

Strategies for Improving the Data Quality in National Hospital Discharge Data System: a Delphi Study

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Original paper ABSTRACT

Introduction: National hospital discharge data system can play a critical role in community health assessment, disease surveillance, strategic planning, policymaking, service quality control, and research. Moreover, the quality of hospital discharge data affects the usefulness of the data and is one of the prerequisites for effective utilization of the data. Thus, the present study aimed to identify the necessary

actions for improving the data quality in the national hospital discharge data system and present a model for Iran based on the experiences of England, Canada, and New Zealand. **Methods:** In doing so, the measures performed in these countries were investigated. The related data were organized in six categories of standards and procedures, training and coordination with the users, assurance from the capability of the system's software, data modification, data quality control, and documenta-

tion and reporting the data quality. According to the gathered data, the primary model was designed. Then, the model was assessed using a two-round Delphi technique by 33 and 31 experts, respectively. **Conclusion:** According to the findings, a model was presented in order to improve the data quality of Iran's national hospital discharge data system.

Key words: Data quality, Health information system, Hospital discharge data

1. INTRODUCTION

A hospital discharge data system is an informational, planning, budgeting, epidemiologic, and quality control tool in modern healthcare. By using this system and provision of data from all the hospitals, a comprehensive image of the whole population as well as the hospital services used in the region will be provided (1).

Hospital discharge data are in fact the most accessible comparative data resources for investigating all the hospitalized patients (2). Such data enable categorization of the hospitals regarding the comparison of expenditures and facilitate assessing the effect of market competition on the hospital cost growth, planning for better resources allocation, and estimation of the economic burden of diseases (3). These data also play a major role in producing the health indicators (1), community health assessment, disease surveillance, strategic planning, service quality control, research, policy making, and preventing injuries (3).

Of course, hospital discharge data quality affects the usefulness of these data and is one of the prerequisites for effective utilization of the data (4, 5). Therefore, the usages of hospital discharge database might be limited due to the problems resulting from the data quality (3).

Murai et al. (2011) believe that the data quality in health information systems is questionable in most developing countries and the majority of these countries still lack strong and effective health information systems (6). Some studies on Iran's national hospital discharge data system revealed data quality problems. In this regard, a study showed that there have been defects in reporting as well as prevention of errors (7). Another research also indicated that the data collected across the country were imperfect (8). Besides, an official report on Iran's system in 2008 pointed to some deficiencies in the national database, such as failure to properly record the patients' age and sex, inaccurate coding of medical diagnoses and procedures, and incom-

pleteness of data (9).

Iran's national hospital discharge data system was established by Ministry of Health in 2000 and has not been modified since that time. Given that the benefits of hospital discharge data system can only be achieved through high-quality information, the development and completion of the current system is necessary to create a comprehensive system and ensure the data quality. Therefore, the present study aims to identify the necessary activities and measures for improving the data quality of the national hospital discharge data system and present a model for Iran based on the experiences of the successful countries.

2. METHODS

The present study was conducted using descriptive methods and the Delphi technique in 2011-2012. The measures performed in England, Canada, New Zealand, and Iran for improving the data quality in the national hospital discharge data system were investigated. The above-men-

tioned 3 countries were selected due to their long history in establishing the systems, expanding the hospital discharge data system to the national level, appropriate investment for design and development of the systems, and focusing on data quality (10, 11, 12).

The study data were collected by studying the documents, articles, books, and journals either in the library or published in the websites of the health organizations of the selected countries as well as consultation with the experts in the field of hospital discharge data systems of the studied countries via email. The data related to Iran were collected from the publications and instructions issued by the Ministry of Health and the provincial offices of hospital discharge data systems. In this regard, interviews were also conducted with officials and experts.

To design the primary model, the data gathered from the selected countries were organized in 6 categories of standards and procedures, training and coordination with the users, assurance from the capability of the system's software, data modification, data quality control, and documentation and reporting the data quality. These categories were emerged inductively as the literature review was conducted. The gathered data were compared regarding the 6 above mentioned categories. Accordingly, similar items were eliminated and dissimilar ones were included in the primary model. The primary proposed model was designed by cooperation of seven experts, including one PhD of Health Information Management, two PhDs of Medical Informatics, one PhD of Computer Sciences, one physician, and two experts of Medical Records.

