RESEARCH ON THE DEVELOPMENT OF MALAYSIAN ROAD
TRAFFIC INJURY SURVEILLANCE SYSTEM

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Abstract: Road traffic accident (RTA) is one of the major social and public health problems in Malaysia. In year 2006 alone, the total road traffic crashes in Malaysia were 341,252 cases whereby 35,425 people sustained injuries due to road traffic accidents. This figure is 0.15% of the total population (26.4 million) in Malaysia. In order to analyze the road traffic injuries, a Malaysian Road Traffic Injury Surveillance System was developed. The system is a database program written in Visual Basic 6.0 (VB6) with MySQL 4.0.21-nt as the database management system (DBMS). It is useful to store RTI data, printing hospitalization report, perform simple cross tabulations and data analysis. The system contributes in adopting the Abbreviated Injury Scale 1990 update 1998 injury codes for describing motor-vehicle injuries.

Keywords: road traffic accident, road traffic injury, injury surveillance

1. INTRODUCTION

Malaysia has experienced a remarkable period of economic expansion and growth in population, economy, industrialisation and motorization after gaining independence in 1957. The increase in population and motorisation has led to a consequent increase in the number of road traffic accidents (RTAs) and road traffic injuries (RTIs). Hence, RTA and RTI have become one of the major socio-economic and public health problems in Malaysia. Besides, RTIs are reported to be one of the leading causes of death and disability in Malaysia (How et al., 2003).

In year 2005 alone, the reported total traffic crashes were 328,264 cases with 47,012 casualties. While for the year of 2006, the total traffic crashes were 341,252 cases with 35,425 casualties (Table 1).
Table 1: Total Casualties Caused by RTA in Malaysia, 1990-2006
(Source: Royal Malaysia Police, 2007)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total RTAs</th>
<th>Fatal</th>
<th>Serious</th>
<th>Minor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>87,999</td>
<td>4,048</td>
<td>8,076</td>
<td>17,690</td>
<td>29,814</td>
</tr>
<tr>
<td>1991</td>
<td>96,513</td>
<td>3,514</td>
<td>9,341</td>
<td>17,252</td>
<td>30,107</td>
</tr>
<tr>
<td>1992</td>
<td>118,554</td>
<td>4,557</td>
<td>10,634</td>
<td>21,071</td>
<td>36,262</td>
</tr>
<tr>
<td>1993</td>
<td>135,995</td>
<td>4,666</td>
<td>11,930</td>
<td>25,090</td>
<td>41,686</td>
</tr>
<tr>
<td>1994</td>
<td>148,401</td>
<td>5,159</td>
<td>13,387</td>
<td>29,957</td>
<td>48,503</td>
</tr>
<tr>
<td>1995</td>
<td>162,491</td>
<td>5,712</td>
<td>15,313</td>
<td>31,127</td>
<td>52,152</td>
</tr>
<tr>
<td>1996</td>
<td>189,109</td>
<td>6,304</td>
<td>14,218</td>
<td>32,953</td>
<td>53,475</td>
</tr>
<tr>
<td>1997</td>
<td>215,632</td>
<td>6,302</td>
<td>14,105</td>
<td>36,167</td>
<td>56,574</td>
</tr>
<tr>
<td>1998</td>
<td>211,037</td>
<td>5,740</td>
<td>12,038</td>
<td>37,809</td>
<td>55,587</td>
</tr>
<tr>
<td>1999</td>
<td>223,116</td>
<td>5,791</td>
<td>10,383</td>
<td>36,866</td>
<td>53,060</td>
</tr>
<tr>
<td>2000</td>
<td>250,429</td>
<td>6,035</td>
<td>9,773</td>
<td>34,246</td>
<td>50,054</td>
</tr>
<tr>
<td>2001</td>
<td>265,175</td>
<td>5,849</td>
<td>8,680</td>
<td>35,994</td>
<td>50,473</td>
</tr>
<tr>
<td>2002</td>
<td>279,237</td>
<td>5,887</td>
<td>8,424</td>
<td>35,171</td>
<td>49,482</td>
</tr>
<tr>
<td>2003</td>
<td>298,653</td>
<td>6,286</td>
<td>9,040</td>
<td>37,415</td>
<td>52,741</td>
</tr>
<tr>
<td>2004</td>
<td>326,817</td>
<td>6,223</td>
<td>9,230</td>
<td>38,631</td>
<td>54,084</td>
</tr>
<tr>
<td>2005</td>
<td>328,264</td>
<td>6,200</td>
<td>9,395</td>
<td>37,417</td>
<td>47,012</td>
</tr>
<tr>
<td>2006</td>
<td>341,252</td>
<td>6,287</td>
<td>9,253</td>
<td>19,885</td>
<td>35,425</td>
</tr>
</tbody>
</table>

Besides, accident is ranked third (9.16%) among the top ten principal causes of hospitalisation in the Ministry of Health Hospitals in year 2003. Meanwhile, in the same year itself, accident is also ranked fifth (6.20%) among the top ten principal causes of death in the Ministry of Health Hospitals (Ministry of Health, 2004).

