

**Health and Life-Related Burden of Motor Vehicle Injuries in
Addis Ababa**

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Acronyms

EFY- Ethiopian Fiscal Year

WHO-World Health Organization

YPLL-Years of Potential Life Lost

GNP-Gross National Product

GC-Gregorian Calendar

UN-United Nations

E.C-Ethiopian Calendar

GDP-Gross Domestic Product

US-United States

PAF-Population-Attributable Fraction

ABC-Activity- Based Costing

AIS-Abbreviated Injury Score

ISS-Injury Severity Score

NISS-New Injury Severity Score

ETB-Ethiopian Birr

USD-United States Dollar

AACCHB-Addis Ababa City Council Health Bureau

MVI-Motor Vehicle Injury

AARTPD-Addis Ababa Region Traffic Police Department

CIA-Central Intelligence Agency

Mx-Management

HMIS-Health Management Information System

Abstract

Ethiopia has a relatively high number of fatalities due to road traffic injuries per number of vehicles as compared to many countries in the world, with a death rate of 80 per 10,000 vehicles. Based on reports from Federal Police Commission, more than 94% of road traffic injuries in Ethiopia occur due to motor vehicle crashes and 60% of road traffic crashes in the country are reported from Addis Ababa. This study aimed to estimate the health and life related burden of motor vehicle injuries that occurred in Addis Ababa, Ethiopia during the year 2001 EFY. The study was conducted from February to June 2010 in six hospitals of the metropolis. It was designed as prevalence based cost -of- illness study from a societal perspective. A retrospective descriptive study was conducted to capture costs incurred by motor vehicle injuries in Addis Ababa in 2001 EFY. Multi-stage cluster sampling technique was used to select 364 study subjects. The total health and life-related cost of motor vehicle injuries in Addis Ababa was estimated to be 31,692,892 birr. Out of this, the indirect and direct costs were 20, 608, 801 and 11,084,091 birr respectively. In conclusion, the enormous health and life related burden caused by motor vehicle injuries implies that such injuries are health problems of economic importance demanding more attention from health planners and policy makers. The health sector should collaborate with other agencies in the prevention of motor vehicle injuries so as to reduce the immense economic burden it inflicts on health services.

1. Introduction

1.1 Background: Injuries account for 12% of the global burden of disease, the third most important cause of overall mortality. The category of injuries worldwide is dominated by those incurred in road crashes. According to WHO data, deaths from road traffic injuries account for about 25% of all deaths from injury. Worldwide, an estimated 1.2 million people are killed in road traffic crashes each year, while the number injured could be as high as 50 million. About 85% of all global road deaths, 90% of the disability-adjusted life years lost due to crashes, and 96% of all children killed worldwide as a result of road traffic injuries occur in low-income and middle-income countries. Over 50% of deaths are among young adults in the age range of 15–44 years. As a result, road traffic injuries contribute the greatest years of potential life lost (YPLL) than any other cause of death (1, 2).

The road traffic death toll represents only the “tip of the iceberg” of the total waste of human and societal resources from road injuries. According to the WHO, worldwide, an estimated 20-50 million people are injured or disabled each year in road traffic crashes. It is estimated that road crash injuries cost roughly 1% of the gross national product (GNP) in low-income countries. The direct economic costs of global road crashes have been estimated at US\$ 518 billion per annum, with the costs in low-income countries – estimated at US\$ 65 billion. If comparable estimates were made of the direct and indirect economic costs of road crashes in low-income and middle-income countries, the total economic cost globally of road crashes would be likely to exceed the stated amount above (2).

The road traffic injury mortality rate is highest in Africa 28.3 per 100,000 population when corrected for under-reporting, compared with 11.0 in Europe. When comparing deaths per 10,000 vehicles, the contrast appears even more significant, with 1.7 deaths per 10,000 vehicles in high-income countries and more than 50 in low-income African countries (3).

According to a 2001 UN report, Ethiopia has a very low motorization level, with 2 vehicles per 1000 people in 2001. Even though the fatality rate is decreasing, Ethiopia has a relatively high number of fatalities due to road traffic injuries as compared to many countries in the world. Nearly 80 deaths per 10,000 vehicles occurred in the country in 2009 G.C (4).

1.2 Statement of the problem: Road traffic injury is emerging as a public health problem in Ethiopia, especially in the metropolis. According to data produced by the National Road Safety Coordination Office in 2009 G.C, Ethiopia has a relatively high number of fatalities due to road traffic injuries per number of vehicles in the world, with a death rate of 80 per 10,000 vehicles. Based on reports from Federal Police Commission, more than 94% of road traffic injuries in Ethiopia occur due to motor vehicle crashes and 60% of these are reported from Addis Ababa (4). Road traffic injury is one of the main burden for the public health sector in Addis Ababa as it accounted for 45% of patients who visited public hospitals twice or more (5). If the present trend of road traffic crashes continues, the health and life related burden is going to be enormous as the number of motor vehicles in the capital increases (4).

1.3 Expected outcome: Such kinds of economic evaluations are used to help set priorities, make resource allocation decisions and design services when there are competing health interventions and limited resources. Once an intervention is established, a cost analysis becomes the more appropriate evaluation for health program managers at the service provision level. It provides budgetary information about the actual resource needs or inputs required to provide the intervention; it improves program budgeting by monitoring costs; it helps to estimate the resources needed to expand the intervention into new woredas; and it also assesses the likely sustainability of the intervention nationally over time. The simpler cost analysis is also useful for assessing the replicability of the project in other settings, and informing budgetary requirements for financial planners and donors (6).

2. Literature Review

2.1 Risk Factors and Determinants of Motor Vehicle Injuries

According to the epidemiological approach, motor vehicle crashes incriminate three groups of factors that increase the risk of injury: host (human) factors, factors associated with the roadway environment (physical and social factors) and agent (motor vehicle) factors. Human factors take into account the actions or conditions of the driver (e.g., age, seat belt non-use, speeding, using alcohol or drugs, inattention, or driving errors) and occupant (e.g., seating position, seat belt non-use). Factors that are related to the roadway environment include design factors (e.g., lane width, curves, signage), roadside hazards (e.g., poles, trees), and driving conditions (e.g., ice, rain, snow, fog or darkness). Vehicle factors are design issues that contribute to a crash and the risk of injury in a crash (e.g., vehicle size). Human factors are considered to be the most important factor contributing to collisions, followed by issues regarding the road environment, and lastly vehicle-related factors (2, 7).

Motor vehicle injuries result as a termination of a set of circumstances and pre-existing conditions which can be best understood as a chain of events. One important model to understand the causal chain of events involved in motor vehicle injuries is that proposed by William Haddon, commonly known as the **Haddon Matrix**. This model extends the **epidemiological approach**, to produce a matrix where the causal factors involved in motor vehicle injury can be better understood through the interaction of multiple factors over time. This nine cell matrix consists of pre-event, event and post-event phases plotted against the host, agent (product) and environmental factors (physical and social) of the epidemiological model. When the two axes, time and other factors, are combined they produce the Haddon Matrix (1).

Haddon's model successfully separates out the factors which predispose a motor vehicle injury causing event to occur (pre-crash phase) from the actual event itself (crash phase) in which energy is transferred to the host in an amount to cause damage. Haddon also added a post-crash phase, which includes transport, emergency care and rehabilitation. The post-crash phase affects survival and ultimate outcome once the energy transfer has occurred. Combining these phases of injury with the epidemiological model creates a matrix for the study of both motor vehicle injury

causation and prevention. The temporal phases are normally associated with primary (pre-crash), secondary (crash) and tertiary (post-crash) prevention. The significance of this model is that it points out different areas in which interventions can be implemented to prevent or reduce the severity of injuries. The point of intervention is not unavoidably early in the chain of events. It should be where the intervention is most effective (1).

2.2 Geographic Distribution and Trends of Motor Vehicle Injuries

Worldwide, an estimated 1.2 million people are killed in road traffic crashes each year, while the number injured could be as high as 50 million. Road traffic deaths are the tenth leading cause of death globally. Of these deaths, 90% occurred in low and middle-income countries. Global fatality trends show a decrease in road traffic mortality in highly motorized developed countries. This reflects that many measures have been implemented in the last 3-4 decades aimed at preventing injuries (1).

With increasing motorization, regions of Asia, Africa and Latin America show an increasing trend in road traffic injury and death as many countries have not put in place adequate road safety measures (1). South-East Asia has the highest proportion of global road deaths (one-third of the 1.2 million occurring each year in the world). Without increased safety efforts in proportion to the increasing number of motor vehicles in low and middle-income countries, road traffic injury is predicted to be the third leading contributor to the global burden of disease and injury by 2020 (up from 9th in 1999 G.C) (1).

Worldwide, over 50% of deaths due to road traffic injuries occur among young adults aged between 15–44 years. Thus, road traffic injuries contribute the greatest years of potential life lost (YPLL) than any other cause of death. Many of these young adults are economically active so there are substantial economic costs, at the family and societal level, associated with road traffic injuries (1,3). Pedestrians, cyclists and motorcycle riders are the most vulnerable road users. In low- and middle-income countries, these road users account for large portions of the road traffic injuries and most road traffic deaths (1).

The road traffic injury mortality rate is highest in Africa 28.3 per 100,000 population when corrected for under-reporting, compared with 11.0 in Europe. When comparing deaths per 10,000 vehicles, the contrast appears even more significant, with 1.7 deaths per 10,000 vehicles in high-income countries and more than 50 in low-income African countries. In Africa, it has been estimated that 59,000 people lost their lives in road traffic crashes in 1990 and that this figure will be 144,000 deaths by 2020, a 144% increase. The number of vehicles per inhabitant is low in Africa: less than one licensed vehicle per 100 inhabitants in low-income African countries versus 60 in the developed world. Fleet growth leads to increased road insecurity in developing countries including Africa. This explains, for instance, the reported 400% increase in road deaths in Nigeria between the 1960s and the 1980s. In South Africa, the most developed African country, there were already 17 licensed vehicles per 100 inhabitants in 2005, and no decline in road traffic deaths has been observed until then (3).

A comprehensive literature review published in 1997 showed that pedestrians accounted for between 41% and 75% of all deaths due to road traffic injuries in developing countries. In Africa, pedestrians and passengers of public transportation are the most affected. They represented 80% of mortality due to road traffic injuries in Kenya in 1990. Pedestrians alone accounted for 55% of mortality due to road traffic injuries in Mozambique in the 1993–2000 period, and 46% in Ghana between 1994 and 1998. In Ghana 73.1% of all fatalities and 68% of all casualties occurred in males. Males are 2.73 times involved in road traffic injuries as compared with females. The severity of road traffic crashes is also likely to be much greater in Africa than elsewhere, not only because many vulnerable road users are involved, but also because of the poor transport conditions such as lack of seat belts, overcrowding, and hazardous vehicle environments (3, 8).

According to a 2001 UN report, Ethiopia has a very low motorization level, with 2 vehicles per 1000 people in 2001. Even though the fatality rate is decreasing, Ethiopia has a relatively high number of fatalities due to road traffic injuries as compared to many countries in the world. Nearly 80 deaths per 10,000 vehicles occurred in the country in 2009 G.C (4). Data of the Federal Police Commission from 1996-2000 E.C. show that 85% of road traffic injuries in the country occurred on asphalt roads; while, 68% of the injuries occurred in urban areas especially

in Addis Ababa. Addis Ababa Traffic Police recently reported that 379 people died of road traffic injuries in 2001 E.C; while 835 were injured seriously and 729 of them got injured slightly. Accordingly, an average of 23 road traffic injuries occurred per day in the metropolis and 1 of them died as a result of the crash (9).

2.3 Prevention and Control

There has been a historical neglect of injury in public health. This is partly attributed to the traditional view of accidents and injuries as being random events that happen to others. However, motor vehicle injuries are preventable with many highly motorized countries achieving significant reductions in deaths and injuries over the past few decades. Road safety is a multisectoral issue as well as a public health issue – all sectors including health; need to be fully engaged in responsibility, activity and advocacy for motor vehicle injury prevention. In the past 45 years or so, there has been a key change in the insight, understanding and practice of motor vehicle injury prevention (1). One of the key aspects of this new understanding is that motor vehicle injuries are basically predictable and preventable (10, 11). This is mainly a human-made problem amenable to rational analysis and countermeasure. The public health approach to motor vehicle injury prevention is based on science. The approach draws on knowledge from different disciplines such as medicine, biomechanics, epidemiology, sociology, behavioral science, criminology, education, economics, and engineering (11).

An important priority in low and middle-income countries is the introduction of a wide range of measures that give vulnerable road users greater protection. Successful specific interventions that can be modified for low and middle-income countries include measures such as

- speed control,
- the enforcement of alcohol limits,
- the use of seat-belts, child restraints and motorcycle helmets,
- and the separation of pedestrians and other vulnerable road users from motor vehicles (1).

Speed is associated with an increased number and severity of motor vehicle injuries, and a greater likelihood of fatality. Speed is a factor in 15% of all crashes and 30% of all fatal crashes (2, 7). Vulnerable road users are at especially high risk of injury from speeding motor vehicles.

The probability of a pedestrian dying as a result of a car crash increases exponentially as the speed of the car increases. Speed limits that road users perceive as realistic and those that are self-enforcing have the best chance for achieving compliance. Speed cameras or radar can catch drivers who are driving beyond speed limits. Publicizing the presence of speed cameras or radar has been found to increase compliance with speed laws and to reduce the incidence of crash and injury substantially. Speed-limiting devices built into vehicles are also effective. Speed-limiting devices in heavy goods vehicles could reduce the incidence of road traffic injury by an estimated 2% (1).

