

Translating volume into evidence:

Data from the first year of a pioneer Regional Trauma Registry
in Rio De Janeiro-Brazil

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I dedicate this work to my dear husband without whom it would have remained only a dream.

Abstract

English

Introduction: Trauma care represents a significant burden to the Brazilian society and relies on scarce non-standardized data. Trauma registry is a fundamental component of trauma systems. The creation of trauma rooms and the implementation of a regional trauma registry began in Rio de Janeiro in 2013. **Methods:** This project is a mixed methods study with the objective of analyzing the implementation of the trauma registry in one public tertiary hospital in Rio de Janeiro and mapping the profile of its trauma patients. **Results:** The Regional Trauma Registry was implemented in Rio de Janeiro in 2018. Salgado Filho Municipal Hospital (SFMH) is one of eight institutions to collect data for the registry in the city. Eighteen trauma nurses input a small set of demographic and injury-related data. The registry recorded 10857 traumas between January 2019 and December 2020, of which the majority (64.43%) were men, with a mean age of 44.9 years. 50% of patients self-presented to SFMH and the most common mechanism of injury was fall, followed by road traffic injuries and interpersonal violence (aggressions). The majority of the nurses consider filling the registry well incorporated to their routine but regard important sections such as diagnosis as complex and in need of further training and refinement of options. **Discussion:** Combining a territory of continental dimensions and a famously diverse population, Brazil presents a challenging scenario for trauma prevention and care coordination. After two years of implementation, during which administrative and financial resources were redirected to fighting a global pandemic, the registry is able to generate important reports containing patient profile, relevant information on pre-hospital care, and epidemiological data that can be used to inform public health policies and institutional quality improvement projects. Valuable inputs and potential points for improvement were highlighted by the nurse registrars.

Français

Introduction: Les traumatismes représentent une charge importante pour la société brésilienne depuis la colonisation. Le registre des traumatismes est un élément fondamental des systèmes de traumatologie. La mise en œuvre d'un registre régional des traumatismes ont débuté à Rio de Janeiro en 2013. **Méthodes:** Ce projet est une étude à méthodes mixtes dont l'objectif est d'analyser la mise en œuvre du registre des traumatismes dans un hôpital tertiaire public de Rio de Janeiro et de cartographier le profil de ses patients traumatisés. **Résultats:** Le registre régional des traumatismes a été mis en œuvre à Rio de Janeiro en 2018. L'hôpital municipal Salgado Filho (SFMH) est l'un des huit établissements à recueillir des données pour le registre dans la ville. Dix-huit infirmières en traumatologie saisissent un petit ensemble de données démographiques et liées aux blessures. Le registre a enregistré 10857 traumatismes entre janvier 2019 et décembre 2020, dont la majorité (64,43%) étaient des hommes, avec un âge moyen de 44,9 ans. 50% des patients se sont présentés d'eux-mêmes au SFMH et le mécanisme de blessure le plus fréquent était la chute, suivi par les accidents de la route et les violences interpersonnelles (agressions). La majorité des infirmières considèrent que le remplissage du registre est bien intégré à leur routine mais considèrent que des sections importantes telles que le diagnostic sont complexes et nécessitent une formation supplémentaire et un affinement des options. **Discussion:** Combinant un territoire aux dimensions continentales et une population fameusement diverse, le Brésil présente un scénario difficile pour la prévention des traumatismes et la coordination des soins. Après deux ans de mise en œuvre, au cours desquels les

ressources administratives et financières ont été réorientées vers la lutte contre une pandémie mondiale, le registre est en mesure de générer d'importants rapports contenant le profil des patients, des informations pertinentes sur les soins pré-hospitaliers et des données épidémiologiques qui peuvent être utilisées pour informer les politiques de santé publique et les projets institutionnels d'amélioration de la qualité. Des contributions précieuses et des points potentiels d'amélioration ont été mis en évidence par les infirmières-stagiaires.

I – Introduction

The goal of this project is to foment local research development by presenting data from the first two years of the trauma registry of a municipal hospital in Rio de Janeiro, Brazil. Guided by the principles of fairness and equity, this work was developed under the light of true cooperation, with the purposes of disseminating evidence from a busy trauma center and fomenting local academic growth.

Through a brief historic overview of public health policies and trauma care in Brazil, this work intends to situate the reader in the context in which the Trauma Registry was designed and implemented. The essential role of Trauma Registries in trauma systems and a revision of the singularities and challenges of implementing trauma registries in low-and-middle-income countries (LMICs) are discussed in this project, seeking to highlight the utmost importance of the Trauma Registry implemented in Rio de Janeiro.

Representing a major burden to health care systems worldwide, trauma has significant associated morbidity, mortality, and expenditures. Injuries were responsible for 4,883,194 deaths worldwide in 2016, according to the WHO. In Canada, this number reached 15,800, and in Brazil, 161,200 deaths for the same year (1). Likewise, in Rio de Janeiro, injuries accounted for 5.536 deaths in 2016. In addition to the health care burden, the years of life lost due to disability have a major impact on economies. Losses in economic productivity from surgical conditions amongst LMICs have been estimated at two million American dollars per year (2).

Since 2015, when the Lancet Commission for Global Surgery published a document with alarming data on the impact of surgical diseases worldwide, a globally coordinated effort was initiated to reduce inequities in access to surgical services (2). A significant portion of this initiative involves enhancing supply and quality of trauma care. Improving a trauma care network is a complex multifactorial process involving governmental accountability; approval of regulatory and preventive laws; implementation and development of trauma systems; continuing education, training, and accreditation of healthcare providers; and adequate rehabilitation programs (3, 4). All these aspects require data collection and analysis for their appropriate implementation and development.

A Trauma Registry collects data related to trauma patients and their care. Access to the high-quality information provided by the Trauma Registry can bring unexpected evidence for the definition of priorities for trauma care. Similar endeavors in cities with

crime rates comparable to Rio de Janeiro demonstrated that the distribution of mechanisms of injury is specific to each urban setting and may not correspond to the expected high prevalence of violent crimes. For example, in Cali, Colombia, against the expectations of Ordoñez and colleagues that firearms injuries would be the most prevalent mechanisms, the implementation of a trauma registry unveiled falls and road traffic injuries as the most common mechanisms of injury during the period analyzed (21).

