segment) and rare events, such as traffic crashes injuries and fatalities, are of concern.

motor vehicles in Africa tend to be old, imported from other continents and unsafe vehicles contribute to traffic crashes and injuries. In most African countries, there is no inspection requirement being in place, and whenever legally mandated safety standards are advocated they have been ruled out, on the ground that vehicle owners cannot afford the corresponding buying and maintenance costs. Recently, a number of African governments are contemplating and implementing policy response to improve vehicle safety. Several African countries have instituted laws limiting or banning importation of the oldest vehicles, but implementation of these laws have been prove to be difficult, and often delayed, due to the many interests involved. In Senegal, for example, a law was promulgated in 2001 which banned importation of cars older than five years and trucks older than 10 years. However, the law has been scheduled to be implemented two years later in 2003 (Lagarde, 2007). No evaluation of the program has been reported, probably due to the novelty of the program, and the complex and the resources that are required for evaluative studies.

Road infrastructures are also a component of road safety and are often prioritized by governments and funding agencies. In the African context, road infrastructure authorities need to pay attention to the most vulnerable users of the road network, the pedestrians. However, few programs and their evaluation have been reported in the literature. The one program in Uganda constructed an overpass across a busy highway, bringing a shopping center (Kobusingye, 2001). A survey of pedestrian traffic in the proximity of the overpass by observing more than 13,000 pedestrians revealed that only 35.4% of target people use the facility. A one-year before and one-year after comparison indicate an increase of traffic crashes (from 13 to 51) and an increase in traffic injuries (from 14 to 17). Meanwhile a reduction in traffic fatalities was observed (from 8 to 2) (Mutto et al, 2002). These changes cannot be directly attributed to the construction of the pedestrian facility. Appropriately designed studies should be conducted to establish the causality in this correlation.

The limited studies that evaluate traffic safety programs are primarily focused on prevention, the pre-crash stage along the timeline in the Haddon Matrix. The one article addresses vehicle safety standard,

which affects road user impact at the crash site, by Lagarde (2007) alluded to issues of vehicle protection at impact. Limiting importation and step-up inspection are the approaches proposed to manage the situation. No study has been found that addresses highway roadside equipment/furniture that are rigid and that can be considered as hazardous.

A few studies have evaluated training programs aimed at improving the post-crash remedial care, including emergency service and trauma treatment (Bergman et al, 2008; Lett et al, 2004; Sasser et al. 2005; Tiska et al. 2004). A Ghana study of pre-hospital care training program reported positive outcomes (Mock et al. 2002). After taken the course, trained drivers reported considerable improvement in the type of first aid they provided. For example, the percentage of drivers who provided crash scene management improved from 7% before to 35% after the course. Those that provided external bleeding control increased from 4% before to 42% after the training program. The improvement was confirmed by attending nurses. On a 0 (potentially harmful) to 10 (perfect) scale, the first aid provided by trained drivers were notably higher (median = 7) than those for a comparison group of 19 untrained drivers (median = 3).

Upon arrival at a hospital, trauma care determines the outcome of the road traffic crash injuries. A recent study in Tanzania found that trauma training courses are an effective way to improve the knowledge and the performance of trauma surgeons (Bergman et al, 2008). Trauma team performance was judged as excellent when assessed with a novel trauma simulation assessment tool. Participants were very supportive of the course measured by a self reported satisfaction survey. Following the Haddon matrix framework (Haddon, 1980), the evaluations of interventions identified from the present study are summarized in Table 3 page 15.

TABLE 3: Example of Published Injury Prevention Countermeasures, 1998 to 2009

	Road user	Vehicle	Road & Environment
Pre-crash	Ghana information campaign using TV programs (Blantari et al, 2005)	Senegal promulgated law in 2001, banned importation of cars older than five years and trucks older than 10 years (Lagarde, 2007).	<ul style="list-style-type: none"> • Ghana program installed speed bumps and rumble strips. Reduction in fatality by 55% (Afukaar, 2003). • Uganda program constructed an overpass across a busy highway. Mixed results in crashes and injuries (Mutto et al, 2002).
At crash	-	- Senegal promulgated law in 2001, banned importation of cars older than five years and trucks older than 10 years (Lagarde, 2007).	-
Post-crash	-	-	<ul style="list-style-type: none"> • Lett R, Kobusingye O, Asingwire N, Ssenooba F (2004) Trauma team training course: Evaluation of Ugandan implementation. • Bergman et al, (2008) • Sasser S et al. Prehospital trauma care systems. Geneva, World Health Organization, 2005.