Alcohol is one of the most important factors contributing to serious motor vehicle collisions. Economically, alcohol is the most significant contributing factor, followed by the non-use of seat belts. Serious injury is more likely among motor vehicle crash patients with a positive alcohol concentration in their blood (2, 7). For most countries, the level of enforcement of drink-driving laws has a direct effect on the incidence of drinking and driving. Using breath testing devices to increase drivers' awareness of the risk of being detected is the most effective means of deterring drinking and driving. Though used in most high-income countries, they are not currently universal elsewhere. This really limits the ability of many countries to respond effectively to the problem of drink-driving (1).

Proper occupant restraint reduces the incidence and severity of injury in a motor vehicle collision, and includes seat belt and child restraint devices. Non-use of seat belts is a major risk factor for vehicle occupant injury (2, 7). Mandatory seat-belt use has been one of motor vehicle injury prevention's greatest strategies and has saved many lives. Seat-belt use legislation in low-income countries is still not widespread, and will become increasingly important as levels of car traffic rise. The cost-benefit ratio of mandatory seat-belt use has been estimated at between 1:3 and 1:8. The level of seat-belt use is influenced by whether there is legislation mandating their use; the degree to which enforcement of the law, complemented by promotion campaigns, is carried out; incentives offered to encourage its use (1). Deaths and injuries resulting from motor vehicle collisions can be prevented by the proper use of child restraint devices, including car seats, booster seats, and seat belts (2, 7).

The main risk factor for motorized two-wheeler users is the non-use of crash helmets. Helmet use has been found to be the most successful approach for preventing injury among motorized two-wheeler riders. Between 20% and 45% of fatal and serious head injuries can be reduced by using helmets. Substantial growths in motorized two-wheeler use in low-income and middle-income countries are being accompanied by an increase in head injuries (2, 7). Increasing helmet wearing through legislation requiring their use is essential, especially in low income countries where motorized two-wheeler use is high and current levels of helmet wearing low. It has been suggested that when a motorcycle is purchased, the acquisition of an approved helmet should be mandated, or at least encouraged, especially in low-income countries (1).

The safety of pedestrians and cyclists can be achieved through area-wide road safety management that includes the following :

- Networks of separate pedestrian and bicycle routes connecting to a public transport system are the ideal. Such a network might consist of sections of footpath or cycle path separate from roads plus sections running alongside roads, with particular attention paid to safe crossings at junctions. Pedestrians have twice the risk of injury where pedestrians are not separated from motor vehicle traffic.
- Traffic-calming measures discourage motorized traffic from traveling at speeds that put pedestrians and cyclists at high risk. They include road narrowing, roundabouts, rumble strips and speed bumps (1).

2.4 The Economics of Motor Vehicle Injuries

2.4.1 Health, Social and Economic Impacts of Motor Vehicle Injuries: Injuries sustained by victims of a road traffic crash vary in type and severity. In most countries, official road traffic injury statistics include three levels of injury severity: fatal, serious and slight injuries. The effect of non-fatal injuries on lost productivity, across the globe, is estimated to far outweigh that attributable to fatal injuries (2, 12). Permanent disability can prevent an individual from performing even minor activities and result in dependence on others for

economic support and routine physical care. Injured people often suffer physical pain and emotional anguish that cannot be compensated by money. Serious burns, contusions and lacerations can lead to emotional trauma associated with permanent disfigurement. Many families and friends of the motor vehicle injury victim experience short-term or long-term adverse social, physical and psychological effects (2).

The most productive age group, those aged between 15 and 44 years, is heavily affected by motor vehicle injuries; therefore, the economic impacts of injuries in this age group are particularly destructive. According to WHO, injuries to individuals in this age group, “tend to affect productivity severely, particularly among the lowest-income groups whose exposure to risk is greatest and whose earning capacity is most likely to rely on physical activity” (2).

Industrialized countries regularly produce annual estimates of the overall cost of road traffic crashes. These estimates include the cost of injuries and fatalities sustained in crashes among others. Of all these costs, costs incurred due to injuries and fatalities are possibly the most difficult to value. Medical and rehabilitation costs can be very expensive and often continue for an indefinite time, especially in the case of serious disabilities resulting from motor vehicle injuries. The results of a study in the United States revealed that 5.27 million people had sustained non-fatal road traffic injuries in 2000. These injuries resulted in medical costs of US\$ 31.7 billion, placing a huge burden on health care services and individual finances. Pertaining unit medical costs per injury level, the most severe injuries such as head and spinal cord injury cost by far the largest amount, at US\$ 332, 457 per injury. A study carried out in the United States, using the human capital approach, estimated the national economic costs of road traffic crashes at US\$ 230.6 billion, or 2.3% of the GDP (2).

Research in Australia put that country’s economic costs at 3.6% of GDP. The cost of traffic crashes as a proportion of GDP for other high-income countries, calculated using the human capital approach, ranges from 0.5% for Great Britain (1990) and 0.9% for Sweden (1995) to 2.8% for Italy (1997). Averaging the cost of traffic crashes in the 1990s across 11 high-income countries, gives an average cost equivalent to 1.4% of GDP (2).

The cost of road traffic collisions in South Africa for 2000 was estimated at approximately R13.8 billion (US\$ 2 billion). Assuming that 80% of seriously-injured and 50% of slightly-injured road traffic collision victims would seek care at a state hospital, basic hospital costs alone for the first year of treatment were calculated to cost the government on the order of R321 million (US\$ 46.4 million). Uganda has an annual road traffic fatality rate of 160 deaths per 10 000 vehicles, one of the highest in Africa. Based on average damage costs per vehicle of US\$ 2290, an average fatality cost of US\$ 8600 and average injury costs of US\$ 1933, road traffic collisions cost the Ugandan economy around US\$ 101 million per year, representing 2.3% of the country's GNP. The mean out-of-pocket treatment cost of motor vehicle crashes in urban part of Ghana is estimated to be 127.28 USD which is against the low per capita GNP (approximately 400 USD) of the country. The total number of disability days due to non-fatal motor vehicle injuries in urban part of Ghana was 3,997 and the mean number of disability days was 86.9. In the mid-1990s, the cost of road traffic injuries in Côte d'Ivoire was estimated to be 1% of GNP (2, 8).

Medical costs and lost productivity do not capture the psychosocial losses associated with motor vehicle crashes, either to those injured or to their families. These costs might possibly exceed the productivity losses and medical costs associated with premature death if they were accurately quantifiable. A study conducted in Sweden showed that there was a high rate of psychosocial complications following road traffic crashes, even for minor injuries. Almost half the respondents in the study group still reported travel anxiety two years after the crash. Pain, fear and fatigue were also commonly found. Of those employed, 16% could not return to their regular jobs, while a third reported a reduction in leisure-time activities (2).

2.4.2 Measuring the Health and Life-Related Burden of Motor Vehicle Injuries

The main purpose of measuring the health and life related burden of motor vehicle injuries is to assess any consequences that might have been avoided by road safety measures (12). Assessment of health and life-related burden of motor vehicle injuries can be conducted with methods that are well known in the health valuation literature (2). One way of quantifying the overall societal burden due to non-fatal motor vehicle injuries is the total number of disability days (8).

Hills and Jones-Lee identified six different methods that can be used to estimate costs on motor vehicle injuries. These are the gross output (also called human capital) approach, the net output approach, the life-insurance approach, the court award approach, the implicit public sector valuation approach, and the value of risk change (willingness-to-pay) approach. They indicated that the appropriate method to use in any particular context may depend upon the objectives and priorities set by those who intend to use the costs concerned (13).

The gross output (or human capital) method estimates costs due to a loss of current resources, such as cost of medical treatment and costs resulting from a loss of future output in terms of wages that could be earned in future years if deaths did not occur. This method includes direct and indirect costs to individuals and society as a whole due to the decline in the general health condition of motor vehicle injury victims. The net output approach estimates costs by subtracting the discounted value of the motor vehicle injury victims' future consumption from gross output figures. The life insurance approach estimates costs based on individuals' willingness to insure their own lives. The court award method estimates the costs based on the sums awarded by the courts to the surviving dependants of the victims who got injured or killed as a result of either crime or negligence, and these sums are regarded as indication of the cost that society associates with motor vehicle injuries. The implicit public sector valuation method estimates costs based on values that are unreservedly placed on motor vehicle injury prevention in safety legislation or in public sector decisions taken either in favor of or against investment programs that affect safety. The willingness-to-pay method estimates costs based on the preferences and wishes of the individual citizens (e.g., the amount that people are prepared to pay for an improvement in road safety) (13).

The economic burden of a disease or injury can be measured by cost-of-illness studies that can be used to estimate the maximum amount that could potentially be saved or gained if a disease or injury was to be eradicated. Cost of illness study is the most basic type of economic evaluation. It is a partial form of economic assessment because it looks only at the costs of the programs and provides no information on the health outcome of interest. A cost of illness study can be used when the effectiveness of an intervention is not yet known (14,

15). A cost-of-illness study may be carried out from several different perspectives. These perspectives may measure costs to society, the health care system, third-party payers, businesses, the government, and participants and their families. The societal perspective is the most comprehensive because it includes all direct and indirect costs for all members of the society. Due to the relatively larger range of costs included the societal and health care system perspectives inevitably tend to result in higher cost estimates than the other approaches (16).

The health and life-related burden of a motor vehicle injury should at least include the direct costs as well as indirect costs of illness. Direct costs measure the opportunity cost of resources used for treating a particular injury, whereas indirect costs measure the value of resources lost due to the injury. Direct costs of illness include both direct medical costs and direct non-medical costs (2, 18). Direct medical costs of those injured in crashes include pre-hospital care, hospital and rehabilitation costs (16, 17). Direct non-medical costs include costs of transportation and meals to patients, informal care or care by relatives, etc. Indirect costs are classified into two parts: productivity costs lost due to illness and productivity costs lost due to premature death (16, 18).

There are three types of methods that can be used to determine health care costs. These are micro costing, average costing and activity-based costing methods. In micro costing, a cost is derived from each component of an intervention such as staff time, supplies and medications, out-of-pocket expenditures, and so on. With average costing, there are no details on the cost of any component visit or stay. In this case, every encounter with the same characteristics is assumed to cost the same. Average costing cannot make a distinction on the costs of two patients in the same bed section on the same day or two patients who have a visit characterized by similar procedures. Micro-costing is preferred when an intervention changes patterns of resource use in a manner that is not reflected by the diagnosis related group, the bed section or the type of procedure. Furthermore, micro costing is needed to capture costs borne by the patient, such as out-of-pocket expenditures. It is also one of the basics of a broader method known as activity-based costing (ABC). In activity-based costing, costs are

structured by activity rather than by department or bed section (14).

Micro cost and average cost methods are not mutually exclusive. It is often proper to use mixed methodologies in the same study. Micro cost methods include three approaches: direct measurement, preparation of pseudo-bills and estimation of cost function. When existing sources become insufficient, researchers can collect data through direct measurement. Direct measurement means gathering data through surveys and personal observation. Researchers may use direct measurement alone or along with other methods such as average costing (14).

In direct measurement, inputs such as staff time and supply costs are directly measured to develop a precise cost estimate. There are three common methods of direct measurement. These include time-and-motion studies, activity logs, and surveys of managers and patients. In time-and-motion study, the data collector directly observes the staff members and keeps track of the time spent on each activity throughout the day. Observing staff members may yield very precise results. In activity logs, employees keep daily activity logs for a sample of survey dates. In manager survey, the surveys can collect two types of information: the number of full-time-equivalent employees involved in the intervention, and the number of hours spent on the intervention per day or per week. The time of each type of staff is estimated and its cost determined from office data. The cost of supplies, equipment and other expenditures needs to be determined as well. Programme volume is determined from administrative records and then the average cost will be estimated. When units of service are not homogenous, unit costs may be estimated by an accounting or an econometric approach (14).

Unit costs are total costs divided by output measure. Output measures can be the number of people reached, patients treated etc. Unit costing attempts to estimate the costs needed per intervention. Unit costs are average figures and they are easy to compute. They are accurate for resource need estimation and allocation purposes (19).

Accounting cost refers to the purchase price of a good minus depreciation. It also includes

the cost of financing. Accounting cost includes the direct cost of staff and supplies used as well as a share of overhead costs. The term overhead cost refers to costs of resources that serve many different departments and programs such as general hospital administration, share of capital cost and other running costs. Capital costs include items such as buildings, vehicles and equipment of a useful life of greater than one year. In general, lifetime of equipment ranges from 3 to 10 years; while, buildings depreciate over a 30 year life span. The average life expectancy of a new vehicle is about 8 years. However, some well built vehicles can serve 15 years if properly maintained (14, 20). Financial cost refers to actual expenditure made for a specific health intervention. While, economic cost represents the foregone benefits of using resources in one intervention rather than in their next best alternative use (14, 21). Economic costing attempts to cover all cost elements including the costs of free items. In economic terms free items do not exist since everything has a price (19).

In order to calculate staff compensation costs accurately, separate responses are obtained for each type of employee involved in the service: registered nurses, physicians, lab technicians, and so on. Manager surveys are common because they take less time to conduct. A single manager is able to report on activities of many staff members, and so another advantage of this method is the relatively small number of people who have to be surveyed. The main weakness of manager surveys is a relative lack of accuracy and precision (14).

Direct costs can be estimated using one of three approaches: the top-down approach, the bottom-up approach, or the econometric approach. The top-down approach measures the proportion of a disease that is due to exposure to the disease or risk factor. The approach uses aggregated data along with a population-attributable fraction (PAF) to calculate the attributable costs. While the top-down approach is a valid approach, to avoid the need to calculate PAFs and the potentially more cumbersome methods needed to prevent a bias in the estimate, the bottom up or econometric approach can be used (16).

The bottom-up approach estimates costs by calculating the average cost of treatment of the

illness or injury and multiplying it by the prevalence of the illness or injury. Because the average cost of treatment for an illness or injury is seldom readily available, the bottom-up approach often calculates the average cost of treatment by adding together the various pieces of the treatment. The bottom-up approach often multiplies the unit cost of a particular treatment by the average amount of utilization of the treatment to get an average cost estimate of the treatment. For example, the average cost of an outpatient physician visit is multiplied by the number of visits to get an average cost of outpatient physician care for the particular illness or injury. The method is repeated for each type of care to obtain a total average cost per case, which is then multiplied by the prevalence of the illness to get an estimate of the total direct costs. While, the econometric or incremental approach estimates the difference in costs between a cohort of the population with the disease and a cohort of the population without the disease (16).

