

Registry Data Coordinator (RDC): a Proper Accessible Strategy for Improving Road Traffic Injury (RTI) Hospital Based Trauma Registry Systems in Developing Countries and Low Income Countries

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ABSTRACT

Introduction: Evidence suggested that a significant level of trauma mortality can be prevented using registry system. **Aim:** This study aimed to improve Kashan Hospital Based Trauma Registry System (KHBTRS) for Road Traffic Injury (RTI). **Material and methods:** After conducting focus group discussion absence of minimum data set (MDS) and poor data collection process (DCP) were identified as main problems for KHBTRS- RTI. Proposed MDS were surveyed by 20 experts of trauma research center of throughout the Iran. Then approved MDS applied for trauma registry system data base in form of SQL. DCP were reform from prospective data collection (review of medical record) to concurrent (through the interview) approach. **Results:** Most of participants for MDS approval belonged to clinical group 13(65%). 146 MDS in eighteen main categories were proposed for RTI. The maximum score for each MDS main categories were attributed to body parts injured 220 (100%) and patient vital signs 139 (99.29%) respectively. Pilot testing of KHBTRS- RTI database of 50 (50%) riders indicated fully completeness 50 (100%) for concurrent approach. It was concluded that based on experts' viewpoints MDS relating to injury nature and place of occurrence have more priority in comparisons to MDS relating to causes of injury. It may attribute to health care providers focus on clinical care and treatment. **Conclusion:** It was concluded that based on experts' viewpoints MDS relating to injury nature and place of occurrence have more priority in comparisons to MDS relating to RTI prevention; it may attribute to health care providers focus on clinical care and treatment. To develop injury interventions based on given data, recruitment of professionals as registry data coordinator with specific job description to collect and advocacy of injury external causes data seems imperative.

Keywords: data collection, registries, trauma, road traffic accident, data completeness, World Health Organization.

1. INTRODUCTION

Road Traffic Injury (RTI) is universally introduced as the leading cause of death and lifelong disability. RTI, as reported by the Institute for Health Metrics and Evaluation (IHME), is considered to be the leading cause of death among people aged 15-29 and as the third cause of fatality among those aged 15-44 (1). In 2013, RTI led to 85 percent of total fatalities as well as 90 percent of disability adjusted life years (DALYs) lost. World Health Organization (WHO) has recently reported that roughly 1.3 million people lose their lives in world's roads every year. While, 90 percent of road traffic fatalities take place in low-and middle-income countries, evidence indicated that a significant level of trauma mortality can be prevented (2, 3). Indeed,

data collection in the form of hospital-based registry system is used as an appropriate strategy to develop preventive intervention related to RTI; therefore, access to quality data to formulate policies and to implement targeted interventions is of great significance (4). The registry is defined as an organized system so that it can apply observational study methods to determine uniform data in order to evaluate the outcomes of a disease and injury/conditions (5). Trauma registry is known as a database to record epidemiology, processes and outcomes of a trauma, and aims, indeed, to provide a function to drive an efficient and effective performance improvement program for the care of the injured patient (6). Despite the pivotal role of data in implementing targeted interventions based on the existing data