An examination of Table 3 suggests that evaluative studies on the effectiveness of traffic safety countermeasures in Africa have been concentrated on the top, the preventive line, and the bottom, the treatment line. Programs on vehicle safety device to protect road users, especially vulnerable road users, and programs on highway designs and safety auditing to reduce roadside hazards are ostensibly missing.

Issues and potential solutions

A number of issues have hampered and is still challenging the improvement of traffic safety in African countries. Among the key obstacles arguably are the lack of a leading and coordinating agency with regulatory power and public support, the paucity and inconsistency of road traffic crash data, the limited traffic safety and injury prevention research, and the inadequacy and variability of traffic law and law enforcement in African countries. These issues are interconnected and somewhat sequential as discussed in this paper. However, the deceiving linearity should not disarm the readers from critically review and design implementation in real life context.

Leading organization and public support

Arguably, the first fundamental barrier to improve traffic safety relates to politics and organizations, as they relate to enabling legislative framework and the financial and other resources. Although many African countries have established road safety agencies in the forms of National Road Safety Council or Road Safety Committee since the early 1980s, most of them do not have the legal and regulative power and resources to develop and enforce traffic laws (Odero, 2004). Future development in this regard includes the establishment of real leading agencies with the participation of all stakeholders including various government agencies, the nonprofit sector, such as the red-cross and safety advocate groups, and corporations, especially insurance companies. As a matter of fact, all organizations need transportation for their goods and services, let along the employees that commute between work and home. A leading agency with the support from all agencies of the government and the public, empowered by statute of law enforcement and required resources, will provide the political and organizational foundation in the pursuit of safer roads and safer communities (Odero et al, 2003).

Data and surveillance systems

The quality and paucity of surveillance data from African countries are a fundamental problem and should be the first technical priority if effective countermeasure is to be developed and implemented successfully. With some exceptions, the current system underestimates the size of the problem (Khayesi and Peden, 2005) therefore prevents it from acquiring deserving public and political attention and adequate funding. Moreover, without good data, the nature of the problem cannot be well defined, nor can effective solutions be rationally and scientifically identified. Moreover, without quality and quantity data, the potential effectiveness of the program cannot be evaluated and disseminated to refine programs, secure funding, and generate scientific knowledge, which could be institutionalized and disseminated for use by neighboring countries.

The development of a road traffic crash and injury surveillance system can be built upon existing data systems and data collection methods, albeit inadequate at the moment. Administrative data are routinely

collected by government and other organizations in most of the African countries, although in diverse forms and with varying level of accuracy and completeness. For example, data are available from police reports, vital statistics, hospital registries, and from epidemiological population surveys in South Africa, Nigeria, and Ghana, just to list a few (Gorell, 2000). Data collection, management, and analysis tools have also been developed and used in several African countries, including Ghana, South Africa, Tanzania, and Zimbabwe often with the support of motorized countries (Butchart, 2001). These administrative data collection and management systems need to be periodically reviewed, revised, standardized so that the information can meet the data needs for road traffic safety analysis and enable comparisons over time and across countries in the long run, so that policies could be developed, implemented, and evaluated on sound empirical basis.

Research and evaluation

Research and evaluation is another weak link in the injury prevention system in most African countries (Lagarde, 2007; Oredo, 2004). The present literature review have only identified a few well-thought out, basic or applied studies of traffic safety and even more scant in the evaluation of traffic safety programs. Without formal study in mind, many of the data, specially collected, may not be put into good and full use, and without well designed study, costly collected data can become information to be used for decision making.