This study will map the profile of patients admitted to the Trauma Room of Salgado Filho Municipal Hospital (SFMH). Data obtained in this study will be analyzed with the purpose of generating a report containing relevant quality information enabling a better understanding of the profile of patients admitted to the Trauma Room of SFMH. The knowledge of the characteristics of patients and the more prevalent mechanism of injury is of vital importance to ensure efficacy of the care provided, reduce costs, and optimize time, human resources and supplies needed. Results in this project have the potential to contribute to excellence in trauma care informing improvements in structure, with acquisition of new technologies and certification of the health care workers; procedure, informing institutional guidelines and protocols of care and patient flow; and outcome, exposing associations between deaths and identifiable risk factors. In the scope of public health, this research can inform regional educational programs, urban transport planning, and injury prevention programs.

II - Literature review

Health care in Brazil

The first Portuguese arrived in Brazil in 1500. Until the late 17th century, healthcare was mainly delivered by healers with the manipulation of herbs and religious rituals.

Physicians were scarce, making healthcare unobtainable for most and available only for the wealthy. In this context, religious charity hospitals called Mercy Homes (“Santas Casas de Misericordia”), were created and remained the only medical assistance available to the poor for many centuries(5). Public health policies were limited to the regulation of medical practice and the scope of healthcare was restricted to combating communicable diseases, with isolating measures and limited therapeutic recommendations. There was no involvement of physicians in the formulation of public health policies. Sanitation, nutrition, and the social determinants of health as defined today were not part of public health.

European physicians and nurses constituted the main healthcare force present until, in 1808, the Portuguese Royal family arrived in Brazil and created medical and surgical universities. Concurrently, the creation of military hospitals, intended to reintegrate diseased soldiers into the forces, shifted the concept of healthcare towards preserving and restoring health. Physicians were now invited to contribute to a more thorough analysis of the reasons for the insalubrity in the city and the social determinants of health were targeted by health authorities(6). After the declaration of independence later in 1822, sanitation and hygiene became object of public health interventions, with the

intent of controlling recurrent outbreaks of yellow fever, malaria, smallpox, and other tropical diseases. Local campaigns for adequate sewage drainage were conducted.

Later in the 19th century, with the proclamation of the Republic, the centralization of government created broader public health policies. Nevertheless, the focus of Brazil's public health has always been communicable diseases. After Brazil's independence, the flow of people and goods from and to Portugal and other European countries remained intense, and the fear of disseminating tropical diseases warranted strict public health vigilance. National sanitary measures such as Vaccination Campaigns were implemented, with special attention to the port areas. The famous Dr. Oswaldo Cruz was the sanitariat physician responsible for contradictory decisive measures, such as mandatory smallpox vaccination.

The unified healthcare system (SUS – “Sistema Único de Saúde”) was formalized in Brazil in 1988 with the new constitution stating: “health is a right of all and a duty of the state”. SUS was created under the principles of universality, integrality, and equity. It is organized under the lenses of decentralization, regionalization and hierarchy, social participation, resolution, and complementarity. Even before the complete organization of SUS, Brazil had developed strong public health interventions targeting prevalent communicable diseases in the 20th century, such as the successful national vaccination plan for Poliomyelitis, eradicating the disease in 1989. With the organization and structure of SUS in place, many other lines of care were created, focusing on prevalent communicable diseases, indigenous health, and child health.

Through the 20th century, Brazil experienced a demographic transition with populational aging. From 1930 to 2000, associated to the implementation and evolution of SUS, this was accompanied by an epidemiologic transition with significant reduction of child and obstetric mortality and increase in prevalence and mortality of non-communicable diseases. Trauma was the leading non-communicable cause of death and followed the trend doubling its mortality rate in the period.

Trauma care in Brazil

Combining a territory of continental dimensions and a famously diverse population, Brazil presents a challenging scenario for trauma prevention and care coordination. Trauma has represented a significant burden to the Brazilian society since colonization, ranking as the second cause of death during the 80s and officially reported as the leading cause of death among the aged 5 to 39 years since the 1990s (7). Despite the long-standing elevated prevalence of trauma, a national policy for reduction of morbidity and mortality from trauma was first published in 2001(8). The document defined trauma as “an event leading to physical, emotional, moral or spiritual damage to self or others” and clearly emphasized its preventable nature. The policy proposed local measures prioritizing primary, secondary, and tertiary prevention, and highlighted the breadth and the impact of primary care and prevention, especially in reducing health care cost. Recommendations from this national policy included: promotion of healthy and safe habits and environments; monitoring of accidents and violent occurrences with the promotion of a continued standardized registry, informing strategies of intervention;

systematization, expansion and strengthening of pre-hospital care; promotion of interdisciplinary trauma care through qualification of human resources; structuring and consolidation of rehabilitation centers; and academic research incentive and development.

In 2002, an ordinance was published entitled “Reduction of Morbimortality by Road Traffic Accidents – Mobilizing Society and Promoting Health”(9). This document focused on promoting educational preventive campaigns and specifically defined data acquisition, analysis and use objectives.

In 2003, a National Policy for Emergent and Urgent Care was developed encompassing pre-hospital, in-hospital, and rehabilitation care. SAMU, the Brazilian pre-hospital system based on the French model, was then created. In this model, early onsite therapeutic interventions are conducted by trained physicians and nurses. Before SAMU, pre-hospital care was provided by the Emergency Rescue Team (ERT), created by the Fire Department in 1986. SAMU was initially included in the health care system as an additional resource to the ERT, but with the ultimate goal of unifying pre-hospital care. Aligned with the principle of integrality, SAMU answered to medical and traumatic events and inevitably became “a gateway into the system”. With 68% of medical events, often related to decompensated chronic medical conditions, SAMU supplied a demand created by the flaws of the system in primary and emergency care, and where reference pathways failed. Social issues also represent a significant need met by SAMU. Rio de Janeiro was the first state to implement the SAMU(10). An important obstacle to the

SAMU administration was, and is, the weak employment relationship and consequent poor employee engagement and lack of adequate technical training. In this perspective, it is important to point out that Emergency Medicine became a recognized specialty in Brazil only in 2015(11). A major challenge in SAMU is that data collection occurs only in the initial regulatory step and there are no reports and indicators with scene data. 50% of calls are dealt with in the regulation, and 50% actually require the ambulance to move, of which 15% require hospital care and 25% are cared for on the scene. Because half of calls are resolved by the regulation physician, collection of data restricted to the regulatory phase represent a significant loss only to traumatic events, all of which require care at the scene. The 2003 policy was complemented in 2011 with a document defining the hospital components of the urgent care network that needed to be integrated, categorizing hospitals according to their capacity and outlining the requirements of each. This document did not include disease-specific protocols(12).

