



A Decade to the Israel National Trauma Registry

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The first recorded systematic attempt to obtain and collect casualty and medical information was ordered by the Surgeon General of the United States Army in 1818 [1]. Computerized trauma registries appeared nearly a century and a half later [2,3], expanding and spreading rapidly [4], and were finally defined as an essential part of a hospital trauma system [5].

In Israel in the early 1990s, a designated national committee (the Revach Committee) studied the needs and defined the standards that became the basis for the establishment of a national trauma system in the country [6]. These recommendations were approved and implemented by the Ministry of Health in the mid-1990s. As part of the overall plan, the National Trauma Registry was established in 1995, providing the tools for continuous monitoring and quality assurance at both the hospital [7] and the national levels [8]. The registry has since been growing and improving, beginning in 1995 with 8576 patients annually at five hospitals, rising to 25,358 patients annually at ten hospitals in 2005. Today, just over a decade after inauguration, we review the history of the trauma registry in Israel, describe changes in the past decade in registry volume and quality, and illustrate the significance and breadth of potential research scope through an exemplar of research products from the registry in recent years.

Evolution of the Trauma Registry

Possibly the first trauma registry in the state of Israel is documented in Figure 1, a photograph of a notebook found in Kibbutz Geshar in northern Israel, where a confrontation with the Jordanian Arab legion took place in April 1948. This modest attempt at recording information included seven columns: date, time, name, age, place, diagnosis, treatment. Injuries were described mostly by body regions, "head," "lower limbs," "head & chest," or "injured in all body regions." Treatments were documented as "bandages," "penicillin," etc.

Other attempts at keeping a registry probably followed in many places, and larger local registries were compiled at the Hadassah University Medical Center (Ein Kerem campus,

Jerusalem) and partially at Rambam Medical Center (Haifa). The most notable step was taken in 1992 with the Ministry of Health's recognition of the need for a national trauma registry; in 1995 the registry was inaugurated [9].

In 1995 the registry collected data at five medical centers – Hadassah (Ein Kerem campus, Jerusalem), Sheba (Tel Hashomer), Rambam (Haifa), Hillel Yaffe (Hadera), and Kaplan (Rehovot) – and used trauma registry software of the U.S. Centers for Disease Control. In 1997 this software was replaced by TraumaBase™ (Clinical Data Management, Conifer, CO, USA). At this stage other hospitals joined: Soroka (Beer Sheva), Rabin (Beilinson campus, Petah Tikva) and Tel Aviv Sourasky, followed by Assaf Harofeh (Zerifin) in 2001, Western Galilee (Nahariya) in 2003, and Shaare Zedek (Jerusalem) in 2006. It is hoped that in the future, more and eventually all hospitals will participate in the registry.

Role of the National Trauma Registry

Trauma registries enable research that can contribute to quality improvement, help identify specific needs in order to direct suitable responses, lead prevention programs towards populations at risk, and provide a factual basis for policy setting in the hands of decision makers.

The goals set at the inception of the Israel Trauma Registry were to provide systematic and detailed documentation of the circumstances of the injury and the treatments provided [10]. The aim of establishing a database in each hospital was to utilize it as an instrument for quality assessment and quality improvement within the hospital. Furthermore, the existence of the trauma registry within the hospital improved the dialogue between the trauma team and the hospital directorate. This dialogue focused on gaps between needs and resources and on casualty characteristics. In the absence of a physical trauma unit, trauma coordination enabled staff to monitor the location of patients and follow-up on their care. With the registry database, however, not only is local research possible, through the efficient identification of process deficiencies, but multicentered epidemiological analysis can also be conducted. Such analysis enables identifying national needs and supports

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Figure 1. Photograph of the Gesher registry (in Hebrew)

decision makers and policy setters in making evidence-based decisions.

Modus operandi

Trauma registrars at the hospitals are part of the trauma staff. Initially data are subject to logical and quality checks and, subsequently, data analysis and interpretation. In order to protect patients' right to privacy, the transferred files do not include personal identifiers such as name, address or identity number.

An annual report of selected statistics for each hospital is produced and a comparison with other similar hospitals in the registry is provided. This report is not published and is available to the trauma director and the general manager of the subject hospital only. A biannual report that contains aggregated unidentified data on all hospitals is made public [10] and is distributed to all interested parties.

