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Research Article

Developing a Minimum Data Set for an Information Management System to Study Traffic Accidents in Iran

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Abstract

Background: Each year, around 1.2 million people die in the road traffic incidents. Reducing traffic accidents requires an exact understanding of the risk factors associated with traffic patterns and behaviors. Properly analyzing these factors calls for a comprehensive system for collecting and processing accident data.

Objectives: The aim of this study was to develop a minimum data set (MDS) for an information management system to study traffic accidents in Iran.

Materials and Methods: This descriptive, cross-sectional study was performed in 2014. Data were collected from the traffic police, trauma centers, medical emergency centers, and via the internet. The investigated resources for this study were forms, databases, and documents retrieved from the internet. Forms and databases were identical, and one sample of each was evaluated. The related internet-sourced data were evaluated in their entirety. Data were collected using three checklists. In order to arrive at a consensus about the data elements, the decision Delphi technique was applied using questionnaires. The content validity and reliability of the questionnaires were assessed by experts' opinions and the test-retest method, respectively.

Results: An (MDS) of a traffic accident information management system was assigned to three sections: a minimum data set for traffic police with six classes, including 118 data elements; a trauma center with five data classes, including 57 data elements; and a medical emergency center, with 11 classes, including 64 data elements.

Conclusions: Planning for the prevention of traffic accidents requires standardized data. As the foundation for crash prevention efforts, existing standard data infrastructures present policymakers and government officials with a great opportunity to strengthen and integrate existing accident information systems to better track road traffic injuries and fatalities.

Keywords: Accidents, Traffic, Trauma Centers, Emergencies

1. Background

Modern industrialization has exposed humans to environmental hazards that can be threatening to their overall health. Road crashes, which emerged as consequence of industrialization, have also contributed to threatening humans' lives (1, 2). Annually, road traffic systems contribute to around 1.2 million deaths and more than 50 million injuries worldwide (3, 4). There are many reasons behind these road crashes. Having a standard data set can improve our understanding of these events, which is essential and of importance for better planning to save lives and avoid the wasting of resources (5).

Emergency and health care systems also play a decisive role in the clinical and financial consequences of traffic accidents. Determining the factors related to crashes is important for the performance of care systems, but analyzing these factors requires a comprehensive system for collecting and processing accident data. In this way, the large volume of data created renders traffic accident information management an integral part of these systems (6). Furthermore, having data sets that potentially provide detailed information about all crashes can be useful for various beneficiaries, but this is not possible without the creation of standard tools to gather uniform and accurate data (7, 8). In line with the documented benefits of the crash databases, some developed countries have developed specialized ones for their region; New Zealand has the Crash Analysis System (CAS); at the European level, the Community Road Accident Database (CARE) has been developed; and in the United States, there are specialized safety databases at the national level while each state has its own safety database that is supposed to follow the Minimum Uniform Crash Criteria Model (MMUCC) (9). Primarily evidence suggests that the crash registration system in Iran suffers from an insufficiency of accurate and up-to-date data (10).

Data collection is the most important part of information management, and MDS is a standard tool for collecting data. The first step in controlling incidents is analyzing them, to identify the underlying causes; therefore, development of an MDS to collect data in a standard and integrated manner at the national level is of great importance (11).

2. Objectives

The aim of this study was to develop a national minimum data set for an information management system to study traffic accidents in Iran.

3. Materials and Methods

This qualitative and descriptive study was performed in 2014. The data were collected from governmental centers, traffic police, trauma, and medical emergency centers in Iran. Data were collected using both forms and databases from traffic accident injures in trauma centers, traffic police, and forms completed in medical emergency centers. Since the forms and databases in all centers were identical, one sample of each form and database was selected for analysis. Thereafter, the included data elements were assessed. A checklist was used in each center to extract data elements.

In the next stage, a literature review was performed to retrieve relevant resources. Data sources for this stage were papers, reports, and forms found on the internet. In this stage, a checklist was used to extract the data elements. Materials relevant to the subject were found using a search strategy (Table 1).

Sampling was not performed at this stage, and all the relevant literature were retrieved and evaluated based on the inclusion criteria. The data elements were entered into the checklist. A literature review was performed until data saturation was reached.

A separate checklist was applied for data collection in each center. Then, the content of the final checklist was constructed by combining the data elements extracted from reviewed forms, databases in Iran, and data elements obtained from the literature review. The data elements of the checklists were used to develop questionnaires. Two columns, "needed" and "not needed," were added in front of each data element. At the end of each section, an empty box was provided to allow experts add any additional data elements they thought were necessary to register.