In 2013, the Federal Ministry of Health published Ordinance No. 1365 putting in place the “Trauma Line of Care in the Emergency and Urgency Care Network” (19). The document emphasized trauma was the third cause of death across all age groups in Brazil at the time and acknowledged the importance of an integrated network of care. Prevention was again recognized as the most important means to reduce mortality. The goals of this new document were to define hospital parameters and establish a coordinated network of trauma care including pre-hospital, hospital, and rehabilitation, adding to the document published in 2011. The need for education and

training was also addressed and the concept of trauma as a public health issue that can be prevented, reinforced.

The public health policies and documents published to guide and formalize an organized network of trauma care are at different stages of implementation across the country. Brazil is a large country with significant geographic, cultural, and financial differences between states.

Trauma care in Rio de Janeiro

Rio was the first state to establish a regional pre-hospital system in 2003. In the same year, Rio de Janeiro implemented the walk-in clinics known as “Unidades de Pronto Atendimento – UPA”, responsible for medical urgencies and, eventually, minor traumas. The public hospital network in the city is wide with their administration divided between the municipality, the state, federal government, and philanthropic and academic institutions. This heterogeneity was and remains an obstacle to the integration of trauma care in Rio. Private hospitals do not care for trauma patients.

In 2013, specific recommendations for trauma care were published by the Ministry of Health. The first step was the restructuring of emergency departments to accommodate Trauma Rooms. The creation of the Trauma Rooms allowed for better institutional protocols and flow of trauma patients. A team of nurses was trained and assigned exclusively to the Trauma Rooms, and investments were made for purchasing equipment such as portable X-rays and ultrasounds. The next major step was the

implementation of the unprecedented digitalized Regional Trauma Registry in January 2018. (18,20)

In all hospitals of the city, the process of collecting data from trauma patients was previously done in a book of minutes, in which the nursing team recorded a simple non-standardized set of demographic information. The lack of standardization of the data collected prevented the comparison between hospitals or regions. In addition, manual registration of information in the book limited the quality and completeness of the inserted data points. Data extraction and analysis were extremely laborious, hindering the generation of reports that could inform institutional improvement programs and the designing of injury prevention campaigns.

The Project of standardizing trauma data was then initiated. From a model utilized in another Municipal hospital in Rio de Janeiro, Lourenço Jorge Municipal Hospital, a simplified demographic form was developed and gradually implemented across all emergency/urgency hospitals of the city.

An online platform was developed for this registry with the goal of reducing implementation costs and ensuring adequacy to the local trauma rooms and their staff and equipment capability. The online database is fed primarily by the nurse staffing the Trauma Room, with information collected at the patient's entry. The current dataset includes demographic data, mechanism of injury, initial diagnosis, and flow in the unit. The data collected in all hospitals is stored online and accessible to all healthcare

providers involved in trauma care, with different levels of authorization according to their position.

Data from 2018 was considered experimental and not included in this study, since it was collected during the piloting period of the online platform. In 2022, a new phase will be initiated with the recording of additional clinical information. With every new phase, nursing staff receives additional training, ensuring the quality of the data collected. The set of data to be collected will be continuously revised by the Trauma Room chiefs and discussed in regular meetings before its adapted accordingly.

The implementation of the Trauma Registry in the City of Rio de Janeiro is a pioneer project in Brazil due to its municipal breadth and digital integration. In other provinces of Brazil, trauma registries have been implemented marking a major step towards the improvement of trauma care, but only at institutional and not at regional levels (18,20). The information from this registry will be invaluable for institutional quality improvement programs and public health policies on injury prevention. Additionally, the data from this registry has vast potential to encourage important scientific publications in the fields of trauma care, institutional guidelines development, and even cost-effective analyses. Furthermore, the achievement of this initiative foments the development of similar regional registries in other provinces, providing useful lessons and insights.

Trauma Registries

Trauma registry is a fundamental component of trauma systems, defined as a database continually and systematically fed with data from trauma patients. Trauma systems are a coordinated hierarchically organized network of care composed of pre-hospital and in-hospital trauma care, rehabilitation, and support services. The need for and importance of trauma systems are extensively acknowledged in the literature and its impact on trauma mortality rates widely published (13-18). The goal of the trauma database is to provide epidemiological data to inform and ensure the efficiency of the trauma system(4). The information collected by the trauma registry allows the development of institutional and regional quality assurance programs, informs, and supports public health policies on injury prevention contributing to the maturation of trauma systems, and foments research (19, 20).

The basic components of a trauma registry are the structure (managing institution with proper funding, equipment, software), inclusion and exclusion criteria, trained registrars, data points to be collected, and data storage and maintenance department. Other essential aspects to a successful registry are strong leadership, motivation, and commitment(21).

Since 1969, when the first computer-based trauma database was developed in Cook County Hospital, Chicago, most developed countries have evolved from Institutional to Regional and National databases(22). In Europe, UK, Germany and Scandinavia started an international database with more than 35 centers from different countries,

gathering data that allow comparison of performance between centers and guide region-appropriate quality improvement programs(4).