The cost of claims to insurance companies for damage vehicle repair due to RTAs is RM 1,192 million and bodily injury or death is RM 695 million (Table 2) in year 2004. In reality, the actual cost of damage vehicle repair and bodily injury or death are much higher than the reported one as there are many cases of unreported RTAs and RTIs. In 2005 and 2006, RTAs has caused 6,200 and 6,287 deaths respectively, at an estimated social cost of around RM 9 billion (Table 3a and 3b).

Table 2: Cost of Claims to Insurance Companies in Malaysia, 2001-2004
(Source: General Insurance Association of Malaysia, 2006)

<table>
<thead>
<tr>
<th>Year</th>
<th>Damage Vehicle Repair</th>
<th>Bodily Injury/ Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>967</td>
<td>330</td>
</tr>
<tr>
<td>2002</td>
<td>926</td>
<td>425</td>
</tr>
<tr>
<td>2003</td>
<td>914</td>
<td>518</td>
</tr>
<tr>
<td>2004</td>
<td>1,192</td>
<td>695</td>
</tr>
</tbody>
</table>

Due to the upward trend in RTAs and RTIs from 1990 to 2006, a series of safety intervention programmes were proposed. In 1996, the Malaysian Government has established five year national road safety target to reduce RTA deaths by 30% (Radin, 1998) by year 2000. During this period, a series of safety programs which was implemented had resulted in an 11% (Radin, 1998) decrease in number of deaths in spite of increase in vehicle ownership in the same period.
Table 3a: Estimated Social Cost for Road Traffic Accidents in Malaysia, 2005

<table>
<thead>
<tr>
<th>Casualties Type</th>
<th>Numbers</th>
<th>Cost/ Casualty (RM)</th>
<th>Total (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>6,200</td>
<td>1,200,000</td>
<td>7,440,000,000</td>
</tr>
<tr>
<td>Serious</td>
<td>9,359</td>
<td>120,000</td>
<td>1,123,080,000</td>
</tr>
<tr>
<td>Minor</td>
<td>37,417</td>
<td>12,000</td>
<td>449,004,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9,012,084,000</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3b: Estimated Social Cost for Road Traffic Accidents in Malaysia, 2006

<table>
<thead>
<tr>
<th>Casualties Type</th>
<th>Numbers</th>
<th>Cost/ Casualty (RM)</th>
<th>Total (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal</td>
<td>6,287</td>
<td>1,200,000</td>
<td>7,544,400,000</td>
</tr>
<tr>
<td>Serious</td>
<td>9,253</td>
<td>120,000</td>
<td>1,110,360,000</td>
</tr>
<tr>
<td>Minor</td>
<td>19,885</td>
<td>12,000</td>
<td>238,620,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,893,380,000</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Later in year 2001, the Malaysian Government set up another national safety target, to reduce 3 deaths per 10,000 vehicles (Law et al., 2002; Radin, 2003) by year 2010. RTA is usually preventable and predictable; most of the RTA is human-made problem (Baker et al., 1992) amenable to rational analysis and countermeasures. Reduction in RTA will surely led to a reduction in RTI.

2. RESEARCH OBJECTIVES AND RESEARCH METHODOLOGY

2.1 Research Objectives

The objective of the research is to develop a Malaysian Road Traffic Injury Surveillance System and used it to analyse the road traffic injuries in Putrajaya Hospital.

2.2 Research Methodology

Figure 1 shows the flow chart for the development of the Malaysian Road Traffic Injury Surveillance System. There are 6 steps in the development of the system, which include; Preliminary Study, System Development, Data Collection, System Verification, Data Collection and Analysis and System Validation.

Preliminary data identification is carried out based on the literature review, research done by Pang (2000) and Chai (2001) in the Road Safety Research Centre, University Putra Malaysia and system used in Putrajaya Hospital. In this phase, data required to develop the system is identified. Based on the necessity and importance of all data required, forty (40) data point is identified to be used in the development of the Malaysian Road Traffic Injury Surveillance System. A 6-page data collection form is created to be used for preliminary data collection.