Both direct and indirect costs are determined through the human capital approach (also referred as the gross output method) (13, 21). This method is frequently recommended for costing motor vehicle injuries in low-income countries (22). The human capital approach estimates an individual's importance or value to society in terms of his/her production potential. This method measures the lost production, in terms of lost earnings. Productivity losses include the value of lost household services and the value of lost earnings for the victim, caregivers and family due to absence from work (2). For mortality or permanent disability costs, the approach multiplies the earnings lost at each age by the probability of living to that age. The earnings in future years are discounted and often a one percent real annual growth rate in earnings is assumed (16).

In order to determine the lost output the following assumptions are made. For fatal motor vehicle injury cases, the number of "person years lost" is found after the average age of motor vehicle injury fatalities is obtained and this is subtracted from the average life expectancy in the country. In the case of major injuries, estimates are obtained about the average number of days that the injured person spends in hospital plus the number of days he/she spends at home recovering from the injury. For minor injury cases too, estimates are

obtained about the number of days that the person is off work receiving treatment for his/her injury, or recovering from the injury (22).

Though the costs of motor vehicle injuries to society can be estimated in economic terms, valuing the suffering and loss of life associated with motor vehicle injuries is difficult and often debatable. As a result, some studies use the willingness to pay method which measures what people would be willing pay to reduce the risk of injury (2). However, this approach is often difficult to implement in cost-of-illness studies. Extensive surveys of people's preferences are needed, although the results rely heavily on people's responses to very specific imaginary questions about their willingness to avoid injury. People only take into account the cost to themselves, without taking into account the societal benefit. Thus, the willingness to pay method is often not feasible for a cost-of-illness study. The human capital approach has also got its own limitation in that it cannot quantify in monetary terms the costs related to pain, suffering and lost quality of life (16, 23).

A common and often powerful single measure of the burden of injury is the summation of the economic costs associated with the incidence or prevalence of a particular condition (21). Prevalence-based studies measure the costs of an illness in one period, usually a year, regardless of the date of onset in order to estimate annual costs. A prevalence-based approach involves identifying all costs associated with the injury related consequences suffered in a given time frame. The costs are normally calculated for the same period of time used to determine prevalence (16, 23).

The value of life is an economic value assigned to life in general. There are many methods used to estimate the value of life related to motor vehicle injury deaths. Among these, human capital and willingness to pay approaches are mostly used. The human capital approach measures the amount of potential production (money) forgone, because it is assumed that the value to society of an individual's life is measured by his or her future production potential. It is calculated by measuring the value of an individual's earnings using an appropriate discount rate. The willingness to pay approach calculates the average willingness to pay for a change that will affect the loss of life (23). It is the sum of the

amounts individuals are willing to pay to avoid a particular injury or small reductions in the probability of their death (15, 23).

Injury Severity Scoring is a process by which complex and variable patient data is reduced to a single number. This value is intended to accurately represent the patient's degree of critical illness. The Abbreviated Injury Scale (AIS) is an anatomical scoring system. Injuries are ranked on a scale of 1 to 6, with 1 being minor, 5 severe and 6 a non-survivable injury. This represents the 'threat to life' associated with an injury and is not meant to signify a comprehensive measure of severity (24).

The Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned AIS and is allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities (including Pelvis), and External). Only the highest AIS score in each body region is used. The 3 most severely injured body regions have their score squared and added together to produce the ISS score. The ISS score takes values from 0 to 75. If an injury is assigned an AIS of 6 (unsurvivable injury), the ISS score is automatically assigned to 75. The ISS score is virtually the only anatomical scoring system in use and correlates linearly with mortality, morbidity, hospital stay and other measures of severity. Its weaknesses are that any error in AIS scoring increases the ISS error (24).

As multiple injuries within the same body region are only assigned a single score in the ISS, the "New Injury Severity Score" (NISS), has been proposed. This is calculated as the sum of the squares of the top three scores regardless of body region. The NISS has been found to statistically outperform the traditional ISS score (24).

There are different ways of getting information from study participants. Among these are self-administered surveys, phone interview, personal interview and observation. Self-administered surveys are usually used to learn about past injury events. The advantage of personal interviews is that more detailed information can be obtained. The disadvantage is that they entail more training for the interviewers. Another method for collecting

information is through observation. For accurate observations, the selection of appropriate sites is very important because it can have influence on the quality of observation (1).

The Delphi technique is a group process that can be used to survey and collect the opinions of experts on a particular subject. The process involves an interaction between the researcher and a group of identified experts on a specified topic, usually through a series of questionnaires. This technique is useful to get the opinions and judgments of experts and practitioners. Delphi has been used to reach a consensus regarding future trends and projections using a systematic process of information gathering. It is especially useful when (i) it is not possible to convene experts in one meeting because of time or cost constraints; (ii) the problem can benefit from subjective judgments on a collective basis. The Delphi technique was identified as a method for gaining judgments on complex matters where accurate information is not available. Delphi was originally intended as a forecasting technique, designed to predict the likelihood of future events. The Delphi technique is beneficial when other methods are inadequate or inappropriate for data collection (25).

Among the various methods that can be used to estimate motor vehicle injury costs, no single method is without its own limitations (13). The limitation with the human capital approach is that it incorporates a zero value for all persons without a labor income. It also assumes no unemployment. It is also not able to quantify in monetary terms the costs related to pain, suffering and lost quality of life. This limitation of the human capital approach can be overcome by the willingness to pay approach (15, 18). However, the willingness to pay method may be extremely difficult to use in developing countries since it is based on filling or responding to complex questionnaires, which relate to perceived risk and payment by individuals to avoid a given hypothetical level of risk (17, 18). The willingness to pay approach is criticized that individuals may state a value that they are not willing to pay in practice. The human capital approach is favored by researchers over the willingness to pay approach for the latter reason (13).

Micro cost methods can be highly precise but prohibitively expensive to employ. Average cost methods require less effort but yield cost estimates that may not fully reflect how an intervention affects the resources used in providing care to patients. For instance, the use of an average cost per day which is calculated on the basis of the institution's entire case load is almost certainly an overestimate or an underestimate of the actual cost for any specific condition (14, 26).

While hospital based casualty surveys are much easier to undertake, they may not be as representative as household surveys. Private hospitals in developing countries can be assumed to have better cost information; however, they will not be representative of public hospitals where the vast majority of road traffic casualties will be treated (17). In addition, it is difficult to get cost data as hospital owners and staffs are usually non-cooperative. According to a rapid assessment done by the National Task Force of Emergency Medical Services, Tikur Anbess, St Paul and Menelik hospitals provide the majority of services to emergency cases than other public hospitals.

One of the limitations of Delphi's technique is that consensus reached in a Delphi may not be a true consensus; it may be a result of manipulated consensus. Consensus reached by this method does not hold the best judgment. Rather, it is a compromise position. Judgments are those of selected group and may not be truly representative. There is a tendency to eliminate extreme opinions and compel a middle-of -the-road consensus. Additionally, exact and always correct predictions are impossible with this method (25).

Efforts should be made not to compromise the services of selected hospitals to patients. Furthermore, information ought to be collected on all socio-economic groups since the hospitals from which data are to be collected should be selected by probability sampling method (27). Questionnaires are used to get expert opinions from experts/practitioners where expressed responses are not identified as being from specific members of the panel. This method of communication allows for anonymity. Controlled feedback allows interaction with a significant reduction in discord among panel members (25).

3. Objectives

3.1 General Objective: To estimate the health and life related burden of motor vehicle injuries that occurred in Addis Ababa, Ethiopia during the year 2001 EFY.

3.2 Specific Objectives:

- 3.2.1 Describe the number, degree of severity and distribution of traffic police reported motor vehicle injuries in 2001 EFY.
- 3.2.2 Describe hospital treated motor vehicle injuries in terms of demographic characteristics, degree of severity and number of disability days.
- 3.2.3 Describe motor vehicle related fatalities in terms of demographic characteristics.
- 3.2.4 Estimate direct and indirect costs of motor vehicle injuries in Addis Ababa in 2001 EFY.

4. Methodology:

4.1 Study Area and Period: The study was conducted in Addis Ababa, which is the capital city of the Federal Democratic Republic of Ethiopia. It is located almost at the center of the country.

According to the Statistical Report of the 2007 Population and Housing Census, the city had a total population of 2,738,248 of which 1,304,518 are males and 1,433,730 are females. As it can be seen from the above figure, male population in the capital is considerably lower (47.6%) than female population (52.4%). The population of Addis Ababa is growing by 2.1% on annual basis. Between the years 1994-2007, the population size of Addis Ababa has grown from 2,112,737 in 1994 to 2,738,248 in 2007.

There are a total of 44 hospitals in Addis Ababa. Out of these 10 are public hospitals, 32 private hospitals, and the rest two are Armed Forces General Hospital and Police Hospital. Out of the 10 public hospitals in the capital, 6 are general hospitals, while 4 are specialized hospitals. Both Armed Forces and Police Hospitals are also general hospitals. Out of the private hospitals in the metropolis, there are 17 general hospitals and 15 specialized hospitals. Out of the 15 specialized private hospitals, 11 are maternity hospitals.

The study was conducted from February to June 2010 in 6 hospitals of the metropolis selected by multi-stage sampling technique. The hospitals in which the studies were conducted are Tikur Anbessa, Menelik II, Yekatit II, Ras Desta Damtew, Myungung and Tzna hospitals. A pilot study was conducted in the first two weeks of February followed by the actual study which was conducted starting in the last two weeks of February to the first two weeks of June.

4.2. Study Design: The focus of this particular study was on the health and life-related burden of motor vehicle injuries to the health sector and patients. An institution based retrospective descriptive study was conducted to capture costs incurred by the health sector and patients who have sustained motor vehicle injuries. It was a prevalence-based cost of illness study, which involved identifying direct and indirect costs associated with motor vehicle injuries suffered in

the year 2001EFY. The costs estimated from the sample during the study period were extrapolated to estimate the 2001 costs. This study attempted to estimate the mean cost of minor and major motor vehicle injuries and deaths to patients and the health sector. The number of disability days due to non-fatal motor vehicle injuries in Addis Ababa was also estimated. Traffic police data of 2001 EFY were reviewed and served as the study population for this particular survey. Type of injuries sustained was recorded and the data classified as minor injury, major injury and death due to motor vehicle crashes. The study was carried out retrospectively on a cross section of data covering one year, Hamle 2000 to Sene 2001E.C from all six hospitals. Multi-stage cluster sampling technique was used to select the required sample for this particular study.

A total of 6 general hospitals were selected randomly out of all non-specialized hospitals in the metropolis with the exception of Zewditu Hospital. Direct medical costs were measured by reviewing the registers and patient records of the selected hospitals as well as interviewing relevant staff of the selected hospitals. Administrative staff and heads of different departments and head nurses or technicians of the selected hospitals were interviewed. Additionally, the administrative records and reports of Ababa City Council Health Bureau, Bole Sub-city Revenues Office and Federal Ministry of Trade and Industry were also reviewed to estimate direct costs. Both micro cost and average cost methods have been used in this study to determine health care costs. Direct non-medical costs were estimated by conducting Delphi technique. To determine indirect costs the administrative records and reports of Ministry of Finance and Economic Development (MOFED) and Central Statistics Agency as well as the internet were used. Delphi was also conducted to determine the number of disability days and so the indirect costs. The human capital approach was used to determine the indirect costs and life related burden of motor vehicle injuries in the metropolis.

The ages and sexes of motor vehicle injury victims as well as degree of severity of motor vehicle injury data were reviewed and recorded. Both patient and health sector (public and private) expenditure on motor vehicle related injuries were collected and analyzed. The life related costs of motor vehicle injuries were also estimated from the survey. Number of disability days of motor vehicle injury victims of 2001 EFY was also estimated.

The life expectancy of Ethiopians was obtained from the internet. Having derived an estimate of the average number of years lost following deaths from motor vehicle injuries from the above data, the monetary value of those lost years was determined. This was obtained by using the national per capita income. Documents of the Ministry of Finance and Economic Development (MOFED) were reviewed to determine the discount rate being used in the country. The annual per capita income of the country was obtained from the internet. In the case of major injuries, estimates were obtained of the average number of days that the injured people spent in hospital together with the number of days they spent at home recovering from the injury. In the case of a minor injury also, an estimate was obtained of the number of days that the person was off work due to receiving treatment (as an outpatient) for the minor injury. Delphi technique was conducted to determine the number of disability days due to both major and minor injuries.

Therefore, the total lost output was estimated based on the information obtained from the above sources. A one percent annual growth in earnings (income) was also taken into consideration. However, since the cost estimated is the value in future years, it has been discounted to 2001EFY values. An 11% discount rate was used to calculate the lost income due to deaths beyond the given time frame. Costs incurred due to deaths were also estimated beyond the given time frame. Using the appropriate discount rate, the total discounted lost output per person was estimated.

Resource requirements for management of motor vehicle injuries were based on programs of Ghana. The most effective and affordable items of trauma care (essential items) from Ghana have been used in this study as essential items for the management of motor vehicle injuries. Similarity was ensured of the items recommended for Ghana to those actually used in the Ethiopian settings by interviewing health professionals from emergency departments, orthopedics and surgical wards of the selected hospitals. The costs of the inputs used for diagnosis and treatment of these injuries were obtained from market prices.