Participation of hospitals in the regional and national registries can be voluntary or mandatory, depending on the structure and legislation in place. The National Trauma Data Bank (NTDB) in the United States, for example, is fed by voluntarily submitted data(22). There are a few considerations to the inclusiveness of this model: high standards for data quality in the NTDB require designated trained personnel, demanding hospitals to allocate sufficient resources to their registry and limiting the collection of data from smaller/less financed institutions; selection of data from well financed institutions also introduces bias from their patient profile and therapeutic standards; lastly, there may be differences in the coding process, despite the extensive orientation material provided by the American College Surgeons for centers entering the NTDB(23). In Quebec, Canada, participation in the regional registry is mandatory, reflecting a more mature trauma system where all trauma centers are adequately financed and trained to collect standardized quality data. In this model, all trauma centers are integrated with pre-hospital care and the referring network is well established. This is possible largely due to government engagement in a publicly funded healthcare system, creating a more inclusive registry that represents more closely the population served(24).

Registries are structured as digital databases often fed through online platforms. Commercial and institutional platforms have been designed and implemented with

specific hardware requirements and staff recommendations (25, 26). Many countries chose to design their own platform, including data points relevant to their setting and adjusting navigability to their culture and resources, aside from reducing the implementation and maintenance cost. On the other hand, tailored platforms can include unusual data points or different categories of variables, impairing adequate comparison with high performance centers at internationally recognized reference databases (27).

To be included in a Trauma Registry, patients must fulfill predetermined inclusion criteria. Criteria are defined within each institution or region. Many employ ICD codes to select patients into the registry, since it is usually available from hospital administrative data(23, 26). Other commonly used criteria are “major traumas” defined by an Injury Severity Score of 12 or higher, ICU admission, and transferred patients (4, 22, 28). A five-year analysis of administrative data from trauma patients admitted to public hospitals in Australia, selected according to their ICD-10 codes, demonstrated that 87.9% did not meet inclusion criteria for their trauma registry due to an ISS of twelve or less, corresponding to “minor trauma”. They also found that “minor traumas” were responsible for 32.8% of traumatic brain injuries, 91.6% of surgeries performed and 75.3% of all rehabilitation events (29). These findings suggest inclusion criteria to trauma registries should be revised for a more accurate analysis of the trauma population. The same authors published equivalent predictive accuracy for trauma mortality between ICD-based and ISS selection in the cohort of 92,140 included in the five-year study (30). The choice of restricting inclusion in the registry to severely injured

patients produces high quality data by reducing confounders. In contrast, introduces selection bias, especially significant for smaller centers with the majority of traumas being isolated low intensity. Variability of inclusion criteria can generate very diverse datasets hindering adequate comparison between centers(22).

The data points included in trauma registries vary according to the resources available and the setting where the registry is implemented. Trauma registries can document patient demographics and comorbidities; circumstances related to the mechanism of injury; pre-hospital clinical parameters and interventions; all course of hospital stay from the acute phase to discharge, including specific injury diagnosis, treatments and complications; and patient outcome (22). Demographic information is universally included since it is standard for hospital administrative data and needed for adequate stratified epidemiological analysis of injury-related data and development of targeted public health policies. Inclusion of specific information such as Injury Severity Scores (ISS), coded procedures and treatments, and clinical measurements, not part of standard hospital administrative records, requires designated trained registrars. For this reason, institutions frequently begin with demographic and injury-related data, adding clinical information as the organization and structure of the registry matures. Furthermore, there is significant cost associated with maintaining continuously trained personnel, updated software, and adequate hardware, required for collection of an extensive dataset.

The quality of the information collected by the registrar depends on multiple factors. Information from paper charts can be difficult to access or interpret; poor charting due to time constraints of demotivated clinicians working in an understaffed low-resource setting and consequent missing, incomplete, or incorrect information. Insertion of data in the registry relies on trained committed registrars. Training is essential for adequate coding and efficient insertion of quality data. In settings with limited resources, registrars are often also working as clinicians, limiting time and engagement in the data collection process. The overwhelming amount of work designated to multitasking registrars in resource-limited institutions can lead to elevated rates of missing data and recurrent choices of unspecific codes, limiting quality of the information in the registry.

Trauma Registries in LMICs

Considerations to the implementation of trauma registries in LMICs go far beyond financial limitation. Although funding constraints is a struggle present across all publications on the topic(27, 31), barriers to the implementation of trauma registries include: young immature public health policies, heterogeneous protocols of trauma care across institutions, limited and poorly integrated pre-hospital care, poor funding, and data quality issues.

LMICs have a convoluted historical, social, and political construct, contributing to an elevated incidence of traumas from increased urban violence and frequent road traffic accidents. Governmental accountability is needed to organize and coordinate trauma care, integrating public health policies with budgeting and practice guidelines in a

mature trauma system(27). Strong governmental programs coordinate institutions, standardizing practices and generating reliable data with good populational representativeness. Trauma cases in LMICs are numerous and often complex, ideally requiring sophisticated facilities and highly trained workers to achieve favorable outcomes. Cutting-edge technology and continuing educational programs are not widely available since trauma care programs in LMICs are recent inclusions to public health policies, typifying immature trauma systems.

Governmental and professional organizations are essential for the maturing of successful trauma systems. Professional organizations have an important role in contributing to the development of adequate guidelines and recommendations to standardize trauma care, improving outcomes, and facilitating the generation of more accurate and complete data. Monitoring of working conditions and reporting inadequacies is also duty of professional organizations. In most LMICs, healthcare is divided between public and private institutions, complicating standardization, and integration of trauma care. Most trauma cases are cared for in the public facilities since pre-hospital care is rarely integrated with private institutions. There is no coordination between public and private facilities, and most patients are transferred to private facilities after the critical initial management is conducted in the public hospitals. There are significant undocumented differences in care and outcome as a consequence of lack of standardization and important resource disparities between public and private facilities.

Pre-hospital care is frequently understaffed and not fully integrated with the hospital network. Individuals working in pre-hospital care are not routinely trained, equipment is often outdated, malfunctioning, or missing. In this context, there is limited focus on documenting information for generating reports and supporting research.

There is economic heterogeneity amongst LMICs and restricted financing affects, direct or indirectly, all aspects of trauma care. Infrastructure, technology, supplies, and human resources are often precarious, outdated, scarce and underqualified. In this resource-limited scenario, registries are considered secondary, restricting collected data to essential hospital administrative information. Implementation and maintenance costs for trauma registries often do not fit institutional budgets. Research and academic development are also discouraged by limited financing, perpetuating a culture where adequate documentation and data collection are undervalued. In this regard, it is relevant to contextualize that academic production and publications have limited relevance to practitioners' careers in LMICs, contributing to their limited interest and dedication.