Until 2005, data were recorded on paper forms at each hospital. These data were later reviewed and approved by the trauma coordinator and trauma director and entered into the software. Once every 6 months a disk with the data of every hospital was transferred to the Israel National Center for Trauma and Emergency Medicine Research at the Gertner Institute for Epidemiology and Health Policy Research. In January 2006 upgraded software was installed. This software is web-based and will not require periodic transfer of data to the national registry, but will support daily access to data by hospitals and the National Center (Gertner Institute). In the future, this system

will also be linked to other systems in the hospital, receiving diagnostic tests, data items directly from labs, etc.

Data collected

A comprehensive list of data routinely collected by most trauma registries is described by Heruti et al. [4]. Specifically, the Israel Trauma Registry records all hospital trauma hospitalizations, in-hospital trauma-related deaths, and transfers of patients presenting with traumatic conditions (ICD-9-CM codes 800-959) to and from other acute care hospitals. Patients dead on arrival, patients discharged following treatment in the emergency room, and cases that do not fall within the formal definition of trauma, such as poisoning, drowning and suffocation, are excluded. Data recorded in the registry include patient demographic data, injury details (type and circumstances), injury diagnoses, treatment at the scene and in the ER, diagnostic and surgical procedures, hospital departments for admission, and outcome (destination and condition at discharge, i.e., death, rehabilitation). Computed items include the injury severity score, the revised trauma score, length of stay, days in the intensive care unit, and more. Between 1997 and 2005, the Registry recorded 184,116 admissions.

Published work based on Trauma Registry data

During recent years much research has utilized Trauma Registry data. In accordance with the goals of the Registry, studies provide data for decision and policy makers and for supporting quality control at the hospital level. A recent example is a study that explored the reasons for transfer to a level I trauma center. The authors concluded with clear recommendations to the Ministry of Health regarding specific areas for improvement of care [11]. Following is a selection of brief summaries of articles that were based on registry data and published in peer-reviewed journals.

Traffic accident injuries in Israel

Traffic accidents have been a focus for several enquiries. Analysis of data from the registry found gaps between statistics published by the Central Bureau of Statistics and the National Trauma Registry [12,13]. One major difference was the volume reported: despite the fact that it operated in ten hospitals only, the registry included more casualties than the national CBS data. A second difference was the distribution of injury causes; for example, bicycle accidents are under-represented in the CBS data (4% vs. 12% in the Registry in 2002). These findings were the basis for the initiation of a national investigation aimed at future linking of data, with the prospect of bringing about a significant improvement in national statistics, resulting in better tools for decision makers to focus on problem areas in road safety.

Trends in inpatient mortality of severely injured patients

A decline in inpatient mortality of severely injured patients was demonstrated using Registry data [14]. During the study period, in-hospital trauma deaths of severely injured patients decreased

ER = emergency room

CBS = Central Bureau of Statistics

from 21.6% to 14.7%. A multivariate analysis of in-hospital trauma deaths adjusted for age, gender, severity of injury (Injury Severity Score ≥ 25), penetrating injury, and year of admission confirmed the downward trend. This improvement was associated with the overall progress in trauma care in Israel following the initiation of a trauma system.

Epidemiology of terror-related injuries

Several studies have focused on injuries from terror-related events [15-19], showing the unique injury patterns and hospital arrival patterns of terror casualties. Apart from producing original statistics on injury patterns, the studies highlighted the distinctive needs related to such events and generated improvements in hospital organization and preparedness. In addition to raising international interest in the Israeli trauma system, these data increased local awareness of the benefits that can be gained from the Registry.

Burn injuries in children

Children aged 0–14 years comprise 51% of all hospitalized burn injuries. Apart from the fact that hospitalizations due to burns are lengthy, the physical and emotional scars of burn injuries are long-lasting. Understanding the etiology of severe burn injuries and identifying high risk groups are essential for allotting resources for prevention and treatment. A 7 year retrospective analysis of trends and characteristics of burn injuries in Israel based on Registry data was recently published [20].

International collaborative effort on injury statistics

Due to the short history of computerized trauma registries worldwide and the unique characteristics of injury data, methodologies for the analysis of these data are still in the making. Data from the Israel National Trauma Registry have been used as a basis for developing methods for data classification [21] and for the analysis of multiple injuries [22,23] by an international group working on these issues [24].

