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Review Article

Eye Injury Registries: A Review on Key Registry Processes

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Abstract

Background: Data management related to eye injuries is vital in improving care process, improving treatment and implementing preventive programs. Implementation of a registry to manage data is an integral part of this process. This systematic review aimed to identify processes related to eye injury registries.

Methods: Databases such as PubMed, Web of Science, Embase and Scopus were used in searching for articles from 2010 to Oct 2020 using the keywords "eye injuries" and" registry". The identified processes related to eye injuries registry such as case finding, data collection, abstracting, reporting, follow-up and data quality control are presented in this review.

Results: Of 1493 articles retrieved, 30 articles were selected for this study based on the inclusion and exclusion criteria. Majority of these studies were conducted in the United States. All registries had case finding and the most common resources for case finding included medical documents, reports and screening results. Moreover, majority of registries collected data electronically. However, few registries used data quality attributes to improve the data collected.

Conclusion: Eye injury registry plays an important role in the management of eye injury data and as a result, better management of these data will be established. Taking into consideration that the quality of collected data has a vital role in adopting prevention strategies, it is essential to use high-quality data and quality control methods in planning and designing eye injury registries.

Keywords: Eye injury registries; Eye injuries; Ocular trauma; Registries; Systematic review

Introduction

Eye injuries is one of the most common causes of unilateral blindness, especially in developing countries, which has significant socio-economic consequences for patients and society (1). Eye injuries alter patients' lives by creating disabilities and imposing high costs of treatment and rehabilitation on the health care system (2, 3). Annually, about 55 million eye injuries occur world-

wide (4, 5). The annual incidence of other injuries that resulted in hospital admission is between 6.5% and 27.7% per 100,000 population (1, 6). In the United States, the prevalence of eye injuries as a primary diagnosis is 3.0% per 100,000 population while the incidence of eye trauma as a secondary diagnosis is estimated at 19.0% per 100,000 population (7). Eye injuries are considered a major problem worldwide, yet they are preventable (8). Adopting prevention strategies depends on identifying the cause of the injury. Therefore, systematic collection of data related to the cause of eye injuries can help ophthalmologists in preventing these injuries (9).

Data management of a related disease can be used as a reference database to achieve various health and medical goals and implement related programs (10). One of the most important data management tools that play an important role in combating diseases is the registry (11). A disease registry is the continuous and systematic collection of information of all individuals in a specific population for whom a specific disease or health event has been diagnosed (12). Registries, as the main tool for managing disease data (including data collection, processing, and dissemination), use existing clinical guidelines and standards to reduce care delivery costs and help improve patient care delivery processes (10, 11, 13, 14).

Registries are divided into two main categories; population registry and hospital registry. The population registry contains information about people with a disease or health consequence who live in a defined geographical area. However, the hospital registry collects information about patients with a specific type of disease referred to a hospital for treatment, this type of registry is divided into two types: single-hospital registry and multi-hospital registry. The focus of this type of registry is mainly on clinical care and hospital management (11, 13).

Hospital registry processes include case finding (identification and diagnosis of cases recorded and reported of disease in the registry), data collection and storage (collection and maintenance of patient information that may have been generated by physicians, and data recording and processing experts), abstracting (according to the scope of information recorded in this step, an abstracting about the disease, diagnosis, treatment and its consequences is recorded), patient follow-up (systematic process of monitoring and monitoring the health status of patients discharged from the hospital, reporting, (any type of reporting or analysis of data in the registry), and data quality control (a continuous process to monitor the quality of data entered in the registry to ensure data quality) (10, 14-17).

The use of registry to improve quality of care and research has grown significantly in recent decades, and with the improvement of IT infrastructures, this trend will continue to grow. A study of 13 disease registries in 5 countries (Australia, Denmark, Sweden, the United Kingdom and the United States) have resulted in improved patient care and reduced costs since medical care providers were able to comply with the evidence-based guidelines thus provide the best clinical practice to their patients (18). Trauma registries, as one of the important components of the comprehensive trauma care system, play an important role in improving and preventing injuries in developed countries (16, 19). In a systematic review, the effectiveness of the Ocular Injury Registry was investigated on improving clinical care related to ocular injuries. Data quality process and patient follow-up were also examined (20). Moreover, Hoskin et al., conducted a review study to examine the processes of identifying, reporting and follow-up recommendations for eye injuries (21).