In a review of implementation of trauma registries in LMICs, concerns of data quality were the most commonly reported issues(27). Data quality concerns involve underreporting, incomplete records, and the use of inappropriate scoring tools. Strict and qualitative non-specific inclusion criteria for the registries leads to poor representativeness of the local trauma population and of the prevailing pattern of injury.

Paper-based records with poor legibility and inconsistency of information makes data collection a challenging process, especially since there are no designated trained registrars due to budget constraints(21). Scarce research incentives lead to poor professional engagement and motivation, contributing to poor charting. Specific trauma scores for LMICs have been studied and may require collection of additional non-standard information(32) without improvement in performance, when compared to ISS. In a National Trauma Data Bank study, simplified mortality-predicting scores that do not include anatomic or injury information were more feasible in a resource-limited environment than ISS-dependent scores, but with worse predicting performance.(33)

The objective of this study is to describe and report the first two years of a single hospital in the Regional Trauma Registry implemented in all Municipal Hospitals in Rio de Janeiro under a qualitative and a quantitative perspectives.

III – Materials and Methods

This project is a retrospective observational study of trauma patients admitted to a public tertiary hospital in Rio de Janeiro, Brazil. Ethical approval was obtained from the Ministry of Health in Brazil and from McGill's Ethics Committee, in Canada. Data was obtained digitally through access to the online registry platform. A quantitative analysis of the data and a qualitative analysis of the process of data collection were conducted and reported.

Data analysis was conducted through virtual collaboration between the Center for Global Surgery, McGill University Health Center, and the author and co-authors from Salgado Filho Municipal Hospital. Open access software R was used for the analyses performed. Results are published according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement (34) and the Standards for Reporting Qualitative Research (SRQR) (35).

Quantitative analysis

Registry data analyzed refers to all trauma patients included in the Regional Trauma Registry of Salgado Filho Municipal Hospital (SFMH), in Rio de Janeiro, from January 2019 to December 2020. The demographic profile of patients, most prevalent mechanisms of injury and the annual distribution of traumas are described.

Quantitative data was extracted from the digital trauma registry through access to the online platform and kept in a password-secured laptop. Information is extractable in monthly reports of age groups, gender, means of transport to the unit, mechanisms of injury, flow inside the unit, mortality on arrival and deaths after initial management. These variables were obtained for 2019 and 2020 and were condensed to build Table 1 and define percentages and means. Color/race, date and time of admission, and preliminary diagnosis are not obtainable from the platform at this point. The categorical variables are grouped by frequencies and percentages, and the continuous variables by means. Age is presented as a categorical variable in age groups, therefore, no

continuous category is presented. The mean age presented was estimated with mean calculations for grouped data. Mean differences and their significances were not verifiable by the Student t test and planned univariate and multivariate Logistic Regression analysis to identify risk factors for the most common diagnosis and mechanisms of injury, and other associations were not feasible since individual data points are not obtainable from the database at this point. Assessment and reporting of missing data was not possible, as well as correspondent sensitivity analysis.

Qualitative analysis

The subjective evaluation of the data collection process was planned as direct observation during day and night shifts in different days of the week, aiming to aggregate important information regarding the context and structure in which the registry functions. The circumstances under which trauma nurses feed data into the registry provide invaluable information and exposes potential points for improvement in the registry. The inevitable limitations of the data collected by multitasking nurses are explored and outlined for quality improvement purposes. However, direct observation of nurse registrars was not possible since hospital access for research purposes was prohibited for a prolonged period due to the COVID-19 pandemic.

Alternatively, a qualitative analysis of the registry was conducted with the trauma nurses through a short digital questionnaire (Figure 1). The questionnaire was designed to allow the nurses to freely express their thoughts and ideas about the registry and their suggestions on how to improve it. Questions were presented through email or

messaging application. Five questions were defined after review of literature and expert contribution, and formulated as concise and objective, to facilitate answering and participation.

Trauma nurses consented to the digital interview. The number of years of experience and whether they completed TEAM or ATCN courses was recorded. Five points Likert scale questions were presented, all followed by open lines for free expression of reflections and considerations. Issues evaluated were relevance and applicability of the registry, availability, and quality of information in the charts, easiness of completion of the form in the platform, and time constraints. Answers are presented as simple counts and percentages.

Figure 1:

Thank you for answering these questions about the Trauma registry:

Years of practice (since completion of training):_____	Completed the TEAM/ATLS course: 1- Y 2- N Year_____
--	--

1) The trauma room is my favorite department to work in the hospital.
1- strongly disagree 2- disagree 3- neutral 4- agree 5- strongly disagree

2) The trauma registry is very important.
1- strongly disagree 2- disagree 3- neutral 4- agree 5- strongly disagree

3) Information required in the trauma registry is readily available in the charts.
1- strongly disagree 2- disagree 3- neutral 4- agree 5- strongly disagree

4) Completing the registry is well incorporated in my routine of the trauma room.
1- strongly disagree 2- disagree 3- neutral 4- agree 5- strongly disagree

5) Information from the registry can inform health care providers and improve their practice.
1- strongly disagree 2- disagree 3- neutral 4- agree 5- strongly disagree

6) Has the data from the registry ever been presented to you? What information would you like to know?
1-yes
2-no

What information do you think is missing from the registry?

IV – Results

The Registry

The Regional Trauma Registry implemented in Rio de Janeiro, Brazil is a database of demographic and injury-related data from all traumas admitted to emergency hospitals in the city. The Registry functions in an online platform and is fed with information from all eight public municipal hospitals. Each hospital inputs data from their own patients. The online platform was developed specifically for the registry and piloted in 2018. Trauma nurses are in charge of accessing the platform and feeding the registry prospectively. Data is inserted in the tailored form with open-ended fields and drop-down menus that seek to facilitate the work of the registrars.