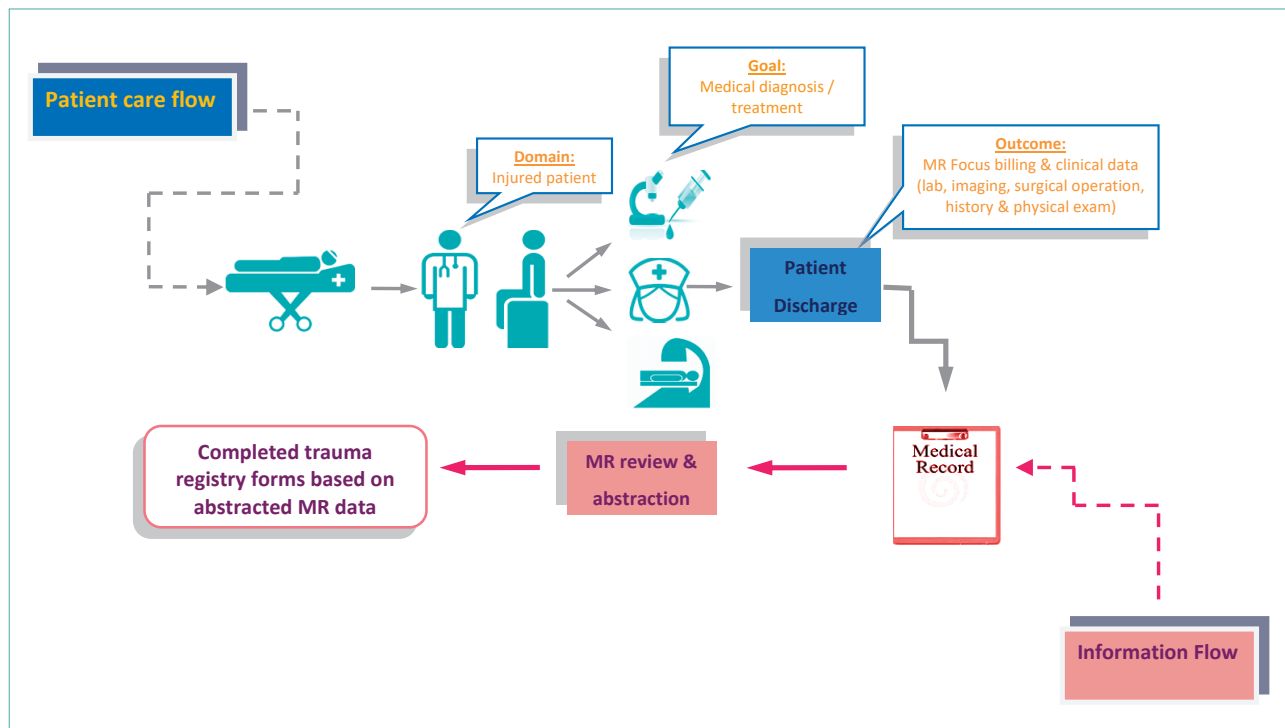


Figure 1. Health care Provider (HCP) based data collection registry systems (Retrospective method of data collection)

in registry systems, previous literature revealed that the data quality is thought to be a major challenge in trauma registry, which in turn requires some interventions (7). Assessing the current status in the trauma registry system in Kashan, and identifying the existing dilemmas as well as implementing an targeted intervention, the present study intends to provide a benchmark to promote the registry system in other countries, and doubtlessly, the findings in this study will be useful for developing countries and developed country as well.

2. METHODS

Kashan Hospital Based Trauma Registry System (KHBTRS) was established at 2004 as the second trauma registry system in Iran. Kashan is a small city in central part of Iran between two main capital cities of Tehran and Esfahan. Consequently, it is potential to highly occurrence of road traffic injuries. Kashan trauma registry center is located at a 510 bed Tertiary Care University Hospital.

KHBTRS for Road Traffic Injury (RTI): data collection process/ work flow analysis

In current KHBTRS all data of RTI were documented in medical record (MR) by health care providers (HCP) then MR were transferred to medical record department (MRD) for completion RTI registry forms by health information management (HIM) professionals. HIM professionals review and abstract MR data to complete RTI forms including injured patient demographic data, injury modules (mode of transport, type of vehicle victim person, accident type), general data of accident (activity, place of injury occurrence). Figure 1. Depict data collection process for injured patients. The collected data and were abstracted into KHBTRS forms analyzed through Excel. The challenges with existing KHBTRS were identified as:

- Poor data quality (e.g. inconsistency and incomplete-

ness of RTI data);

- MR more focus on data relating to injury and medical care;
- RTI minimum data set were not standard and fully consistent with international classification of diseases/injury (ICD);
- There is no interrelationship and convergence between injured patient care flow and RTI information flow;
- Retrospective data collection (after patient discharge) induces poor data quality.

Start up phase for reforming KHBTRS - RTI

A KHBTRS team consisting of surgery chief, medical director, nursing, vital statistics, epidemiology, information technology (IT), and HIM professionals were formed to make decision to reform existing system. Before proceeding with the reforming, the goals were clarified: a) identifying the existing problems with RTI data collection and analysis; b) definition of fresh objectives for KHBTRS - RTI; c) identifying standard minimum data set (MDS) for RTI to facilitate meaningful national and international comparisons and research; d) developing a SLQ server database for collecting and analyzing RTI data.