So far, no review study was conducted with regards to registry processes. Considering the importance and the role of eye injury hospital registry systems in the management of data related to eye injuries and also its necessity as a basis for creating a registry system, the present study was aimed at identifying the features of eye injury registry with much focus on its processes.

Methods

Search Strategy and Information Sources

Articles from 2000 to Oct 2020 were retrieved through electronic searches in some scientific databases, namely Web of Science, PubMed, Embase and Scopus. Moreover, a scatter search was performed to retrieve relevant articles. The search strategy included Mesh terms and other relevant keywords; "Eye injury OR "Ocular trauma" OR "Eye injury prevention" OR "Eye protection" AND "registry" OR "Data Management" OR "Information Management" OR "surveillance system".

Eligibility Criteria

Inclusion criteria: All articles published in English in peer-reviewed journals, conference papers with available full texts, original observational studies (focusing on hospital-based ocular trauma registries, and if they addressed key registry processes, single-center, multicenter, regional, statewide, national, and multinational registries were included in our searches.

***Exclusion criteria*:** Review articles, case reports, case studies or study protocols, letter to editors, and corresponding and conference papers (without available full text), interventional studies such as clinical trials and clinical trials registries were excluded.

Study Selection

After searching and retrieving the articles from the 4 mentioned databases, articles that met the inclusion criteria were entered into the Endnote software and duplicate articles were deleted using endnote software. Article titles and abstracts were reviewed by two authors. Again, full-text articles were reviewed based on the inclusion and exclusion criteria and any disagreements were resolved by discussion and with the presence of the third author (Fig. 1). The quality assessment of the papers based on Cochrane Effective Practice and Organization of Care (EPOC) guideline (22).

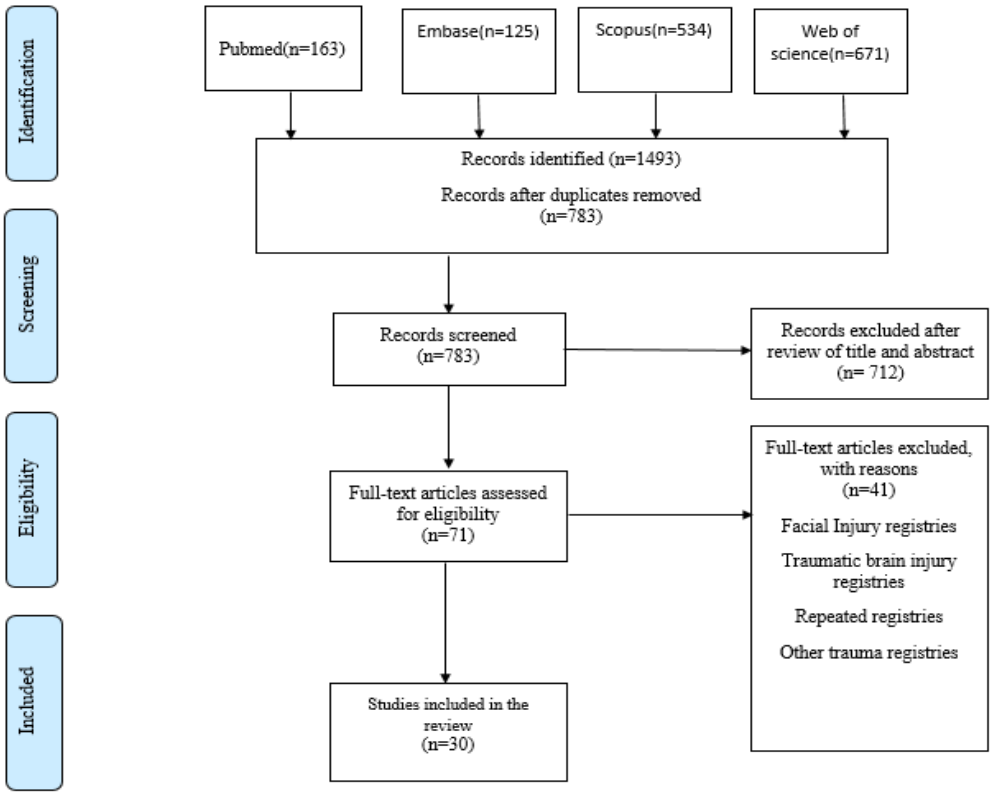

Fig. 1: Selection diagram based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

Information Extraction

After selecting the final articles for the study, data related to the selected registry were extracted using the data extraction form. Data extraction form consists of five parts; general information about the selected registry (name of registry, aim, country, type of registry, time of data collection, and the extent of implementation), Registry processes (case finding, data collection, abstracting, reporting, follow-up and data quality control), as well as data items collected by the eye injury registry.