Inclusion criteria for the trauma registry was set broadly and all patients entering the trauma rooms are included in the registry. Exclusion criteria was defined as patients inappropriately triaged to the trauma room, who did not experience any trauma. Occasionally, patients are deemed superficial traumas and are taken to the general surgery consult room, not being included in the registry.

The dataset collected in the registry comprises: date and time of entry to the unit; chart number; if police occurrence (Y/N); if work-related (Y/N); if dead upon arrival (Y/N); name; age; gender; color/race; means of transport to the unit; mechanism of injury; initial diagnosis; flow in the unit; date and time of discharge from the trauma room.

Categorical variables are recorded from drop down menus in the form. Means of transport to the unit, mechanisms of injury, and flow in the unit have defined categories including “others”. There is considerable subjectivity in the selection of the “others” category, and it is selected anytime the information is not found or misrepresented by the available categories, demonstrated by the relatively elevated prevalence of this category as the third most common (8%) mechanism of injury.

A total of 18 nurses are authorized to work as registrars at SFMH, inputting data in the registry during their shifts. For full time trauma registrars completing a dataset of fifty variables, it is recommended to have 750 to 1500 patients per registrar per year(25). In SFMH, there were 332 patients per registrars in 2019 to collect 14 data points, considering all eighteen trauma nurses work the same number of hours and emphasizing they share their time between patient care and data input.

The online platform of the registry allows the user to generate monthly reports of age groups, gender, means of transport to the unit, mechanisms of injury, flow inside the unit, mortality on arrival and deaths after initial management. Individual data points are only accessible online and not exportable from the platform at this point. The inclusion of clinical data points to be collected are under evaluation by the municipal authorities and should be implemented in 2022.

Quantitative analysis

The registry recorded 10857 traumas between January 2019 and December 2020. The population covered by SFMH is estimated to be 45.972 people. The incidence of trauma in the region in 2019 was 13% and in 2020 was 10%. The majority (64.43%) of patients admitted to SFMH during the study period were men, with a mean age of 44.9 years. Age groups 15 to 35 corresponded to 41% of all trauma admissions.

50% of patients self-presented to SFMH and 37.5% were brought by pre-hospital care teams. The most common mechanism of injury was fall, followed by road traffic injuries and interpersonal violence (aggressions). Most patients (63.94%) were directed to x-ray and/or CT scan after their initial assessment, 15% were discharged after initial assessment in the trauma room and 3.6% required immediate surgery.

Mortality of victims transported to the unit before arrival corresponded to 0.85% of all trauma entries and were defined as patients who arrived without any signs of life to the trauma room. Patients who died after their initial assessment in the trauma room were included in the category “death” of the variable “flow in the unit” and corresponded to 1.13% in 2019 and 0.4% of cases in 2020. Aggregating deaths on arrival and deaths after initial management, mortality rate was 3.7% for 2019 and 1.9% for 2020.

Table 1

Traumas	2019		2020	
	n	%	n	%
	5983		4874	
Deaths n (%)	68	1.13%	24	0.40%

Gender n (%)	Male	3804	63.59%	3191	65.48%
	Female	2161	36.11%	1653	33.92%
	Unidentified	18	0.30%	30	0.60%
Age group n (%)	0 – 4	53	0.89%	31	0.64%
	5 - 9	1	0.02%	0	0.00%
	10 – 14	36	0.60%	23	0.47%
	15 – 19	467	7.81%	358	7.35%
	20 – 24	697	11.65%	633	12.99%
	25 – 29	647	10.81%	544	11.16%
	30 – 34	549	9.18%	456	9.36%
	35 – 39	477	7.97%	451	9.25%
	40 – 44	393	6.57%	339	6.96%
	45 – 49	306	5.11%	284	5.83%
	50 – 54	382	6.38%	259	5.31%
	55 – 59	299	5.00%	255	5.23%
	60 – 64	291	4.86%	286	5.87%
	65 – 69	283	4.73%	217	4.45%
	70 – 74	294	4.91%	192	3.94%
	75 – 79	238	3.98%	164	3.36%
	80 – 84	249	4.16%	165	3.39%
	85 – 89	180	3.01%	130	2.67%
	90 – 94	99	1.65%	67	1.37%
	95 – 99	33	0.55%	16	0.33%
	➤ 100	0	0.00%	0	0.00%
	Mean	45.55		44.27	
Means of transport the unit	Self-presentation	3019	50.46%	2520	51.70%
	Pre-hospital (SAMU/GSE)	2275	38.02%	1821	37.36%
	Military Police	248	4.15%	180	3.69%
	Transfer	184	3.08%	198	4.06%
	Other	155	2.59%	84	1.72%
	Private ambulance	84	1.40%	45	0.92%
	Municipal Guards	18	0.30%	26	0.53%
		5983		4874	
Mechanisms of Injury	Falls	2372	39.65%	1917	39.33%
	Road Traffic Injuries	1948	32.56%	1743	35.76%
	Aggressions	624	10.43%	490	10.05%

	Others	527	8.81%	367	7.53%
	GSWs	364	6.08%	209	4.29%
	Burns	40	0.67%	30	0.62%
	Stab wounds	54	0.90%	82	1.68%
	Blast injuries	16	0.27%	17	0.35%
	Suicide attempt	32	0.53%	13	0.27%
	Sexual assault	4	0.07%	3	0.06%
	Drowning	1	0.02%	3	0.06%
		5982		4874	
Flow in the unit	Discharged	1047	17.53%	584	11.98%
		531	8.89%	121	2.48%
	Xray	1946	32.57%	1545	31.70%
	Sala Amarela	199	3.33%	116	2.38%
	LAMA	162	2.71%	90	1.85%
	OR (Operating room)	192	3.21%	204	4.19%
	Death	156	2.61%	69	1.42%
	CT scan	1519	25.43%	1926	39.52%
	Medicine admission	115	1.93%	49	1.01%
	Transferred to a public unit	24	0.40%	29	0.59%
	Surgical admission	61	1.02%	90	1.85%
	ICU	7	0.12%	2	0.04%
	Transferred to a private unit	15	0.25%	49	1.01%
		5974		4874	

Qualitative

8 of the 18 nurses answered the questionnaire. All questions were answered, and participation was voluntary and anonymous. The mean number of years of practice was 15, and with trauma care, 12. 62% of the nurses had specific Trauma Care training and 100% agreed or completely agreed that the trauma room is their favorite place to work in the hospital.

