Introduction

The Trauma Surgery Unit was established as a subspecialty under the Department of Surgery, Hospital Sultanah Aminah, in March 2011. The unit is staffed by a Consultant Trauma Surgeon, a Fellow Trauma Surgeon, a Trauma Coordinator, a registrar/medical officer and a house officer on a rotational basis. Besides clinical aspects of patient care, the unit is also heavily involved in other aspects of trauma care, such as, in-hospital systems development, training and education of Specialist Fellows, doctors and nurses, as well as registry data collection, processing and audits. The trauma registry started data acquisition in May 2011. This is the second report of the registry, for the period of May 2012 ending April 2013

Data Capture and entry

Data from the following were captured for entry into the registry:

- All adult trauma patients admitted to the Department of Surgery, Hospital Sultanah Aminah, whether directly or referred from other hospitals.
- All other adult trauma patients referred to the Trauma Surgery Service of the Department of Surgery, from other Departments/ Services within Hospital Sultanah Aminah.

Data is entered by a dedicated staff member. It is kept and processed with a statistic programme configured to the needs of the registry.

Definitions

This registry *EXCLUDES*:

a. Injury resulting from pathological conditions (i.e pathological fractures resulting from malignancy) and injury resulting from degenerative changes or medical illnesses.

b. Hanging, drowning, burns and envenomation.

c. Very late presentations or transfers or referrals from other hospitals for conditions not as a direct result of the initial trauma insult where definitive treatment had been accomplished in the hospital of origin (i.e bowel obstruction following a laparotomy performed for trauma) or sequelae of complications occurring temporally distant from the index injury.

d. Isolated head and/or isolated skeletal fractures.

“Major Trauma”

The only globally accepted definition of “Major Trauma” are injuries with an ISS of more than 15. Subsequent additional criteria vary by institutions and regions. The criteria used for “major trauma” for Hospital Sultanah Aminah is as below:

- All adult trauma patients with an Injury Severity Score of more than 15 and/or,
- All adult trauma patients in the care of the Trauma Surgery Service requiring admission to the Intensive Care Unit (does not include Neurosurgical HDU).
- Trauma patients who die in the Emergency Department having been brought in with signs of life.
- All hemodynamically unstable pelvic fractures requiring surgical/radiological hemostatic intervention.

Injury Severity Score (ISS) and New Injury Severity Score (NISS)

ISS is an anatomical score used to quantitatively assign the severity of multiple injury. Each injury is assigned an Abbreviated Injury Score (AIS) and only the highest AIS within a certain body region included in the final calculation. There are five body region divisions and the top 3 scoring injuries are identified. Each of these 3 AIS scores are squared and the sum total constitutes the ISS (Baker et. al., 1974)[2]. In this report, where “ISS” is stated, it was calculated with the **NISS principle** (Osler, 1997)[3].

Abbreviated Injury Score (AIS)

The AIS is a score weighted on the severity of injury to a given anatomic organ. It is graded 1 to 6 in ascending severity, 6 being unsurvivable. The AIS for solid organs are coded according to AAST (American Association for the Surgery for Trauma) guidelines, 1990. All other AIS scores are clinician subjective. For this registry, the AIS scores were decided and assigned to an injury by cross referencing at least two or preferentially three sources of information, which are, radiological data (X-rays and scans), operative notes and communication with the operating team surgeon/s.

Revised Trauma Score (RTS)

The Revised Trauma Score is a physiologic severity score that can be a useful triage tool and is an accurate predictor for the probability for survival. This score assigns coded values for 3 parameters, namely the first recordings of the Glasgow Coma Scale, systolic blood pressure and respiratory rate as below;

Glasgow Coma Scale (GCS)	Systolic Blood Pressure (SBP)	Respiratory Rate (RR)	Coded Value
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

RTS = 0.9368 GCS + 0.7326 SBP + 0.2908 RR

Values range from 0.00 to 7.84. The higher the RTS value, a higher probability for survival is expected. The values used for calculation are that obtained from the first recorded values in the emergency department.

TRISS

TRISS, combines both ISS and RTS to give a probability of survival (Ps) for a given patient. It is derived from the formula as shown below:

$$Ps = 1/(1+e^{-b})$$

Where b = b0 + b1(RTS) + b2(ISS) + b3(Age Index)

The coefficient b to b3 are derived from multiple regression analysis from data obtained from the Major Trauma Outcome Study (MTOS), these coefficients are different for blunt and penetrating injuries. Age Index is 0 if the age is below 55 years and 1 if 55 years or more. If the patient is below 15 years old, blunt coefficients are used regardless of mechanism.

	Blunt	Penetrating
b0	-0.4499	-2.5355
b1	0.8085	0.9934
b2	-0.0835	-0.0651
b3	-1.7430	-1.1360

The Functional Independence Measure Score (FIMS)

The FIM score is a functional outcome score that measures the patient in four areas, which are self care, mobility, communication and social cognition. Each of these areas are subdivided into smaller subdivisions and are given 7 score levels, which will subsequently

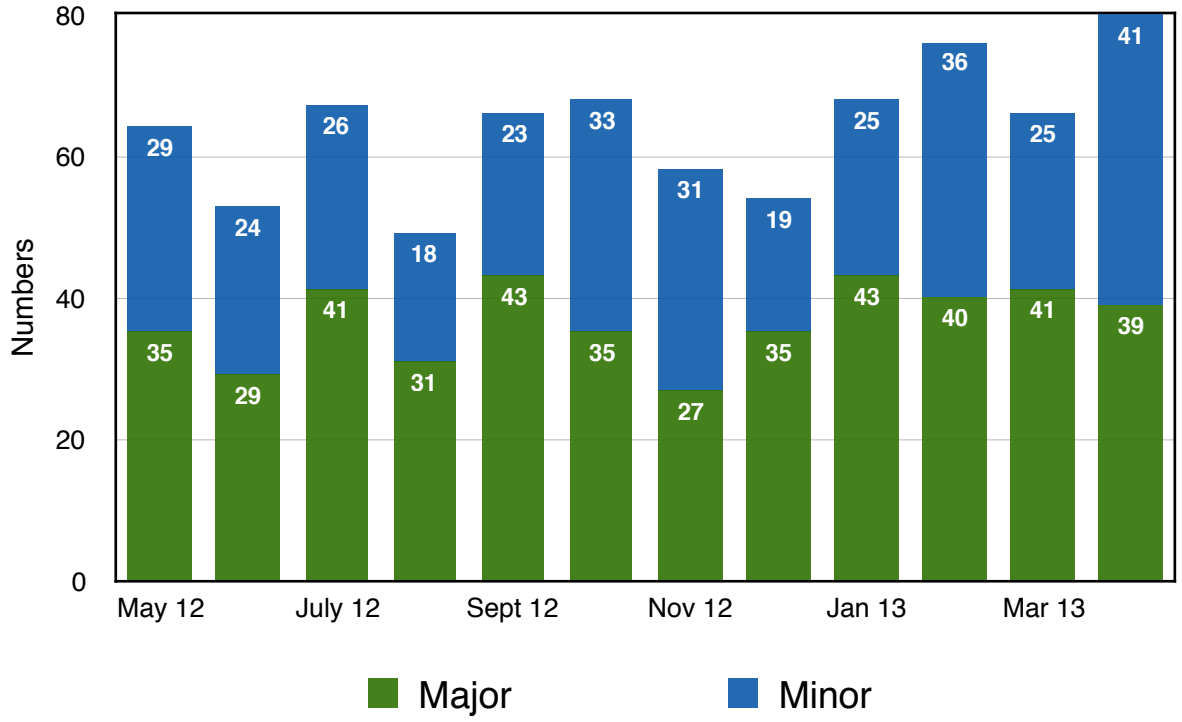
be totalled for each area. Patients are scored by nursing staff just before hospital discharge.

HSAJB Trauma Registry Report 2012-2013

Part 1 General Data

Admissions 2012-2013

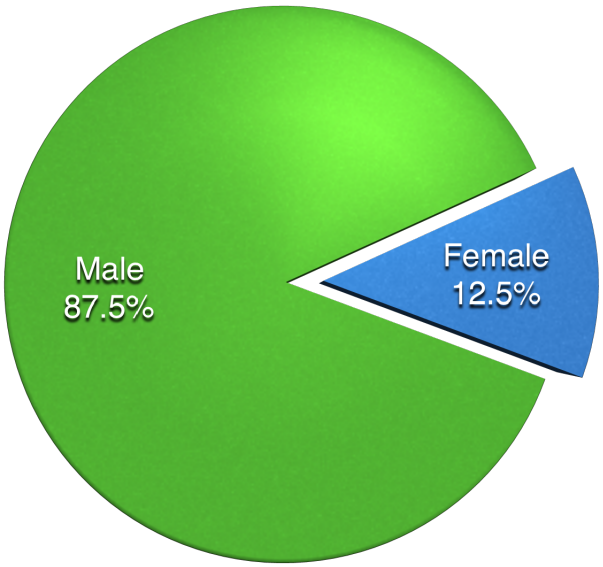
Figure 1 : Admissions 2012-2013



There were a total of 769 admissions compared with only 687 admissions during the 2011-2012 period. This represents a 11.9% increase in number of admissions. There were an average of 64 admissions per month and major trauma comprised 57.7% of total admissions compared to 57.25% in the preceding year.

Gender Distribution

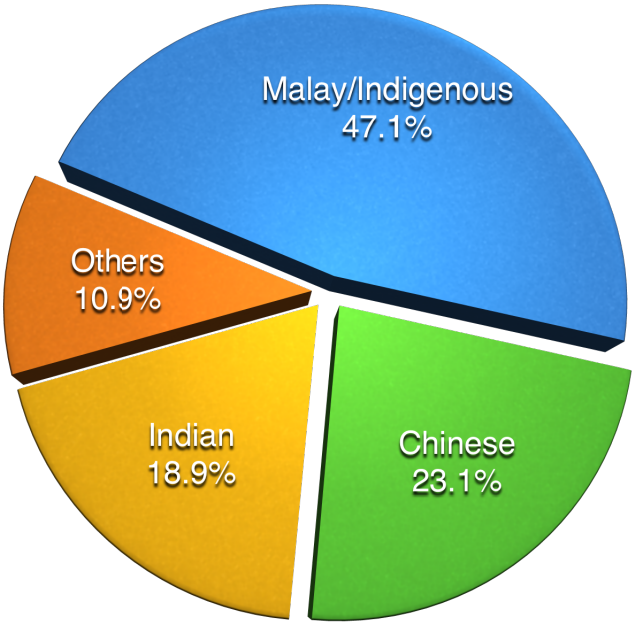
Fig 2 : Gender Distribution



The gender distribution in 2012 is very similar to the previous year's distribution in which males dominate the admissions at 87.5%.