Then, the Delphi technique was used to determine the validity of the proposed model. In doing so, a ques-

Characteristic		First round % (n = 33)	Second round % (n = 31)
Sex	Male	30.3	32.3
	female	69.7	67.7
Age	25-34	27.7	29
	35-44	39.4	35.5
	>45	33.3	35.5
Working experience (years)	4-12	45.5	48.4
	13-20	24.2	19.3
	>20	30.3	32.3
Responsibility	Faculty members or university professors	72.7	74.2
	Authorities of provincial hospital discharge data systems	27.3	25.8
Education	Ph.D. degree	21.2	19.4
	M.Sc.	66.7	67.7
	B.Sc.	12.1	12.9
Field of study	Health information management	57.6	54.9
	Medical records	27.3	29
	Medical informatics, computer sciences, and information technology	15.1	16.1

Table 1. Demographic characteristics of experts participated in the Delphi technique

Category	Strategies	Source			
		Canada	England	New Zealand	Used In Iran
1-Standards and procedures	1-1 Existence of minimum data set and its utilization in the national level	*	*	*	No
	1-2 Existence and utilization of standard forms for data collection	*			Yes
	1-3 Using national standards and guidelines for coding the medical diagnoses and treatments	*	*	*	No
	1-4 Existence of a comprehensive guide for abstracting and data collection	*	*	*	No
	1-5 Having access to the abstracting guideline and data cleaning rules through the website	*	*	*	No
	1-6 Existence of data quality control procedures	*	*	*	No
	1-7 Regular update of the policies and procedures	*	*	*	No
	1-8 Having access to all the records of a patient and identifying the re-admissions using the patient's identifier		*	*	No
	1-9 Possibility of matching the diagnoses and treatment measures of various classifications with the conversion tables	*		*	No
	1-10 Predicting identifiers for establishing linkages with other datasets	*	*	*	No
	1-11 Existence of national due for data presentation and modification and prior declaration of the official data release date	*			No

Table 2. Strategies related to standards and procedures

tionnaire was prepared based on the primary model. The questionnaire was sent to 40 experts in health information systems and health information management through E-mail and 33 completed questionnaires were returned (response rate: 82.5%). These experts were the professors of Iran's universities of medical sciences or the authorities of provincial hospital discharge data systems of the country. The participants in the Delphi technique had to score the components of the proposed model using the 5-point Likert scale (1=completely disagree, 5=completely agree) and present their suggestions, as well.

In each round of the Delphi technique, the items with median scores

≥4 could remain in the model. According to the results of the first round of Delphi, another questionnaire was prepared for the second round. Then, the questionnaire was sent to the 33 experts who had taken part in the first round of Delphi through E-mail and 31 questionnaires were returned (response rate: 93.9%). After the two rounds, agreement was achieved regarding the components of the proposed model.

3. RESULTS

The demographic characteristics of the experts who participated in Delphi technique are shown in Table 1. A total of 33 experts took part in the first round of the Delphi technique and 31 ones participated in the second round. The majority of the experts were faculty members or university professors (72.7 % and 74.2% in rounds one and two, respectively) and the others were the authorities of provincial hospital discharge data systems.

The items of the validated model, including 67 strategies, are presented in 6 categories of standards and procedures, training and coordination with the users, assurance from the capability of the system's software, data modification, data quality control, and documentation and reporting the data quality. After all, 56 strategies based on the experiences of the studied countries and 11 items according to Delphi experts' suggestions were added to the model. Overall, only 5 items of the proposed model have been used in Iran's current system (Tables 2 to 7).

4. DISCUSSION

The results of this research showed that the studied countries (Canada, England, and New Zealand) have undertaken a variety of activities and measures related to the data quality of their hospital discharge data systems. According to the findings, very limited activities have been done in Iran in this regard. Even the items that have been emphasized in all the 3 selected countries, such as utilization of minimum data set in the national level, existence of a comprehensive guide for abstracting and data collection, existence of data

quality control procedures, and automated data cleaning, have been neglected in Iran's systems. Therefore, this system needs to be reviewed and developed.

Besides, the results indicated that the study experts added 11 new items, such as motivating the staff, providing conditions for preventing the staff from being transferred or leaving the system, and employing specialist workforce in health information management, to the model. This can result in a more complete model.

The most important category of the model is the category of standards and procedures and its strategies should be considered prior to the other presented strategies. However, all the items of models are essential for improving the data quality and their implementation is recommended.

4.1. Standards and procedures

Zadka et al. showed that in order for the national hospital discharge databases to be comparable, existence of sufficient descriptions about these databases which encompass all the comparability disturbing issues and identify the differences is necessary (13). Furthermore, to gather the data in a standard manner, the necessary data should be obtained based on the clear definitions and a standard guideline should also be designed regarding data collection (14, 15, 16). The importance of standardization of the methods has been emphasized by Buffum, as well (17). In fact, standardization of the methods lead to better coordination as well as more desirable outcomes; of course, guidelines should be periodically reviewed. In this regard, Richards et al. emphasized revision of the discharge abstract manual documentation and considered it as a mechanism for supporting the data quality improvement (18). Overall, using a minimum data set in the hospital discharge data system plays a critical role in definition of data elements and creating coordination in data collection, reporting, and usage. In fact, development and utilization of a minimum data set also provides the ground for data quality improve-

ment.

According to Gray and Clement, linkage capability is a basic feature of data sets and is necessary for responding to a great number of research questions. In addition, by predicting the organizational or geographical identifiers and linking to other related data sets, the necessary information can be provided (19). Schoenman et al. considered the capability of linkage to other databases as a criterion for evaluating the hospital discharge databases (3). Thus, the authorities of hospital discharge data systems should establish appropriate linkages.