87.5% affirmed the trauma registry is very important and five of the eight nurses agreed information from the Trauma Registry can be used to improve care practices. Five nurses reported filling the trauma registry is well incorporated to their routine, but 62.5% reported information required is not readily available.

Patient comorbidities, team performance and outcome data were pointed as missing from the Registry. Five nurses mentioned the means of transport to the unit and mechanism of injury codes are non-specific and should be expanded to better represent the profile of patients in the unit. Lack of flexibility of the form was reported by six of the eight interviewees. Only one nurse informed having received training to fill the registry. All responders informed the data has not been presented to them yet.

V – Discussion

Reducing the burden of injuries (2) is a complex multifactorial process that involves government accountability and approval of preventive and regulatory legislations; development of trauma systems; education, training, and accreditation of health care providers; implementation of institutional protocols of care; and proper rehabilitation processes (3, 4). Improving the quality of trauma care represents a challenge and requires tireless dedication and commitment.

Trauma is a disease historically neglected by the Brazilian health authorities with chronically limited investments in data collection, quality assessment, and analysis.

There is an unfortunate longstanding history of corruption in health care administration in Rio, with diversion of monetary resources and negotiation of shady deals. Poorly engaged government and institutional leaders exercise little advocacy for quality improvement initiatives such as the trauma registry, hindering the development of a trauma system. Motivation is also weakened between healthcare professionals working understaffed, underpaid and in inadequate conditions. The crowded emergency departments contribute to staff frustration and, often, burnout. Scarce resources entail old hardware, missing or malfunctioning equipment, and limited supplies.

Trauma is an endemic condition that impacts disproportionately the poor and consumes a significant portion of healthcare budget, requiring highly trained professionals and sophisticated equipment. Thus, financing is disproportionately insufficient considering the young deaths, countless years lost to disability and the economic damage trauma brings when neglected and poorly managed. The devastating consequences of trauma remain unmeasured and, consequently, ignored in most parts of Brazil and specially in Rio de Janeiro.

The development of a trauma system in Rio de Janeiro is a challenge, considering the elevated crime rates, the complex mountainous landscape and longstanding corruption with scrapping of public health care institutions. The volume and complexity of traumas in Rio have the potential to bring great contributions to injury care worldwide. The study of data from traumas in Rio de Janeiro, first and foremost, will reduce mortality in a city with incidence and severity of lesions comparable to war zones. Secondly, lessons

learnt from the process of implementing the regional trauma registry, and eventually a mature regional trauma system, can be used to inform the same process in other parts of Brazil and similar endeavors for different diseases. Lastly, the data collected by this registry will foment research, contributing to the scientific community and providing substantial evidence to improve trauma care worldwide.

The overall frequency of traumas may be underreported in this analysis including pandemic years, but studies have demonstrated only small transient reductions in the volume of cases in trauma centers during lockdown periods (36-39). In a published review of trauma trends during the pandemic, 7201 admissions in 2020 were compared to 7381 in the historical control from 2019, in 15 levels 1 and 2 trauma centers in Los Angeles, California(40). This study also demonstrated brief reductions in the number of trauma cases during lockdown measures, without significant overall reduction in the trauma volumes. Interestingly, the busiest center reviewed registered less than 1500 trauma admissions per year, which corresponds to a quarter of the volume seen in Salgado Filho Municipal Hospital (SFMH). This disparity demonstrates SFMH deals with a high volume of trauma and the potential of the data collected by its Trauma Registry should be explored.

Despite the small reduction in the number of cases in 2020 and the significant drop in mortality, SFMH did not register change in patterns of mechanism of injury. One possible reason for the significant reduction in mortality in 2020, when compared to

2019 (3.7 to 1.9%), is the reduction in severity of cases during lockdown periods. No clinical data was collected during these years to reject this hypothesis.

Outcomes for severely injured patients are strongly associated with trauma centers volume (41) and despite limited resources and other constraints of a public hospital in a LMIC(42), SFMH has low early mortality rates. This indicator exposes a very important aspect of trauma care in Rio, that is the quality of pre-hospital care. Presumably, the low mortality rate after initial assessment in the trauma room can be attributed to less severely injured patients arriving to the unit, while the sickest die at the scene or on the way to the hospital. In addition, comparing this mortality rate with published HIC level one trauma centers indicators is not adequate since most include only patients with ISS of 15 or higher, while SFMH rates are not stratified. Another important difference is that mortality is often reported as early mortality, encompassing the first 24hs of admission. In this registry, the mortality rate refers only to patients that entered the trauma room and that died during the initial assessment, contributing to its underestimation.

The most common mean of transport to the unit was self-presentation, highlighting the need for expansion of capacity of the pre-hospital system. Many patients prefer to take a private vehicle to the hospital because of the delay in arrival of the ambulances to the scene. The elevated self-presenting rate may also represent the majority of cases are minor traumas and raises an important point of discussion concerning the inclusion criteria of the registry. As the amount of data to be collected increases with the

additional clinical data, the inclusion criteria might require revision to ensure data quality with the same number of registrars under the same budget.

The most prevalent mechanism of injury was fall. Typically, most falls are from own height involving the elderly and work accident from construction sites. However, in the catchment area of SFMH there are many irregular constructions (accumulating in what are known as “favelas”), where children and young adults have the cultural habit of flying kites on the rooftops from which they frequently fall. Other common site of injuries in SFMH area is the train station, located immediately across the street from the hospital. Fall from the train station platform and from the walls and safety grids are also frequent among homeless and buglers in the area. Unfortunately, the presence of the train line also allows SFMH to admit unusual and very severe traumas from pedestrians hit by the train.