Ethnicity Distribution

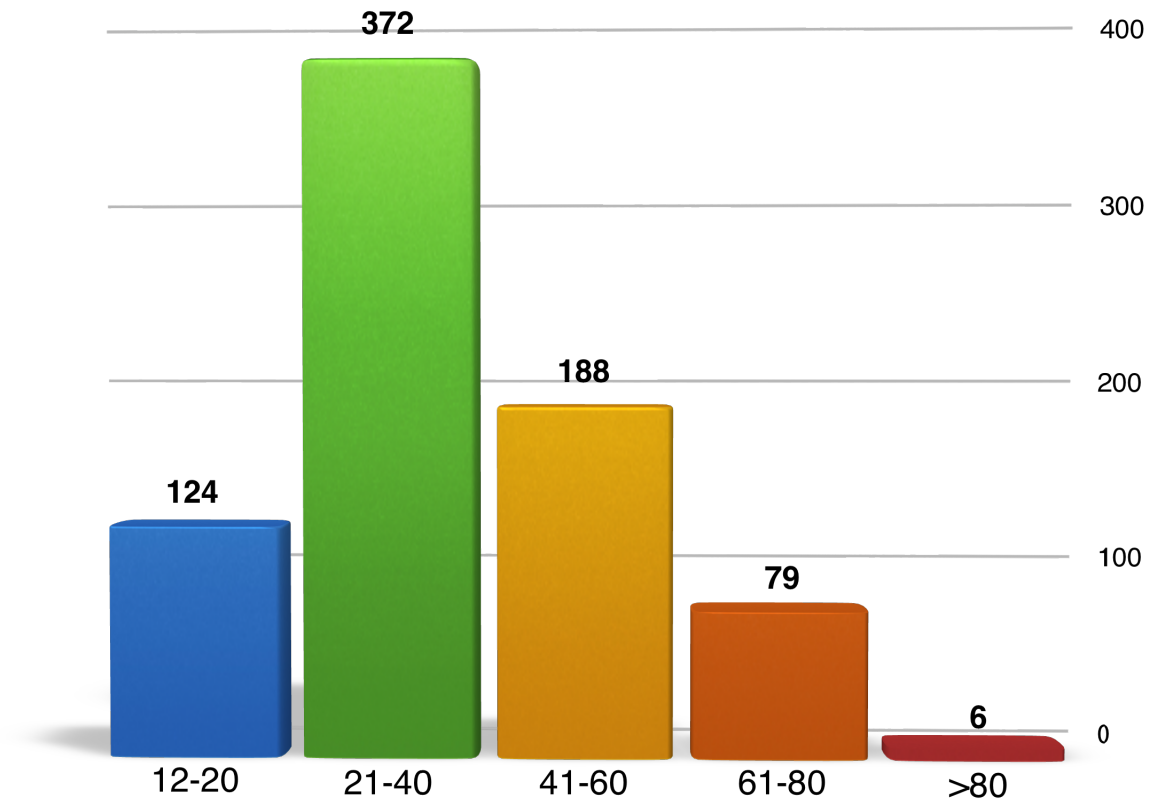
Fig 3 : Ethnicity Distribution



Among the three major races in Malaysia, Malay/Indigenous people comprises the majority of the admissions compared with other races. The percentages has dropped slightly compared with the previous year's report (49.9%). There was a slight increase in the number of admissions among the Indians, from 16.4% to 18.9% this year. There were not much variation in admissions among the Chinese and other races. Due to rapid development and demand for manpower in Johor, a significant number of admissions classified as "other races" are mainly foreigners and comprise 10.9% of patients.

Age Distribution

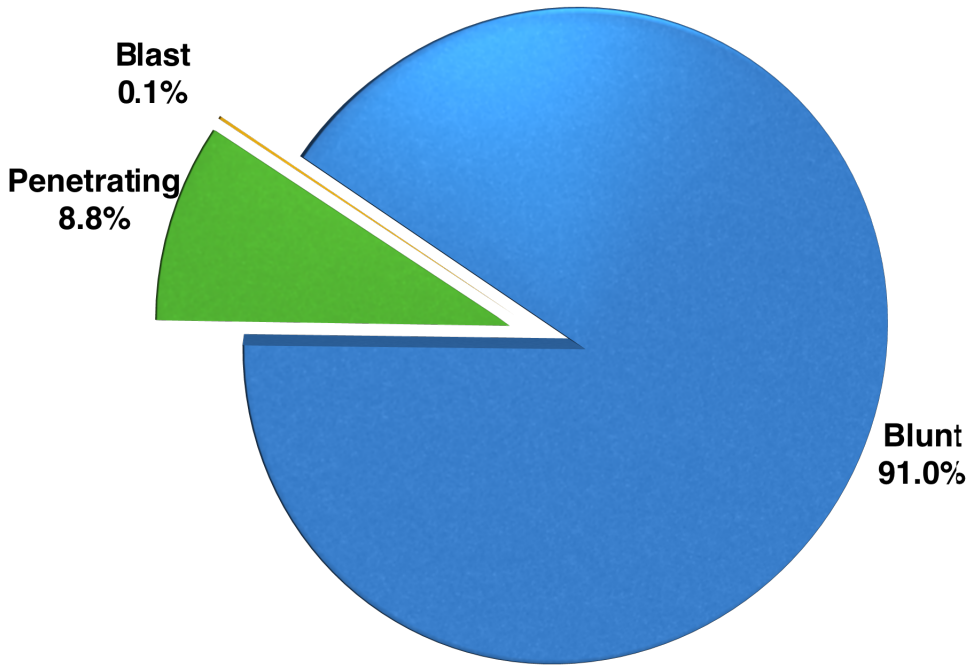
Figure 4 : Age Distribution



Young males in the age group of 21-40 years forms the majority of the cases. This distribution is very similar with the previous year's admission. However there was an increase of about 24.5% of cases among the age group of 41-60 years old compared with the previous year's report. We also have a few patients who were more than 80 years old and 66.6% of them survived the ordeal even though all of them suffered major trauma.

Trauma by Mechanism

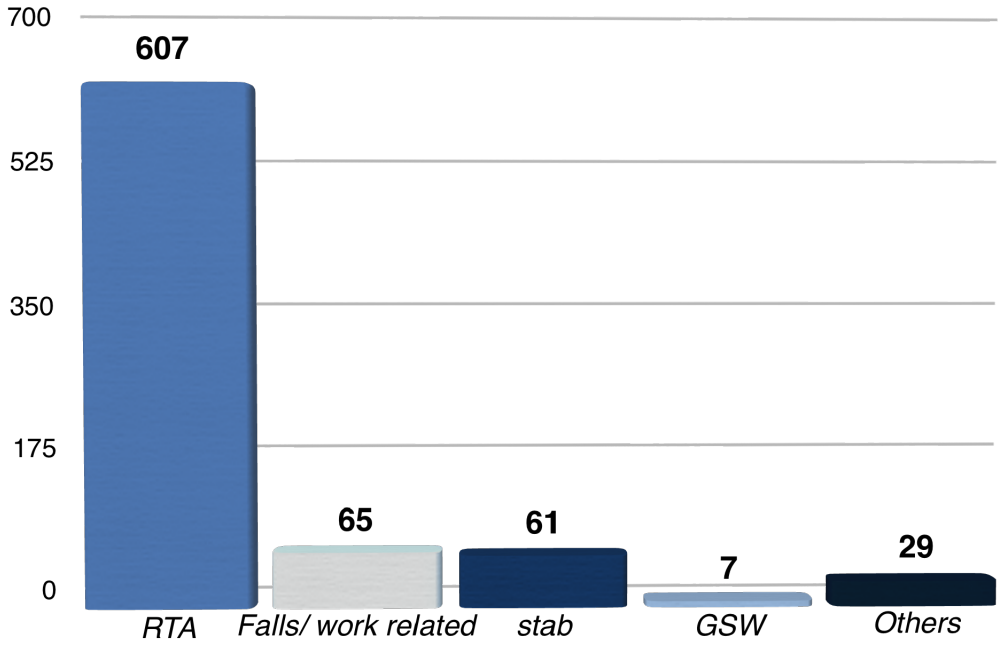
Figure 5 : Trauma by Mechanism



Blunt trauma is the most common mechanism of injury admitted to the unit and amongst those who died, 97.8% were due to blunt trauma. Penetrating injuries are mainly stabbings, as tight gun control laws in Malaysia leads to low levels of gun related crimes and injuries. Blast injuries are exceedingly rare.