The system developed is an electronic injury surveillance system instead of a manual injury surveillance system. The system developed focuses only on road traffic injuries. An electronic injury surveillance system is more suitable than a manual injury surveillance system because computers can handle large amount of data. Although the manual injury surveillance system is a cheap and effective way in data processing (Holder et al., 2001), it is time consuming to carry out manual data processing.

Among all the programming languages and Database Management System (DBMS), Visual Basic 6.0 (VB6) and MySQL is deemed to be most suitable for developing the Malaysian Traffic Injury Surveillance System. Three modules (Data Input Module, Data Output Module
and Data Analysis Module) are identified for the development of the Malaysian Road Traffic Injury Surveillance System.

The developed system was tested with inputting dummy data obtained from Road Safety Research Centre collected by Pang (2000) for his research on ‘Injury Characteristics of Motorcyclists Involved in Motorcycle Crashes in Klang Valley, Malaysia’. After several times of testing, debugging and compiling of the system, it is then used to input real data collected from the Emergency Department of Putrajaya Hospital. During the preliminary data collection period in Putrajaya Hospital, the existing computerised patient administration system and the manual triage system in Putrajaya Hospital was studied as well. The aim of the data collection is as a pilot study to obtain real data to test and verify the system.

System verification is very important in reviewing; inspecting and testing of the system whether the system is conform to specified requirement. Data collected from Putrajaya Hospital is inputted into the system for verifying purposes. Unnecessary and irrelevant data field in the system is removed but others useful data information obtained from pilot study is added into the system. After the system verification and modification, data collection is carried out once again from October 2005 to January 2006 for a period of 4 months. The data collected was used to analyse the RTIs in Putrajaya Hospital and at the same time to validate the system developed. System validation is a confirmation of the systems’ specifications conform to user needs and intended uses, and that all requirements can be consistently fulfilled. It is a necessary stage because system validation ensures the data quality.

3. SYSTEM OVERVIEW, DATA ANALYSIS AND DISCUSSIONS

3.1 Overview of the Malaysian Road Traffic Injury Surveillance System
The Malaysian Road Traffic Injury Surveillance System is designed to store large volumes of
data and to organize the data in a format that simplifies retrieval. This is accomplished with a Database Management System (DBMS), a mechanism for manipulating tabular data with high-level commands. The system developed has the following capabilities;

- Storing patient’s information, hospitalization information, road traffic accident information and injuries information.
- Storing graphical injury information such as x-ray, scanning, photographs, sketching of injuries etc.
- Producing patient’s hospitalization report.
- Performing simple cross-tabulations and data analysis.

The main contribution of the system is that the user can customize road traffic injuries easily using the Abbreviated Injury Scale (AIS) and that the system is able to calculate the Injury Severity Score (ISS) based on the AIS selected. The complete library codes for all types of injuries are stored in the system. Thus, users can customize injuries easily without referring to the code from the book.

The system can be set up easily in three simple steps, whereby the user is required to set up the system, followed by installing MySQL and lastly the database. The system and MySQL can be set up with the minimum computer requirement of a 1 GB hard disk space, 128 MB of RAM and the operating system Microsoft Windows 98 or equivalent and above. The Malaysian Road Traffic Injury Surveillance System is designed in such a way that it is suitable to run in personal computer (standalone) or in a computer network environment. Therefore, the system is suitable for personal and corporate use in collecting the RTI data.

The system is capable of running in a computer-networking environment; therefore, it can support multiple users concurrently. It is using Open Database Connection (ODBC) technique to connect every client computer to server. It is suitable to be installed in health clinics, hospitals, research centre etc. If the system is to be installed in a hospital, the MySQL DBMS just needs to be installed in the server computer while the Malaysian Road Traffic Injury Surveillance System needs to be installed in each client computer. Multiple users can then carry out the data entry at the same time.

The Accident and Emergency (A&E) Department in any hospitals is identified as the most representative location to obtain reliable RTI data. This is because the A&E department usually handles RTI cases that are admitted to wards as well as cases that are treated and then discharged. Therefore, installing the system in the A&E department will be the ideal location to obtain RTI data that can be used for the planning, implementation, and evaluation of health practices.