The content validity of the questionnaires was evaluated using the comments from experts in the fields of health information management, traffic police, computer engineering, and clinical staff (physicians and nurses). A total of eight persons, two experts from each field, consulted.

To ensure their reliability, the questionnaires were completed by 20 of the aforementioned experts; they were asked to complete the questionnaires for a second time after two weeks. The collected data were analyzed using SPSS 16. The Spearman's rank correlation coefficient was used to evaluate the reliability of the questionnaires, which showed coefficients of 77%, 74%, and 76% for the traffic police, trauma center, and medical emergency center questionnaires, respectively.

To determine the MDS of the traffic accident information management system, the final data elements were chosen from 220 samples of attended experts in the aforementioned centers (Table 2), applying the Decision Delphi technique in two rounds. Decisions about the included data elements were based on the agreement level. In this way, data elements with less than 50% agreement were excluded in the first round, and those with more than 75% agreement were included in the first round. Those with 50% to 75% agreement were surveyed in the second round and, if there was 75% consensus over a subject, it was regarded as a final data element.

4. Results

The MDS of the traffic accident information management system was assigned to three sections: traffic police with six, trauma centers with five, and medical emergency centers with 11 classes. Total number of data elements collected from the traffic police offices, trauma centers, and medical emergency center sections were 138, 75 and 91, respectively. After applying the two rounds of the decision Delphi technique, the final set of data elements was determined for traffic police with 118, trauma centers with 57, and medical emergency centers with 64 (Tables 3 - 5).

The traffic police data classes consisted of many elements. First, a data class was related to the date, location, and time when crash occurred, including its location, road name, coordinate system, date and time when the traffic police were informed about the crash, when police appeared on the scene, and when police surveyed the crash. Second, a crash information data class included data elements about the type of crash and the identifying factors that related to law or legal factors (human, vehicle, justice, and total). Third was a road and weather conditions data class related to road failures, lighting, the road surface, and weather conditions (cloudy, rainy, dusty). The fourth class was related to vehicle information and included data elements related to culpable and non-culpable vehicles involved in the crash. Fifth, the driver information data class included drivers' demographic information, health condition (physical and mental), drug/alcohol abuse, and license status. Sixth, the passengers and pedestrian information data class included elements about the number of injured persons, their demographic information, injury severity, and set position.

The trauma center data classes consist of, first, a trauma center profile data class that included elements related to contact information, equipment, in-patient and para-clinical wards. A second class, injured information, showed data about the date and time of admission, as well as patients' record numbers. The third and fourth classes, accident and injury description, included data elements that describe the accidents according to V00-V85 and injuries according to S00-T07, the subcategories established by the International Statistical Classification of Diseases and Related Health Problems: Tenth Revision (ICD-10) and procedures according to volume three of the International Classification of

Diseases-Ninth Revision-Clinical Modification (ICD-9-CM). Fifth, the service cost data class, included elements pertaining to cost of each service, both separately and as a whole.

The emergency center data classes include first, the emergency center profile data class, which consists of the name, type, and coordinate system and emergency center distance from/to police/ fire station/another emergency center. Second and third, the ambulance and network connection classes included the number of ambulance and type of communication device that was used. Fourth, the personnel data class was related to the number of staff on hand and their type of expertise. Fifth data class, injured information, related to data elements about the demographic information of injured persons. Sixth, the date/time of emergency mission data class included: inform time, arriving at the scene, dispatch time, and arriving at the hospital.

Seventh, the transferor data class showed the name and code of the transferor. Eighth, the injury location data class indicated the coordinate system and mission environment (e.g., residential, educational, sports, nature). Ninth, the injured status data class included data elements on vital signs and drug prescriptions. Tenth, the diagnoses data class included data elements about patient status such as their delivery time to the hospital, probable diagnosis, pain score, and procedures that were performed. The final data class was mission results by emergency, which included the hospital name, if the injured person was transferred, outpatient treatment on the scene, and death (Table 6).