Taxi drivers were interviewed to obtain the taxi prices for the year 2001 EFY. Costs of ambulance transport and care were obtained from transport and pre-hospital care providers. Documents of Ministry of Trade and Industry were reviewed to obtain the unit price of fuel in

2001 EFY. Expenses of meals and drinks were estimated by interviewing the owners and/or cashiers of cafeterias and restaurants found inside as well as around the hospitals. The Delphi technique was conducted to estimate percentage of motor vehicle injury victims using private car, taxi or ambulance for transport and/or care. Delphi was also used to estimate the percentage of motor vehicle injury victims using the hospital cafeteria or nearby restaurant for meal.

4.3 Study Population: The study or source population was all motor vehicle injury and fatality cases of all age groups reported by Addis Ababa Region Traffic Police Department in 2001E.C (2008/09G.C). The study subjects (sample) in which the study was conducted are all motor vehicle injury cases that were managed in the outpatient/emergency departments and wards of 6 hospitals in Addis Ababa selected by multi-stage cluster sampling technique. Thus, data were collected from patient records and hospital registries of the selected health facilities and the information obtained from these was supplemented by interviewing relevant staff from the same hospitals. An expert panel of general surgeons, orthopedics surgeons, neuro and dental surgeons consisting of 11 members were the other study participants. Guards of the selected hospitals, heads of transport/ambulance service, private ambulance service providers and cashiers or owners of the cafeterias or restaurants in and around the hospitals were used as a panel of practitioners to estimate the non-medical expenses. The internet was also browsed to get additional information.

4.4 Sample Size: The study subjects or sample of this study were motor vehicle injury cases found on the patient records and registries of all selected hospitals for this particular survey. To determine the number of secondary cases included in this particular survey, the single population mean formula was used. The mean cost and standard deviation were derived from a study done in urban part of Ghana. Based on that study the mean cost and standard deviation for motor vehicle crashes were 127.28 and 208.11 USD respectively. The margin of error in this study is taken as $1/4^{\text{th}}$ of the mean treatment cost of motor vehicle injuries in Ghana. Thus, the margin of error, d , is assumed to be 31.82 USD which is equivalent to 322.97 ETB. (1 USD=10.15 Ethiopian birr according to the exchange rate in mid 2001 EFY). Therefore, the required sample size, n , at 95% confidence interval is:

$$n = \frac{Z^2 \alpha/2^2 SD^2}{d^2}$$

$$n = \frac{(1.96)^2 (208.11 * 10.15)^2}{(322.97)^2} + (10\% \text{ non-response rate}).$$

$$n = \frac{(3.84) (2,112.32)^2}{104,309.62} + 10\% \text{ non-response rate}$$

$$n = \frac{3.84 * 4,461,895.78}{104,309.62} + 10\% \text{ non-response rate}$$

$$n = \frac{17,133,679.8}{104,309.62} + 10\% \text{ non-response rate}$$

$$n = 164.3 + 10\% \text{ non-response rate}$$

$$= 165 + 16.5$$

$$= 181.5$$

$$= 182$$

However, since multi-stage cluster sampling technique was used in this research the design effect has been applied in order to make allowance for a loss of variation in the sample. In calculating the required sample size, inclusion of the design effect increases the sample size in proportion to the degree of bias that can be introduced by clustering. Based on experience from other cluster surveys, the WHO recommends using a design effect of 2.

$$n = 182 * 2$$

$$n = 364$$

4.5 Sampling Procedures:

Addis Ababa was selected as the study area purposively for administrative convenience and relatively higher number of motor vehicle injuries as compared to other regions. Six clusters (hospitals) were selected out of 24 general hospitals in Addis Ababa. Adequate sample was obtained from all six hospitals using multi-stage sampling technique. Both first and second stage

units were selected using simple random sampling techniques. In order to select the study hospitals (first stage units) the 24 general hospitals were initially stratified into 3 strata based on the quantity of emergency medical services they provide. Tikur Anbessa, Saint Paul and Menelik II hospitals were included in the first stratum; the rest of the public hospitals were included under the second stratum; and, the private hospitals were included under the third stratum. Two hospitals were selected from each stratum by lottery method.

A total of 7 data collectors were used for data collection. Secondary data were collected from the patient records and registries of all six hospitals. Interviews of relevant staff were also conducted in this study besides review of secondary data. Additionally, relevant hospital staffs from the selected hospitals including orthopedics and general surgeons, radiologists, head nurses, radiographers, druggists or pharmacists and drivers were interviewed.

The panels of experts/practitioners were selected by convenience sampling technique. The Delphi technique was used to gather the opinions and judgments of those experts. Finally, the administrative records and reports of AACCHB, Bole Sub-city Revenue Office, Ministry of Finance and Economic Development and Ministry of Trade and Industry were reviewed.

4.6 Data Collection Procedures:

(A)Patient's record review: patient records were used to collect information on demographic characteristics, type of injuries and fatalities, physicians' requests and orders as well as the average number of hospital stay due to motor vehicle accidents. The administrative records and reports of AACCHB, Bole Sub-city Revenue Office, Ministry of Finance and Economic Development, Ministry of Trade and Industry were reviewed.

(B)Administrative and literature review: Data on health services' capital and recurrent costs from Hamle 2000-June 2001E.C were collected from all six hospitals. The administrative records and reports of AACCHB and Bole Sub-city Revenue Office were reviewed. Printed materials were reviewed to enumerate inputs required for management of motor vehicle injuries. Statisticians were interviewed and the reports/statistics as well as the registries of the selected hospitals were

reviewed to determine the total number of visits and hospitalizations due to motor vehicle injuries.

(C) Interviews: Administrators, heads of department and head nurses of the selected hospitals were interviewed. Data were also collected from relevant staffs of different cost centers: emergency department, inpatient, pharmacy, radiology and operation theatre allocate percentage of inputs for management of motor vehicle injuries as well as to estimate the number of hours spent by medical personnel on motor vehicle injuries. These include general and orthopedic surgeons, radiologists, pharmacists, druggists, radiographers, nurses, lab technicians and drivers.

(D) Self administered questionnaires. Delphi was conducted using self administered questionnaires. The steps that have been pursued to conduct the Delphi technique include:

1. Identify orthopedics surgeons, general surgeons, neuro and dental surgeons and other practitioners whose consensus opinions are sought.

2. Preparation of questionnaire. The questionnaire that was sent to the panels of experts and practitioners included a list of predictions to be made about the number of disability days for different types of injuries sustained due to motor vehicle injuries. Furthermore, opinions were sought on the percentage of motor vehicle injury patients using different modes of transport and restaurants/cafeterias. Once the questionnaires were filled and received, the individual inputs were compiled into basic statements. The preliminary level of group consensus was presented in the form of questionnaire 2.

3. Questionnaire two. The 2nd questionnaire included the basic statements and the consensus of the experts/practitioners. The experts/practitioners were asked to either revise their opinions or discuss their reasons for not coming to consensus with the group.

A pilot study was conducted to test the questionnaire, which was subsequently enriched based on the feedback obtained from the data collectors. Then after the study began, the principal investigator checked for completeness, accuracy, and clarity of the questionnaire on twice per week basis. Data was also entered and cleaned carefully by the principal investigator.

4.7 Data Analysis Procedures:

This study analyzed the issue of health and life related burden of motor vehicle injuries from a societal perspective. The analysis included direct costs and indirect costs due to motor vehicle injuries. Costs incurred by the public health sector, private health sector and patients were analyzed in this study. The total cost of a health intervention is a function of the quantity and type of inputs used; the price of those inputs; and the quality of service. While estimating indirect costs of motor vehicle injuries and value of life, the per capita income of the country was taken into consideration in order to overcome the limitation that arises from overestimation of productivity loss. Once the costs of motor vehicle injuries were estimated on the selected sample, extrapolation was eventually made for all the cases.

The objective of valuing costs is to obtain an estimate of the worth of resources depleted by the programme. This may necessitate adjustments to some evident programme costs (for example, the case of subsidized services). Hospital- based costs of motor vehicle injuries were calculated after enumeration of inputs and assignment of market prices and allocation rules. In other words, resources used to diagnose or treat motor vehicle injuries were identified, prices assigned, and the percent use of that input for motor vehicle injuries estimated. The methodology included apportioning of the costs of inputs such as personnel, vehicles, building, supplies and equipment that are shared among health activities performed in the hospitals.

Due to inadequacy of time and budget for this study, the proportion of total working time spent by medical personnel on management of motor vehicle injuries was assessed by conducting interviews of matrons, experts such as general and orthopedics surgeons and heads of emergency, pharmacy, laboratory and radiology departments. However, to determine the proportion of total working time spent by non-medical personnel on MVIs the number of visits for MVIs was divided by the total number of visits made to the facility in 2001EFY. Percent use of the vehicles of the hospitals for motor vehicle injury related activities was determined in a similar way. While, the percent use of supplies, equipment and building used for motor vehicle

injuries was determined by interviewing matrons, head nurses of emergency departments and operation theatres and heads of pharmacy and radiology units.

The direct medical cost of a health intervention is a product of the quantity of inputs consumed, the percent use for management of motor vehicle injuries and the unit price of the input. Unit prices correspond to the unit of measurement used, such as the price for a full treatment regimen. The productivity cost of disabled persons and victims of premature death is the present value of productivity loss of patients from the time of permanent disability or death until the average age of life expectancy for Addis Ababa or the country. The cost was calculated by finding Ethiopia's average per capita income (at the 2001 value) for each year after death until the age of life expectancy for the country. Yearly per capita income was calculated based on a 1% increase in income from the 2001 value and an 11% discount rate.

The cost categories in this cost analysis include costs of personnel, pharmaceuticals, supplies and over head costs. The term overhead cost refers to costs of resources that serve many different departments and programs such as general hospital administration, share of capital cost and other running costs. Capital costs include items such as buildings, vehicles and equipment of a useful life of greater than one year. The best method used to measure capital costs is annuitizing the initial capital expenditure over the useful life of the item. This was done by calculating the equivalent annual cost of the items. This method incorporates both the depreciation aspect and the opportunity cost aspect of the capital expenditure. The equivalent annual cost was calculated by assuming a useful life of 30 years for buildings, 15 years for vehicles and 10 years for equipment.

Recurrent costs mainly include costs of personnel, supplies, drugs, office material, gasoline, utilities, and maintenance costs. Personnel costs include time spent by specialists, general practitioners, radiographers, etc. Pharmaceutical costs include costs due to drugs, IV fluids, laboratory reagents and other pharmaceuticals used. Supply costs include those due to bandages, gauze, needles, etc used. Costs of equipment include annual value of x-ray machines, surgical equipment, life-support equipment, operating tables, examination equipment, etc. Costs of vehicles include annual value of vehicles used for transporting patients to and from hospital,

particularly for motor vehicle injury victims; and, building costs include annual value of buildings particularly related to the amount of space used to deliver in-patient care and outpatient services.

Calculation of direct cost was done in the following manner:

A. Direct cost to the health sector

I. Fixed capital assets

Annual cost of vehicles= the depreciated cost of vehicles from the original purchase price X percent use for MVIs

Annual cost of equipment = the depreciated cost of equipment from the original purchase price X percent use for MVIs

Annual cost of building = the depreciated cost of building from the original cost of construction X percent use for MVIs

II. Running costs

Personnel costs=Number of personnel X {(Number of hours/week on MVIs/Number of working hours/week)} X Gross monthly salary and benefits X 12

Pharmaceuticals and supplies' costs + other running costs= annual expenditures X (number of visits by motor vehicle injury patients/total number of visits by all patients)

B. Direct cost to patients

I. Direct non-medical cost was estimated by taking the average of the judgments of restaurant/cafeteria owners on the costs of meals and transport incurred by motor vehicle injury victims.

Direct non-medical costs= (Average price of meal and drink/MVI X Number of visits per year for MVI X Percent use of the restaurant by the MVI victims)+ (Average price of transport/MVI X Number of visits per year for MVI X Percent use of the restaurant by the MVI victims)

II. Direct medical cost =cost of expenditures on laboratory examination +radiological and other examinations+ medications+ medical supplies+ consultation, in-patient treatment and procedures

All categories of motor vehicle injury related costs to the health sector were added up and divided by number of visits due to motor vehicle injuries to identify the unit cost of motor vehicle injuries to the health sector. Total direct cost of motor vehicle injuries = (unit cost to the health sector x number of MVI cases in 2001) +B

Unit cost of motor vehicle injuries (MVIs) to health sector = $\frac{\text{Total cost to the health sector}}{\text{Total number of visits due to MVIs}}$

Finally the total cost of motor vehicle injuries was computed for minor, major and fatal injuries.

To determine the indirect costs, estimates were obtained of the average number of days the injured person is off work due to receiving treatment either in hospital or at home recovering from the injury. This figure was multiplied by the per capita income of the country. According to the Ethiopia economic fact sheet of the United States Embassy in Addis Ababa the GDP per capita of Ethiopia in 2008/09 was 404 USD, which is equivalent to 4,100 birr based on the exchange rate in mid 2001 EFY. The average life related burden of MVIs was also computed. To compute the average life related burden of motor vehicle injuries the average age of mortality from motor vehicle injuries (as calculated from the secondary data) was subtracted from the life expectancy in 2001 EFY. This gave an estimate of the average number of years lost from motor vehicle injury deaths. Based on the CIA world fact book, the life expectancy of Ethiopians is 55.41 for the total population (52.92 years for males and 57.97 years for females). To determine the monetary value of those lost years the average years of lost output was multiplied by the per capita income of Addis Ababa or Ethiopia.

Data template was designed based on the questionnaire format. The variables of the quantitative study were pre-coded and then entered using EPI INFO version 3.3. Data cleaning was done in order to check and correct errors related to inconsistency of data as well as arrange data in ascending order. Data were analyzed using both EPI INFO 3.3 and SPSS 16.0 for windows. The number and severity of injuries (minor, major and death) as well as direct and indirect costs of motor vehicle injuries were summarized in tables. The costs were summarized for minor and major injuries as well as death due to motor vehicle injuries. Finally extrapolation was eventually made for the study population.