Trauma by Cause

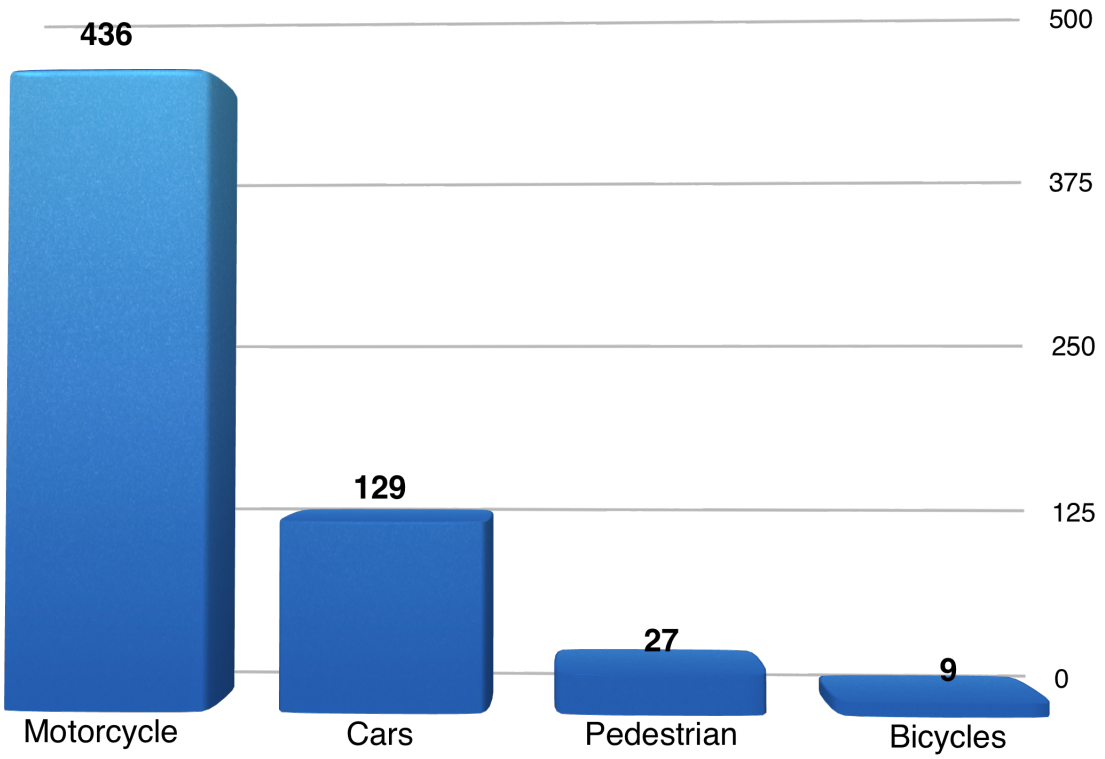
Figure 6 : Trauma by Cause



Road traffic accidents (RTA) is still the leading cause of admission, but there was a significant rise of injury attributed to gunshots, it represents almost a 4 fold increase as compared to the previous year's report (2 cases). Fall or work related injuries contribute 8.5% and almost half (44.6%) of the injured were foreign workers mostly working in high rise constructions.

Breakdown of RTA

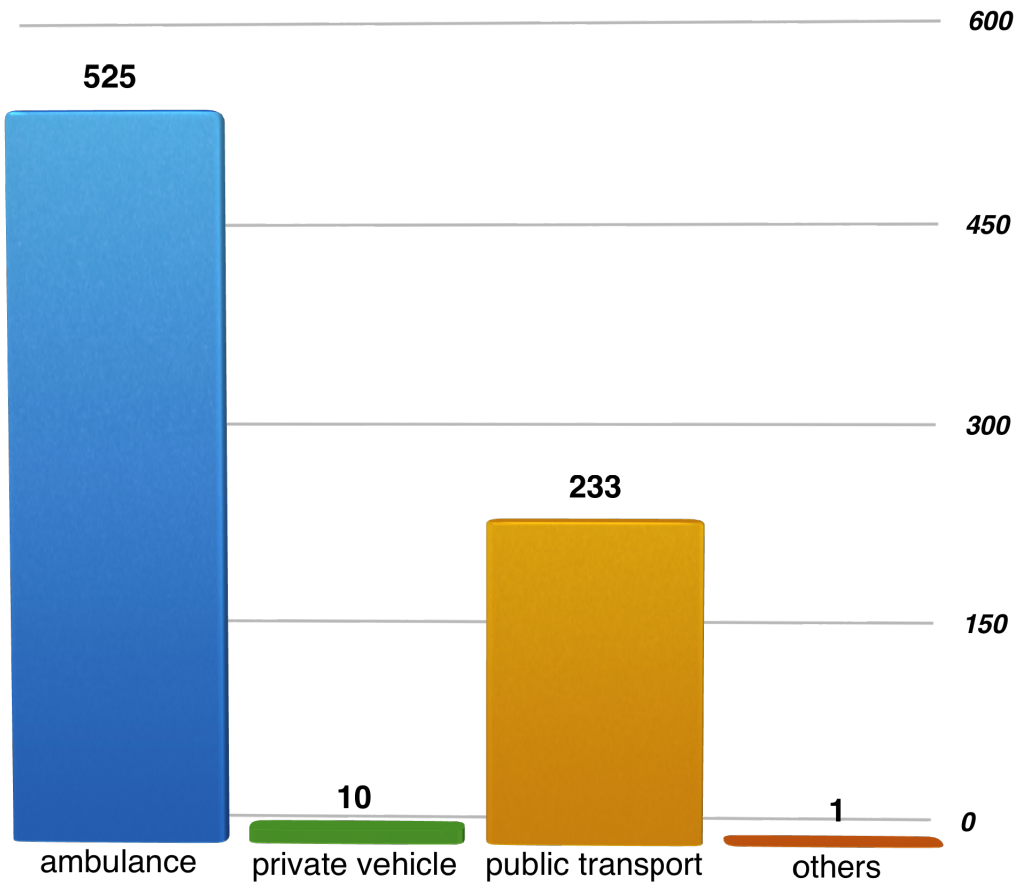
Figure 7 : Breakdown of RTA



Blunt trauma as a result of RTA forms the major mechanism of injury accounting for 78.9% compared with other mechanisms the majority of which are motorcycle crashes, that contributes 71.8% of injuries. The state of Johor has the highest number of motorcycle registrations nationwide.

Mode of transport to hospital

Figure 8 : Mode of Transport to Hospital



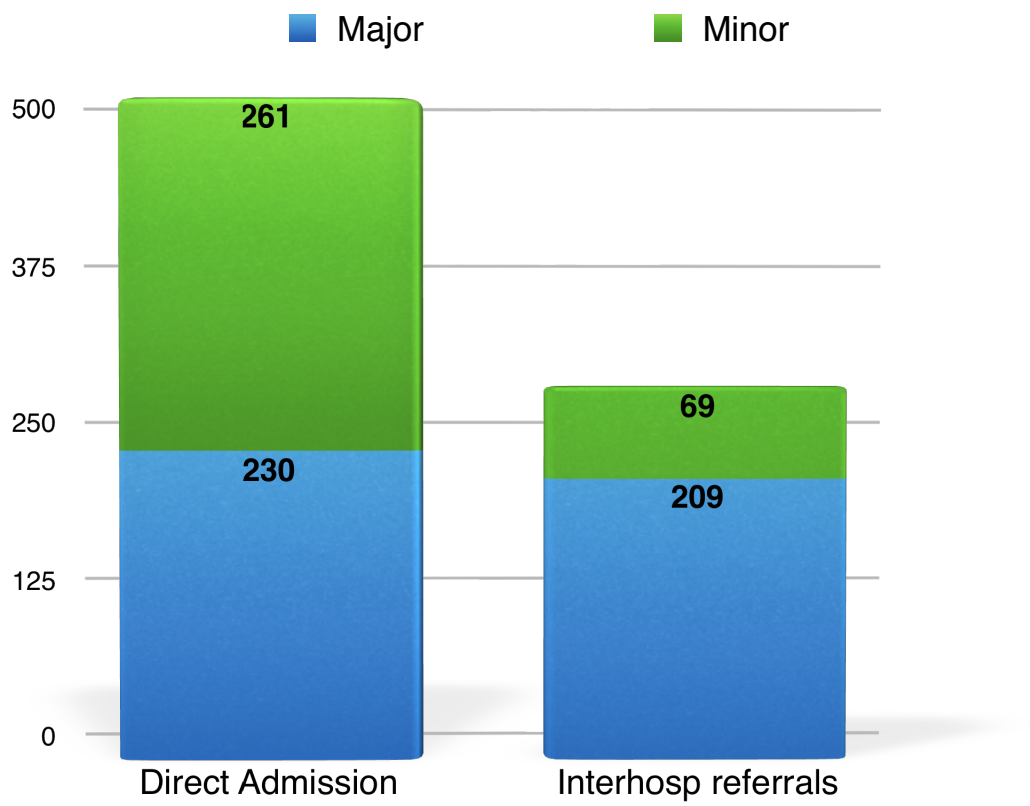
The majority of cases (68.3%) arrived by ambulance, the percentage showed a slight drop in comparison with the previous year (70.3%). It must also be considered that about 36.2% of cases were referred from other hospitals and thus transported by ambulances. There was a significant drop of cases brought in by private vehicles compared with the previous year from 193 cases to just 10 cases this year. However, cases brought in by public transport increased tremendously, compared with only 9 cases in the previous year. This data ought to be examined in conjunction with data that gauges end-user satisfaction of the pre-hospital service and public awareness and perception on the provision of ambulance services within our area of responsibility. This will help in the planing and improvement of the pre-hospital system.

ED admission

Table 1

Source of patient	Total	Major
Direct admission	491	230
Interhospital referrals/transfers	278	209