Table 1. Search Strategy for Retrieving Data Elements of Information Management System for Traffic Accidents

Sites, Criteria, Strategy	Descriptions, Characteristics
Websites	world health organization, texas department of transportation; www.miros.gov.my; www.jmwengineering.com/aims00/new.html; http://roadsafety.transport.nsw.gov.au, http://internationaltransportforum.org/irtadpublic; website: www.sgi.sk.ca
Search engines	Yahoo; Google
Databases	Google Scholar; PubMed; ISI Web of Science; Scopus; EMBASE, IEEE; Cochrane; SID; Mag Iran; IranMedex, (through July 30, 2014)
Inclusion and Exclusion criteria	Inclusion criteria: Literature in the English language; papers; annual reports; reports; guidelines, and forms of research published from 2000 through July 2014; in full text form, from valid sources, with a clearly stated purpose. Exclusion criteria: Non peer-reviewed papers; reports; and forms retrieved from personal weblogs and abstracts without accessible full text.
Strategy	#1
#1	"accident or crash data element"; "traffic accident data element"; "accident information management System"; "accident information management"; "traffic accident information management system"; "minimum data set" and crash or accident; "road traffic accident" and "minimum data set"

Table 2. Characteristics of the Samples[a]

Institute/ Organization	Samples	Gender		Academic Field	Education Level	Number	Total Number of Samples From Each Institute
		Male	Female				
Traffic police							66
	Accident officer	22	NA	Police = 22	Expert accident = 22	22	
	IT expert	17	5	Computer sciences = 22	Bachelor of sciences = 15; master of sciences = 7	22	
	Statistician	19	3	Statistics = 22	Bachelor of sciences = 19; master of sciences = 3	22	
Trauma center							88
	Staff for registration accident records	5	17	Medical record = 22	Bachelor of sciences = 22	22	
	Staff for registration accident costs	9	13	Accounting = 22	Bachelor of sciences = 22	22	
	Director of information management department	10	12	Medical record = 22	Bachelor of sciences = 18; master of sciences = 4	22	
	Hospital manager	19	3	Physician = 14; health services management = 8	General physician = 12; specialist = 4; health services management = 6	22	
Emergency center							66
	Chef of emergency centre	22	NA	Physician = 22	Specialist = 13; general hysician = 9	22	
	Statistician	12	10	Statistics = 22	Bachelor of sciences = 18; master of sciences = 4	22	
	IT expert	16	6	Computer sciences = 22	Bachelor of sciences = 19; master of sciences = 3	22	

Abbreviation: NA, not available.

[a]Total number of samples = 220.

Table 3. Traffic Police Data Classes for a Minimum Data Set for an Information Management System for Traffic Accidents

Institute	Data Classes	Number of Data Elements	First Round of Delphi			Second Round of Delphi			Final
			< 50%	50 - 75%	75% <	< 50%	50 - 75%	75% <	
Traffic police									
	Crash location and date/time	17	1	2	14	1	0	1	15
	Crash Information	21	4	3	14	2	0	1	15
	Road and weather conditions	21	2	5	14	2	0	3	17
	Vehicle information	35	3	8	24	2	0	6	30
	Driver information	22	0	8	14	1	0	7	21
	Pedestrian and passenger information	22	0	2	20	2	0	0	20
Total		138	10	28	100	10	0	18	118

Table 4. Trauma Center Data Classes for a Minimum Data Set for an Information Management System for Traffic Accidents

Institute	Data Classes	Number of Data Elements	First Round of Delphi			Second Round of Delphi			Final
			< 50%	50 - 75%	75% <	< 50%	50 - 75%	75% <	
Trauma center									
	Trauma center profile	13	0	0	13	NA	NA	NA	13
	Injured information	15	0	0	15	NA	NA	NA	15
	Accident descriptions	9	3	1	5	1	0	0	5
	Injury descriptions	14	3	6	5	4	0	2	7
	Services cost	24	4	5	15	3	0	2	17
Total		75	10	12	53	8	0	4	57

Abbreviation: NA, not available.

Table 5. Emergency Center Data Classes for a Minimum Data Set for an Information Management System for Traffic Accidents

Institute	Data classes	Number of data elements	First round of Delphi			Second round of Delphi			Final
			< 50%	50 - 75%	75% <	< 50%	50 - 75%	75% <	
Emergency center									
	Emergency center profile	26	2	8	16	7	0	1	17
	Ambulance information	4	0	2	2	2	0	0	2
	Network connection details	6	5	0	1	NA	NA	NA	1
	Personnel information	10	0	4	6	4	0	0	6
	Injured information	5	0	0	5	NA	NA	NA	5
	Date/Time of emergency mission	8	0	0	8	NA	NA	NA	8
	Transferor information	5	1	0	4	NA	NA	NA	4
	Injury location	6	0	3	3	3	0	0	3
	Injured status	8	0	0	8	NA	NA	NA	8
	Diagnoses	10	2	4	4	1	0	3	7
	Mission results	3	0	0	3	NA	NA	NA	3
Total		91	10	21	60	17	0	4	64

Abbreviation: NA, not available.