There are various functions in the Malaysian Road Traffic Injury Surveillance System. Generally, the system enables the users to do data input, data output and data analysis (Figure 2). These functions featured in the injury surveillance system enables the user to carry out tasks rapidly and observe the results within seconds. The error handling functions are incorporated in the system to avoid any run time error.
3.1.1 Data Input

Generally, there are four major sections under data input; these sections are ‘Patient Information’, ‘Hospital Admission’, ‘Accident Information’ and ‘Injury Information’. The ‘Patient Information’ is meant for entering the patient’s personal details such as name, gender, age, ID number, ethnic, nationality and etc. The ‘Patient Information’ details are very important in order to classify patients into different categories when carrying out analysis.

The ‘Hospital Admission’ is mainly for the hospital to record and identify each patient that registers with the hospital. The registration procedure is carried out in all departments of the hospital once the patient seeks treatment at the hospital. Under ‘Hospital Admission’, details such as admission date (date of registration), admission time (time of registration), and general scanning of patients for blood pressure, pulse and etc is mandatory field especially for patients admitted to the accident and emergency department.

The ‘Accident Information’ data is very important in the system. Under ‘Accident Information’, the users need to identify the accident date, accident time, collision type, mode of transport etc related to each patient. The provision of accident report location (State, District, Police Station and Report No.) is meant for the purpose of future data linking with the data collected by the Royal Malaysia Police.

The ‘Injury Description’ section is divided to ‘AIS’, ‘Injury Details’ and ‘Injury Sketch’. The ‘AIS’ section is use to classify all types of injuries according to the coding of the Abbreviated Injury Scale. The ‘Injury Details’ record all the medical notes of the paramedics and the ‘Injury Sketch’ is meant for storing the x-ray, photos, scanning and sketches of injuries of the patient.

The system is designed to avoid data duplication, data over-writing and null data. Therefore, each injury case is assigned a case number when the data is entered to the system. The ‘case number’ will be generated automatically by the system in the database when the data is entered into the system but the case number will not be displayed in any of the system interfaces. Another primary key for the system is the ‘ID number’. The ‘ID number’ is selected as the primary key because the ID number is identical and generic for each and every
person.

The reason for choosing ‘case number’ and ‘ID number’ as the primary key is because of the same person might be involved in RTA more than once and sustained injury. If only the ‘ID number’ was selected as the primary key, the old data in the system will be over-write upon entering of new data to the system. However, if only the ‘case number’ is used as the primary key, it is not effective in handling all data especially during record searching. Data duplication and data over-writing problem will be avoided by using both ‘ID number’ and ‘case number’ as the control for the system.

3.1.2 AIS Classification and ISS in the System
There are many studies and researches that had adopted the AIS injury classification system to classify injuries. However, most of the studies only take into consideration the AIS score and neglect the complete set of the AIS code that classify injuries. There are some studies that use the complete AIS code to classify injuries but the injuries were classified manually. It is time consuming to assign each injury with the 7-digit AIS code manually as the users need to refer to the manual and they might need to go through and understand thousands of codes, before they can do the classification.

The Malaysian Road Traffic Injury Surveillance System is the first injury surveillance system that is fully preloaded with all the complete set of 7-digit numerical injury identifier for classifying the motor-vehicle related injuries. A total of 1,332 AIS code from the AIS 1990 Revision Update 98 is preloaded into the system. The computerized AIS library allows users to classify all the motor vehicle related injuries in a few seconds without referring to the AIS manual.

The AIS code is divided into 4 major combo boxes. The first combo box refers to the ‘AIS Body Region’, the second combo box refers to the type of ‘Anatomic Structure’, the third combo box refers to the ‘Specific Anatomic Structures’ and the last combo box refers to the ‘Level’ of injuries. As the AIS score for each injury is fixed, therefore, by choosing the body region, type of anatomic structure, specific anatomic structure and levels of injuries, the complete 7-digit numerical code will be displayed. Users can select the AIS code easily without referring to the AIS manual. The user is allowed to add at most 10 AIS code for each patient’s injury case and the system can calculate the injury severity score within seconds.

3.1.3 Data Output
Most of the injury surveillance system was designed to collect, analyze and interpret health data (Holder et al., 2001) essential to the planning, implementation and evaluation of health practice. However, most of the surveillance system was not design to perform data output for each individual cases. The Malaysian Road Traffic Injury Surveillance System is designed to display the output as a medical report in four pages. Since the system is designed to be applied in the Accident and Emergency Department, it will benefit the house staff if the system can produce reports (Note: In Malaysia, most of the doctors, paramedics and house staffs are still required to prepare report in hand writing).