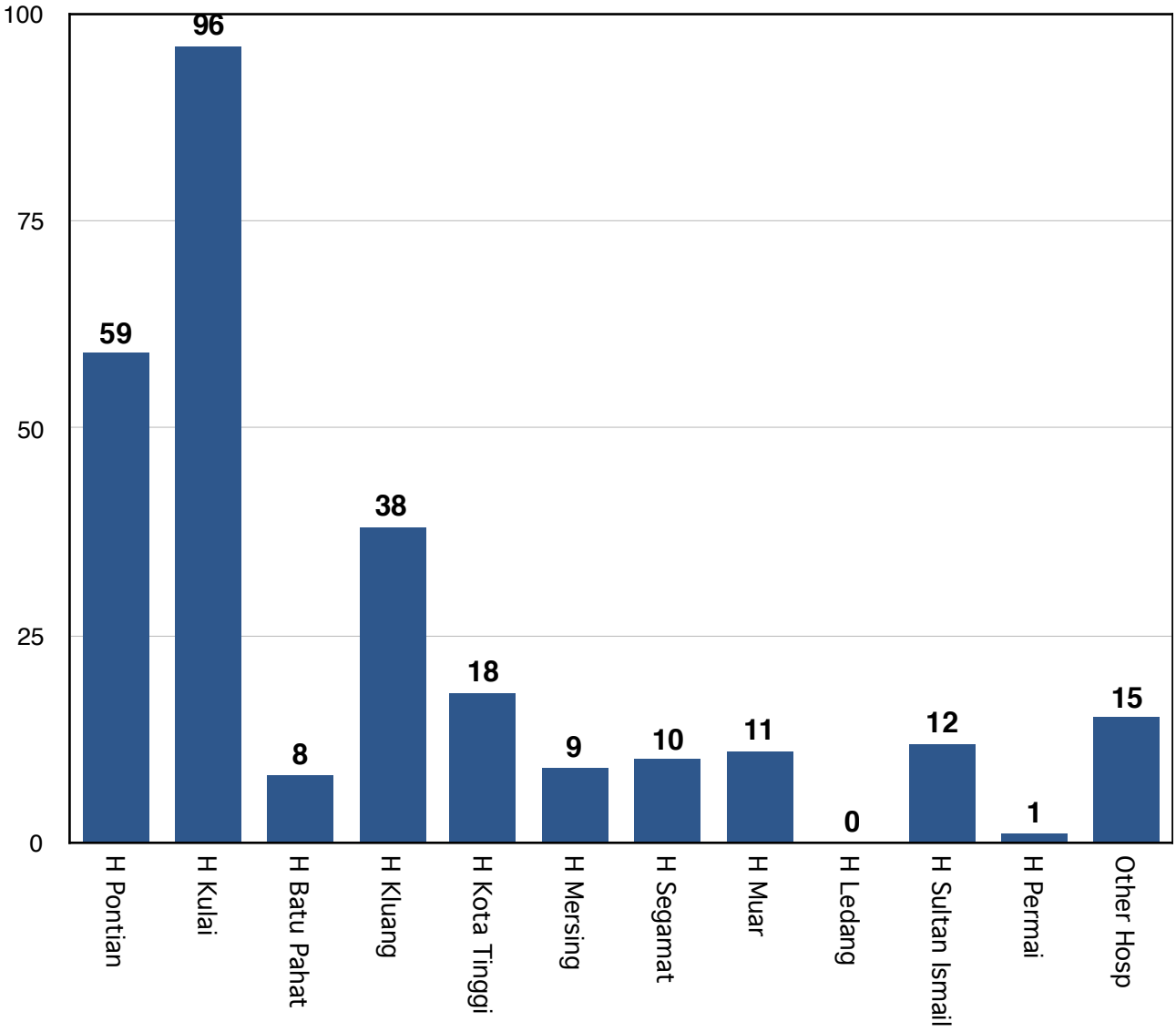
Figure 9 : ED Admission



Most trauma cases (63.8%) are direct admissions to our ED and 36.2% are referrals. The number of major and minor injuries admitted directly were almost equal. Approximately three quarters of referred patients were major traumas (75.1%). The large number of inter-hospital transfers, especially with major trauma, reflects HSAJB's position as the apex hospital for the state of Johor.

Sources of referrals/districts

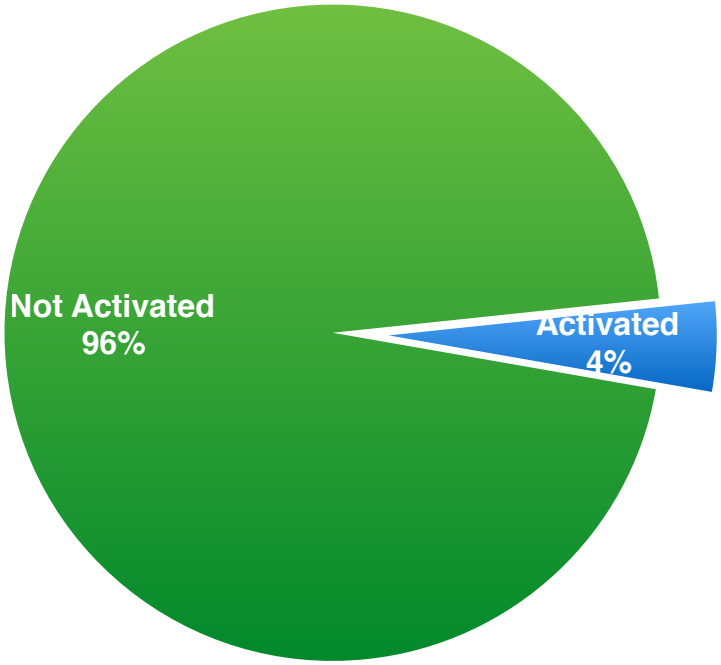
Figure 10: Sources of Referral



HSAJB received cases from other hospitals in the state of Johor and a large proportion originated from Kulai (21%), Pontian (35%) and Kluang(14%). All three hospitals contributed about 70% of inter hospital transfers. Kulai, Pontian, Kota Tinggi and Mersing hospitals are district hospitals without specialistic services, thus cases are referred to the nearest hospital with surgical expertise. Other hospitals with basic specialistic services such as Muar, Batu Pahat, Segamat, Kluang and Sultan Ismail refers to the trauma surgery unit patients with concomitant brain or vascular injuries, as these services are unavailable elsewhere. The high number of cases originating from Kulai and Pontian is a direct reflection of the heavy burden of cases presenting to both hospitals.

Trauma team activation

Figure 11 : Trauma Team Activation



The Trauma Team Activation system was introduced at the end of 2011 and it is still in its infancy. Due to resource limitations, this system only runs during normal working hours on weekdays. The 4% figure shows a severe under-triage of cases. There is still room to improve the level of awareness about this system amongst our ED staff. We hope that with maturation and expansion of this system, in the future, there will be a higher level of sensitivity to activation and less under triaging.

Total hospital length of stay (excluding deaths)

Table 2. Total hospital length of stay (excluding deaths)

	Days
Mean	10.2
Median	6
Range	1 - 108

The mean length of stay excluding deaths was 10.2 days with a median of 6 days. There were 29 cases (4.2%) with a one day stay in hospital. These cases constitute those with minor injuries and those whose requested to be transferred to nearby private facilities.

ICU admissions

Figure 12 : ICU Admission

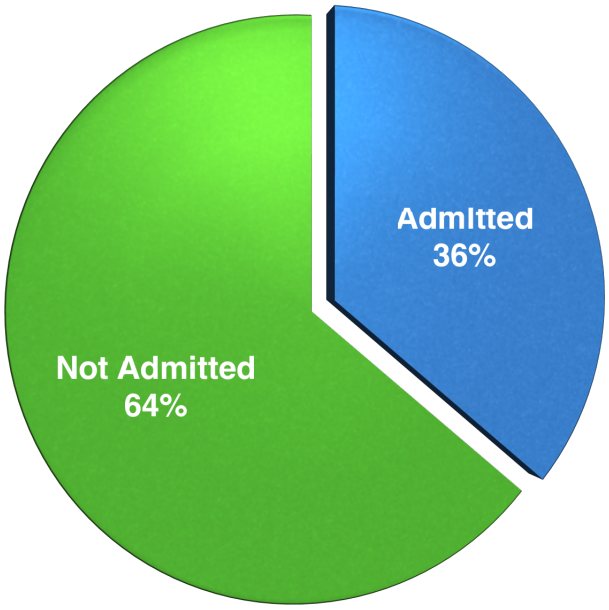
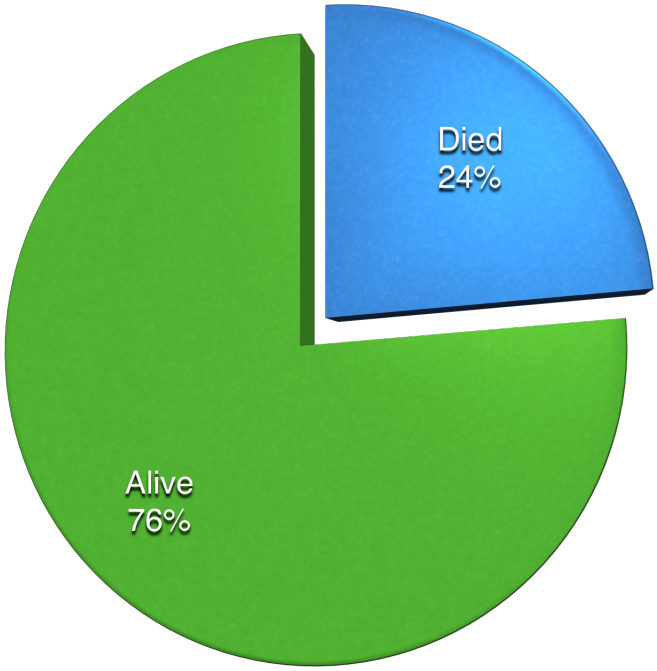


Table 3. Length of ICU stay (excluding deaths)

LOS	Days
Mean	8.2
Median	5
Range	1 - 46

ICU outcome

Figure 13 : ICU Outcome



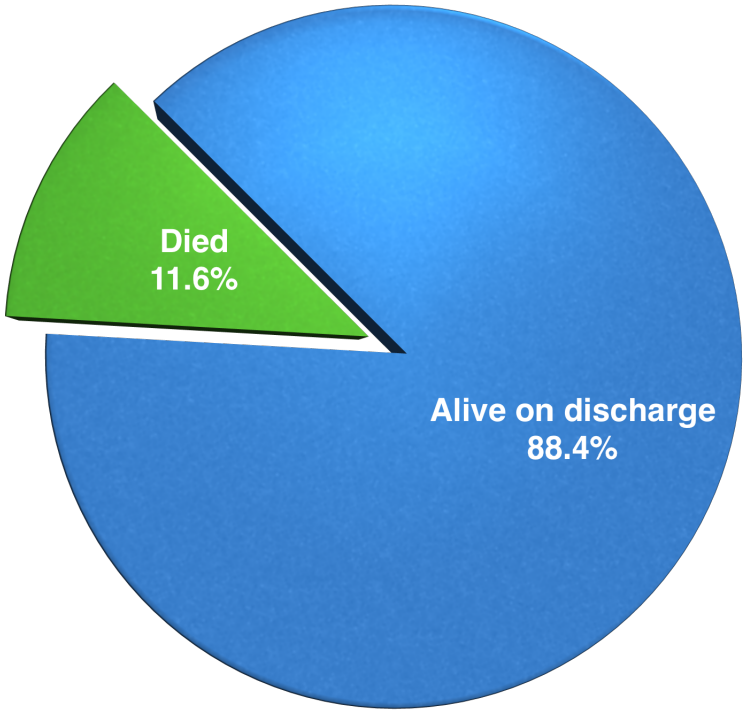
About a third of cases required admission to the general ICU and this reflects the severity of the cases managed by the unit. As compared to the previous year, there is an increase of 5% in ICU admissions. The mean length of ICU stay was 8.2 days with a range of 1-46 days. Multi-trauma cases admitted to the Neurosurgical High Dependency Unit were not classified as ICU admission. About a quarter of the patients admitted to ICU, succumbed, with 42.4% as a result of associated severe head injury and 34.8% subsequently died as a consequence of sepsis.