4.8 Data Quality Management:

A pilot study was conducted to test the questionnaire, which was enriched based on the feedback obtained from the data collectors. While the study was being conducted, the principal investigator was checking for the completeness, accuracy, and clarity of the questionnaire on daily basis. Errors, ambiguities and incompleteness encountered during the study were addressed on twice per week basis. Incorrectly filled or missed ones were immediately corrected during the supervision. Data was entered and cleaned carefully by the principal investigator.

In this study efforts were made to fulfill the following data quality requirements: A unique ID was assigned for each subject/questionnaire; a variable was stored as only one data type, in only one type of measurement and as only those values specified in its definition. The heterogeneity of participants in Delphi was preserved to assure the validity of results. This helped to avoid domination by quantity and strength of personality (“bandwagon effect”).

4.9 Operational Definitions:

Injury is defined as one that leads immediately to death or that is non-fatal but severe enough to warrant hospital treatment.

Motor vehicle related injuries or motor vehicle injuries are injuries due to any crash originating, terminating or involving a motor vehicle partially or fully on a public highway.

Major injury: any motor vehicle injury requiring hospital admission and/or resulting in bone fracture whether or not the patient is admitted. It includes those who are permanently paralyzed or die beyond the 30-day definition of a fatal casualty.

Minor injury: any motor vehicle injury requiring hospital treatment but not requiring admission.

Death: persons who sustained fatal injuries immediately at the site or who died in hospital within 30 days as a result of motor vehicle injury accident.

Disability: any restriction or lack of ability (resulting from an impairment) to perform an activity in the manner or within the range considered normal for a human being. The impairment may be transitory and permanent in nature.

Hospitalization or Hospital admission refers to the fact that motor vehicle injury victims stayed in hospital beds and received treatment for more than 24 hours.

Direct costs: Costs of diagnosing and treating the disease (motor vehicle injuries), which includes direct medical costs as well as direct non-medical costs.

Indirect costs are the costs that are not actually paid and are defined as productivity loss due to motor vehicle injuries.

4.10 Inclusion/Exclusion Criteria:

Inclusion Criteria

1. All motor vehicle accident cases with minor, major and/or fatal injury that occurred within the locality of Addis Ababa.
2. Motor vehicle injury victims of all age groups.
3. Motor vehicle injury victims of both sexes.
4. All motor vehicle injury cases that have been diagnosed or treated within the selected general hospitals in Addis Ababa.

5. All relevant staffs that are directly or indirectly responsible for the diagnosis and treatment of motor vehicle injuries.
6. General and orthopedics surgeons, neuro and dental surgeons as the expert panel.
7. Practitioners including guards, ambulance care providers, heads of transport services and cafeteria/restaurant owners as the panel of practitioners.

Exclusion Criteria

1. Motor vehicle injury cases who sustained injury outside of Addis Ababa.
2. Motor vehicle crash cases that did not result in any form of injuries.
3. Direct medical costs of pre-hospital care especially in public hospitals.
4. All road traffic injuries that did not occur as a result of motor vehicle crashes.

4.11 Ethical Consideration:

The subjects were recognized as collaborators of this particular investigation. Ethical clearance was obtained from the Institutional Review Board of Addis Ababa University, Faculty of Medicine. A formal letter was written to the selected hospitals and the government offices by the School of Public Health and Addis Ababa City Council Health Bureau. Consent was also obtained from the expert panel, practitioners and relevant staff of the selected hospitals. The study participants were assured that personal information will not be disclosed to a third party. In the course of the study, efforts were made not to compromise the services of the hospitals to patients. Data collectors to be assigned in the selected hospitals were recruited from the same hospitals. All motor vehicle injury cases in the selected hospitals were included in the sampling frame thereby ensuring inclusion of cases from all socio-demographic characteristics. The study attempted to maximize benefits to the society since it was conducted from a societal perspective. Using questionnaires to conduct Delphi technique allowed for anonymity. The names of the study participants were not written on the questionnaires.

5. Results

The study was started by reviewing the 2001 reports of Addis Ababa Traffic Police Department. According to the report a total of 1943 persons have sustained road traffic injuries in 2001 EFY. Out of these injuries 1575 (81.1%) occurred due to motor vehicle crashes. In the year 2001EFY, 338 (21.5%) of the motor vehicle crashes resulted in fatalities. While 683 (44.2%) of them sustained major injuries and 554 (35.2%) of these sustained minor injuries. The details of road traffic injuries and motor vehicle injuries that occurred in Addis Ababa in 2001E.C are summarized in tables 1, 2 and 3.

Table 1: Distribution of motor vehicle injuries by injury severity, Addis Ababa, 2001 EFY

Degree of severity	Number	Percentage	Cumulative percentage
Deaths	338	21.5	21
Major injuries	683	43.4	65
Minor injuries	554	35.1	100
Total	1575	100	

Source: Addis Ababa Traffic Police Department, 2001 E.C

Table 2: Distribution of road traffic injuries by age group and injury severity, Addis Ababa, 2001 EFY

Age(years)	Death	Major injury	Minor injury	Total
Below 18	48	144	76	268
18-30	139	342	355	836
31-50	112	222	212	546
Above 50	80	127	86	293
Total	379	835	729	1943

Source: Addis Ababa Traffic Police Department, 2001 E.C

Table 3: Distribution of road traffic injuries by sex and injury severity, Addis Ababa, 2001

Sex	Death	Major injury	Minor injury	Total
Male	299	597	532	1428
Female	80	238	197	515
Total	379	835	729	1943

Source: Addis Ababa Traffic Police Department, 2001 E.C

A total of 329 patient records were reviewed from all selected hospitals out of which 317 were from public and 12 from private hospitals. The hospitals in which the study was conducted are Tikur Anbessa, Menelik II, Yekatit XII, Ras Desta, Myungsung and Tezene hospitals. The non-response rate of this study was 9.6%. Additionally, relevant staff were interviewed from the study hospitals and administrative records reviewed.

5.1 Characteristics of the Study Subjects

The study subjects consisted of 216 (65.9%) males and 113 (34.1%) females. The age range of the study subjects was 4-80 years. Of these, 39 (12.1%) of the victims were under 18 years, 159 (49.2%) were between 18 and 30 years old, 87 (26.9%) were between 31 and 50 years and 38(11.8%) were above 51 years of age. The results show that males are more affected by motor vehicle injuries than females and the most affected age group is that between 18 and 30 years. The report of AARTPD also shows similar finding. According to the findings of this particular study the average age of motor vehicle injury victims was 31.41.

Based on the findings of this particular study, 248 patients (75.4%) had minor injuries, 76 (23.1%) had major injuries and the rest 5 had sustained fatal injuries. Out of the minor injury cases 161 were males and 88 were females. Out of the major injury cases 51 were males and 24 were females. While, out of the fatal injury cases 4 were males and only 1 of them was a female. These findings clearly show that males are more predisposed to severe injuries as well as to fatal injuries.

The mean number of disability days due to motor vehicle injuries based on the findings of the Delphi was 48.93 days. The results showed that the number of disability days has a wide range between 3 and 6993 days. Accordingly, the total number of disability days due to motor vehicle injuries that occurred in Addis Ababa in 2001 EFY was estimated to be 60,526.41 days or 165.83 years. This was calculated by using the survey results from the study hospitals and the report of Addis Ababa Traffic Police Department as a source of data. Descriptive statistics show that the mean number of disability days for minor injuries was 15.4 days with a range of 3 to 109; while for major injuries it was 158.1 days with a wide range of 36 to 6993 days. As a result the total number of disability days due to minor and major motor vehicle injuries that occurred in Addis Ababa in 2001 EFY was estimated to be 8,531.6 days and 107,982.3 days respectively.

5.2 Direct Costs of Motor Vehicle Injuries to Patients

5.2.1 Direct Medical Costs

5.2.1.1 Patients' Expenditure on Laboratory Investigations

Out of the 329 study subjects who were treated at all 6 hospitals only 44 (13.4%) were investigated with laboratory examinations. Of these 44 motor vehicle injury victims, 39 (88.64%) were investigated at 3 public hospitals and 5 (11.36%) at a private hospital. The subjects at 1 public and 1 private hospital have not undergone laboratory examination. The mean cost of laboratory investigation at the hospitals was 18.23 birr with a range of 0 to 43 birr; while the total cost was 802 birr. The mean expenditure of motor vehicle injury victims on laboratory investigations was 17.19 and 18.24 birr for minor and major injuries respectively. On the other hand, the mean expenditure of the victims on laboratory investigations was 12.11 and 33.60 birr at public and private hospitals respectively.

5.2.1.2 Patients' Expenditure on Radiological and Other Examinations

Out of the 329 study subjects who were treated at all six hospitals, 259 (78.8%) had undergone radiological and other examinations such as ECG. Of these 259 motor vehicle injury victims, 248 (95.8%) were investigated at public hospitals and 11 (4.3%) at private hospitals. The mean cost of radiological and other examinations at the hospitals was 80.94 birr with a range of 15 to 2000 birr; while the total cost was 20,963 birr. The mean

expenditure of the motor vehicle injury victims on radiological and other examinations was 42.39 and 196.21 for minor and major injuries respectively. On the other hand, the mean expenditure of the victims on radiological and other examinations is 63.86 and 163.50 birr at public and private hospitals respectively.

5.2.1.3 Patients' Expenditure on Medications

Out of the 329 motor vehicle injury victims who were examined in all six hospitals, 302 (91.8%) were given medications. Of these study subjects, 292 (96.7%) were treated at the public hospitals and 10 (3.3%) at private hospitals. The mean expenditure incurred by those patients who sought treatment at the hospitals was 47.56 birr with a range of 1 to 1398 birr; while the total cost was 14,364 birr. The mean expenditure of the motor vehicle injury victims on medications was 23.82 and 122.82 birr for minor and major injuries respectively. On the other hand, the mean expenditure of the victims on medications was 38.57 and 153.39 birr at public and private hospitals respectively.

5.2.1.4 Patients' Expenditure on Medical Supplies

Out of the 329 motor vehicle injury victims who were examined in all six hospitals, medical supplies were used by 270 (82.1%). Of these study subjects, 261 (79.3%) used the medical supplies at the public hospitals and 9 (3.3%) at private hospitals. The mean expenditure incurred by those patients who sought treatment at the hospitals was 11.91 birr with a range of 1 to 553 birr; while the total cost was 3,215 birr. The mean expenditure of the motor vehicle injury victims on medical supplies was 7.01 and 29.81 birr for minor and major injuries respectively. On the other hand, the mean expenditure of the motor vehicle injury victims on medications was 8.50 and 45.25 birr at public and private hospitals respectively.

5.2.1.5 Patients' Expenditure on Procedures, In-patient Treatment and Consultation

Out of the 329 motor vehicle injury victims who were examined in all six hospitals, either minor or major procedures were done on 213 (64.7%). All patients had consulted either a nurse or a physician. However, only 23 of them were treated as in-patients. The mean expenditure incurred by those patients for procedures, in-patient treatment and consultation at the hospitals was 469.91 birr; while the total cost was 103,380 birr. The mean expenditure of

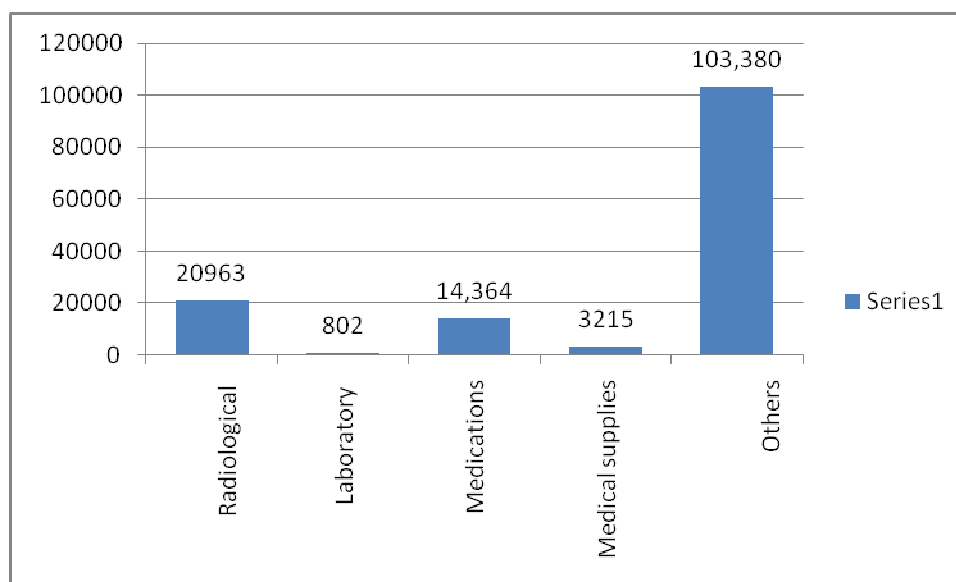
the motor vehicle injury victims on procedures, in-patient treatment and consultation was 299.93 and 1012.34 birr for minor and major injuries respectively. On the other hand, the mean payment made by the victims for procedures, in-patient treatment and consultation was 318.16 and 1,342.61 birr at public and private hospitals respectively.

Table 4: Distribution of patient-side direct medical cost of motor vehicle injuries in six hospitals, Addis Ababa, Ethiopia, 2001 EFY

	Radiological and other examinations	Laboratory investigations	Medications	Medical supplies	Procedures, in- patient treatment consultation	Total
Mean	80.94	18.23	47.56	11.91	469.91	433.97
Std. Deviation	219.826	8.808	108.997	35.774	1404.79	1241.23
Minimum	15	0	1	1	10	10
Maximum	2000	43	1398	553	6350	7386
Sum	20963	802	14,364	3215	103,380	142,724

In summary, 329 motor vehicle injury patients that have been studied. The mean cost of consultation, diagnosis and treatment of motor vehicle injuries was 433.97 birr. An estimated 142, 724 birr have been paid by the study subjects for consultation, diagnosis and treatment. The mean expenditure of the motor vehicle injury victims on procedures, in-patient treatment and consultation was 269.81, 888.59, 1690.87 birr for minor, major and fatal injuries respectively. On the other hand, the mean payment made by motor vehicle injury victims for consultation, diagnosis and treatment was 299.96 and 1,675.96 at public and private hospitals respectively. However, the total direct medical cost incurred by all MVI victims in Addis Ababa was estimated to be 683,502.75 birr. In figure 2, others stands for total costs incurred by study subjects for procedures, in-patient treatment and consultation in relation to motor vehicle injuries.