Discussion

Although trauma registries have been in existence in one form or another for decades [3], computerization has enabled better utilization of the data accumulated. Current registries help improve patient care by means of analysis of process and outcome measures, based on data accumulated in the Registry. Additionally, risk factors and predictors of morbidity and mortality can be identified and used. Supporting decision makers with viable data and providing a basis for identifying and following intervention programs for injury reduction have proven useful, whereas the initial aims – such as being a tool for quality assurance within hospitals and departments – are achieved to a lesser extent. Nevertheless, the Registry does serve as an instrument for quality assurance through the identification of points of failure. Furthermore, the Registry supports clinical and epidemiological studies, some of which serve to focus resource allocation to areas in need.

The Israel National Trauma Council was appointed to advise

the Ministry of Health on issues related to trauma. During the 1990s several steps were taken to improve the national trauma system. The establishment of the National Trauma Registry – a tool for monitoring and improving quality within the trauma system – was only part of the change. At the pre-hospital level, advanced life support capabilities were acquired by medical and paramedical personnel participating in several courses, such as Emergency Medicine Technicians-Paramedics (EMT-P) and Pre-Hospital Trauma Life Support (PHTLS). Ambulance dispatch centers were redistributed to reduce response time. At the hospital level, Advanced Trauma Life Support (ATLS) certification was made mandatory for all surgery residents, and emergency rooms were rebuilt with a functional operational approach to ensure optimal efficiency and equipped with appropriate resources for management of complex trauma. Six medical centers were designated as level I trauma centers according to criteria set by the American College of Surgeons, with modifications to suit local needs. Other hospitals were designated as regional (similar to level II) trauma centers. Intensive care units were equipped with modern technology and apparatuses. All these steps, including the definition and accreditation of hospitals as trauma centers, brought about a significant advance in trauma care. The Registry helps monitor trends and identify areas that require improvement. Advances in medical technology enabled better care. Additional factors that had a cumulative contribution were experience gained by trauma centers due to the transfer of the more severely injured patients to level I centers, experience gained from mass casualty events, and lessons learned from peer-review groups that met regularly to discuss mortality. The national awareness of trauma has increased greatly, creating an atmosphere of a systematic upgrade in both resources and status of trauma care in Israel. The Registry serves to describe the pattern of injury case mix and trauma workload, provides data for research, and demonstrates changes in patient outcomes and relates them to the injury sustained and the care provided. Quality improvement utilizing trauma registries at the hospital level was demonstrated when several hospitals in the registry used it to identify local problems through their institutional trauma registry reports and, after correcting the flaws identified, managed to significantly reduce inpatient mortality [14]. This promoted interest and set the ground for the National Trauma Registry. The data proved to be a good basis for the identification of trends and for analyzing the current status of trauma in the country.

The importance of a national database as a foundation for policy setting and decision making was noted in 1995 by Shemer and Shapira [9] and cannot be over-emphasized. During recent years the Trauma Registry has provided a means of standard enquiry and research that is essential for quality monitoring and improvement. It also provides an information base for policy decision making at all levels of the care chain.

At the national level, the Registry provides information that is a snapshot of the epidemiology of injury in the country. Policy setters and decision makers can base planning and operational changes in work practices on knowledge gained from this data source to support evidence-based policy decisions.

One recent example was the decision to assign DRG to hip fracture treatment. For patients undergoing surgery within 48 hours, the full DRG rate is paid and any delay beyond that deducts a sum from this amount. Trauma Registry data are being used to evaluate the effectiveness of this approach in reducing waiting time for these operations and will be the basis for further policy changes on this issue. Finally, educators, public health personnel, non-governmental organizations and others can use this information to efficiently direct prevention programs towards areas of need.

At the hospital level, the Registry helps control, manage and understand specific needs and measures. As such, it can help raise important issues that can be used to provide better care due to improved understanding of both case mix and needs. It is important to keep in mind that the Trauma Registry represents only the tip of the iceberg in terms of injury. Hospitalized patients constitute a small proportion of patients arriving at emergency rooms, and these are only a proportion of patients seeking care in the community, so the Registry is a means of representing the more severely injured individuals in the community, but definitely not all injuries.