Table 6. Examples of Data Elements in the Information Management System for Traffic Accidents

Data classes	Data elements
Police Office	
Crash location and date/time	Province name; street name; accident location; coordinates
Crash information	Type of crash (property, injury, death); definite cause of crash; crash with (Motorcycles, bicycles, single or multi-vehicle)
Road and weather conditions	Lighting; barriers to see; weather; road repairs
Vehicle information	Type of vehicle; vehicle registration number; technical examination
Driver information	Nationality; driver name and family; educational level; license status
Pedestrian and passenger information	Total occupants; number of injured persons; name and family; education; Job
Trauma Center	
Trauma center profile	Hospital name; coordination X,Y; number of active beds
Injured information	Admission date; admission time; hospital record number
Accident description	Injury description (V00-V99, ICD-10); injured set position
Injury description	Type of injury; type of operation; length of stay
Services cost	Visit cost; operation cost; bed cost; cost as a whole
Emergency Center	
Emergency center profile	Emergency center name; type of emergency center; distance to road; distance to the next emergency
Ambulance information	The total number of ambulances; the total number of active ambulances
Network connection details	Mobile; masts; fixed; manual
Personnel information	The total number of personnel; number of physicians; number of experts
Injured information	Injured name and family; age; gender
Date/Time of emergency mission	Crash report to emergency; dispatch from emergency; arrival time of EMS to the scene; move from the scene ; arrival time to hospital
Transferor information	Transmitter name; transmitter code
Injury location	Type of trauma; mission environment (residential, educational, nature); coordination X,Y
Injured Status	Pulse rate; respiratory rate; GCS
Diagnoses	Patient status in delivered time to hospital (conscious, semiconscious, coma); type of trauma; pain score
Mission results	Transfer to hospital; outpatient treatment; died before reaching the technician, during transfer

5. Discussion

The quality of decision making in road safety and death prevention is dependent on the quality of the data on which decisions are based (9). When addressing this issue, collecting accurate and standard data is of great importance. The WHO has urged countries to design and develop traffic accident information systems (12).

The high rate of accidents in Iran highlights need to take measures to improve the underlying infrastructure (13, 14). The results of this study showed that, in Iran, there are gaps in traffic accident data coverage, in terms of sufficient data elements, standardized tools, and integrated information systems that may be used by police, trauma, and medical emergency centers.

In the data classes related to traffic police, the lack of road numbers, work zones, and week days were highlighted, and in the recording of crash information, the different resources revealed that sketches are drawn in various ways (digitally, manually, or photos are taken) (9). In contrast, in Iran, sketches are drawn manually.

For crash fatality information, the absence of the internationally recommended 30-day follow-up of a crash fatality for most resources was obvious (12). This leads to an inconsistency in the comparison of data across countries and within different sectors of a country (15). Injury severity was only included in some resources. There was a large variation in property damage reports for different contexts; in Iran, this report included a notation if the value of damage exceeded 30,000,000 Rials in 2014 (16, 17).

Despite the fact that climate factors largely contribute to road accidents throughout the world (18), data for traffic volumes and road classification have not been recorded in Iranian databases, even though data about vision obstacles and road repairs were uniquely included. Data about vehicles, drivers, and passengers/pedestrians, including the availability of safety equipment, safety equipment performance, type of insurance and insurance expiration dates, drug and alcohol tests, and physical status, injury severity, and cause of injury for passengers or pedestrians were not recorded for Iran. Though establishing standard data elements for crashes allows for a comparison across countries (19, 20), there is a large deficiency in Iran's data elements.

Health Care system is the main responsible body for determining the medical and financial consequences of a traffic accident (6). In this regard, the Iranian Ministry of Health established a road traffic management system in 2010 to oversee data collection in trauma centers related to traffic injuries (21). The most important weaknesses of this data, in comparison with other countries, were the lack of a full, documented diagnosis of traumatic injuries based on the ICD, evaluating the severity of the accidents, and rehabilitation time.