Figure 1: Distribution of patient-side direct medical cost in birr of motor vehicle injuries in six hospitals, Addis Ababa, Ethiopia, 2001 E.C.



5.2.2 Direct Non-Medical Costs

5.2.2.1 Transport Expenses

Based on the findings of the Delphi, out of all motor vehicle injury patients that visited public hospitals 126 (40.2%) used contract taxi for transport to and away from the hospital; 129 (41%) used private car for transport; 42 (13.3%) used red cross ambulance; 13 (4%) used minibus taxis and buses for transport; while, the rest 5 (1.5) % used other means of transport. The total expenditure spent by the motor vehicle injury victims who visited public hospitals on transport was estimated to be 10,934.05 birr and the mean expenditure on transport was 35.27 birr. However, the expenditure made by patients who visited public hospitals on pre-hospital care is assumed to be 0 birr since pre-hospital care was not provided by ambulances of public hospitals and even Red Cross ambulances.

Out of all motor vehicle injury patients that visited private hospitals, 5 used contract taxi for transport to and away from the hospital; 3 used private cars for transport; while, 2 of

them used hospital and private ambulances for transport and even pre-hospital care. The total expenditure spent by the motor vehicle injury victims who visited private hospitals on transport and pre-hospital care was estimated to be 1123 birr and the mean expenditure was 112.30 birr. The costs of pre-hospital care are included in this case since the selected private hospitals are providing pre-hospital care services.

In summary, the total expenditure made by motor vehicle injury victims who visited all six hospitals on transport and pre-hospital care was estimated to be 12,057 birr and the mean expenditure was 37.21 birr. When this figure is extrapolated to all cases that occurred in Addis Ababa in 2001 EFY, it is estimated to be 58,605.75 birr.

5.2.2.2 Expenditure on Food and Drinks

Based on the findings of the Delphi, out of all motor vehicle injury victims that visited public hospitals 128 (40.7%) used the cafeterias of the hospitals for lunch and refreshment. While, 94 (30%) of them used the nearby restaurants and/or cafeterias for lunch and refreshment. However, the remaining 92 (29.3) % used neither the hospital cafeterias nor the nearby cafeterias/restaurants for lunch. The total expenditure made by the motor vehicle injury patients who visited public hospitals on lunch and refreshments was estimated to be 3,986.78 birr and the mean expenditure was 17.96 birr.

Out of all motor vehicle injury patients that visited private hospitals 5 used the hospital cafeterias for lunch and refreshment. None of the patients used the nearby restaurants for meal or drinks. That means the rest 5 used neither the hospital cafeterias nor the nearby cafeterias/restaurants. The total expenditure made by the motor vehicle injury patients who visited private hospitals on lunch and refreshments was estimated to be 85.65 birr and the mean expenditure was 17.13 birr.

In summary, the total expenditure made by motor vehicle injury victims who visited all six hospitals on lunch and refreshment was estimated to be 4,072.43 birr and the mean expenditure was 12.57 birr. In general, the total non-medical expenditure of the motor vehicle injury patients in the study hospitals was estimated to be 16,129.43 birr and the

mean expenditure was 49.78 birr. Therefore, the total direct non-medical expenditure made by all MVI victims in Addis Ababa was estimated to be 78,403.50.

5.3 Direct Costs of MVIs to the Health Sector

5.3.1 Personnel Costs

An estimated 8,453 patients have been directly or indirectly managed by different categories of health workers and a few supporting staff in all six hospitals. The total personnel costs of motor vehicle injuries in both public and private hospitals was calculated by using the information on the number of health personnel and number of working hours spent on motor vehicle injuries (as determined by interviews) as well as their monthly salaries and benefits.

The total personnel cost of motor vehicle injuries for the 4 public hospitals was estimated to be 40,901, 243 birr. On the other hand, the personnel cost of motor vehicle injuries in the private hospitals was estimated to be 1,808,505 birr. The average gross monthly salary and benefit of the health personnel involved in the management of motor vehicle injuries in all six hospitals was 2,373 birr. The average number of hours spent by the health personnel on management of motor vehicle injuries in all six hospitals was estimated to be 6 hours and 15 minutes. A total of 1623 health personnel been directly or indirectly involved in the management of motor vehicle injuries in the hospitals. In summary, the total personnel cost of motor vehicle injuries in all six hospitals was estimated to be 42,709,748 birr.

5.3.2 Costs of Pharmaceuticals and Supplies

The cost of pharmaceutical and medical supplies of the study hospitals was calculated based on the annual financial reports of the hospitals and the percent use for motor vehicle injuries as determined by interviews. The total expenditure of the public hospitals on pharmaceuticals and medical supplies in relation to the management of motor vehicle injuries was estimated to be 2,333, 702 birr; while the total expenditure of private hospitals was 152,388.60 birr. In summary, the total motor vehicle injury related expenditure of all six hospitals on pharmaceuticals and medical supplies in 2001 EFY was 2,486,090.60 birr.

5.3.3 Overhead Costs

The overhead costs of the hospitals on motor vehicle injuries were calculated based on the annual financial reports and the information obtained from the records of the hospitals as well as interviews of relevant staff. The original cost of construction was used to calculate the capital cost of buildings of private hospitals by taking into consideration a useful life of 30 years. However, the capital cost of buildings was not calculated for public hospitals since all were constructed more than 30 years back. The original purchase price or the market price was used for vehicles and equipment of all six hospitals by taking into consideration useful lives of 20 and 10 years respectively. Even though some of the vehicles and equipment were donated to the hospitals the market prices of the capital assets will be considered to calculate the capital costs of the items in relation to motor vehicle injuries.

The total cost of buildings in relation to motor vehicle injuries for 2001 E.C was calculated by subtracting the depreciated cost of buildings from the original cost of construction of the buildings and then multiplying this value by the percent use of the buildings for motor vehicle injuries as determined by interviews. Thus, the total annual cost of buildings in relation to motor vehicle injuries was calculated to be 3, 789, and 999.80.

The total cost of vehicles and equipment in relation to motor vehicle injuries was determined in the same way as that of buildings. However, the capital cost of all public hospitals was also determined in these cases. To determine the 2001 cost of equipment in all hospitals, those equipment that are used to diagnose and treat motor vehicle injuries have been identified, their prices were assigned based on the original purchase price or market prices or and the percent use of the equipment for motor vehicle injuries were estimated by interviewing relevant hospital staff.

The 2001 cost of vehicles of all 4 public hospitals was added up to be 268, 701.72 birr. On the other hand the cost of private hospitals was 74,431.63 birr. In general, the 2001 capital cost of vehicles of all hospitals included in this survey in relation to motor vehicle injuries was added up to be 343, 133.35 birr. On the other hand, the 2001 cost of equipment, which

includes medical equipment and office equipment, of private hospitals was estimated to be 931,770 birr. The cost of equipment for public hospitals was estimated to be 628,289 birr. In summary, the total cost of equipment to the study hospitals in relation to motor vehicle injuries was estimated to be 1,560,059 birr.

Table 5: Overhead costs of MVIs in six hospitals for 12 months period ending Sene 30, 2001, Addis Ababa, Ethiopia

Item	Cost in birr
Building	3, 789, 999
Vehicles(ambulances, toyota, land cruisers , minibuses, etc)	343, 133
Equipment(medical equipment, office furniture including computers, beds)	1,560,059
General administrative costs(printing, food items, fuel, uniforms, etc)	296,624
Other running costs	760,838
Total	6,744,653

5.8 Indirect Costs of Motor Vehicle Injuries

The productivity loss of motor vehicle injuries has been calculated by using the mean number of disability days and the GDP per capita income of the country. The mean productivity loss of an injured person was estimated to be 548.84 birr. For minor motor vehicle injuries the total productivity loss in Addis Ababa was estimated to be 95,848.43 birr; while, for major motor vehicle injuries it was 1,213,129.37 birr. These figures do not include the productivity loss of fatal motor vehicle injuries.

To determine the value of life or productivity loss of fatal motor vehicle injuries, the mean age of fatal motor vehicle injury cases was taken into consideration. The mean age of fatal motor vehicle injuries was 40.8 years. A 1% annual growth in per capita income and a discount rate of 11% has been used in this study to calculate the value of life. The number of

'person years lost' was obtained by subtracting the average age of fatal injuries (40.8) from the average age of life expectancy (55.41). So, on average there are 14.61 years of lost output following motor vehicle injury deaths. The GDP per capita of the country for the year 2001E.C was 4,100.6 birr. Thus, the total lost output per person is estimated to be 64, 159.14 birr. However, this cost is the value in future years, so it has to be discounted to 2001 E.C values. Using an 11% discount rate, the total discounted lost output is estimated to be 57,101.63 birr per person. Therefore, the total life related burden of motor vehicle injuries in Addis Ababa was estimated to be 19,300,350.94 birr.

The unit cost of motor vehicle injury to the health sector was computed by dividing the total cost of MVIs to the study hospitals by the total number of visits due to MVI. Thus, unit cost of motor vehicle injury to the health sector= $\frac{51,940,491}{8453}$ =6144.63 birr.

8453

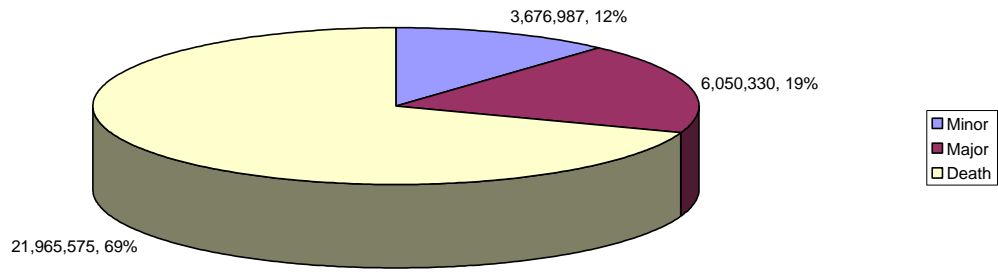
This value was extrapolated to estimate the total cost of motor vehicle injuries to the health sector in Addis Ababa in 2001 EFY. As a result, the total cost of motor vehicle injuries to the health sector is estimated to be $6144.63 \times 1575 = 9,677,792.25$. Therefore, the total health and life-related cost of motor vehicle injuries in Addis Ababa was estimated to be 31,692,892 birr. Table 6 shows a summary of the total costs of motor vehicle injuries in Addis Ababa in 2001 EFY based on cost data from survey conducted in hospitals and distribution of MVI data from police report.

Table 6: Summary of total motor vehicle injury costs, Addis Ababa, Ethiopia, 2001 E.C

Cost in birr	Minor	Major	Death	Total
Direct medical cost to patients	149,474.74	606,906.97	571,514.06	1,327,895.77
Direct non-medical cost to patients	27,578.12	33,999.74	16,825.64	78,403.50
Direct cost to the health sector	3,404,125.02	4,196,782.29	2,076,884.94	9,677,792
Productivity cost of injured person	95,809.87	1,212,641.23	-	1,308,451.1
Productivity cost of death	-	-	19,300,350.94	19,300,350.94
Total	3,676,987	6,050,330	21,965,575	31,692,892

The health and life related burden of minor, major and fatal motor vehicle injuries in Addis Ababa, as shown in figure 1, were estimated to be 3,676,987; 6,050,330; and 21,965,575 birr respectively. These results were obtained by extrapolation of mean costs of minor, major and fatal motor vehicle injuries from hospital survey. The mean costs were multiplied by the respective number of injuries as obtained from Addis Ababa Region Traffic Police Department.

Figure 2: Distribution of MVI costs by injury severity, Addis Ababa, Ethiopia, 2001 EFY



6. Discussion and conclusion

6.1 Discussion

There is no detailed study on the costs of motor vehicle injuries (4). In Ethiopia, research on the health consequences of injuries including motor vehicle injuries have not received due attention. This might be attributed to the lack of information on the magnitude of the problem. Furthermore, it is difficult to measure and forecast disability with certainty (5, 7). Therefore, this study has used methods that can provide estimates of the health and life related burden of motor vehicle injuries in the metropolis.

Based on the 2001 EFY report of AARTPD, males represent almost 73.5% of all casualties due to road traffic injuries. This shows that males are more involved in motor vehicle injuries than females. The productive age groups (31-50 years) are more affected by motor vehicle injuries than the other age groups as shown by almost 70% involvement in the motor vehicle crashes. The findings on severity of motor vehicle injuries in this report indicate that 35.1% had minor injuries; 43.4% had major injuries and 21.5% had fatal injuries. When fatal injuries are further described, 78.9% of them were males and the rest were females. This finding is consistent to the study done in Addis Ababa about 20 years ago which showed that 78.8% of fatal injuries were males (3).

The mean and total number of disability days due to motor vehicle injuries is 48.9 and 60,526.41 days respectively which is very inconsistent to the finding in urban part of Ghana (86.9 and 3,997 days respectively). The discrepancy may be explained by the difference in the techniques used in determining the number of disability days. This study used Delphi technique to estimate the total number of disability days. While, the other study probably used the average length of hospital stay to determine number of disability days due to road traffic injuries (11).