Focus group discussion to reform KHBTRS-RTI

Recruiting focus group discussion participants

The focus group discussion (FGD) intended to customize road traffic injury MDS for KHBTRS based on the opinions of an expert panel. Ten experts from various parties including, information technology, medicine, epidemiology, health information management, nursing and people who charge in KHBTRS were purposefully selected. To conduct FGD the expert panel ten experts with consideration of two main inclusion criteria was established: a) working on education, treatment, research, data collection and developing in-

Job Titles	No of participants	Education	Experiences with RTI
Medical	3	Anesthesiology	Head of KHBTR RTI education, research and injured patient treatment
		Neurosurgery	Vice chancellor of KHBTR RTI education, research and injured patient treatment
		Medical Doctor (MD)	Executive manager of KHBTR RTI education, research and injured patient treatment
Non-medical	2	Epidemiology and vital statistics	Members of KHBTR RTI education and research
	2	Nurses	Members of KHBTR RTI education, research and injured patient treatment
	2	Health information management (HIM)	Specialist in working with injury/ accident classification systems (ICD, ICECI) Serves as a data scientist (data collection e.g. registry systems data sources and minimum data sets; data analysis; and data distribution)
	1	Information Technology (IT)	Developing and adopting electronic information systems for disease registry

Table 1. Characteristics of the experts for reforming KHBTRS

formation systems for RTI; b) having related background to address all aspects and objects of KHBTRS- RTI at start up phase. The researcher believed that this arrangement helps to get the ideas of experts from both research and practice. Expert panel characteristics are presented in Table 1.

Conducting FGD

For the initial step, the FGD trained moderator (researcher) explained the aim of the study and the non-evaluative environment of the FGD. The assistant moderator (recorder) was responsible for recording the discussion, observing the FGD, and taking notes. Examples of questions used to guide the expert panel during the FGD include:

- Do KHBTRS meet your research requirements for RTI?
- Do KHBTRS provide meaningful and comparative data within KHBTRS and between KHBTRS and other trauma registry center?
- Do KHBTRS provide worthwhile data for targeted intervention about RTI?
- What are KHBTRS-RTI pinpoint problematic areas and challenges?

- What are KHBTRS drawbacks for collecting and managing RTI data?
- Are these problems attributed to in-use information systems capabilities or data set and data collection processes for RTI?
- Do we need to reform the current KHBTRS- RTI?
- What objectives the proposed KHBTRS-RTI should be addressed?
- How should KHBTRS- RTI be rearranged to support national and international research and injury prevention?

Outcome for FGD

In the first session of the FGD, a wide spectrum problems and drawbacks were presented. Five 4-hour meetings were held under moderator supervision in which the participants enjoyed the freedom to debate KHBTRS-RTI problematic areas and present proper solutions. At the end of the fifth 4-hour round, four main problematic areas including minimum data set (MDS), data collection, data analysis, and data collectors were identified. Full description for challenges of current KHBTRS-RTI and advantages of proposed model was indicated in Table 2. Data sets serve building blocks of a registry system and should be adopted according to the most relevant existing injuries/accidents classification systems including e.g. International classification of diseases (ICD) and International Classification of External Causes of Injuries (ICECI) (8, 9).

To specify standards MDS for KHBTRS- RTI a review of related literature was conducted and analyzed through the content analysis. Finally, 150 MDS were selected through the FGD and classified into eighteen main categories for describing. At this phase, 150 confirmed MDS through FGD were distributed among 25 informants from all over the country (Iran) in the form of Delphi technique to reach consensus.

Reaching consensus on MDS for RTI through Delphi technique

The Delphi technique was used to reach consensus on MDS for RTI. The Delphi serves as a group decision-making technique to obtain consensus on the opinions of experts referred to as rounds. It is an iterative multistage process that conducted through questionnaire until group consensus is achieved (10). At the end of the FGD, the preliminary MDS for RTI were formatted in terms of a questionnaire on a five-

	Current KHBTRS- RTI		Proposed KHBTRS- RTI	
	Current processes	Challenges	Proposed processes	Advantages
Data sets	Expert based data set	Inadequate Unqualified Non- standardized Non- comparable Poor relationship between RTI mechanism and external causes	Developing MDS based on standard accident and injury classification systems including (ICD) and (ICECI).	Meaningful use of RTI data National & international comparison of RTI Providing Data for targeted intervention
Data collection	Retrospective (review of medical records)	Missing data Incomplete Inconsistent Secondary sources (not patient, data recorded by health care practitioner about patient Low data currency	Concurrent (patient and patient family interview)	Primary data source (patient/ patient family) Decrease inadequate and unqualified data Increase data currency Provide a chance to data error recovery
Data collector	Health care provider data collection (HCPDC)	Focus on direct patient care not medical record documentation Focus on medical care not public health data and prevention	Registry data coordinator (RDC)/ HIM professionals	Expert in disease / injury classification (e.g. ICD, ICECI) Expert in data collection, analysis and distribution