3.1.4 Data Analysis
The system can perform simple cross-tabulations and data analysis such as creating summary tables, charts and graphs. The user is able to create conditional cross-tabulations query. The user can filter all data by gender, age, race, collision type, admission date etc. If conditional query is not selected, the cross-tabulations will display results based on all data available in
the database. The system uses logics (i.e. 0 and 1) to handle all conditional queries. The system can handle maximum 10 ‘And’ conditional queries and 10 ‘Or’ conditional queries.

3.2 Data Collection, Analysis and Interpretation

The data collection from October 2005 to January 2006 in Putrajaya Hospital shows a trend that 70% of the road users admitted to the Emergency Department is among 20-34 years old. Nearly 40% of the injured road users are within age range 20-24 years old and most of the injured road users are motorcyclists. The Malays contributed nearly 85% injuries within age range 20-24 years old. Out of this figure, 70% were males. This indicates that Malay male’s rider has a relative high exposure to road traffic injuries compare to other ethnics group in Malaysia.

Motorcyclist account for 62.7% of total injured road users as motorcycle is one of the largest proportion of registered vehicle in Malaysia for year 2005. Among the injured motorcyclist, 92.3% are males while 7.7% are females. The predominant cause of motorcyclist injuries was crash with others vehicle, a total of 67.3% were due to multiple vehicle crash involving other moving vehicles, most of it is rear end road traffic accident; whereas, 32.7% were due to single vehicle collisions with fix object and poor road surface condition such as pothole and oily pavement.

Motorcyclist at the age of 20 contributes the highest statistic to injuries. In late 90s, Malaysia has increased the legal riding age from 16 years old to 17 years old, this measure produced a positive net benefit but the magnitude of the saving was small. However, the analysis from the Malaysian Road Traffic Injury Surveillance System shows that if the proposed legal riding age is set to 21 years old, the measures will produce greater cost benefit. About 90.9% of the motorcyclist not more than 22 years old were holding a full riding license of not more than 5 years. About 20% of the injured motorcyclist not more than 22 years old was riding without a valid license.

About 94.2% of the motorcyclists sustained injuries in the ISS body region of ‘Extremities’. The motorcyclist has higher risk compare to other victim because during accidents, their hand and legs tends to get injured more easily because they are the vulnerable group that are not protected by their vehicle.

3.3 Discussions

Malaysia’s society is heterogeneous with the politically dominant Malays making up the majority, close to 52% of the population, followed by Chinese, Indians and other minorities such as Iban, Kadazan, Dusun, Sikh etc. In Malaysia, the total length of expressway network is around 1,192 km. Motorcycles are the most affordable means of transport; therefore, they involved in a large proportion of road traffic collisions. The data analysis shows the same trend that motorcyclist injuries are the greatest among other victims. The young male’s riders are generally the contributors to the road traffic injuries.

The increasing motorcyclists always have to share traffic space with other larger vehicles, such as cars, buses and trucks. Road design and traffic management are generally poor and fail to provide adequate safety in such a mix of traffic for the motorcyclists. Besides, the motorcyclist riding behavior is also one of the challenges towards reducing the road traffic accidents and road traffic injuries. Most of the time, motorcyclist tends to speed, ride without helmets, or even with helmet, the helmet is not fastened.
Motorcyclists suffer the most severe injuries as a result of the road traffic collisions, report more continuing medical problems and require more assistance, compared with other types of road users (Ooi et al., 2002). Motorcycle crashes are complex, involving a variety of factors that lead to range of post impact trajectories for both the rider and the vehicle.

Motorcyclists require much of the needed intervention compared to other road user. The strategy towards enhancing motorcycle safety includes behaviour modification, injury control, road engineering aspect, vehicle safety aspect and exposure control. Some of the safety interventions taken by the government are proven effective measures in reducing the road traffic accidents and road traffic injuries. These safety interventions are such as fluorescent clothing, reflectorised number plates, fluorescent and light coloured helmets and high visibility painted motorcycles.

Motorcycle speed management, helmet wearing, protective clothing, leg protection, trauma management, after-care program, red light camera, safety audits for motorcycle safety, blackspot treatments for motorcyclist, motorcycle shelter or layby, motorcycle lanes, motorcycle riding exposure, introduction of age limits for riders, encouraging park and ride are some of the areas that the local government shall look into in order to reduce the road traffic accidents and road traffic injuries that involve this group of vulnerable road users.