Moreover, this system was established only in trauma centers, and there are no interactions in terms of data exchanges with other beneficiaries. This was consistent with findings from some other studies (15). To solve this problem, we constructed an MDS for trauma centers in five classes, which makes data exchangeable across different beneficiaries. As illustrated in Table 6, these classes describe data about the equipment in trauma centers, injured parties' information, the accidents, injury descriptions based on ICD, and the cost of services.

From the results of this study, it is obvious that there were considerable gaps in terms of required minimum data sets, and these needed to be addressed. It is suggested that rather disparate sources from various sectors should be integrated uniformly, in order to maximally capture the true burden of crashes (22, 23) and increase their comparability using international guidelines.

Crashes are one of the main causes for Traffic congestion. This is more noticeable during peak hours, and in places that are far from emergency centers or where the population density is high. In today's traffic world, ambulances play a major role in saving the lives of accident victims (23, 24).

Transportation of an injured person to an emergency hospital is a complicated mission (25). Hence, developing an MSD to identify the required data, in order to help decision makers to improve and equip the organization of pre-hospital emergency efforts, is critical (26).

To complete an MDS of traffic accident information, data elements required for emergency centers were built on 11 classes. These classes, as shown in Table 6, included data on the profiles and equipment of emergency centers, status and numbers of ambulances, technologies that are used to connect and inform responders about crashes, and the number of personnel on hand and their specialties. Data elements associated with the times related to dispatch, transferor and injured information, performed procedures, and mission results were also determined to comprise an emergency minimum data set.

Road accidents are the main cause of the injuries in the world (22). On the other hand, precise and accurate data are required for the purpose of ensuring the continuity of care and clarifying legal statements. Therefore, standard collection techniques and definitions should be used for data with minimal free text (27). As Laing states, the MDS can provide a construction to facilitate a comprehensive documentation of the records (28). As the base for crash prevention programs, the existence of standardized data infrastructures is essential. Using these data, policymakers and decision makers will be better able to track road traffic injuries and fatalities.

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Footnotes

Authors' Contribution: Ali Mohammadi participated in the developing the study design, data acquisition, statistical analysis, and drafting the manuscript. Maryam Ahmadi contributed to the statistical analysis, interpretation of data, and drafting the manuscript. Alireza Gharagozlu provided technical support.

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References

1. Mahmud AR, Zarrinbashar E. Intelligent GIS-Based road accident analysis and real-time monitoring automated system using WiMAX/GPRS. *Int J Eng*. 2008;**2**(1):1–7.
2. Lai PC, Chan WY. GIS for road accident analysis in Hong Kong. *Ann of GIS* . 2004;**10**(1):58–67. doi: 10.1080/10824000409480655.
3. Rezaei S, Arab M, Karami Matin B, Akbari Sari A. Extent, consequences and economic burden of road traffic crashes in Iran. *J Inj Violence Res*. 2014;**6**(2):57–63. doi: 10.5249/jivr.v6i2.191. [PubMed: 24045158]
4. Majdan M, Mauritz W, Wilbacher I, Janciak I, Brazinova A, Rusnak M, et al. Traumatic brain injuries caused by traffic accidents in five European countries: outcome and public health consequences. *Eur J Public Health*. 2012;**23**(4):682–7. doi: 10.1093/eurpub/cks074. [PubMed: 22689382]
5. Mohsenian H, Rahimi Khameneh A. Analysis in GIS database crashes in 2007. *Mashhad Arch J*. 2010;**13**(37-38):98–105.
6. Movahedi M, Severi H, Ainy E, Mehmandar MR. Comparative mapping information provided by the sources of information used in the model American and Asian. *Payesh J*. 2011;**11**(1):21–7.
7. Sadat Hosseini SM, Soleymani M. Causes of death in a highway accident (Case Study: Isfahan) traffic management studies. 2009;**4**(14):71–84.
8. Zayrzadh A, Ahadi R, editors. A comprehensive database of information on effective step towards reducing traffic accidents.; Fourth national congress on civil engineering..2008; Tehran.

