Admissions and Costs to Acute Hospitals Resulting from Road Traffic Crashes, 2005-2009

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Abstract
Road traffic crashes (RTCs) remain a leading cause of death and injury. The aim of this study was to explore the use of hospital data as a source of RTC-related injury data in Ireland, as current systems are believed to under-estimate the burden. Information on inpatient discharges for years 2005-2009, admitted with RTC-related injuries were extracted from HIPE. There were 14,861 discharges; 9,661 (65.0%) were male, with an average age of 33 years. The median length of stay was two days. The most common diagnosis was head injury (n=4,644; 31.2%). The average inpatient hospital cost was 6,395 per discharge. 1,498 (10.1%) were admitted to intensive care units. This study has identified 3.5 times more serious injuries (14,861) than identified in the Road Safety Authority (RSA) statistics (4,263) indicating that the extent of road injuries is greater than previously estimated. Hospital data could be used annually in conjunction with RSA and other data; ideally the data should be linked.

Introduction
The World Health Organization (WHO) reports that as many as 50 million people are injured in road traffic crashes (RTCs) worldwide each year [1]. The current Road Safety Strategy 2007-2012 states: â that as per international evidence, statistics and facts on serious injuries from road collisions in Ireland are highly unreliableâ 2. Evidence attributes this to under-reporting despite increased efforts in recent years by both An Garda Sˆochˆ¡na and the Road Safety Authority (RSA) to report on serious injury [2]. To date, no other possible sources of data have been developed to provide information on the level of injuries. An examination of data and literature from other countries suggests that other sources of information in addition to that collated by the police should be used to estimate the true numbers injured in RTCs; including cause of death statistics, as well as medical and insurance databases [3-7]. The literature also suggests that in particular, little is known of the inpatient hospital costs associated with RTC-related injuries [8,9].

Given the RSAâ s acknowledgement of possible under-estimation of the number of road injuries in Ireland, this study sought to explore if an alternative source of data provided a more accurate reflection on the burden of RTC-related injuries. In Ireland, no national data are reported on hospital admissions as a result of RTCs; consequently, the aims of this study were: to profile and analyse trends in acute inpatient care in hospitals in Ireland for RTC-related injuries, 2005-2009; to compare these data with the data published by the RSA, 2005-2009; to profile trends in the ratio of hospitalised road users to fatally injured road users, 2005-2009 and, to calculate hospital costs associated with these injuries, 2005-2008.

Methods
The RSAâ s definition of serious injury is an injury for which the person is detained in hospital as an inpatient, or any of the following injuries whether or not detained in hospital: fractures, concussion, internal injuries, crushings, severe cuts and lacerations, or severe general shock requiring medical treatment [2]. For the purpose of this study, only those warranting hospital inpatient admission were studied as there is no national computer information system on those presenting to emergency departments (EDs), general practitioners (GPs) or private hospitals.

Data for this study were extracted from the Hospital In-Patient Enquiry (HIPE) system via Health Atlas Ireland. All discharges from acute hospitals in Ireland for the years 2005-2009, and who had been admitted as an emergency and assigned any diagnosis codes V01-V89 (land transport injuries) using ICD-10-AM were extracted. All non-traffic collisions were excluded, as were unspecified collisions. Only one emergency admission per patient was extracted from the database, where possible. Direct methods of standardisation were used to allow comparison of rates. All rates were calculated using StatsDirect [10]. Total resident population data for 2006 was obtained from the Central Statistics Office of Ireland (CSO) [11] as were national population estimates for the years 2005, 2007, 2008 and 2009 [12].

Costs for these RTC-related discharges were calculated using diagnosis related groups (DRGs) via Health Atlas Ireland for the years 2005-2008 only, as DRGs for 2009 were not finalised at time of analysis. In order to calculate the ratio of hospitalised road users to fatally injured road users, the number of discharges hospitalised for longer than one day with road injuries was compared to the number of fatally injured road users [13]. Data were analysed using JMP statistical package and statistical analysis was carried out using either the Chi-square test or Fishers exact test, where appropriate [14]. Hospital data and RSA data for serious injuries were compared for the years 2005-2009 [15-19].

Figure 1: Age profile of the RTC-related hospital discharges by 5-year age-groups, and gender, 2005-2009

Results
Annual Number of RTC-related Hospital Discharges, 2005-2009
There were 14,861 hospital discharges of persons who had been admitted as an emergency with an RTC-related diagnosis during 2005-2009. The annual number of discharges decreased (7.9%, n=243) from 3,080 in 2005 to 2,837 in 2009. Discharges with RTC-related diagnoses accounted for approximately 0.9% of all emergency inpatient discharges per year.

Profile of the Injured
Two-thirds (65.0%, n=9,661) of hospital discharges were male. The mean age of those injured was 33.1 years (Standard Deviation (SD) 20.1 years). Figure 1 details the ages of the hospital discharges by 5-year age-group, and by gender, with almost half (43.3%, n=6,430) aged less than 25 years.