Results

Majority of the registries evaluated originated from the United States of America (14 registries), followed by China (3 registries) which has the highest registry for eye injuries and Germany (2 registries) respectively.

Quality assessment

According to the quality assessment of papers, 15 studies (24-27,29,30-35, 39, 45,,48,51) were considered as "high quality"; 10 studies (23, 28, 36-38, 40-43, 52) were assigned as "fair to good quality", and 5 studies (44, 46, 47, 49, 50) were regarded as low quality.

With regards to type, majority of these registries (n=23) are multi-institutional while 7 registries are of the single registry type, with regards to registry classified by the type of data collection in terms of time; 9 registries were retrospective while 21 registries were prospective and with regards to the extent of coverage, 21 registries have national coverage while another 21 registries have international coverage (Table 1).

The basic method for case finding in all registries under study were review of patients, records of inpatient and outpatient visits, a review of patients' examination results and medical reports and a review of screening results (23-48).

Table 1: Characteristics of registries reviewed in this study

Registry name	***Registry aim(s)***	***Country***	***Registry type***		***Data gathering type (Time)***		***Registry implementation scale***		
			Multi institution registry	Single hospital registry	Prospective	Retrospective	Local	National	International
USEIR(23)	Drawing the severity and long-term effects of football related eye injuries	Portugal		✓	✓			✓	
Italian Eye Injury Registry(24)	Collection of eye trauma data in Italy through an integrated national database	Italy	✓		✓			✓	
IGATES(25)	Evaluation of patients' eyesight after corneal surgery (due eye injury)	India	✓		✓			✓	
WROTD(26)	Prevalence of eye injuries	USA	✓		✓				✓
TR-DGU(27)	Prevalence and characteristics of eye injuries	German	✓		✓				✓

UK Transplant Registry(28)	Evaluation of patients' eye-sight after corneal surgery (due of eye injury)	United Kingdom	✓		✓		✓
CSR(29)al	Consequence of rupture of the posterior capsule of the eye	Malaysia	✓		✓		✓
Elmhurst City Hospital Trauma Regis-try(30)	Prevalence of eye injuries	USA		✓		✓	✓
WEIR AND USEIR(31)	Epidemiological descrip-tion of eye injuries	Australia		✓		✓	✓
WEIR(32)	Epidemiological descrip-tion of eye injuries	Oman		✓		✓	✓
NEISS(33)	Estimation of eye injuries related to manufactured products	USA	✓		✓		✓
China Eye Injury Registry(34)	Describe clinical features, surgical interventions, ana-tomical outcomes and post-traumatic vision, and design prognostic indica-tors, which can help physi-cians make the right deci-sion and choose appropri-ate method for managing ruptured eye	China	✓		✓		✓
EIVS (35)	Evaluation of clinical fea-tures and predictors of visual and anatomical out-come in eye injuries	China	✓			✓	✓
Cuban Ocular Trauma Regis-try(36)	Evaluate clinical features and prevent injuries	Cuba	✓		✓		✓
NEISS-AIP(37)	Incidence, Risk Factors, and Characteristics of Mo-tor Vehicle Accident Inju-ries	USA	✓			✓	✓
NEISS(38)	Estimation of eye damage related to manufactured products	USA	✓		✓		✓
Computerized eye injury da-tabase(39)	Evaluation of epidemiolo-gy, clinical features, prog-nostic factors and visual results from the presence of a foreign body inside the eye	China	✓			✓	✓
Hospital data-base(40)	Identify the number of eye amputations and the surgi-cal-related symptoms and the surgical procedures used	Denmark		✓	✓		✓