This study showed that the mean cost of consultation, diagnosis and treatment of motor vehicle injuries was 433.97 birr which is inconsistent with the finding in urban part of Ghana (127.28 USD). The per capita GNP for Ghana was about 400 USD as compared to 280 USD in the Ethiopian context during the time of the study. The cost in Ghana is too much for a per capita

GNP of 400 USD. The discrepancy might be explained by differences in treatment costs of motor vehicle injuries between hospitals in Addis Ababa and urban part of Ghana (11). This study further revealed that the mean direct cost of motor vehicle injury in Addis Ababa in 2001 EFY was 7,037.52 birr. It also showed that the mean expenditure of the motor vehicle injury victims on procedures, in-patient treatment and consultation was much higher for major injuries (1012.34) than minor injuries (299.93). This is consistent with the finding in the Lesotho study (15).

The percentage distribution of the costs of minor, major and fatal motor vehicle injuries out of the total cost in Addis Ababa were 12%, 19% and 69% respectively. This is inconsistent to the study done in Lesotho where the percentage distribution was 8, 58.3 and 32.8% respectively. The discrepancy may be due to the difference in methodologies used by the two studies (15).

The mean productivity cost of an injured person in this study was 1057.76 birr which is consistent to the finding of the Lesotho study (128 USD). The productivity cost per injured person in Lesotho was almost 1/4th of the per capita GDP which was 522.78 USD at the time of the study. The total productivity cost of a fatal injury was estimated to be 57,101.62 birr as compared to 11,160 USD of Lesotho. The finding of this particular study was almost 14 times the per capita GDP of Ethiopia. While, the Lesotho result was about 21 times the per capita GDP at the time of the study. The discrepancy could be explained by the difference in the mean age of fatal injury cases which may have arisen due to the small number of fatal injury cases analyzed in this study. Only 5 fatal injury cases were collected and analyzed in this study which could be due to the high number of fatal injury cases being taken to the mortuary of Menelik II hospital rather than to other hospitals. As a result adequate sample of fatal cases could not be obtained in this study in proportion to the traffic police reported data. The mean age of fatal injury in this study was about 41 years; while, it was 28 years in the Lesotho study (15).

The mean cost of motor vehicle injury in this study was 27,117.19 birr which is equivalent to 2,671.64 USD. This is about 7 times per capita GDP of Ethiopia for 2001 EFY. However, this can not be compared to other studies due to differences in methodologies used (15).

The indirect cost estimated in this study accounted for about 65% of the total cost of motor vehicle injuries. The productivity cost of fatal injuries was responsible for 93.7% of the total productivity cost of motor vehicle injuries in Addis Ababa in 2001 EFY. The direct cost in this study accounted for almost 35% of the total cost. The direct cost to the health sector accounted for 87% of the total direct cost.

6.2 Conclusion

This study showed that males are more affected by motor vehicle injuries than females. The proportion of fatal injuries in males is much higher than that of females. The productive age group (31-50 years) is mostly involved in motor vehicle injury. This results in substantial economic loss to the patients themselves. It is possible that the majority are bread winners as is the case in many developing countries. Therefore, the economic burden of motor vehicle injuries to the families of the victims is expected to be high. The involvement of this age group in motor vehicle crashes will also affect the economy of the society at large and the country as a whole since a lot of investment has probably been made on them to develop their capacity.

One of the reasons that motor vehicle injuries bring an immense burden on the economy of the country is that the consequences of injuries especially disability becomes a burden to the families of the victims and the country as a whole. It forces the victims to be partially or completely home-bound due to disability. This imposes substantial burden on the economy of patients, their families and the society at large. Motor vehicle injury imposes substantial work load on health workers and consumes the meager resources of the health sector. Thus, the economic burden of motor vehicle injuries on the health services of the country cannot be underestimated.

The productivity cost of motor vehicle injuries in general and the life related burden in particular has taken the lion' share of the total health and life-related cost of motor vehicle injuries in Addis Ababa. Therefore, policy makers in the health and economic sectors need to give attention to the burden imposed by such injuries on the economy of the country as a whole.

The cost of major motor vehicle injuries is considerably higher than that of minor injuries since more resources are required to diagnose and treat such injuries than the minor ones. More experienced and well trained health professionals are required to treat such injuries as compared to minor injuries. More sophisticated equipment is also needed to diagnose and treat such patients. The enormous health and life related burden caused by motor vehicle injuries in general implies that such injuries are a health problem of economic importance demanding more attention from health planners and policy makers.

6.3 Strengths and limitations of the study

6.3.1 Strengths

- The study was primarily conducted to estimate the costs of motor vehicle injuries from a societal perspective which enabled us to include more cost components.
- The study was designed as prevalence based cost of illness study and conducted to capture costs incurred by motor vehicle injuries during a period of one year.
- Probability sampling technique was used in this study which enabled us to extrapolate the study findings to the study population.

6.3.2 Limitations

- Because of the constraints of budget, supervisors could not be used in this study. Additionally, all the costs of the inputs that contribute to a small fraction of the total costs could not be identified.
- The fact that this study was designed as a retrospective study has forced us to conduct interviews rather than observe health personnel to measure personnel time distribution. This might have introduced recall or personal bias in to the study. Estimating the non-medical cost of motor vehicle injuries was particularly challenging. The socio-demographic characteristics of the study subjects could not be found on patient records with the exception of age and sex. The recently published patients records do not include allow this. Furthermore, expenditures that were not recorded on the patient records could not be captured during the data collection.
- Majority of private health facilities were not cooperative and this has caused a delay in the data collection process.
- Some health facilities have poor recording system and the HMIS of the country is not well developed especially in reporting injuries in general and road traffic injuries in particular.

6.4 Recommendations

- The health sector should collaborate with the lead agency in the prevention of motor vehicle injuries so as to reduce the relatively immense economic burden it causes on health services. However, emphasis needs to be given to the provision of emergency medical services especially pre-hospital care to motor vehicle injury victims. A multi-sectoral road traffic injury prevention and emergency medical services strategic plan needs to be developed and implemented to this end.
- The HMIS of the country needs to give due attention to the reporting of road traffic injuries. A standard road traffic injury reporting form needs to be developed with the participation of all relevant stakeholders of road safety.
- More attention should be given to research on the magnitude and health consequences of road traffic injuries.
- A mechanism to regulate private health facilities needs to be created especially in providing sufficient data on issues that improve the health status of the community.
- A detailed prospective study should be conducted as it provides more reliable cost estimates of motor vehicle injuries in the metropolis.

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Annexes

I. Study information sheet (SIS)

Hello; my name is _____. I am a nurse from _____ organization. I am the principal investigator as well as a data collector in this study that assesses the health and life related burden of motor vehicle injuries. I have obtained permission from Addis Ababa University to conduct this survey on motor vehicle injuries. Injuries are a common cause of death and disability in this country (show letter Addis Ababa University).

Study title: Health and life related burden of motor vehicle injuries in Addis Ababa.

The assessment is done on Health and life related burden of motor vehicle injuries. By injury I mean “any physical damage or wound, caused either unintentionally (by accident) or intentionally (on purpose), such as a cut, bruise, burn, fracture, poisoning or loss of consciousness due to a blow to the head or neck”. One of its causes is a traffic collision. I would like to understand how big the burden of motor vehicle injuries is and how motor vehicle injuries may have affected the society and the health sector. To get this information, I have carried out interviews and record reviews in the hospital. I use self-administered questionnaires to gather the required information especially on the number of disability days due to traumatic injuries. By disability I mean “any restriction or lack of ability (resulting from an impairment) to perform an activity in the manner or within the range considered normal for a human being. The impairment may be transitory and permanent in nature.” The results from this project will be used to help agencies and officials decide on what needs to be done about the problem and assess whether health services that are used to treat injured people are adequate. The study will be conducted from Feb. 1 to May 15, 2010.

The study result has no negative consequences on your personal career; it will rather serve to strengthen road safety efforts in the country. The information you provide me

will be kept strictly confidential. This information will be kept securely and no one outside of this project will find out the answers you are writing on the questionnaires. I will not ask or write down your name so that none of this information can be traced back to you. The results will not be reported as individual cases, but only as overall results for the community. You are free to stop the interview at any point, or to not answer any of the questions that I ask. Your right to participate in the study is purely on voluntary basis. You have the right to withdraw from study any time you like if you feel that it will affect your daily activities. If you have questions or complaints, please call me or send me a message any time you like.

Name of principal investigator-Mussie G/Michael

Address:

Telephone number-+251911842259

E -mail address-mosess2005@yahoo.com

Informed consent

I, a _____surgeon from _____department of _____Hospital, have heard the information in the consent sheet and understood what is required from me, in what way it will affect the study and what will be the benefit if I take part in the study. I also believe in the objective of the study. I have been told that all the information obtained from me will only serve for the study objective and not for any other purpose. I know that I have the right to withdraw any time from the study if it affects my daily activities and future career.

Do I have your permission to proceed/May I continue? Yes / No.

- If the selected participant said: 1. Yes _administer the questionnaire
2. No _ thank him/her for his/her time but do not administer the questionnaire.

Interviewer agreement

I certify that I have received permission from the respected respondent in that he/ she agreed to participate in the study after understanding all the information correctly.

Data collector name _____ sign _____ date _____

Supervisor name _____ sign _____ date _____

II. Questionnaires

Questionnaire 1

1. Identification details			
1.1	Serial no		
1.2	Identification no		
1.3	Name of the hospital		
1.4	Name of data collector		
2. General information and socio-demographic details			
2.1	Date of injury Accident reported to the police Where did the injury occur? Presentation to hospital Was the patient treated elsewhere before he came to this hospital? Is the patient referred to another hospital?	<p>_____</p> <p>Yes____1 No____2</p> <p>Sub-city_____</p> <p>Referral_____1</p> <p>Self appearance_____2</p> <p>If referred, name of hospital_____</p> <p>Yes_____1</p> <p>No_____2</p> <p>If yes, mention medications given and procedures done elsewhere_____</p> <p>Yes_____1</p> <p>No_____2</p> <p>If yes, mention name of hospital_____</p>	
2.2	Sex	Male_____1 Female_____2	
2.3	Age	_____years	
2.4	Address	Sub-city_____	
3.0	Diagnosis		

4.0	Type of injury sustained	Intracranial injury____1	Open wound (laceration)____2	
		Fractured patella, tibia or fibula____3	Fractured femur____4	
		Internal injuries____5	Fractured ulna or radius____6	
		Fractured clavicle, scapula or humerus____7	Fractured facial bones____8	
		Fractured rib or sternum____9	Fractured ankle____10	
		Fractured vertebral column____11	Fractured pelvis____12	
		Sprains____13	Fractured skull____14	
		Fractured foot bones____15	Fractured hand bones____16	
		Spinal cord injury____17	Dislocated shoulder____18	
		Dislocated wrist____19	Dislocated hip____20	
		Dislocated ankle____21	Dislocated elbow____22	
		Dislocated knee____23	Bruise/abrasion____24	

		Eye injury_____25 Others_____26
5.0 Physician's requests and orders		
5.1	Requested radiological examinations. Write result in bracket if it is available	
5.2	Requested laboratory investigations	
5.3	Ordered medications	
5.4	Ordered supplies	
6. Used pharmaceuticals and supplies (include doses of drugs and number of supplies prescribed here)		
6.1	Quantity of medications such as drugs, IV fluids, etc used by the MVI victim in 2001	
6.2	Quantity of supplies such as bandages, needles, etc used by the MVI victim in 2001	
7.0	Procedures/interventions	
8.0	Severity	Minor injury_____1 Major injury_____2 Death_____3

Questionnaire 2

1. Identification details			
1.1	Name of the hospital		
1.2	Respondent's title		
1.3	Name(s) of data collectors		
1.4	Date of interview		
2	Service output for motor vehicle injuries	Average no of visits due to all diseases/day_____ Average no of visits due to MVIs/day_____ Bed occupancy rate_____ Average length of stay_____ Number of prescriptions/day_____ Number of radiological examination requests/day_____	
3. Personnel cost details			
3.1	Number and type of health professionals	Interns_____ GPs_____ Internists_____ Pediatricians_____ Surgeons_____ Orthopedics surgeons_____ Professional nurses_____ Clinical nurses_____ Pharmacists_____ Pharmacy technicians_____ Lab technicians_____ X-ray technicians_____ Radiologists_____ Physiotherapists_____ Others _____ _____ _____ Total no _____	

3.2	Number of working hours of health personnel per week		
3.3	Gross monthly salaries+ benefits of health personnel working in the hospital	Interns: salary _____ benefit _____ GPs: salary _____ benefit _____ Internists: salary _____ benefit _____ Pediatricians: salary _____ benefit _____ Surgeons: salary _____ benefit _____ Orthopedics surgeons: salary _____ benefit _____ General nurses: salary _____ benefit _____ Pharmacists: salary _____ benefit _____ Lab technicians: salary _____ benefit _____ X-ray technicians: salary _____ benefit _____ Radiologists: salary _____ benefit _____ Others: salary _____ benefit _____	
3.4	Number of hours spent by health personnel per week on motor vehicle injuries	Interns _____ GPs _____ Internists _____ Pediatricians _____ Surgeons _____ Orthopedics surgeons _____ Different categories of nurses _____ Pharmacists _____ Lab technicians _____ X-ray technicians _____ Radiologists _____ Others _____	