The Malaysian Road Traffic Injury Surveillance plays an important role in providing real time statistics that will support the countermeasures taken to reduce the road traffic accidents and road traffic injuries that involve motorcyclist in Malaysia. To reduce motorcyclist’s injuries, several types of intervention are likely to be effective. Changes to the road environment is highly beneficial, such as,

- Separating motorcycles from other forms of traffic
- Exclusive motorcycle lanes
- Removing obstacles from roads
- Repairing road surfaces, to remove pot-holes and dangerous curbs

Measures involving changes in personal behaviour include,

- Use of a motorcycle helmet and fasten it
- Safe riding practices
- Respectful behaviour towards others sharing the road

Shifting the mode of transport might be one of the effective interventions that reduce the road traffic accidents and road traffic injuries of motorcyclist. With the promotions of a better public transport services such as bus service, the commuter trains and the light railway transit, it is predicted that most of the motorcyclist will shift to public transport.

Road safety is one of the prime concerns to many individuals, groups and organizations. While different users have different data needs, reliable data and evidence are essential for describing the burden of road traffic injuries, assessing risk factors, developing and evaluating interventions, providing information for policy-makers and decision-makers, and raising awareness. Without reliable information, the priorities for road traffic injury prevention cannot be rationally or satisfactorily determined.

Road traffic injury prevention is a highly politicized issue. Most people have their own
opinions on what could make the roads safer. Anecdotal information and its reporting by the media all too often allow issues to be understood as major road traffic safety problems requiring priority action, which in turn puts pressure on policy-makers to respond. Policy decisions for effective road injury prevention need to be based on data and objective information, not on anecdotal evidence.

First, data on the incidence and types of crashes are needed. After that, a detailed understanding of the circumstances that lead to crashes is required to guide safety policy. Furthermore, knowledge of how injuries are caused and of what type they are is a valuable instrument for identifying interventions and for monitoring the effectiveness of interventions. In our country, systematic efforts to collect road traffic injuries data are not well developed and underreporting of injuries is common.

The health sector has an important responsibility to ensure that the necessary data systems are established and that data on the main injury problems and on the effectiveness of interventions is communicated to a wider audience. Only by systematic and data-led management of the leading road injury problems will significant reductions in exposure to crash risk and in the severity of crashes be achieved.

The modern medicine has two central aims, which is to advance knowledge and promote practices that are based on evidence. This emphasis on evidence reflects the need to continuously review and strengthen the evidence base for public health interventions. This applies not only to communicable diseases but also to non-communicable diseases and injuries, such as road traffic injuries.

In general, the Malaysian Road Traffic Injury Surveillance System does not only function as an injury surveillance system that perform systematic road traffic injuries data collection, analysis and interpretation of health data but it also function as a computerized database system that enables users to store, retrieve, manipulate, analyze and print information.

Since the system’s DBMS is provided by MySQL version 4.0.21-nt standard edition, it can handle large amount of data in an organized, efficient and accurate manner. The system is able to run in individual computer or in a computer network environment. As MySQL can support multiple users at the same time; multiple users can input new injuries data, perform analysis, print report concurrently. Therefore, using it as the database is most suitable and reliable.

The system is suitable to be installed in health clinics, hospitals, research centre and etc. Among all the locations, the Accident and Emergency (A&E) Department of any hospitals is found to be most suitable for installing the system. This is because most of the road traffic accident cases with injuries are referred to the A&E department. The A&E department will treat all the patients whether these patients are later admitted for further diagnosis or discharged. Therefore, the road traffic injuries data collected in the A&E department are expected to be the most comprehensive.

The system is a confidential and secure injury surveillance system, as such, only authorised users are allowed to login to the system, to add, retrieve, edit, delete and print data. Records of individual cases would be kept entirely confidential. System would never expose personal information that embarrasses or threatened people, or that jeopardizes their jobs or their relationships. Therefore, the patient’s personal record shall be safe under control.
The system most significant contribution is in adopting the coding of the Abbreviated Injury Scale to describe the motor vehicles injuries. It is the first system that has a complete AIS library in digital manner. All AIS codes from the *Abbreviated Injury Scale 1990 Revision Update 1998* were loaded into the system. This enables the user to code all motor vehicles injuries in a simpler manner.

Unlike other injury surveillance systems, the system is not only designed to store data but it can also standalone in performing simple cross-tabulations. Most of the time, cross-tabulations of the injury surveillance system requires some other supportive software such as Microsoft Excel, SPSS, Minitab, Epi Info and etc. to carry out the analysis. Since simple cross-tabulations are integrated into the system, users can run any data analysis anytime without the hassle of exporting the data to other supportive software.