The examples of studies provided in this paper demonstrate how Trauma Registry data can be used to focus on specific populations, identify their injury characteristics and help improve care. While it is a good indicator and can be used for monitoring trends, the National Trauma Registry is not yet a means for producing national injury statistics. The geographic distribution of hospitals in the Registry is such that the northern part of Israel is not adequately covered. With the addition of Nahariya in 2003, this coverage has improved considerably but not enough. Ideally, in such a small country with only 27 general hospitals we strive for complete coverage, yet to date, the Registry records hospitalizations in only 11 hospitals in the country. Despite the lack of complete coverage, the majority of severe trauma cases is included since all level I trauma centers in the country appear in the Registry. Although we do not provide national statistics, in one area of injury the Registry has improved national data. Road casualties are reported by the Central Bureau of Statistics based on police data; however, following the publication on under-reporting in this area, a formal enquiry is presently underway with the aim of ensuring more accurate reporting of national data on road injury in the future by using both data sources (hospital and police).

The improved survival of severely injured patients in all level I trauma centers in Israel in the past decade [14] provides a positive feedback to the process that is taking place. While continuous analysis of various aspects of Registry data is important, and comparing achievements with other countries is interesting, one word of caution is necessary when comparing results obtained from different trauma registries. Registry exclusion criteria may significantly alter the apparent severity of injury, and the use of divergent exclusion criteria in the analysis of trauma registry data may be misleading; for example, registries that include trauma patients hospitalized for longer than 24 hours as compared to registries that include all patients hospitalized or all trauma

patients admitted to emergency rooms regardless of hospitalization or discharge.

Clearly defined, the systematic and standardized collection of data is therefore at the basis of comparisons with other institutions and other countries. One of the first issues to be concerned about in this respect is the clarity of the definition of trauma to be included in the Registry. The Israel Trauma Registry records patients with ICD-9-CM codes in the range of 800-959, a subset of the "injury and poisoning" chapter that ranges from 800 to 999. This definition is common, yet it includes a large group of hip fractures (ICD-9-CM code 820) that are frequently excluded from registries elsewhere. Since isolated hip fractures are typical of elderly women, comparing two registries – one with and one without fractures – would be methodologically incorrect. However, these differences, once identified, can be overcome easily and populations can be matched.

Conclusions

The Israel National Trauma Registry has made great strides in the past ten years, from inauguration, through implementation, to an instrument that produces annual statistics, promotes research, monitors quality, and identifies trends in injury patterns. Data availability as well as results that have been put to action have contributed to an improvement in outcomes and care. Decision makers and policy setters have a database to rely upon for making knowledgeable, evidence-based decisions. In view of the fact that coverage of the country is incomplete, and since participating hospitals have upgraded the level of quality control and subsequently the trauma care they provide, it is crucial that this growth trend be continued until all hospitals in the country are part of the Registry.

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Our deeds determine us, as much as we determine our deeds

George Eliot (real name Mary Ann Evans) (1819-1889), unconventional English novelist whose most famous works are *Middlemarch*, *Adam Bede*, *Silas Marner*, and *Mill on the Floss*

Capsule

Obesity is in the brain or the gut?

Although some blame high-fat foods for the global spread of obesity, the mechanistic connection is not solid. The hormone leptin regulates body weight by binding to receptors in the hypothalamus and initiating signaling via JAK2, STAT3, and PI3K transducer molecules. JAK2 is a cytoplasmic tyrosine kinase and is the target of several regulators, including the SH2-B family. Mice whose SH2B1 is systemically knocked out become leptin-resistant and obese and develop type 2 diabetes. Ren et al. have found that if SH2B1 is restored specifically to neural tissues, the obese mice stop overeating, the hyperlipidemia is corrected, the leptin sensitivity is restored, and the obesity reverses.

Nevertheless, therapeutic targeting of this signal may not be a simple matter if, as suggested by Ley et al. and Turnbaugh et al., obesity can be mediated by members of the gut flora. It appears that obese mice and humans have a greater proportion of Firmicutes in their gut flora and that they extract energy from food more efficiently (because of the bacterial capacity for breaking down indigestible polysaccharides) than the Bacteroidetes group that dominates the flora of lean mice and people. Moreover, obesity in mice can be induced by infection.

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