3.5	List of essential items being used for management of motor vehicle injuries in the hospital(Yes-1, No-2)	Oral or nasal airway_____ Suction device(manual or foot pump)_____ Suction device(electric)_____ Suction tubing_____ Laryngoscope_____ Endotracheal tube _____ Bag-valve mask_____ Magil forceps_____ Stethoscope_____ Oxygen cylinder_____ Needle and syringe_____ Chest tubes_____ Underwater seal bottle_____ Mechanical ventilator_____ Intravenous infusion sets(lines and cannulas) _____ Intraosseous needle_____ Central venous lines_____ Blood pressure(BP) cuff_____ Urinary catheter_____ Nasogastric tube_____ Thermometer_____ Weighing scale for children_____ Drill or other suitable equipment for burr holes_____ Equipment for intermediate thoracotomy_____ Equipment for intermediate laparotomy_____ Equipment for advanced laparotomy _____ Spine board_____	
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	<p>Essential items(continued)</p> <p>Yes-1 No-2</p>	<p>Water proof gowns(macintosh) _____</p> <p>Plastic apron _____</p> <p>Theatre boots _____</p> <p>Torch(flash light) _____</p> <p>Otoscope _____</p> <p>Ophthalmoscope _____</p> <p>Gloves _____</p> <p>Goggles _____</p> <p>Sharps disposal _____</p> <p>Biological waste disposal _____</p> <p>Paediatric-sizes for nasal and oral airways, bag-valve-masks, laryngoscopes and endotracheal tubes _____</p> <p>Paediatric- size equipment for oxygen face masks and for chest tubes _____</p> <p>Paediatric- size IV cannulas, BP cuff, urinary catheters, NG tubes, Intraosseous needle, C-collars _____</p> <p>Others _____</p> <p>_____</p> <p>_____</p> <p>_____</p>	
3.6	<p>List of essential pharmaceuticals for management of MVIs</p>	<p>Crystalloids _____</p> <p>Pressors(for neurogenic/spinal shock) _____</p> <p>Tetanus prophylaxis(toxoid,antiserum) _____</p> <p>Post-exposure prophylaxis for HIV _____</p> <p>Others _____</p> <p>_____</p> <p>_____</p> <p>_____</p>	

3.7	<p>Essential procedures/interventions for management of MVIs</p> <p>Yes-1 No-2</p>	<p>Immobilization(C-collar, backboard) _____</p> <p>Surgical treatment of spinal injury_____</p> <p>Non-surgical management of wounds: clean and dress_____</p> <p>Minor surgical treatment of wounds: clean and suture_____</p> <p>Major surgical debridement and repair_____</p> <p>Physiotherapy/occupational therapy for recovery of extremity injuries_____</p> <p>Full spectrum of physiotherapy_____</p> <p>Full spectrum of occupational therapy_____</p> <p>Prosthetics_____</p> <p>Psychological counseling_____</p> <p>More advanced neurosurgical procedures than burr holes_____</p> <p>Surgical treatment of open depressed skull fractures_____</p> <p>Surgical treatment of closed depressed skull fractures_____</p> <p>Recognize platysmal penetration_____</p> <p>External pressure for bleeding_____</p> <p>Adequate pain control for chest injuries/rib fractures_____</p> <p>Respiratory therapy for chest injuries/rib fractures_____</p> <p>Rib block or intrapleural block_____</p> <p>Epidural analgesia_____</p> <p>Basic immobilization(sling,splint) _____</p> <p>Wrapping of pelvic fractures for haemorrhage control_____</p> <p>Skin traction_____</p> <p>Closed reduction_____</p> <p>Skeletal traction_____</p>	
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		<p>Operative wound management_____</p> <p>External fixation_____</p> <p>Internal fixation_____</p> <p>Tendon repair_____</p> <p>Fasciotomy for compartment syndrome_____</p> <p>Amputation_____</p> <p>Others_____</p> <p>_____</p> <p>_____</p>	
3.8	Essential investigations for diagnosis of MVIs?	<p>Electronic cardiac monitoring_____</p> <p>Pulsoximetry_____</p> <p>Contrast radiography_____</p> <p>Endoscopy_____</p> <p>Diagnostic peritoneal lavage_____</p> <p>Ultrasonography_____</p> <p>X-ray(plain) _____</p> <p>Portable x-ray_____</p> <p>Image intensification_____</p> <p>Central venous pressure monitoring_____</p> <p>Glucose test_____</p> <p>Gm stain _____</p> <p>Bacterial cultures_____</p> <p>Hb/Hct_____</p> <p>Others_____</p> <p>_____</p> <p>_____</p>	

3.9.1	Which of the items listed under 3.5 are used for the management of minor motor vehicle injuries?		
3.9.2	Which of the items listed under 3.5 are used for the management of major motor vehicle injuries?		
3.9.3	Which procedures listed under 3.7 are used for the management of minor motor vehicle injuries?		
3.9.4	Which procedures listed under 3.7 are used for the management of major motor vehicle injuries?		
4. Equipment costs			
4.1	What is the original purchase price of the items listed under 3.5 and 3.8?	Please write the unit prices on the space provided next to the answers to question 3.5 separated by comma.	
4.2	When were the medical equipment listed under 3.5 and 3.8 purchased?		

4.3	Percent use of equipment for MVIs		
5.0	Unit price of drugs, IV fluids and other pharmaceuticals used by a motor vehicle injury victim in 2001		
6.0	Unit price of supplies used by a motor vehicle injury victim in 2001		
7.0	What is the cost of the procedures done to manage MVIs?		
8.1	Cost of laboratory investigations		
8.0	What is the cost of the radiological investigations done to diagnose MVIs?		
9. Vehicle costs			
9.1	Number of vehicles in the hospital used for transporting patients		
9.2	Number of vehicles used for other purposes		
9.3	Percent use of the vehicles for MVIs		
9.4	Original purchase price of the vehicles		

9.5	Number of round trips of hospital vehicles per year		
9.6	Average distance per round trip		
9.7	Unit cost of fuel used by the vehicles in 2001		
10. Equipment costs			
10.1	Number of each type of equipment used for management of MVIs		
10.2	What was the cost of furnishing the hospital?		
10.4	Percent use of each equipment by motor vehicle injuries		
11. Building costs			
11.1	When was the hospital built?		
11.2	Cost of construction of the hospital		
11.3	Percent use of the hospital ED and wards for MVIs		
12. Non-medical expenses			

12.1	Transport expenses	<p>What percentages of motor vehicle injury victims use contract taxi for transport to the hospital?</p> <p>What percentage use contract taxi to and from the hospital?</p> <p>What percentage use private car for transport?</p> <p>What percentage use Red Cross Ambulance for transport?</p> <p>What percentages use the hospital ambulance for transport?</p> <p>What is the cost of transport by a hospital ambulance?</p> <p>What is the cost of pre-hospital care?</p>	
12.2	Meal and drink expenses	<p>What percentages of motor vehicle injury victims use the hospital cafeterias for meal or drinks?</p> <p>What was the cost of lunch in the hospital cafeteria in 2001?</p> <p>What was the cost of soft drink and hot drinks in the hospital cafeteria in 2001?</p> <p>What percentages use the nearby restaurants/cafterias for meal or drinks?</p> <p>What is the average cost of lunch in the nearby restaurant?</p> <p>What is the cost of soft drink or hot drinks in the nearby restaurant or cafeteria?</p>	
13. Dressing(wound care)			
13.1	Pieces of gauze	<p>What is the average number of pieces of gauze used to dress a lacerated (open wound)?</p> <p>What is the average number of pieces of gauze used to dress an abrasion?</p>	
13.2	Frequency of dressing	<p>On average how many times (for how many days) do you dress an open wound?</p> <p>On average how many times (for how many days) do you dress an abrasion?</p>	

Questionnaire 3

Additional information from other ministries or organizations, taxi owners and internet			
1.	Age of life expectancy		
2.	Projected population for 2001		
3.	GDP and GDP per capita of Ethiopia		
4.	Average wage rate/per capita income		
5	Taxi fare for 2001		

Questionnaire 4

Please mention your opinion on the number of disability days due to trauma to the following body parts:

1. A bruise on the head? _____
Soft tissue contusion on the head? _____
Scalp abrasion? _____
Scalp laceration? _____
Hematoma on occipital region? _____
Laceration on the forehead? _____
Soft tissue contusion of the mandible? _____
Compound left mandibular fracture? _____
Mild degree sensori hearing loss? _____
Basal skull fracture? _____
Sub-acute subdural hematoma? _____
Punctate hemorrhage in left temporo-parietal lobes of the brain? _____
Intra- cerebral hemorrhage? _____
Mild head injury? _____
Left lateral maxillary bone fracture? _____
Bilateral skull fracture with mild head injury? _____
Partial skull fracture with intracranial hemorrhage? _____
Cerebral contusion of frontal lobe? _____
Brain concussion? _____
Brain contusion? _____

- Wide open linear skull vault fracture with left fronto-parietal lobe contusion and hemorrhage? _____
- Severe head injury with intracranial hemorrhage (burr hole done)? _____
- Right frontal lobe acute hemorrhage+ depressed skull fracture? _____
- Depressed skull fracture? _____
- Slightly depressed skull fracture and separation of the right lambdoid suture with small area of contusion at the left parieto-occipital lobe of the brain? _____
- Linear skull fracture? _____
- Laceration on the cervical region? _____
2. Peri-orbital hematoma? _____
- Laceration of upper and lower eyelids of the right eye? _____
- Laceration on peri-orbital region? _____
3. An abrasion on the nose? _____
- Laceration on the nose? _____
- Nasal bone fracture? _____
4. Soft tissue injury(laceration) of the right junction of the lips _____
- Laceration over the upper lip? _____
- Bruise over the lower lip? _____
5. Fracture of the 21st tooth? _____
- Mobility of the 11th and 22nd teeth? _____
- Complete loss of the 11th and 21st teeth? _____
- Enamel crack of the 23rd tooth? _____
- Root stamp on the 12th and 13th teeth? _____
- Widening of PDI on the 22nd teeth? _____

- De-rooted tooth? _____
6. Soft tissue contusion of the chest wall? _____
- Bruise on the chest wall? _____
- Laceration on the chest wall? _____
- Seventh rib fracture? _____
- Fracture of the 4th left posterior rib? _____
- Pneumothorax+ rib fracture? _____
- Fracture of the 5th, 6th and 8th ribs? _____
- Multiple rib fracture? _____
- Left sided hemothorax? _____
7. Abrasion on the right flank area? _____
- Bruise on the flank area? _____
- Soft tissue contusion on the abdomen? _____
8. A bruise on the left knee? _____
- Abrasion on both knees? _____
- An abrasion on the left knee? _____
- Laceration on the knee? _____
- Soft tissue contusion of knee? _____
- Left patellar fracture? _____
9. A bruise on the leg? _____
- An abrasion on the leg? _____
- Laceration on the leg? _____
- Soft tissue contusion of the leg? _____

- Compound tibio-fibular fracture of left leg? _____
- Tibio-fibular fracture+ degloving injury of left leg? _____
- Closed tibio-fibular fracture? _____
- Proximal fibular fracture (closed)? _____
- Distal tibial fracture (closed)? _____
10. Laceration on the palmar aspect of the hand? _____
- Laceration on the dorsum of the hand? _____
- Abrasion on left hand? _____
- Degloving injury of right little finger? _____
- Laceration on the right 4th finger? _____
- Left big toe laceration? _____
- Fracture of the right middle finger? _____
- Fracture of the proximal phalangeal bone of the first finger? _____
11. Bruise on the right arm? _____
- An abrasion on the arm? _____
- Laceration on left arm? _____
- Degloved wound on right arm with humeral fracture? _____
- Surgical neck fracture of left humerus? _____
- Comminuted fracture of the middle third of the humerus? _____
12. An abrasion on right thigh? _____
- A bruise on the thigh? _____
- Soft contusion of the thigh? _____
- Laceration on the thigh? _____

- Left thigh hematoma? _____
- Proximal femoral fracture? _____
- Fracture of the middle 3rd of the femur? _____
13. An abrasion on the right forearm? _____
- Bruise on the right forearm? _____
- Laceration on the forearm? _____
- Degloving injury of left forearm? _____
- Left radio-ulnar fracture? _____
14. Laceration on the shoulder area? _____
- Abrasion on the left shoulder area? _____
- Soft tissue contusion of right shoulder area? _____
- Right shoulder joint dislocation? _____
- A bruise on the left clavicle area? _____
- Fracture of the left clavicle? _____
- Soft tissue contusion of the scapular area? _____
15. Soft tissue contusion of the elbow area? _____
- Bruise on the elbow area? _____
- Abrasion on the elbow? _____
- Laceration on elbow area? _____
- Compound intercondylar fracture of elbow? _____
16. An abrasion on the lumbar region? _____
- Bruise over the thoraco-lumbar region? _____
- Soft tissue contusion of the lumbar area? _____

Soft tissue contusion of the lumbo-sacral area? _____

Comminuted fracture of 3rd, 4th lumbar and 1st sacral vertebrae and paraparesis secondary to compressed spinal cord? _____

17. A bruise on the foot? _____

Soft tissue contusion of the foot? _____

An abrasion on the left foot? _____

Fracture of the metatarsal bones? _____

Fracture of the 5th metatarsal bone? _____

Fracture of the calcaneus? _____

18. An abrasion on the ankle area? _____

Spain of the ankle? _____

Soft tissue contusion of the left ankle? _____

Extensive soft tissue injury of right ankle area? _____

Minor laceration on the ankle area ? _____

Fracture dislocation of the right ankle? _____

Bi-malleolar fracture of left ankle+ degloved wound on same area? _____

19. An abrasion on the left groin area? _____

Soft tissue contusion of the groin area ? _____

Bruise in the groin area? _____

Laceration on the groin area? _____

An abrasion on the hip area? _____

Soft tissue contusion of the hip area? _____

Bruise over the hip area? _____

Soft tissue contusion on the gluteal region? _____

Ileo-sacral bone fracture? _____

Multiple fractures of the pelvic bone? _____

Fracture of the superior and inferior ramus of the pubic bone? _____

Bilateral pubic ramus fractures? _____

Fracture of right pelvic bone? _____

Right iliac bone fracture? _____

Fracture of right pelvic bone with extensive soft tissue injury? _____

Bilateral hip dislocation? _____

Hip dislocation? _____

Declaration

I the under signed, declared that this thesis is my original work, has never been presented in this or any other universities, and that all the resources and materials used for the thesis, have been duly acknowledged.

Name: Mussie G/Michael

Signature: _____

Place: Addis Ababa, Ethiopia

Date of submission: _____

This thesis has been submitted for examination with my approval as a university advisor.

Name: Professor Damen H/Mariam

Signature: _____

Date: _____