Table 2. Comparing Current KHBTRS- RTI and Proposed KHBTRS- RTI: challenges and advantages

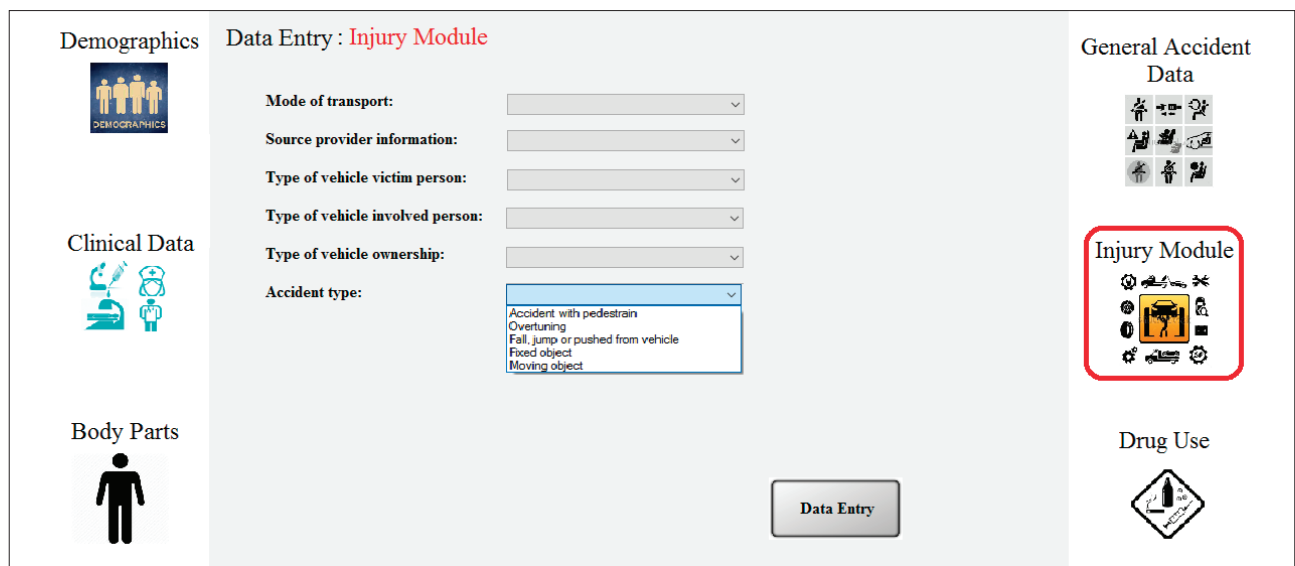


Figure 2. KHBTRS-RTI database

point Likert scale (1 = strongly disagree to 4 = strongly agree) and was distributed among 25 experts from other trauma registry centers throughout Iran. This questionnaire embraced three parts including demographic information of experts, 150 closed questions based on proposed MDS, and open ended questions to collect other comments considered by experts.

Data Analysis

Data for MDS was analyzed through descriptive statistics (frequency, mean); MDS with mean final scores of ≥ 75 were confirmed and those with mean final scores of < 50 were omitted. Those with final mean scores of 50-74 were presented to experts for further analysis until they were either confirmed or omitted from the questionnaire.

Developing KHBTRS- RTI database

After MDS identification, entity relationship diagram (ERD) was designed to depict the relationship between each entity (MDS) and developing computerized data base in terms of SQL server systems. KHBTRS-RTI database develop: a) to enhance data collection and analysis; b) compare KHBTRS-RTI data completeness in retrospective and concurrent data collection methods (Figure 2). Completeness is among the main characteristics of data quality and defines “as the rate of non missing data in the registry”. Experts are in belief without the data completeness the other data quality characteristics in terms of consistency, timeliness, etc is not realized (7, 11).