9. Montella A, Andreassen D, Tarko AP, Turner S, Mauriello F, Imbriani LL, et al. Critical review of the international crash databases and proposals for improvement of the italian national database. *Procedia Soc Behav Sci.* 2012;**53**:49–61. doi: 10.1016/j.sbspro.2012.09.859.
10. Ahmadi M, Mahmoodabad Dehghani A, Fozonkhah SH. Messaging standard for electronic health records in the selected organizations. . *Health Inform Manage.* 2012;**9**(2):161–70.
11. Ahmadi M, Mohammadi A, Chraghbaigi R, Fathi T, Shojaee Baghini M. Developing a minimum data set of the information management system for orthopedic injuries in iran. *Iran Red Crescent Med J.* 2014;**16**(7):e17020. doi: 10.5812/ircmj.17020. [PubMed: 25237576]
12. World Health Organization. *WHO global status report on road safety 2013: Supporting a decade of action.* World Health Organization; 2013.
13. Pakgohar A, Tabrizi Sigari R, Khalili M, Esmaeili A. The role of human factor in incidence and severity of road crashes based on the CART and LR regression: a data mining approach. *Procedia Comput Sci.* 2011;**3**:764–9. doi: 10.1016/j.procs.2010.12.126.
14. Zangiabbadi A, Shiran G, Gashtyl K. Investigate the causes of accidents on motorways (A Case Study of Urban Highways). *Res stud Rahvr.* 2012;**9**(17):37–57.
15. Puvanachandra P, Hoe C, El-Sayed HF, Saad R, Al-Gasseer N, Bakr M, et al. Road traffic injuries and data systems in Egypt: addressing the challenges. *Traffic Inj Prev.* 2012;**13 Suppl 1**:44–56. doi: 10.1080/15389588.2011.639417. [PubMed: 22414128]
16. Tarko AP, Bar-Gera H, Thomaz J, Issariyanukula A. Model-Based application of abbreviated injury scale to police-reported crash injuries. *Transport Res Record: J Transpo Res Board.* 2010;**2148**:59–68. doi: 10.3141/2148-07.
17. Tarko A, Azam MS. Pedestrian injury analysis with consideration of the selectivity bias in linked police-hospital data. *Accid Anal Prev.* 2011;**43**(5):1689–95. doi: 10.1016/j.aap.2011.03.027. [PubMed: 21658495]
18. Habibi Nokhandan M, Bazrafshan J, Ghorbani K. A quantitative analysis of risk based on climatic factors on the roads in Iran. *Meteorol Appl.* 2008;**15**(3):347–57. doi: 10.1002/met.77.
19. World Health Organization, editor. Data systems: a road safety manual for decision-makers and practitioners.; 2010; Paris, France.
20. NHTSA. *MMUCC Guideline, Model Minimum Uniform Crash Criteria, . . Fourth ed. Washington, D.C., US.: Report* DOT HS 811 631, US Department of Transportation; 2012.
21. Iranian Ministry of Health and Medical Education. *Instructions for record traffic accidents. In Deputy of treatment.* Tehran: Ministry of Health and Medical Education; 2010. Available from: http://92.health.gov.ir/pages/fin.aspx.
22. Peden M, Scurfield R, Sleet D, Mohan D, Adnan A, Hyder Jarawan E, et al. *World report on road traffic injury prevention.* Geneva: 2004.
23. Ardalan A, Sepehrvand N, Pourmalek F, Masoumi G, Sarvar M, Mahmoudabadi A, et al. Deadly rural road traffic injury: a rising public health concern in I.R. Iran. *Int J Prev Med.* 2014;**5**(2):241–4. [PubMed: 24627755]
24. Kalantari M, Moradi Mofrad S. Spatial analysis of accident black spots in Zanjan. *Res stud Rahvr.* 2013;(2):4.
25. Haynes R, Jones AP, Sauerzapf V, Zhao H. Validation of travel times to hospital estimated by GIS. IJHG. *International Journal of Health Geographics.* 2006;**5**(1):40. doi: 10.1186/1476-072x-5-40. [PubMed: 16984650]
26. Bahadori M, Ravangard R. Determining and Prioritizing the Organizational Determinants of Emergency Medical Services (EMS) in Iran. *Iran Red Crescent Med J.* 2013;**15**(4):307–11. doi: 10.5812/ircmj.2192. [PubMed: 24083003]
27. Tierney WM, Beck EJ, Gardner RM, Musick B, Shields M, Shiyonga NM, et al. Viewpoint: A pragmatic approach to constructing a minimum data set for care of patients with hiv in developing countries. *J Am Med Inform Assoc.* 2006;**13**(3):253–60. doi: 10.1197/jamia.M2005. [PubMed: 16501175]
28. Laing K. Use of the SGNA Minimum Data Set in the clinical area. *Gastroenterol Nurs.* 2005;**28**(1):59–60. [PubMed: 15738737]