Overall case fatalities

Table 4 : Overall case fatalities

Outcome	N	%
Alive at discharge	680	88.4
Died	89	11.6
Total	769	100

Figure 14 : Overall case fatalities



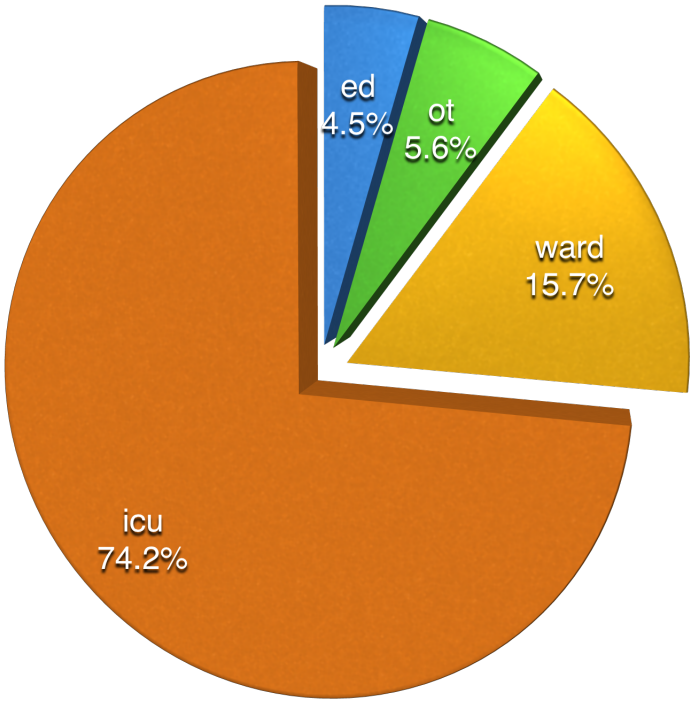
The overall mortality was 11.6% and the rate is very much similar to the previous year (11.1%). It approximates most figures in Australasian Trauma Registry Reports of Case Fatality Rates in the past few years.

Death by Location

Table 5. Death by location

Location	N	%
ED	4	4.5
OT	5	5.6
Wards	14	15.7
ICU	66	74.2
Total	89	100

Figure 15 : Death by Location



Overall survival of all trauma cases was 88.4%. Of those who died, the majority of the deaths (74.2%) occurred in the ICU. There were 4 deaths in ED, these cases presented “in-extremis”, with low RTS values and 3 of them presented with severe head injuries. Five cases died in OT as a consequence of massive uncontrolled haemorrhage.

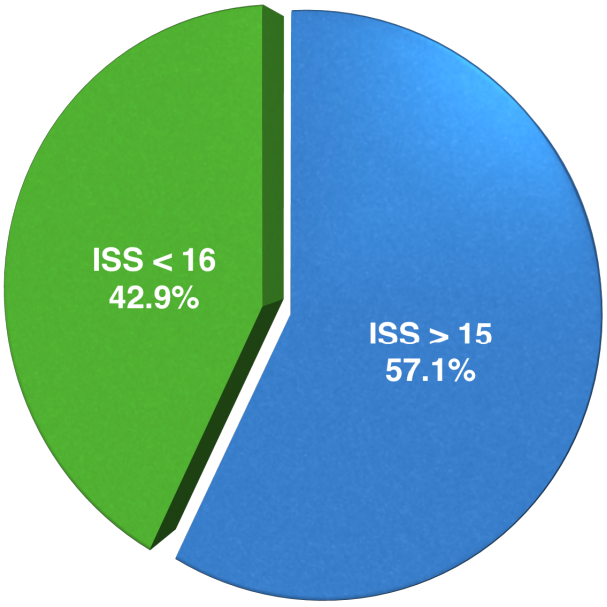
Part II. Major Trauma Data

Injury severity

Table 6. Injury Severity Score

ISS	N
ISS > 15	439
ISS < 16	330

Figure 16 : Injury Severity Score



Four hundred thirty nine cases (57.1%) had an ISS of more than 15. This figure showed a significant increase of 6.7% compared with the previous year (50.4%). This represents a significant burden of care for the unit. Less than half of the remaining were minor trauma.

Outcome of major trauma

Table 7. Major Trauma Outcome (patients with ISS > 15)

Outcome	N	%
Dead	85	19.4
Alive at discharge	354	80.6

Mortality for major trauma stands at 19.4% or 85 patients which showed slight improvement compared with the previous report at 21.9%. This figure does not stratify the severity of trauma involved. The majority (18.9%) died of blunt trauma. All deaths occurred within the blunt trauma group and blunt trauma is a significant and major contributor for all major trauma cases.

Figure 17 : Major Trauma Outcome ISS > 15

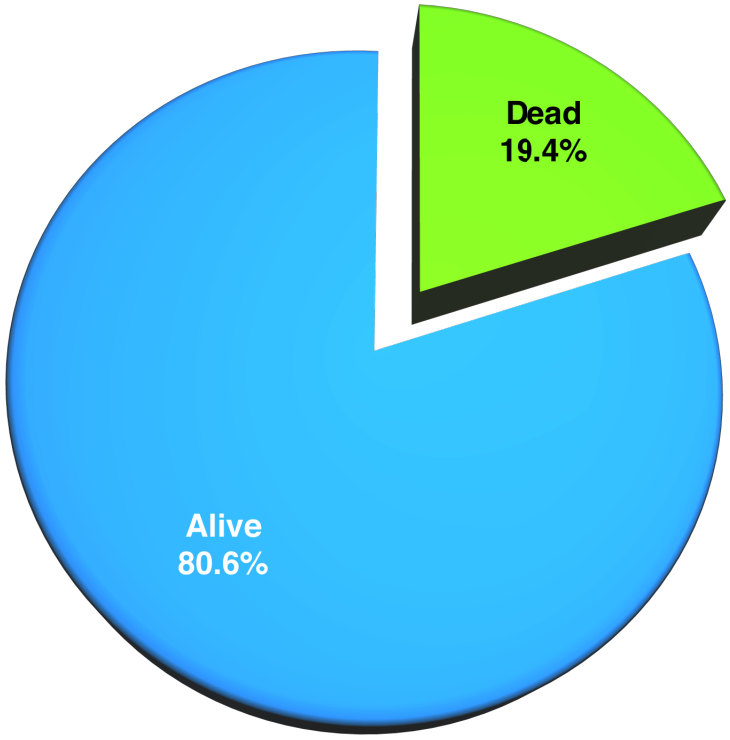
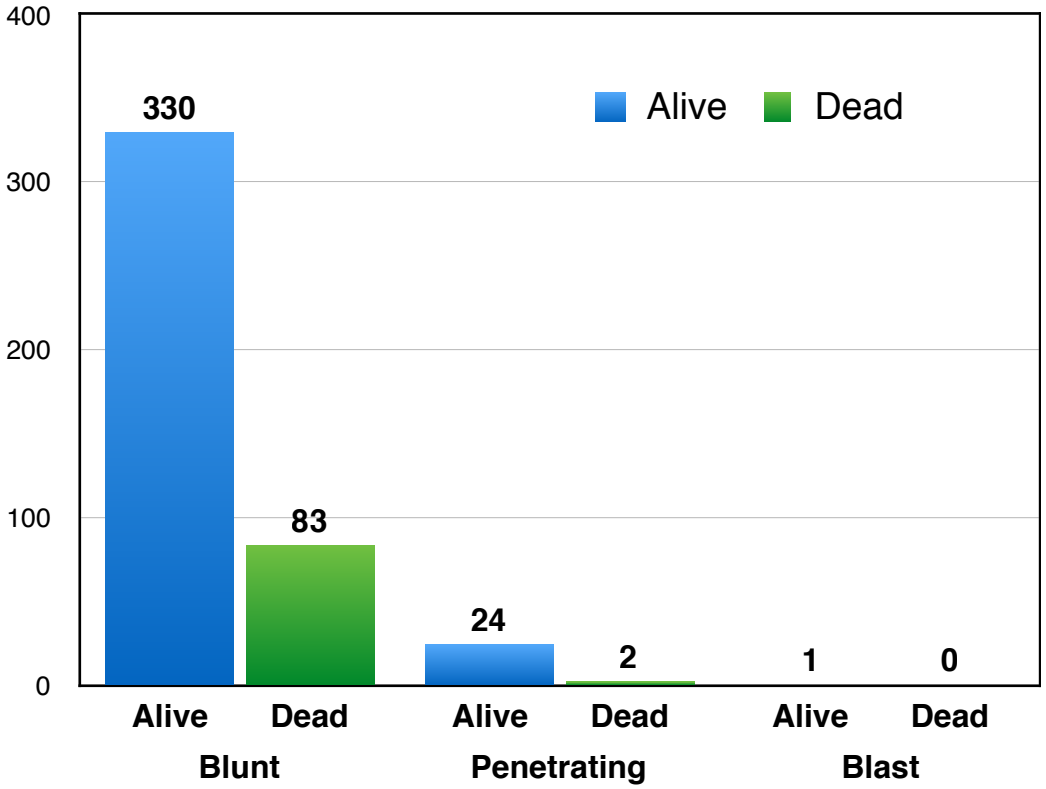


Figure 18 : Major Trauma Deaths by Mechanism (ISS > 15)