No sufficient data was available for a comprehensive data analysis at the moment. However, by having sufficient data in the database, the system can actually provide a more comprehensive data analysis that can represent the population’s epidemic in road traffic injuries. The results of analysis may give an idea to the authorities, town planners, engineers and etc. to identify the high risk population of a particular road traffic injury and therefore to make good decisions on the injury prevention strategies.

The setting up of Malaysian Road Traffic Injury Surveillance System will benefit the society in such a way that:

- There will be a proper computerized system to store all road traffic accidents related injuries data in a systematic manner. The Royal Malaysia Police classifies injuries in a very general manner, i.e. minor, serious or fatal. However, with the system, motor-vehicle related injuries can now be classified according to the AIS injuries code which is to be considered as a comprehensive way in classifying injuries. Using this type of classification, the road traffic injuries can actually be grouped and certain injuries can be identified easily.
- The system can monitor the road traffic injuries severity level in Malaysia.
- The system can identify populations at high risk from particular road traffic injuries.
- The system can provide data that are critical for the government, authorities, town planners, engineers and etc. to make good decisions on road traffic accidents and road traffic injuries prevention strategies.
- The system will be a 'stepping stone’ for Malaysia to establish a national level of injury surveillance system that can monitor all type of injuries in Malaysia.

No matter how effective and efficient a system is established, developed, build or programmed, it will have some shortcomings. The Malaysian Road Traffic Injuries Surveillance System is designed to focus on road traffic injuries; which is only one type of the injuries burden in Malaysia. Although solving problems related to road traffic injuries will solve most of the injuries problem in Malaysia, there is a need to establish a better injury surveillance system that can monitor all types of injuries in Malaysia.

Injuries are viewed as an epidemic nowadays; therefore require a national level of injury surveillance system to monitor it so that proper injury prevention programs can be launch to tackle this problem. Although Malaysia has been putting many efforts in handling road traffic accidents, the country is still in the preliminary stages in handling road traffic injuries. Not much effort has been put into the research and development of road traffic injuries related
issues. With the development of the Malaysian Road Traffic Injury Surveillance System, it is hoped that all the road traffic injuries data can be gathered easily under one centralized system.

Since the system is the pioneer in the injury surveillance system in Malaysia, more expansion work shall be done towards the development of a more comprehensive injury surveillance system in Malaysia. Firstly, the system shall be installed in hospitals as the first step in implementing an injury surveillance system in Malaysia. Installing a system is easy but effort should be put into maintaining the system and encouraging people to use it.

Since the system is to be implemented in the A&E department of a hospital, the house staff should not only be trained to use the system but to understand what injury surveillance is actually about. Adirim et al. (1999) has pointed out in his research that the house staff of a paediatric department will only be concerned about patient care and neglect the data collection for the injury surveillance system. Therefore, training on how injury surveillance works and its importance is very critical in making sure that the house staff participates and supports the system.

Furthermore, the system shall be integrated to the A&E department house staff’s daily work routine so that the data collection for the injury surveillance system will not be an extra burden to them. As mentioned, an injury surveillance system should be flexible in the sense that the system can be modified to suit the situation and environment. Flexibility here means that the system can be easily changed when ongoing evaluation shows that there is a need to do so.

The next step of the expansion work on the system is to link the system to other systems that may be useful in road traffic accidents and road traffic injuries data collection and data output. The system can be linked to other systems such as the RAV-GIS system used by the Royal Malaysia Police. This can benefit the researchers, paramedics and engineers to identify the black spots on the road that cause the road traffic injuries. Besides, the database system may be centralized or synchronized with the government department such as the Ministry of Health (MoH) and Ministry of Transport (MoT).

Meanwhile, the expansion work on data analysis can be carried out with respect to the necessity of the system. Data analysis such as modelling can be integrated into the system so that models on road traffic injuries can be established easily. The system shall be monitored and evaluated from time to time to suits the current needs of the country.

Within some time, a national level of Malaysian Injury Surveillance System can be established if the Malaysian Road Traffic Injury Surveillance System implementation is successful at the local level. However, the results and the successful of the system rely heavily on all the stakeholders such as the government, the authorities and the community. It is hoped that by developing the Malaysian Road Traffic Injury Surveillance System; it will create awareness and draw attention of all levels towards overcoming the burden of road traffic accidents and road traffic injuries in Malaysia.

4. CONCLUSION AND RECOMMENDATION

4.1 Conclusion
In the end of the research, a Malaysian Road Traffic Injury Surveillance System is developed
to provide a data entry module for the purpose of storing, retrieving, editing, deleting and saving the road traffic injuries data. The system has adopted the Abbreviated Injury Scale (AIS) for describing the motor vehicle injuries. It can provide a data output module for the purpose of printing the road traffic injuries data and it is a complete system with simple data analysis that is able to filter data.