The majority of patients were directed to imaging scans after the initial assessment in the trauma room, nearly equally divided between x-rays and CT scans. SFMH has one portable x-ray machine to serve the entire hospital. There is no x-ray machine in the trauma room or exclusive to the ER. Another important consideration is that motorcycle accidents are very common in Rio and often lead to extremities traumas that require radiologic evaluation. In addition, the use of helmets is frequently neglected by riders and CT is often needed to exclude any anatomical lesions from traumatic brain injury, due to the high energy nature of the traumas. Nevertheless, reporting flow of patients to the imaging sector prevents the actual trajectory of care to be recorded. After imaging,

almost all patients return to the trauma room for reassessment and finally directed to their definitive destination in the unit or discharged. It is not clear from the reports obtained if the 15% of patients recorded as discharged after initial assessment in the trauma room did not have any imaging study done before discharge.

Objectively reviewing the data enables the identification of several points for improvement in the registry. The majority involves better definition of data points and criteria for each category. Imaging studies should be registered, if done, and not considered a destination in the unit for the trauma patient. Strategy for dealing with missing data is not defined, exposing another area to be developed in the registry.

To be able to identify and interpret the structure and functioning, as well as its pitfalls, the perspective of the nurse registrars was explored. Virtual interviews with the nurse registrars were carried as a surrogate to direct observation of the data collection process previously considered. The virtual nature of interviews and the anonymous recording of answers allowed them to freely express their considerations, and important observations and suggestions arose. The nurses' perspectives on the data collection process and the registry platform are essential, and their motivation and commitment ensure the database is formed with high quality data.

Interviewees reported the platform of the registry is user-friendly but the options in the drop-down menus are limited and do not adequately capture the profile of patients (*"Codes are not facilitators. Codes are comprehensive and non-specific"*). Nurses

reported, for example, that the choice of mechanism of injury available in the platform does not encompass common events such as falls from heights. The presence of non-specific categories in the data collection form, such as “fall” as a mechanism of injury with no additional information, uncovers potential areas of improvement concerning design of the platform, categories available for each variable collected, and data collection procedures.

In addition, information is not easily collectable from the charts due to lack of standardizing of reports, illegibility and use of non-specific codes. Another variable highlighted as poorly recorded in the registry is the initial diagnosis. Because this information is often not available in the charts and the options available in the form are limited, the nurses choose non-specific codes in the drop-down menu of the platform, restricting valuable information from the database. Even the nurses that replied 3 or less for the importance of the registry demonstrated, in the free comments section, awareness of relevant missing information and how this can impact the applicability of the data.

The dedication of the trauma nurses filling the registry demonstrates that organization and engagement enable the implementation and maintenance of relevant endeavors such as the Trauma Registry, even when resources are deemed insufficient by HIC standards. Protocols that ensure active continuous involvement of the nurses in the development of the registry should be implemented and encouraged. Regular sessions to obtain the nurses’ input would provide invaluable information on how to improve the

data collection process and, consequently, the quality of collected data. The result of this project hopes to foment institutional campaigns of appreciation and qualification of the health care workers, both required for excellence in trauma care.

After two years of implementation, during which administrative and financial resources were redirected to fighting a global pandemic, the registry is able to generate important reports containing patient profile, relevant information on pre-hospital care, and epidemiological data that can be used to inform public health policies and institutional quality improvement projects.

Strengths

As a pioneer project in Brazil, this project is of major importance for the study of trauma and the development of public health policies with adequate epidemiological background.

In a single center in the hospital network, the volume of trauma cases is bigger than trauma centers in high-income countries, demonstrating the immense potential of the registry and significance of the study.

The development of a mixed method study incorporated critical information and added relevant perspectives of the Regional Trauma Registry in Rio de Janeiro, Brazil. The inclusion of a qualitative analysis elevated the quality of the results presented, generating a more comprehensive report of the data collection process.

Limitations

This study presents limitations concerning study design, data quality and feasibility issues from unprecedented circumstances.

This project obtained data from one of the eight hospitals in the network of the Regional Trauma Registry in Rio de Janeiro, Brazil, restricting the patient profile and trauma epidemiology to the population and region served by this single hospital. Therefore, representing a small picture of the trauma dynamics in Rio de Janeiro and, thus, jeopardizing generalizability of the findings presented.

The transformative potential of the impressive number of cases registered is depreciated by data accuracy concerns. Data analyzed in this study was previously included in the registry, as it is inherent to the retrospective design of this study. Restrict access to the individual data points limited appraisal of important information of all ten thousand patients in the registry. Missing clinical data limits the capability of stratifying and analyzing specific groups and trauma scenarios. Nonexistence of a data collection protocol and a data quality program present additional limitations to the reliability of the information.

This project was developed during the outbreak of a global pandemic. This unexpected and dramatic event exposed the unfair distribution of resources and where they are most needed. Inequalities in health care are exposed when there is a sudden increase

in demand. Trauma is often received as an unexpected demand, even though it is a common condition and an essential line of care required in any healthcare system.

Trauma shares the unpredictability of an outbreak and provokes the same exposing effect, in a smaller scale. The trauma room is a standby unit and when a severely injured patient arrives, all that is not readily available, and functioning is revealed. In the same manner as the pandemic, during the initial assessment of a trauma patient the sequence of events unravels quickly and the circumstances can change rapidly, requiring all players to be “on top of their game”. The need for immediate actions demands that all involved are well trained, equipment is working, and protocols are diffusely implemented to coordinate care as efficiently as possible.

The global pandemic presented a significant hurdle to the data collection process. Health care resources and personnel were redirected to fighting the pandemic, significantly delaying obtention of ethical approval and access to the registry.

Future directions

The report generated by the present study has the potential to outline opportunities for improvement of the trauma registry in SFMH, and support institutional performance reports, ensuring adequate resource allocation. This report values the institutional effort of maintaining a high quality of care with increasing demand and workload, after the implementation of the TR. Particularly during pandemic years, it is remarkable that this project has been implemented and developed, institutionally and regionally. Contributing

to the improvement of the registry is a mandatory retribution to all the dedicated healthcare professionals involved at SFMH.

The next project to be developed is the expansion of interviews and to conduct them in-person, exploring all nuances of the rich perspectives of the front-line nurses. Obtaining clinical data to allow for adequate comparisons of indicators and evaluation of correlations between variables will follow.

I hope the publication of the information obtained from the first years of the Trauma Registry will attest to its successful and priceless contribution to trauma care in Rio de Janeiro, in Brazil and internationally.

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