Ethical Consideration

The research proposal was approved by the Ethical Committee for Biomedical Research at Kashan University of Medical Sciences [Ethics code No. 2979]. Using the mixed method, the ethical considerations for current research were discussed within two parts: a) as parts of the focus group discussion and b) Delphi methods for MDS consensus. Before the FGD round, all participants signed informed consent forms which described the research founder, goals of the study, non-critical and unbiased climate of the meeting, voluntary nature of participation, and assured the confidentiality of the information. For parts two, the research participants were informed about the purpose of the study and the

voluntary nature of participation prior to completion of the questionnaire. They were assured of anonymity and the confidentiality of the responses.

3. RESULTS

Demographic data

Most of the experts who participated in this study were males 16 (80%). Most participants’ age was 40-49, 8 (40%). Most of participants field of study belonged to clinical group 4(20%). Most of participants’ education 9 (45%) was PhD (Table 3).

Characteristics of newly proposed KHBTRS – RTI

MDS for KHBTRS-RTI: experts’ viewpoints

At the first phase of the modified Delphi technique (expert

	Demographics data	N	%
Sex	Male	16	80
	Female	4	20
Age	<39	4	20
	40-49	8	40
	50-59	7	35
	60 >	1	5
Field of Study	Cardiovascular Surgery	1	5
	Neurosurgeon	2	10
	Surgeon General	3	15
	Orthopedic surgery	2	10
	General Medicine	1	5
	Anesthesiology	1	5
	Midwifery	1	5
	Nursing	2	10
	Total	13	65
	Non clinical	Epidemiology	2
Social Medicine		4	20
Health Information management		1	5
Total		7	35
Level of Education	Specialist	8	40
	PhD	9	45
	General Medicine	1	5
	Master	2	10

Table 3. Experts demographic data

panel phase), 140 of 145 MDS got the mean scores of 75% or higher and were thus approved. Eight MDS obtained the mean scores of 2 of 50-74 and were then considered in the second phase of Delphi. Ultimately, these MDS got the mean score of 75% and were approved by the expert panel. In the classic Delphi phase, four MDS were suggested by national experts. Again, the newly suggested MDS as well as those that had gotten mean scores of 50-74 were presented to the experts in the second phase of the Delphi technique. Ultimately, 146 MDS were proposed for KHBTRS-RTI. Results also indicated that MDS which acquired the maximum score based on sum of the agreed comments for each MDS main categories were respectively: body parts injured total 220 (100%); patient vital signs 139 (99.29%); place of accident 139 (99.29%); safety equipment use in cars 99 (99%); source of provider information 79 (98.75%); role of the injured person 407 (96.90%); and use of drugs 116 (96.67%). The minimum MDS score were attributed to categories of intent 56 (70 %) and type of vehicle ownership 61 (76.25) respectively.

Data collection process and Data collector

Two trained health information management professionals were recruited to gather the RTI data using checklist based on newly proposed MDS through the interview with health care providers, patient and patient family in active patient episode of care (concurrently). Figure 3 indicate the comparison between HCP (current) vs. RDC (proposed) data collection methods.

Comparisons of RTI data completeness between HCP data collection and RDC data collection

Pilot testing of KHBTRS-RTI database of 100 patients indicated that most injured victims of RTI in Kashan 50 (50%) were motorcycle riders. Data completeness percentages (DCP) of those 50 motorcycle riders were compared according to five categories including type of vehicle involved person, role of the injured person, activity type, type of collision and cause of collision. RDC data collection process indicated fully completeness 50 (100%). Maximum DCP in HCP data collection process attributed to category for "role of injured person" 40 (80%). Minimum DCP in HCP data collection process attributed to category for "type of activity" 0 (0%).

4. DISCUSSION

Findings indicate that most experts agree with the existence of the demographic data of the injured including their age and gender. The results of this study are consistent with those of Duan's, Ma and Rojas Medina studies regarding the design of trauma systems (12-14).

In his study, Woratanarat indicated that road traffic has much to do with the drivers' age and gender, expressing that men motorcyclists aged 15-19 are more involved in road accidents. Similarly, after some educational interventions and with comparing the trained group and control group, he could demonstrate that education can contribute to a reduction of road traffic injuries (3). According to the findings, experts are unanimously agreed upon the impact of individual's type of activities at the time of an accident. The study results are consistent with those of Duan's on the design of trauma system (12). Previous literature concluded that there is relationship between individual's activities and road accidents;

motorcyclists and taxi drivers are more accident-prone due to their longer rush hour involvement. He has also postulated specific education to prevent accidents and certain service concerning accidents and emergency measures to soften the consequences (15).