If the Malaysian Road Traffic Injury Surveillance System is to be implemented in local or national level, it can be used as a basis to conduct further and more comprehensive researches based on the findings and data stored in the database. The system can serve as an analytical tool to give researches a sense of detection on what kind of in-depth research to conduct as the database would show a pattern or a trend in the road traffic accident and road traffic injuries.

Based on the findings of the researches, corrective and preventive measures can be taken to rectify the accident prone area. There are a few approaches that can be taken to counter these problems; one of it is by means engineering. The accident prone area can go through a treatment to make it less dangerous to road users. Road can be straighten and widen, radius of curve can be increased, crash cushion can be installed, additional signboards can be placed to warn the public of dangers ahead depending on the type of treatment required at that particular location. All these can help to reduce the rate of road traffic accidents and consequently led to reduce of road traffic injuries.

Based on the injuries suffered by road traffic accident’s victims and condition of the vehicle, the car manufacturer can play a role in cushioning the effects of the crash by providing extra safety features in the car like airbags, sturdier car frame, rear seatbelt and so on. Car manufacturers can also come up with better and safer designs for their new line of cars to protect their future customers while taking into consideration the results of the researches conducted. The motorcyclist manufacturer together with the helps of the local governments or relevant authorities can imposes limits, for safety reasons, on the engine size and performance of motorcycles used domestically to maximum outputs, for example 9 kW.

Finally yet importantly is the tremendous weight that the government bears on its shoulder to reduce road traffic accidents and road traffic injuries. As road fatalities costs the government billions of Ringgit each year (RM 9.0 billion for year 2005 and 2006), corrected efforts are being implemented to reduce this enormous annual economic loss. The Malaysian Road Traffic Injury Surveillance System serves as an ideal tool to equip the policy makers with the necessary information to enact laws that will make Malaysia’s roads safer. By evaluating the data stored in the system’s database, the government can focus and target the high-risk road users and propose counter measures to reduce road traffic accidents and road traffic injuries among this group. The government’s role does not stop here. They can also raise awareness as well as educate the public on road safety depending on the kind of knowledge the public is lacking. This can also be done by studying and analyzing data available from the system’s database.

These are just some of the few ways that the system can benefit and contribute to lowering the fatalities, road traffic accidents and road traffic injuries in Malaysia. If the system can be further developed and installed in every hospital, clinic and police station in Malaysia and linked to a central database, a very detail and comprehensive data can be collected. With these updated and large pools of data, the system will become the national database for road traffic accidents and road traffic injuries and the main source of reference for researchers to nationwide.
Since the Malaysian Road Traffic Injury Surveillance System is developed with the aim of collecting road traffic injuries data only, it is hoped that this system can be a ‘stepping stone’ for the establishment of a comprehensive Malaysian Injury Surveillance System. As the whole world has foreseen the problems related to injury, and has classify injury as an epidemic, Malaysia has to work out some solutions to tackle this problem. Injuries, in categories of unintentional or intentional can be prevented. By monitoring injuries using the injury surveillance system, it will help the government and certain authorities to plan for better implementation of injuries prevention strategies in order to reduce the cases of injuries and minimize the risk to the populations in Malaysia.

4.2 Recommendation for Future Development
Therefore, in order to effectively tackle the problem related to road traffic accidents and road traffic injuries, it would be an added advantage if a link is created between the in house GIS-RAV system and the Malaysian Road Traffic Injury Surveillance System. By doing some linking and coding, the factors of injured accident can be easily identified. By having both the accident and injuries data, it can help the authorities, town planners and engineers to plan better development for the country, such as planning and building safer roads, setting up more hospital and trauma rehabilitation centre, designing a safer vehicles and etc.

As road traffic accidents is one of the most serious public health and social problems in Malaysia, Malaysian Road Traffic Injury Surveillance System is developed to monitor the road traffic related injuries only. Since the system is only meant for the road traffic injuries, the system may not be user friendly to all levels of injuries besides the road traffic related injuries. Therefore, more efforts should be put in in-order to develop a more comprehensive national injury surveillance system that can be use in national level to monitor all types of injuries in Malaysia.

REFERENCES


Investigation into Neck Injuries sustained by Malaysian Motorcyclists. Road Safety Research Centre, Selangor.


Ministry of Transport (MoT) Official Site
http://www.mot.gov.my/English/index.htm

Royal Malaysia Police (RMP) Official Site