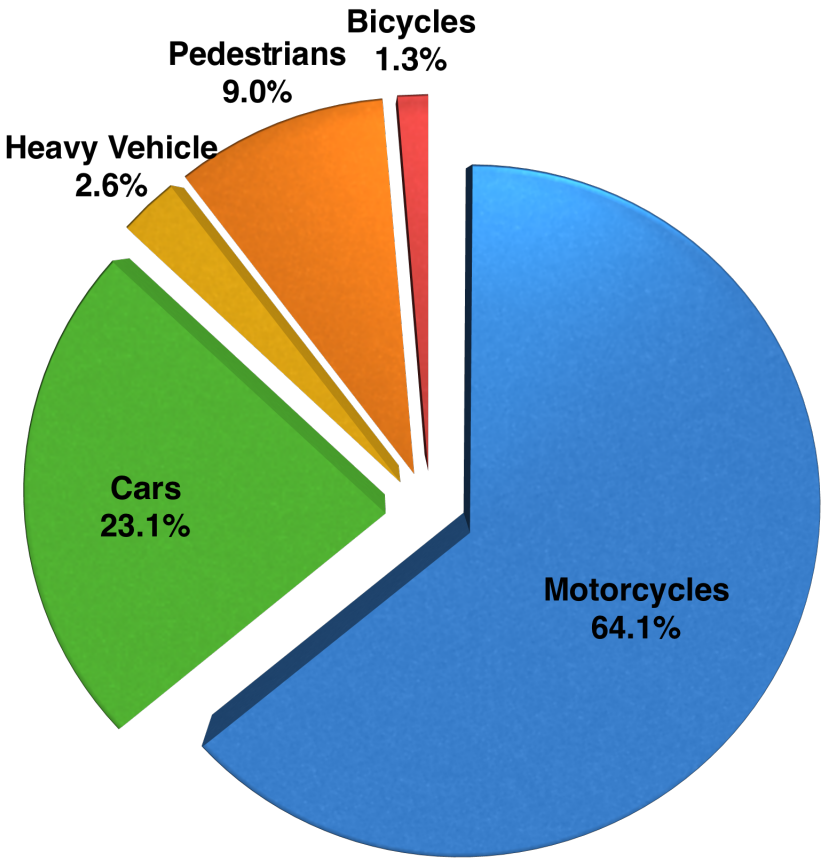


Figure 19 : RTA Deaths ISS > 15

Among those involved in a RTA and sustained major trauma, an overwhelming majority of deaths occurred amongst motorcyclist who constitute the bulk of trauma patients involved in RTA.

Table 8 : Major Trauma Length of Stay (days) excluding deaths

ISS	Mean	Median	Range
16 - 24	9.9	7	1 - 61
26 - 40	16.2	12	1 - 87
41 - 75	24.9	18	1 - 108

The largest group of patients were within the ISS 16 - 24 range and also had the shortest duration of stay. As expected the more severe the injury (the higher the ISS values), the longer the duration of stay in hospital. This also correlates with other outcome measures such as mortality. There is improvement in mean LOS among the ISS 16-24 as compared with the previous year's report. However the mean LOS for a group of ISS 41-75 has worsened from 16.6 to 24.9 in the current report.

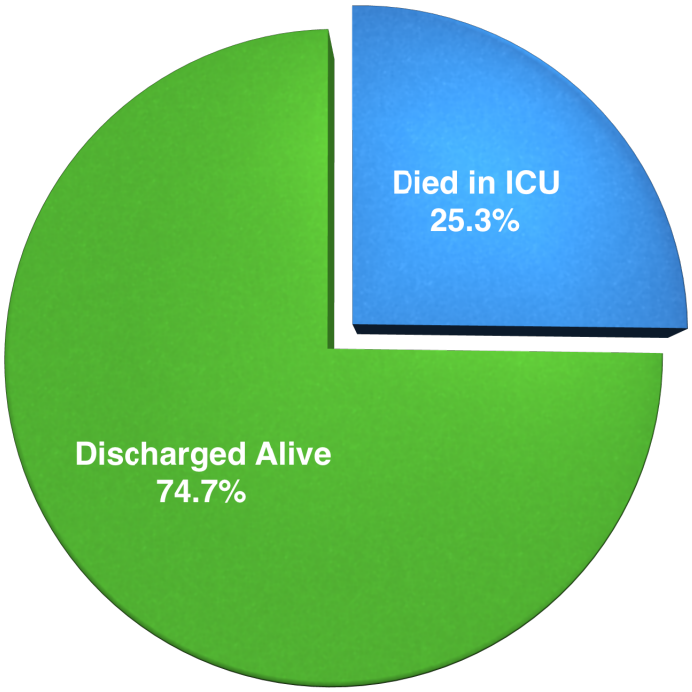
Part III. Outcomes

ICU mortality for major trauma

Table 9. ICU deaths (ISS > 15)

Died in ICU	64
Discharged alive from ICU	189

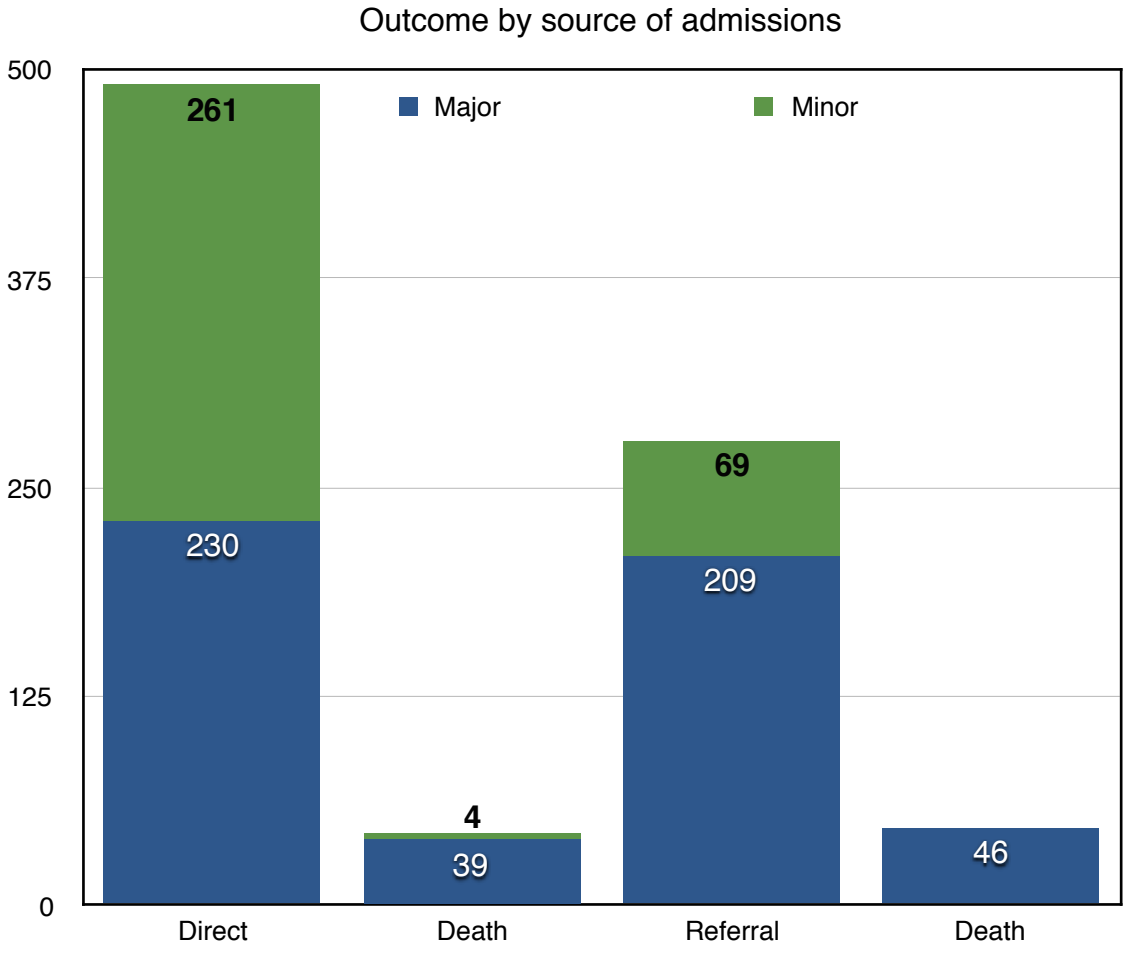
Figure 20 : ICU Deaths (ISS>15)



There were 254 admissions for major trauma to ICU. Of these, about a quarter of them died mainly as a consequence of severe head injury and sepsis. The percentage is almost the same as the previous year's report at 24.3%. These cases tended to be the most severely injured with higher ISS values.

Table 10 : Outcome by source of admissions and severity of injury

Source	Total	Severity		Deaths
Direct admission	491	Major	230	39
		Minor	261	4
Referrals and transfers	278	Major	209	46
		Minor	69	0



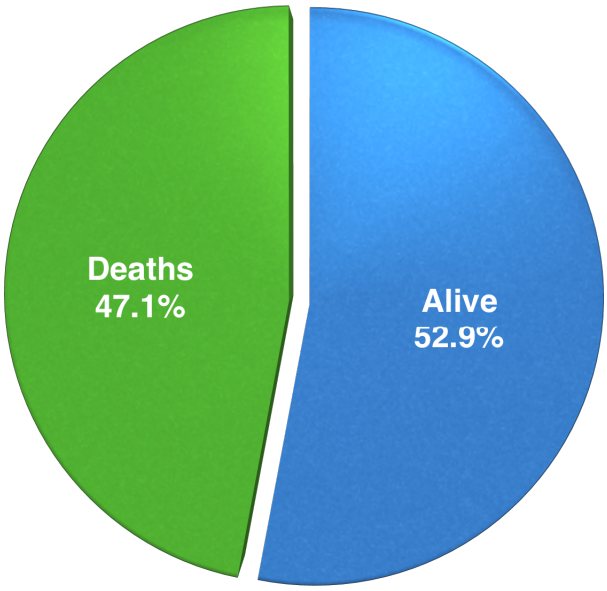
Most patients were admitted directly through the ED and more than half of them had minor injury and 91.2% of direct admissions survived to discharge. Approximately three quarters (75.2%) of referred cases had major trauma and 83.5% survived. There were no deaths from minor trauma referred from other hospitals, but there were four eventual deaths from

minor trauma that presented directly to our ED, three of these deaths were due to bleeding and one from sepsis.