As the results of this study suggested, almost all experts agreed upon the existence of "Safety Equipment Use" options such as "safety belt", "airbag", "child safety belt", and "anti-lock braking (ABS) system". This study, regarding the design of the trauma system, has reached to the same results as the Stevens' study has. Other studies have also linked the application of the above-mentioned equipment with the reduction of accidents aftermath. In a 16-year-long study of some individuals with traumatic brain injuries (TBI) in Taiwan, Kuo concluded that TBI is more likely to occur among drivers with no safety belt on (16).

Thus, not only does the RTI data collection in the form of standard MDS provide a meaningful and comparable data both nationally and internationally, but also makes it possible, describing the related data with trauma-causing factors to carry out targeted interventions.

Disapproving the role of electronic database in improving data quality in registry systems, the current study indicated that even KHBTRS promotion does not guarantee the promotion in data quality (16). Similarly, the lack of data quality in other studies has made it rather difficult to perform data linkage or data integration and to use IT in registry systems (17).

In a study, integrating electronic medical record (EMR) into disease registry to improve health outcomes, it was concluded that although it is possible to integrate the systems, it is not feasible to promote health outcomes due to lack of standards for data collection, coding and transmission (18). Aimed to analyze the effect of poor data quality on clinical decision support system (CDSS), Hassan's study illustrated, through a simulation, that the poor data quality challenged health care providers' clinical decision making in CDSS (7). Computer systems are not of value unless they own data quality; it is critical to improve the collection and registry processes in a registry system. The sole automation of unqualified processes often leads to failure (19).

As the findings of this study presented, changing or upgrading the KHBTRS software does not help to eliminate the necessity for data quality. Indeed, in a retrospective study-based data collection, the HCP focus and concerns is direct care of patients.

As previous evidence debated that medical record documentation serves as less popular among HCPs; they believed to hinder the main responsibility (direct care of the patients) and superimpose on their workload. On the other hand, sharing the responsibility among different HCPs, including interns, residents, physicians and nurses, to register the medical documents may lead to inconsistency in the data (20, 21).

Finally, these inadequate medical records are analyzed and abstracted through the chart review by a distinct person in medical record department (22). Existing "various data registry hand off" and using a secondary source of data (medical record) instead of a direct interview with the patient in addition to reviewing MR will double the poor data quality, as well.