NEISS(41)	Estimation of eye damage related to manufactured products	USA	✓		✓		✓
NEISS(42)	Estimation of eye damage related to manufactured products	USA	✓		✓		✓
USEIR(43)	Epidemiological analysis and clinical features of serious eye injuries and improvement of treatment and development / implementation of preventive measures.	USA	✓			✓	✓
USEIR(44)	To evaluate the relationship between structural and functional ocular features and the risk of glaucoma following foreign objects penetration	USA	✓		✓		✓
EOCR(45)	Epidemiological description of traumatic optic neuropathy	Germany		✓	✓		✓
NCR(46)	Increase knowledge about the process and results of cataract surgery	Sweden	✓		✓		✓
USEIR(47)	Epidemiology of ocular trauma, identification and reduction of risk factors	USA	✓		✓		✓
USMEIR(48)	Defining and describing patterns of eye injury in the military community	USA	✓		✓		✓
EIVS(49)	Evaluating the effectiveness of using vitreoretinopathy surgery	USA	✓		✓		✓
EIVS(50)	Evaluating the effectiveness of using vitreoretinal surgery	USA	✓		✓		✓
UHWI trauma database(51)	Epidemiological evaluation of ocular trauma in adult patients and determination of the causes of injury	Jamaica		✓		✓	✓
NEISS(52)	Describe gun-related eye injuries	USA	✓			✓	✓

IGATES; International globe and adnexal trauma epidemiology study, WROTD; Walter Reed Ocular Trauma Database, TR-DGU; Trauma Register DGU®, CSR; Cataract Surgery Registry, WEIR; World Eye Injury Registry, USEIR; United States Eye Injury Registry, NEISS; National Electronic Injury Surveillance System, EIVS; Eye Injury Vitrectomy Study, NEISS-AIP; National Electronic Injury Surveillance System All Injury Program, UHWI; University Hospital of the West Indies, EOCR; Erlangen Ocular Contusion Registry, NCR; Swedish National Cataract Register, USMEIR; U.S. Military Eye Injury Registry

Majority of the registries have used the web-based model as a tool in gathering data (60%) while (40%) of registries are extracting data manually. Data sources available for data collection included inpatient records, outpatient records, transfer summaries, operative reports, medical

records, laboratory findings, UK Ocular Tissue Transplant Record form, and electronic medical records (Table 2).

Table 2: Data gathering tools and data sources within eye injury registries

Tools	*Data sources*	*References*
Manual case report forms	Inpatient records, outpatient records, transfer summaries, and operative reports.	(25, 26, 32, 38-41, 45-48, 51)
Electronic case report forms	Medical records, laboratory findings, UK ocular tissue transplant record form ,electronic medical records	(23, 24, 27-29, 31, 33, 34, 37, 42-44, 50, 52)

Of the 30 registries surveyed, only 6 used data quality and quality control methods (24-26, 33, 34). The most common type of tool used to control data quality was pre-designed checklists. Data quality control was performed by inspectors, researchers, registry administrators, data management experts, and secretaries. Most registries evaluated also used terminologies and International Classification of Diseases System (Ocular Trauma Score, Birmingham Eye Trauma Terminology) to name, define and classify eye injuries (24-27, 31, 32, 34, 36, 39, 43, 44, 49, 50) while only four registries have used the International Classification of Diseases Ninth Revision (ICD-9) coding systems. The International Classification of Diseases (ICD-10)) was used for classifying variety of injuries, medical interventions and treatments for eye injuries (30, 31, 33, 37, 40).

The minimum data sets in the studied registries were classified into 12 data classes. Most of the data items used in the eye injury registry are patients' demographics, cause of injury, location of injury, and type of eye injury (Table 3).

Table 3: Minimum data set is eye injury registries

Data classes	*Data items*		*References*
Patient demographics	First name, surname, ID number, sex, age, nationality, socio-economic status, ethnicity, type of admission, date of injury, postcode, eye injured (Right/ Left/ Both eyes)		(23-25, 27-29, 31-37, 39-52)
Surgery	First name and surname of the physician, physician's ID number, grade of surgeon		(28)
Initial examination	Medical History	History of ophthalmic disorders, previous history of eye trauma, history of ophthalmic surgery, previous ocular surgery	(36,31)
	Ocular Trauma	Without enucleation, unilateral enucleation bilateral enucleation	(27)
	Optic nerve trauma	Unilateral, bilateral	(27, 30)
	Grade (initial and final visual acuity)	A. 20/40 B. 20/50 to 20/100 C. 19/100 to 5/200 D. 4/200 to light perception	(23, 25, 26, 28, 33, 39, 45, 48)
	use of alcohol or recreational drugs at the time of the trauma		(31, 29)