Table 11: Mortality in relation to trauma alerts

Trauma Alerts	Total deaths	Location of death	N
34	16	ED	0
		OT	2
		ICU	13
		Ward	1

Figure 21: Outcome of Trauma Alerts

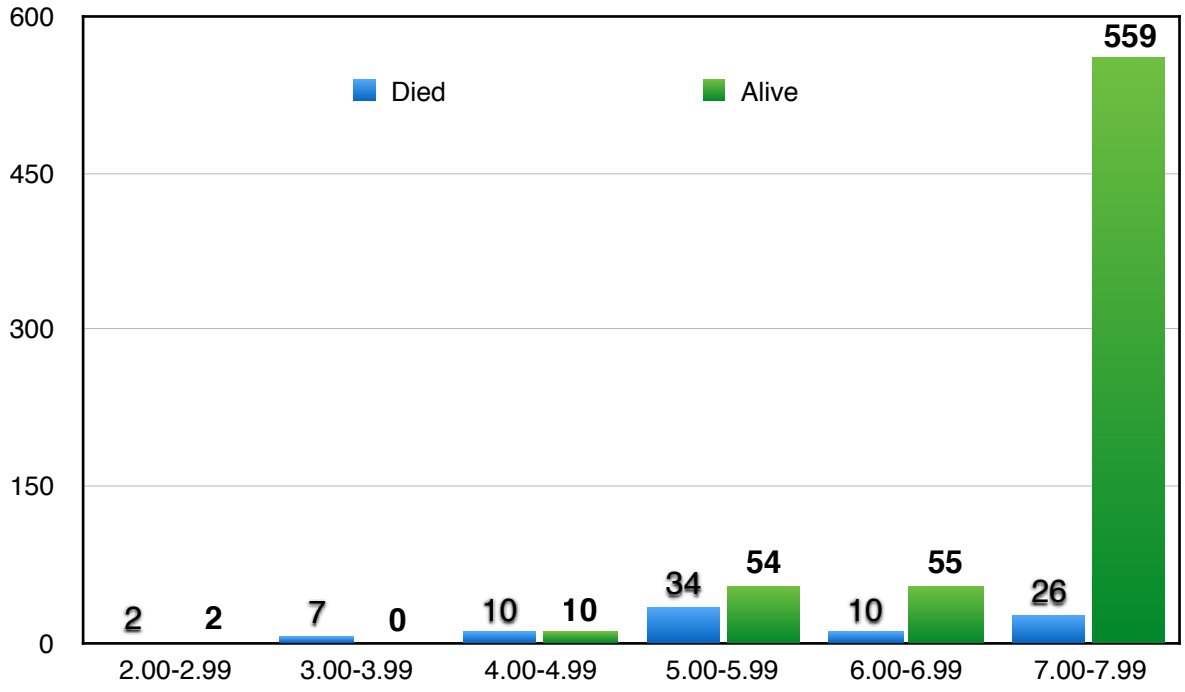


Hospital Sultanah Aminah's trauma team activation system was introduced in Nov 2011. It is a single tiered system which is activated by the ED Physician, based upon predetermined criteria. Due to resource limitations, the system has a predefined work period. Initial data shows slightly less than half of patients in trauma activations die. Most of them died almost exclusively in ICU due to various complications of major trauma and severe head injury. Two cases died in OT as a consequence of massive uncontrolled haemorrhage.

Table 12: Outcome by RTS

RTS	Died	Alive at discharge	Total
2.00 - 2.99	2	2	4
3.00 - 3.99	7	0	7
4.00 - 4.99	10	10	20
5.00 - 5.99	34	54	90
6.00 - 6.99	10	55	65
7.00 - 7.99	26	559	585

Figure 22: Outcome by RTS

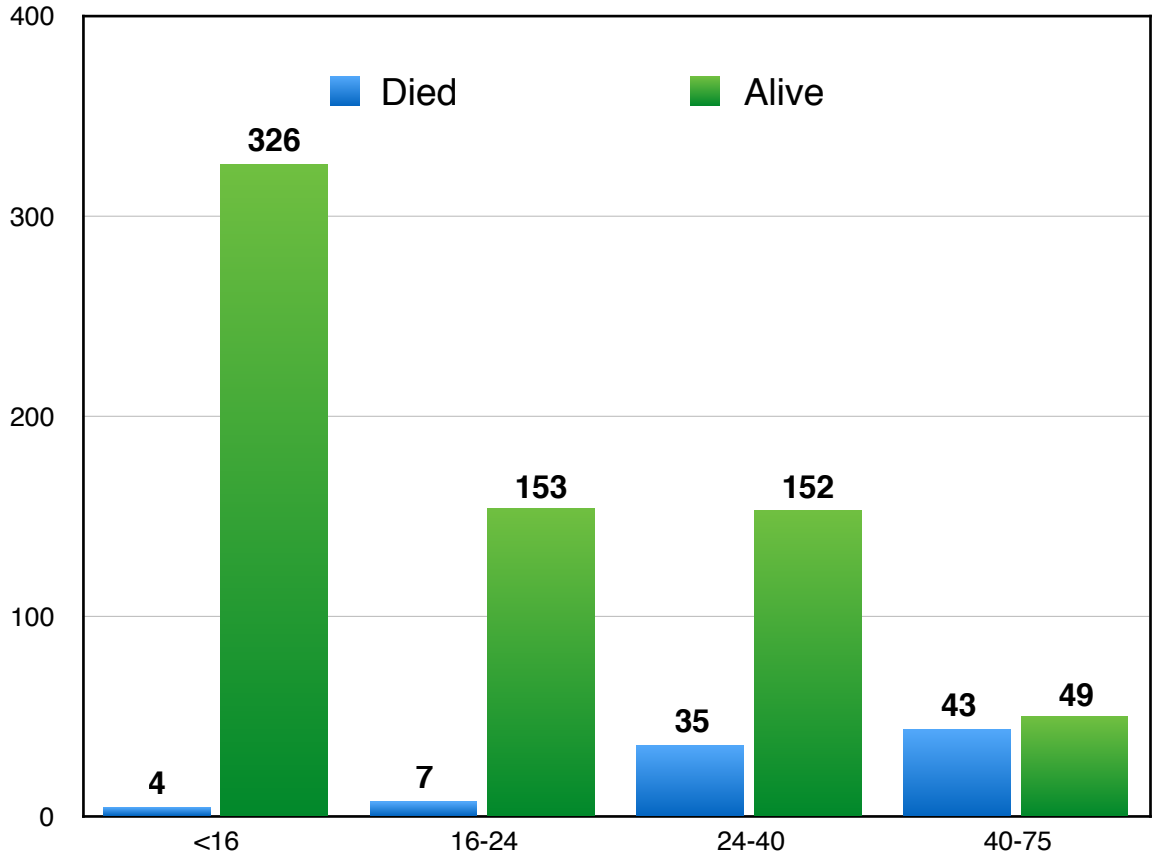


The distribution of deaths per RTS follows normal convention with more survivors seen with higher RT scores. However, the data shows a deviation in numbers of deaths in the group with mid-range RT scores, which may not be significant. Nonetheless audits and reviews will be conducted to further elucidate the cause of this anomaly and to institute improvements in practice, if warranted.

Table 13. Outcome by injury severity

Outcome	ISS			
	< 16	16 - 24	24 -40	40 - 75
Died	4	7	35	43
Alive at discharge	326	153	152	49
Total	330	160	187	92

Figure 23: Outcome by Severity of Injury



Major trauma mortality (ISS > 15) was 11.1%. Four cases of minor trauma (ISS<15) died (1.2%), due to sepsis and bleeding. As expected, the mortality increased with increasing injury severity. The mortality of patients with ISS > 40 was 46.7%, which showed a slight improvement seen from the previous year's report (48.9%). There was only one patient with an ISS of 75 and this did not significantly influence the eventual mortality rate of those with ISS>40.

Table 15. Mortality by mechanism and severity

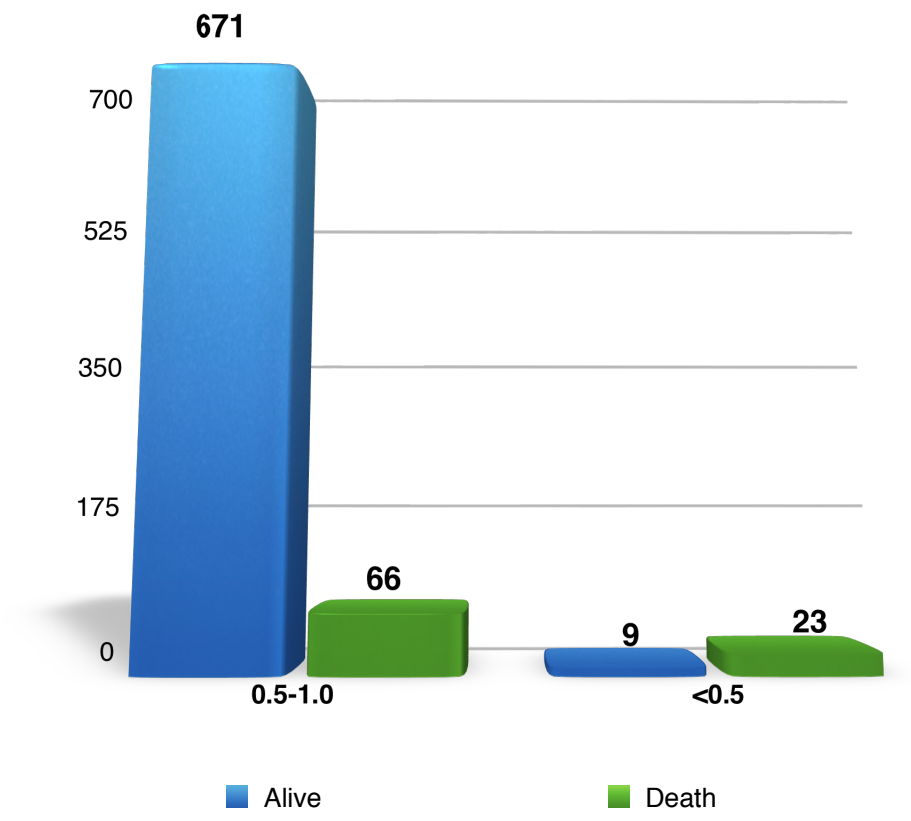
Mechanism	Deaths	ISS	Deaths
Blunt	87	< 16	4
		16 - 24	7
		25 - 40	35
		41 - 75	41
Penetrating	2	16	0
		24	0
		25 - 40	0
		41 - 75	2

There were 87 deaths resulting from blunt trauma, which were distributed accordingly in ascending order to their injury severity. Only two deaths resulted from penetrating trauma and both cases had high injury severity scores. All four deaths of minor traumas were caused by blunt injuries.