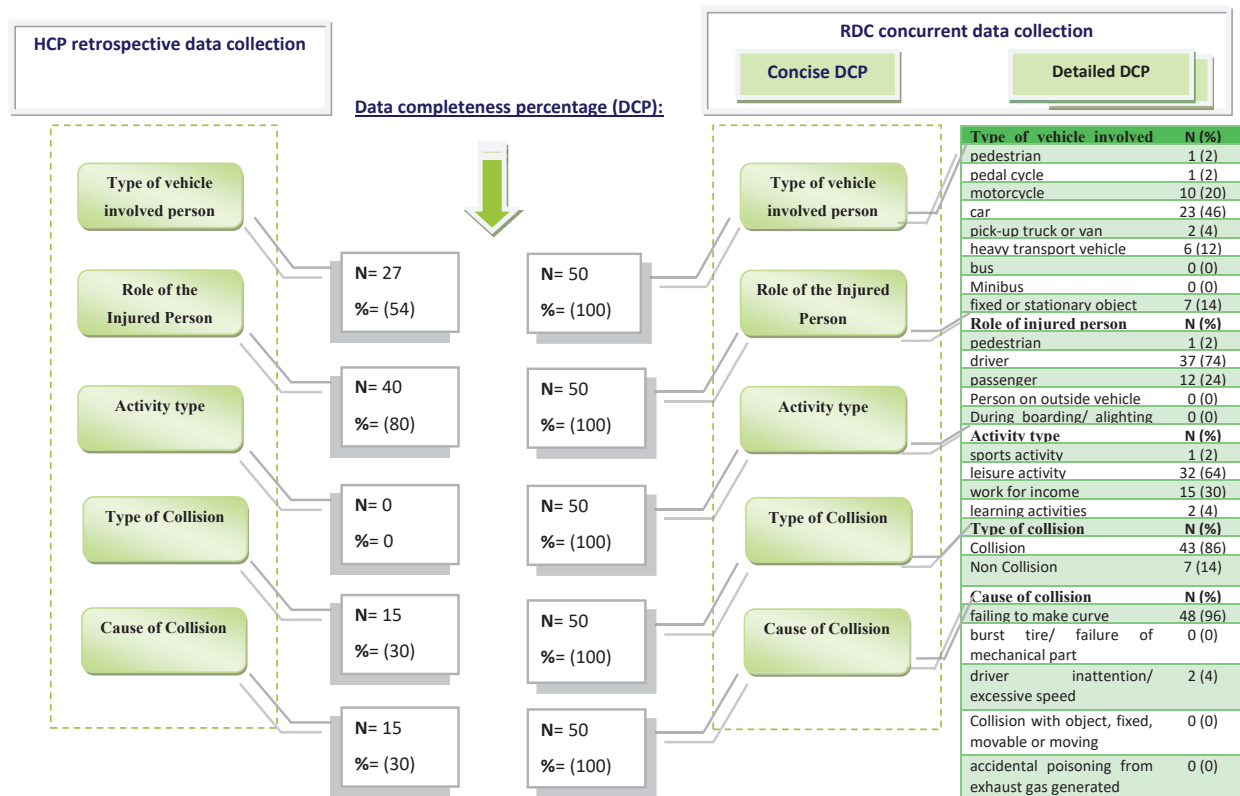


Figure 3. Comparison of data completeness percentages between HCP retrospective data collection process and RDC concurrent data collection

Herein, recruiting qualified staff in charge for collecting data during patient episode of care and stewardship of registry data quality as a “Registry Data Coordinators (RDC)” will pave the way for achieving the registry system purposes (prevention and public health promotion). Indeed, as intrinsically required by medical care, health information flow which embody in direct patient care tasks are overlooked. Accordingly, considering a medical record with primary focus of concern on treatment of patient specific as a main origin for registry system make quality of collected data in jeopardized. Contrariwise, the essence of a registry system is a data-based activity focusing on prevention and implementation of targeted interventions (5).

5. CONCLUSION

Rearrangement of data collection process provides modest affordable approach to improve data quality challenges within registry systems in LMIC. A main challenge for registry systems in LMIC and even developed countries is to overlook the health information flow which embodies in direct patient care tasks. Comparable to other activities (treatment, care, diagnostic, surgery) in health care settings, collecting and maintaining the quality of data needs to be advocated by specific custodians; those with main concerns and responsibilities to maintain data quality throughout the health systems, particularly the registry system.

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• **Conflicts of interest:** Authors declare that there are no conflicts of interest.

REFERENCES

1. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2015 Jan 10; 385(9963): 117-71.
2. Puvanachandra P, Hoe C Fau-El-Sayed HF, El-Sayed Hf Fau-Saad R, Saad R Fau-Al-Gasseer N, Al-Gasseer N Fau-Bakr M, Bakr M Fau-Hyder AA, et al. Road traffic injuries and data systems in Egypt: addressing the challenges. *Traffic Inj Prev*. 2012; 13 Suppl 1: 44-56.
3. Woratanarat P, Ingsathit A Fau-Chatchaipan P, Chatchaipan P Fau-Suriyawongpaisal P, Suriyawongpaisal P. Safety riding program and motorcycle-related injuries in Thailand. *Accid Anal Prev*. 2013 Sep; 58: 115-21.
4. Miranda JJ, Lopez-Rivera LA, Quistberg DA, Rosales-Mayor E, Gianella C, Paca-Palao A, et al. Epidemiology of road traffic incidents in Peru 1973-2008: incidence, mortality, and fatality. *PLoS One*. 2014 Jun 13; 9(6): e99662.
5. Gliklich R, Dreyer NA, Leavy MB, Velentgas p, Khurana L. Standards in the Conduct of Registry Studies for Patient-Centered Outcomes Research. *Patient-Centered Outcomes Research Institute*, 2012 March 15.
6. O’Reilly GM, Gabbe B, Cameron PA. Trauma registry methodology: a survey of trauma registry custodians to determine current approaches. *Injury*. 2015 Feb; 46(2): 201-6.
7. Hasan S, Padman R. Analyzing the effect of data quality on the accuracy of clinical decision support systems: a computer simu-