	Intent	Unintentional, assault, self-inflicted (intentional), unknown	(32, 33, 52)
Activity leading to injury		Industrial accidents Playing/Sport activities Accidents as bystander/observer Others (activities not within these categories) Farming accidents	(23, 25, 38, 40)
Etiology of trauma		Hammer on metal, sharp object, nail, fireworks, burns, wood, gunshot, working with metal, pen/ pencil, iron, glass/sharps, stone, animal horn, traffic accident-car, traffic accident-motorbike, traffic accident-bicycle, traffic accident-pedestrian high fall > 3 m, low fall < 3 m Others (agents not within these categories)	(23-25, 27, 30-45, 47-52)
Mechanism of injury		Contact with nonchemical product, contact with chemical products, foreign body fall from, onto, or caused by product, contact with another person, and other	(25, 38, 41)
Tissues involved		Lids, lacrimal system, cornea, anterior, chamber, lens, sclera, iris, vitreous, retina macula, choroid, extraocular muscle, orbit optic nerve, others	(32, 36, 48, 50)
Wound location		A. Cornea and limbus B. Limbus to 5 mm posterior into sclera C. Posterior to 5 mm from the limbus D. External (limited to bulbar conjunctiva, sclera, cornea) E. Anterior segment (includes structures of the anterior segment and the pars plicata) F. Posterior segment (all internal structures posterior to the posterior lens capsule)	(24, 44)
Location/Zone of ocular injury		Industrial premises, farm, home, school, place for recreation & sport, street and highway, public building, unknown, others	(23-25, 31-37, 42-45, 47-49, 51)
Surgery report		Type of surgery, type of anesthesia, ocular comorbidity of the eye, surgeon status, surgical techniques, date of surgery	(29, 40, 46)
Type of eye injury diagnosis		Open globe injuries A. Rupture B. Penetrating C. Intraocular foreign body D. Perforating E. Mixed Closed globe injuries A. Contusion B. Lamellar laceration C. Superficial foreign body D. Mixed Infective keratitis, hemorrhage, penetration burns (electrical, scald, chemical, thermal, radiation, not specified), dermatitis/conjunctivitis conjunctive laceration, intracranial foreign body, hyphema, orbital cellulites corneal laceration	(36, 38, 39, 41-44, 49, 52)
Patient's status on discharge		Date of discharge, number of days hospitalized, discharge status and medications prescribed on discharge	(45)

Most registries used performance indicators for reporting . Lists the processing key indicators used for reporting in reviewed registries, such as Time from injury to surgery, Total number of injuries, Number of death due to ocular injuries (Table 4).

Table 4: The most important processing indices reported in eye injury registries

Row	*Indices*	*References*
1	Time from injury to surgery Total number of surgeries that the patients underwent	(25, 40)
2	Total number of injuries Average annual rate of hospitalized ocular injuries Number of walls fractures	(26)
3	Mean / median calculated treatment costs Mean / median hospital stays (days) Mean / median ICU treatment duration (days) Mean / median intubation time (days) Traffic accident-car (%) Traffic accident-motorbike (%) Traffic accident-bicycle (%) Traffic accident-pedestrian (%) High fall > 3 m (%) Low fall < 3 m (%) Optic nerve trauma (%) Ocular Trauma (%)	(27)
4	Mean age of corneal graft surgery recipients Repeat corneal graft surgery Percentage of corneal graft surgery infections Percentage of Graft failure	(28)
5	Percentage of intraoperative complications in total number of cataract surgeries Percentage of patients developed infectious endophthalmitis following cataract surgery Percentage of patients without ocular co-morbidity obtained visual acuity of 6/12 or better within (≤) 3 months following cataract surgery Percentage of Patient with Unplanned Readmission within 24 hours of discharge Percentage of patients with waiting time of ≤90 minutes to see doctor at Ophthalmology Clinic Percentage of patients developed Infectious Endophthalmitis following cataract surgery	(29)
6	Number of death due to ocular injuries	(30)
7	Number of ocular trauma cases over the total number emergency cases seen	(32)
8	The number of eyes removed	(40)
9	Place of trauma Age of patients Open trauma Closed trauma	(24)

Most registries (n=19) used the registry follow-up feature to track patients' status. The primary goal of follow-up in the studied registries was to follow the status of patients after injury and to follow the effectiveness of measures undertaken for patients with eye injuries and their secondary goal is to assess eye injuries related to manufacturing products. Moreover, all registries used patient's attendance visits as a follow-up method (Table 5).