Table 14. Survival by TRISS

TRISS, Ps	No of patients	Actual deaths	Alive
0.5 - 1.0	737	66	671
< 0.5	32	23	9

Figure 24: Survival by TRISS



There were 66 unexpected deaths out of 737 patients. Vice versa, there were nine patients who survived from a group of 32 patients that were expected to have died based on the probability of survival.

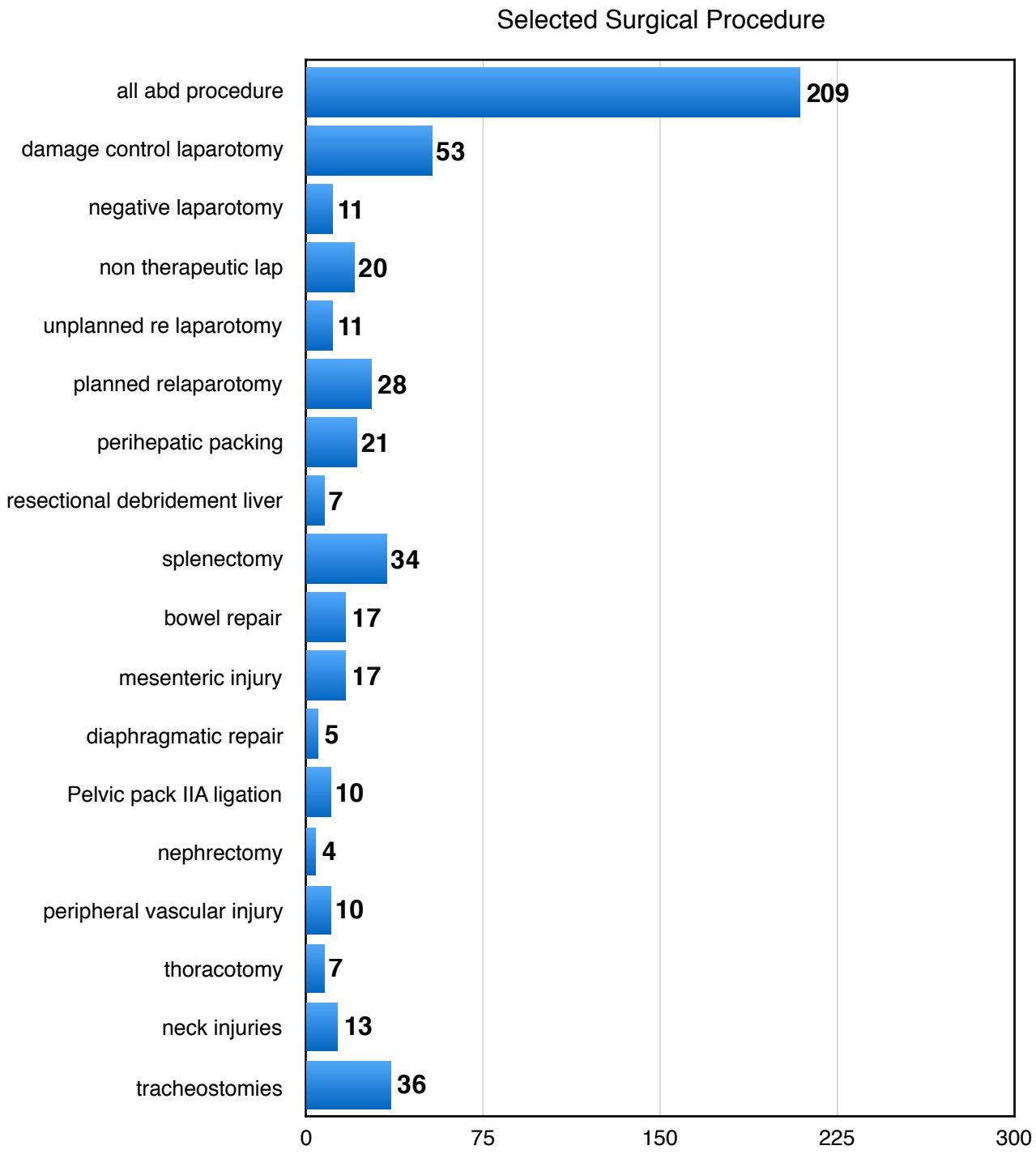
Table 16. Functional outcomes

FIM	MEAN	P_{90}	RANGE
Self care	50.3	56	8 - 56
Mobility	30.1	35	5 - 35
Communication	13.6	14	2 - 14
Social cognition	20.3	21	3 - 21

FIMS showed good functional outcomes in most areas of assessment. The scores are very similar to the previous year's report.

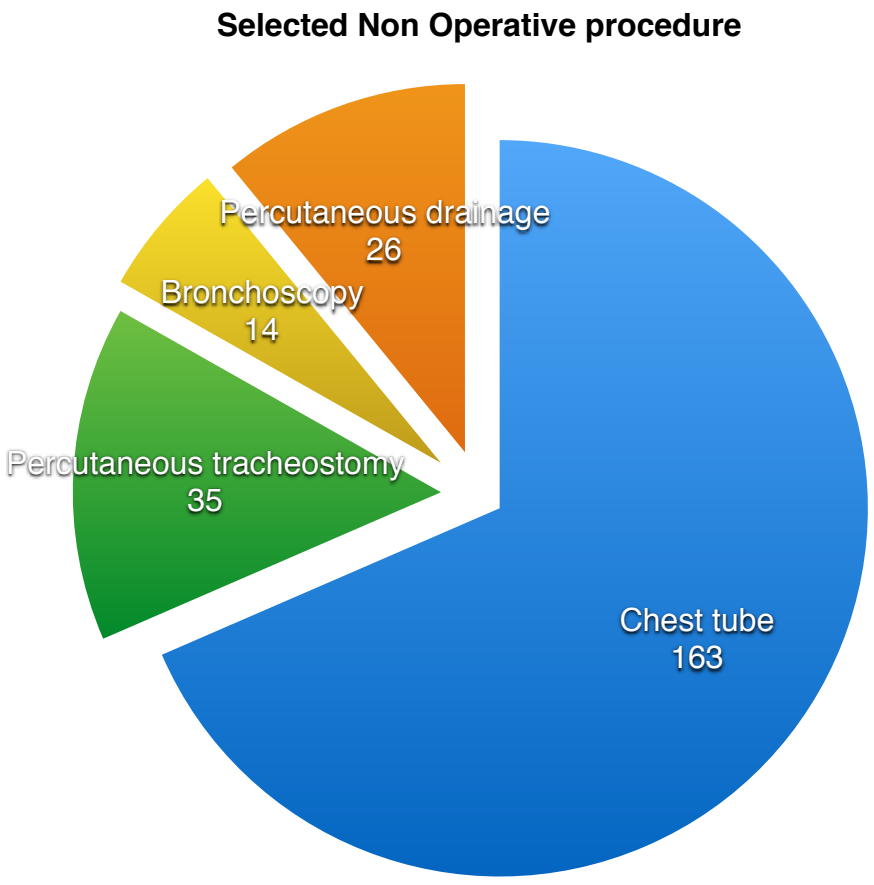
Part IV. Selected operative procedures

Procedure	N
All abdominal procedures	209
Damage control laparotomy	53
Negative laparotomy	11
Non therapeutic laparotomy	20
Unplanned repeat laparotomy	11
Planned second look laparotomy	28
Peri hepatic packing	21
Resectional debridement of liver	7
Splenectomy	34
Repair of bowel perforations	17
Mesenteric tears- haemostasis and repairs	17
Repair of diaphragmatic tears	5
Pelvic packings and iliac vessel ligations	10
Nephrectomy	4
Revascularization of upper limbs	6
Revascularization of lower limb	4
Thoracotomy (all procedures)	7
Surgeries for neck injuries (all procedures)	13
Surgical tracheostomies	36


Selected Surgical Procedure
all abd procedure
209
damage control laparotomy
53
negative laparotomy
11
non therapeutic lap
20
unplanned re laparotomy
11
planned relaparotomy
28
perihepatic packing
21
resectional debridement liver
7
splenectomy
34
bowel repair
17
mesenteric injury
17
diaphragmatic repair
5
Pelvic pack IIA ligation
10
nephrectomy
4
peripheral vascular injury
10
thoracotomy
7
neck injuries
13
tracheostomies
36
0
75
150
225
300

Part V. Selected non operative procedures

Chest drains/tubes (1)	163
Percutaneous tracheostomy (6)	35
Bronchoscopy (4)	14
Percutaneous drainage, all regions (16)	13



Selected intra abdominal solid organ injuries

Organ	N	Operative management	% Non operative management
Liver	72	17	72.2%
Spleen	59	31	47.5%
Renal	39	4	89.7%
Pancreas	9	0	100%

Most patients with intra abdominal solid organ injuries were managed non operatively, with the exception of splenic injuries of which more than half required splenectomies. Pancreatic injury is not as uncommon as previously thought and all of them were managed conservatively during the period reported.

Part VI. Common complications

Complication	N	Admitted to ICU	Not Admitted to ICU
Wound infection	43	41	2
Pneumonia (incl. VAP)	50	45	5
Wound dehiscence	18	10	8
Bedsores	5	3	2
Renal failure	56	50	6

Complications arising during the course of treatment showed a propensity to occur in patients who had been admitted to ICU. This most probably reflects the severity of injuries in itself rather than the admitting facility, as patient who require ICU care are more likely to have higher injury severity scores, longer stays in hospital and higher mortality.