- lation approach. *AMIA Annu Symp Proc.* 2006; 324-8.
8. Holder Y, Peden M, Krug E, Lund J, Gururaj G, Kobusingye O. *Injury Surveillance Guidelines.* World Health Organization, 2001.
 9. Mulder S, Dekker R, Kemmeren J, Haagsma J. *Implementation of the Minimum Data Sets on Injuries (MDS-Is).* Consumer Safety Institute, 2002.
 10. Keeney S, Hasson F, McKenna H. *The Delphi Technique in Nursing and Health Research.* 2011.
 11. Nathan M, Jacobs ML, Gaynor JW, Newburger JW, Dunbar Masterson C, Lambert LM, et al. Completeness and Accuracy of Local Clinical Registry Data for Children Undergoing Heart Surgery. LID-S0003-4975(16)30916-X [pii] LID-10.1016/j.athoracsur.2016.06.111 [doi]. *Ann Thorac Surg.* 2016 Oct 7.
 12. Duan L, Deng X, Wang Y, Wu C, Jiang W, He S, et al. The National Injury Surveillance System in China: a six-year review. *Injury.* 2015 Apr; 46(4): 572-9.
 13. Ma S, Li Q Fau-Zhou M, Zhou M Fau-Duan L, Duan L Fau-Bishai D, Bishai D. Road traffic injury in China: a review of national data sources. *Traffic Inj Prev.* 2012; 13 Suppl 1: 57-63.
 14. Rojas Medina Y, Espitia-Hardeman V Fau-Dellinger AM, Dellinger Am Fau-Loayza M, Loayza M Fau-Leiva R, Leiva R Fau-Cisneros G, Cisneros G. A road traffic injury surveillance system using combined data sources in Peru. *Rev Panam Salud Publica.* 2011 Mar; 29(3): 191-7.
 15. Almeida GC, Medeiros Fda C, Pinto LO, Moura JM, Lima KC. Prevalence and factors associated with traffic accidents involving motorcycle taxis. *Rev Bras Enferm.* 2016 Mar-Apr; 69(2): 382-8.
 16. Kuo CY, Chiou HY, Lin JW, Tsai SH, Chiang YH, Lin CM, et al. Seatbelt Use and Traumatic Brain Injury in Taiwan: A 16-Year Study. *Iran J Public Health.* 2015 Apr; 44(4): 470-8.
 17. Saez C, Zurriaga O, Perez-Panades J, Melchor I, Robles M, Garcia-Gomez JM. Applying probabilistic temporal and multisite data quality control methods to a public health mortality registry in Spain: a systematic approach to quality control of repositories. *J Am Med Inform Assoc.* 2016 Nov; 23(6): 1085-95.
 18. Weiss Ns Fau-Cooper SP, Cooper Sp Fau-Socias C, Socias C Fau-Weiss RA, Weiss Ra Fau-Chen VW, Chen VW. Coding of Central Cancer Registry Industry and Occupation Information: The Texas and Louisiana Experiences. *J Registry Manag.* 2015 Fall; 42(3): 103-10.
 19. Meidani Z, Sadoughi F Fau-Maleki MR, Maleki Mr Fau-Tofighi S, Tofighi S Fau-Marani AB, Marani AB. Organization's quality maturity as a vehicle for EHR success. *J Med Syst.* 2012 Jun; 36(3): 1229-34.
 20. Farzandipour M, Meidani Z Fau-Rangraz Jeddi F, Rangraz Jeddi F Fau-Gilasi H, Gilasi H Fau-Shokrizadeh Arani L, Shokrizadeh Arani L Fau-Fakharian E, Fakharian E Fau-Saddik B, et al. A pilot study of the impact of an educational intervention aimed at improving medical record documentation. (2042-8189 (Electronic)).
 21. Farzandipour M, Meidani Z Fau-Riazi H, Riazi H Fau-Sadeqi Jabali M, Sadeqi Jabali M. Nursing Information Systems Requirements: A Milestone for Patient Outcome and Patient Safety Improvement. *Comput Inform Nurs.* 2016 Dec; 34(12): 601-12.
 22. Dente CJ, Ashley DW, Dunne JR, Henderson V, Ferdinand C, Renz B, et al. Heterogeneity in Trauma Registry Data Quality: Implications for Regional and National Performance Improvement in Trauma. *J Am Coll Surg.* 2016 Mar; 222(3): 288-95.