Table 5: Objectives of patient follow-up in eye injury registries

Objectives of follow-up	*Methods*	*References*
Following the outcomes surgery	Visit	(25, 28, 29, 35, 40, 46, 49)
Following the visual outcomes after injuries	Visit	(23, 30, 31, 37, 44, 47, 48)
Following patients' adherence to treatment	Visit	(36)
Following consumer product-related injuries	Visit	(33, 38, 41, 42)

Discussion

Majority of the registries evaluated in the present study have registry processes and belong to the United States of America (26, 30, 33, 37, 38, 41, 42, 44, 47-50, 52). The high prevalence of ocular injuries in the United States compared to other countries, as well as the vital role of the registry in the prevention and control of ocular injuries has led to the creation of multiple registries in that country and therefore, the United States is leading in the field of eye registries worldwide (8). The use of registry is an important component of the eye health care system in developed and developing countries and as the main tool for managing disease data, reduces the cost of providing care and helps improve patient care delivery processes (53).

Results of the study showed that all surveyed registries have given special attention to data collection methods and tools used for data collection and each registry has used standard tools and special forms for this purpose. In addition to data collection as one of the main features of the registry, the quality of the collected data plays an important role in other processes in the registry. Data collection and its quality are considered as one of the main components in data management (54). Besides, the quality of data in the registry plays an important role in creating criteria for evaluation, decision making and policymaking in the field of health and treatment (55-58). Incomplete and poor-quality data leads to poor health care and low understanding of the effectiveness of the registry in the quality of care (59). Results of the present study indicated that most of the surveyed registries used nomenclature and classification systems to create standard definitions and appropriate classification of eye injuries. In addition to the use of standard naming and classification systems, the existence of standard datasets for collecting and reporting eye injuries in the studied registries was taken into consideration. Having a comprehensive minimum data set provides valuable resources for evaluation, treatment planning, continuous evaluation of patient progress and performance, and serve as useful information for policymakers, health care professionals and stakeholders, and ultimately improve the quality of health care services (60, 61). Minimum data set is necessary in registry processes for collection and reporting and is one of the main steps in registry development. Creating a minimum data set in the registry reduces confusion in the type of data collection and reporting. Collecting comprehensive and accurate minimum data sets improves care and quality of life, and reduces length of hospital stay (57, 62).

Based on the findings of the present study, most registries have used different indicators for reporting based on the nature and purpose of the registry. Indicators such as the number of eye injuries, the cause of the injuries, the location of the injury, the number and type of surgery performed, and finally the mortality caused by eye injuries. Creating and reporting these indicators in the eye injury registry plays an important role in decision making and improving the quality of eye injury care and in implementing prevention strategies (26, 28, 30, 32, 40). The use of indicators in the registry plays a key role in the ability to report for different groups and compare data at different levels of management (11). Another important process in the registry is follow-up, reported in most of the surveyed registries. The main purpose of follow-up in the registries under study was to follow the status of patients after the injury, to follow the effectiveness of medical interventions undertaken, and to follow-up product-related damage to the patient's eyes. However, it is important to use the right method to make follow-up process easier, all registries surveyed have used face-to-face visits for follow-up. On the other hand, the use of reminder messages, using email or mobile phones to contact patients or their families is an important step in improving the follow-up process (63).

Conclusion

The use of eye injury registry plays an important role in managing data related to eye injuries and ultimately yields better care, better disease management and create prevention strategies to prevent eye injuries. Considering the role and the impact of access to quality data in adopting measures and strategies to prevent eye damage, it is suggested that in designing and in planning eye injury registries, the criteria on data quality control should be given more emphasis.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of interest

The authors declare that there is no conflict of interest.

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