Research is expensive and evaluation can be political, in addition to draining resources from programs that they purport to investigate. Research and evaluation need to be well justified to acquire the resources, especially in African countries, where so many worthwhile causes are competing for funding. In addition to organize and raise public awareness of the issue as discussed in the previous section, they could also take advantage of the momentum from many world organizations, including the United Nature to foster cooperation with developed countries in conducting research and development. Traffic safety and injury prevention personnel are also advised to consider the potential transplantation from existing studies from the more motorized world. Much knowledge and information can be transferred, given the similarity in contributing factors, and given that many motorized countries have gone through a similar developmental

stage. Reinventing the wheel may be avoided if enough consideration is given to the local culture and other dissimilarities, and necessary adjustment is made to fit into the local context and to smooth the program implementation, an easily said than done saga, which has been deemed failed in so many places and in so many domains in foreign aid to Africa.

Traffic law and law enforcement

Traffic law and law enforcement vary and in general are inadequate in African countries. The lack of specific regulation and the power and will to punish those who violate the law render to a large extent the unsafe road in many countries in the continent. Many reasons are proposed to account for the phenomenon, including historical/cultural, economic and political reason. Traffic safety has been deemed as accidents, an act of God (Dixey, 1999). Lacking of the awareness of the potential consequence of unsafe driving, which the traffic law intends to control, the public may resent the impediment of safety devices, the inconvenience of traffic fines, and therefore against certain traffic laws. For instance, the helmet law (for motorcyclists) enacted in 1976 was later repealed in Nigeria, and the wearing rate declined from 92% in 1982 to 10% in 1996, resulting in a dramatic increase in head injuries (Odero, 2004). The economic constraint should be also taken into consideration. In many African countries the lack of road side alcohol detecting device has frustrated and hinder the alcohol law enforcement. Political consideration may also affect law enactment and enforcement. Advocacy groups need to form broad alliance and general wide public support to educate the citizens, generate the political will, and hopefully in time to change the culture for better and effective traffic laws and law enforcement.

Closing remarks

Road traffic crashes and injuries are affecting the social and economic fabric and the future development of African countries. The vulnerable road users, mostly the poor, are disproportionately and negatively impacted by this man-made and to a large extent preventable carnage. With the increase in motorization, even more traffic casualties are expected in the years to come. Something major has to be done to stop it.

A number of causal factors similar to those in motorized countries have been identified and corresponding solutions to address them proposed by previous researchers and confirmed through this literature review. A key safety issue at the present stage in African countries relates to the vulnerable road users, especially the pedestrian in the urban area and passengers using public transportation in the country side. Reducing exposure to risk through land-use planning has not been seriously considered in most African countries. The possibility of providing efficient networks where the shortest or quickest routes coincide with the safest routes should be investigated in all system designs, especially in the urban areas. Vehicle and road engineering measures should take into account of vulnerable road users' physical limitation. Traffic safety programs that address solely the safety of the drivers could prove to be neither effective nor equitable. Coordinated interventions, including the construction of pedestrian facilities and pedestrian friendly vehicle bumpers, the enactment and enforcement of speed and drinking-driving laws, and tighter regulation on the safety of public transportation, couple with education and publicity campaign for all road users are needed to address this issue of vulnerable road users, among other serious safety concerns.

Traffic safety programs require resources, which are scarce in most African countries (Bishai et al, 2003). The mobilization of all the stakeholders, through education and public campaigns are critical to generate the political will, putting traffic safety on its deserving priority position in national political and administrative decision agenda. Convincing the world village, the many international organizations and the United Nation member countries for instance, to contribute to the just and far reaching cause is also important. Political, financial and technical assistance from donor nations will not only help African countries to improve road safety and their national economy, but also create a reciprocal effect benefiting the donor countries. Everyone will benefit from a thriving Africa, as a resource rich continent and a market place in a more politically and militarily stable 21st century.

A number of important technical and capacity issues need to be addressed after political and international campaign. The establishment of an accurate and comprehensive surveillance system to generate timely, accurate, and comprehensive data is the technical bedrock for safety improvement. Evidence based scientific research to generate knowledge of collision causes and rigorous program evaluation to test and

select the most effective countermeasures are an essential process. Vehicle safety and roadside hazard management need to be taken into account in reducing the frequency and severity of injuries. The establishment of emergency medical services and the training and staffing of medical personnel in trauma care facilities are the last resort in saving lives and improving the long term health outcome of the victims. A systematic capacity building should undergird all the activities for and on the young and promising African lands.

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