Figure 2: Month and year of hospital admission with RTC-related injury, 2005-2009

*Data for December 2009 is incomplete, as all admissions in December 2009 may not have been discharged by 31st December

Figure 3: Age standardised discharge rate per 100,000 population for RTC-related injuries, all users and by road user group (excluding fatal injuries), 2005-2009

Hospital Admission
Figure 2 details the number of hospital admissions per month, with more RTC-related hospital admissions during the summer months. The seasonal variation in admissions is clear from this graph, as are the decreasing number of admissions over time. Saturdays and Sundays were the most common (32.8%, n=4,875) days for RTC-related admissions. The median length of hospital stay was two days. The total number of bed days used was 87,750 days, which equates to 48.1 beds occupied in Irish hospitals per day, on average. Overall, 10.1% (n=1,498) of discharges required admission to an Intensive Care Unit (ICU). The median length of ICU stay was three days. The most common principal diagnoses recorded were head injuries (31.2%, n=4,644). Two-thirds (65.1%, n=9,672) of those injured had a procedure recorded, with procedures on the musculoskeletal system (39.6%, n=3,827) most common. Almost 90% (87.4%; n=12,987) were discharged home directly from hospital, while 10.8% (n=1,601) were transferred to other hospitals or facilities, and 211 (1.4%) died in hospital.

Inpatient Hospital Costs
Inpatient hospital costs were calculated using DRGs in HIPE via Health Atlas Ireland. During 2005-2008, hospital inpatient costs for RTC-related injuries increased by 12.2% from 18.1 million in 2005 to 20.3 million in 2008. The average inpatient hospital cost for any RTC-related injury was 6,395.

Trends 2005-2009
The age-standardised discharge rate for Irish residents with RTC-related injuries (excluding fatal injuries) decreased significantly from 69.1 per 100,000 population in 2005 to 61.5 per 100,000 population in 2009, ($p<0.01$). There was a downward trend in the rates of discharge among car occupants, pedestrians and occupants of vans/trucks/pick-ups/other vehicles during the years 2005-2009. The ratio of the number of hospitalised road users for greater than one day to the number of fatally injured road users increased from 4.6 in 2005 to 7.0 in 2009.

Comparison of Data
Table 1 details the number of serious injuries reported by the RSA for 2005-2009, as well as the number of RTC-related inpatient discharges for the same period, as per HIPE data. Comparing these two data sources, the difference in numbers between the two sources is more than three-fold (3.5).

Discussion

It is important to have data which accurately estimates the number of people who suffer serious injuries resulting from collisions on Irish roads. Without these data it will be difficult to fully evaluate the effectiveness of measures aimed at reducing such injuries. The Road Safety Strategy for 2007-2012 stated that it was not possible to set a benchmark for a reduction in serious injuries as there were doubts about the reliability of the reported figures [2]. This study has confirmed that those doubts were in fact true, and has identified an under-reporting of serious injuries following RTCs by a factor of more than three (3.5). The under-estimation is even greater as this report does not include data from EDs, GPs or private hospitals, as these data are not available nationally on a computerised database.

This finding is not surprising given that other countries have reported similar under-estimation in the numbers injured in RTCs. Research has shown that multiple data sources provide a more accurate picture of the true extent of road injuries and therefore allows policy-makers to make appropriate decisions [3]. Reliance on one set of data may give a misleading impression of an improving situation without another source of data to augment or validate it. Ideally information systems should be linked to get the best information, with personal identification codes for linking, if possible [20]. The Western Australian Road Injury Database is an example of such a system. It uses on-going linkage of crash details from police reports with the details of injuries in hospital and death records [6]. RSA data is exclusively based on An Garda Sˆ›ochˆ¡na reports using the CT68 form. This form is completed by Gardaˆ›, often at the scene of the crash, and always within three days of the crash. However, not all injuries or crashes are reported to the Gardaˆ›.

The trend over the five year period of 2005-2009 shows a statistically significant reduction in the number (7.9%, n=243) of road injuries treated in hospital. The dramatic reduction in numbers from 2005 to 2006 may have been contributed to by the introduction of mandatory breath testing in July 2006. While the numbers injured may have decreased, the ratio of the number of hospitalisations to the number fatally injured has increased; this is because the numbers injured have not decreased as dramatically over time as the numbers fatally injured. The Irish ratio (7.0 hospitalisations per fatality) compares favourably to a number of OECD member countries with a low of three hospitalisations per fatality reported by Portugal and a high of 21 hospitalisations reported by the Czech Republic [20].

Hospital inpatient costs increased during 2005-2008 although the numbers of RTC-related hospitalisations decreased; this is probably a reflection of medical inflation. The average cost of hospital inpatient care for any RTC-related injury for the years 2005-2008 was 6,395 per discharge. These costs do not include care in the EDs, in outpatient departments, or day case admissions, but they do include the costs of any pre-existing conditions the person may have had on admission; therefore, the current information systems may not allow for an accurate estimation of costs. However, hospital costs are not the only costs resulting from RTCs. Other costs include costs to the police, fire services, loss of income to the injured persons and loss of productivity at an employment level. In 2004, Goodbody Consultants estimated the total economic cost to society of a serious injury crash at 304,600 [21]. The data presented in this report highlights the major under-reporting of serious injury crashes using An Garda Sˆ›ochˆ¡na data only. Therefore, the total cost of RTC-related injuries to the economy must also be under-estimated, if based on the routinely reported data. Based on the number of hospitalisations reported in this paper and using the Goodbody Consultants data, the total economic cost to society of these RTCs would have been 4.5 billion for five years, or an average of 0.9 billion per annum. This highlights the potential to save not just injuries and lives, but also substantial costs to the economy by implementing evidence-based road safety initiatives.

This is the first national report on RTC-related injuries requiring hospitalisation in Ireland. The data are available from the Economic & Social Research Institute (ESRI) via HIPE and should be reported on as a routine each year in conjunction with An Garda Sˆ›ochˆ¡na and other data to provide realistic and timely injury trends. Ideally, the data should be linked as in other countries; however, the lack of a unique identification system and data protection issues remain as obstacles to the linking of these data [22].

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