4.2. Training and coordination with the users

Buffum states that training the data collectors leads to the databases' readiness for being used in healthcare decisions (17). In the same line, Richards et al. believe that holding educational meetings and teleconferences is effective in improving the hospital discharge data quality (18). In this regard, holding training courses on coding the diseases is of utmost importance. As Lawrence et al. have mentioned, since the usefulness of hospital discharge data is affected by the quality of diseases coding, presenting a consistent, clear guide about the necessities and expectations to the hospitals and coders is highly important (4). Furthermore, according to Arts et al., a major part of error prevention is related to selection as well as education of sufficient, motivated personnel. They also believe that in order for continuity in error prevention in databases, the staff of the central coordinating center as well as those of the local sites should be motivated (20). Similar to other studies conducted on the issue, the findings of the present study showed that training the users can be highly ef-

fective in improving the data quality. Therefore, in addition to holding the common training courses, the authorities of this system have to perform educational needs assessment and hold special training courses for the staff of the hospital discharge data system in both the central office and the local cooperating sites.

4.3. Assurance from the capability of the system's software

Friedman and Gustafson have emphasized that the utilized software in healthcare organizations should facilitate the users' quick and timely access to their required data; in a way that no error be there when responding to the information requests (21). After determination of the users' information requirements and the expected reports, the authorities of hospital discharge data system should reflect the standards as well as the necessary infor-

Category	Strategies	Source					Used in Iran
		Canada	England	New Zealand	Experts' suggestions		
2-Training and coordination with the users	2-1 Holding training courses on data processing and reporting for the database users	*	*				No
	2-2 Holding training courses on data collection for database users	*					Yes
	2-3 Holding training courses on clinical coding for improving the data sent to the database	*	*	*			No
	2-4 Provision of the educational information through the Internet	*	*	*			No
	2-5 Providing consultation and responding to the providers' questions through the liaisons of the database	*					Yes
	2-6 Possibility of question making and searching the previous questions and answers through the Internet	*		*			No
	2-7 Providing the users with information regarding the data updates and the changes applied to the dataset	*	*				No
	2-8 Holding training courses for explaining the importance of database and motivating the staff cooperating with the database					*	No
	2-9 Making arrangements for consolidation of the staff cooperating with the national database in different levels and preventing their transfer to other units or leaving the organization					*	No
	2-10 Employing expert workforce in health information management					*	No

Table 3. Strategies related to category training and coordination with the users

Category	Strategies	Source					Used in Iran
		Canada	England	New Zealand	Experts' suggestions		
3-Assurance from the capability of the system's software	3-1 Supporting the producers (vendors) of the system's software in designing	*		*			No
	3-2 Necessity of paying attention to information and reporting requirements in selection and preparation of the software	*	*				No
	3-3 Explaining the modification features and validation and identification of the necessary specifications of the file in the related document for the software producers	*		*			No
	3-4 Obliging the producers (vendors) to annually assess the software for errors in the data	*					No
	3-5 Affirmation of the software and issuing a certificate for it after success in the test	*		*			No
	3-6 Evaluation of the conformity of the hospitals' data management systems or data collection software to the national database system	*	*	*			No
	3-7 Existence of on-call specialists in hospitals for solving the probable problems					*	No
	3-8 Identifying the needs of the primary and secondary users for software designers					*	No
	3-9 Designing an appropriate user interface for the system					*	No

Table 4. Strategies related to category assurance from the capability of the system's software

Category	Strategies	Source					Used in Iran
		Canada	England	New Zealand	Experts' suggestions		
4-Modification of the data	4-1 Automated data cleaning	*	*	*			No
	4-2 Manual data cleaning		*	*			Yes
	4-3 Removing the duplicate abstracts	*	*	*			No
	4-4 Processing the incoming files		*	*			No
	4-5 Referring the non-compliant records with the database to their providing institute for investigation and correction of the invalid values	*	*	*			No
	4-6 Repeating the data modification if necessary up to the closure of the database	*	*				No
	4-7 Modification and validation of the data by the providers before being sent to the database	*	*	*			No
	4-8 Adding the missing abstracts by the hospitals		*				No
	4-9 Performing validation checks for all data elements	*	*	*			No
	4-10 Assessing the data according to the validation rules	*	*	*			No
	4-11 Investigating the data integrity (investigation of the consistency of the field values)	*	*				No
	4-12 Removing the invalid codes		*				Yes
	4-13 Replacing the invalid or missing data elements whose modification is not possible with a special code	*	*				No
	4-14 Editing the format of the data (the codes' form and domain)	*	*	*			No
	4-15 Performing the modifications by gaining the agreement of the data providing organizations					*	No
	4-16 Direct data collection from the patients' medical records for reducing the errors					*	No

Table 5. Strategies related to category of data modification

mation to the software producers. The documents related to the description of the validation rules and the intended features for the files sent to the database should be provided for the software producers, as well (22). Data validation rules are in fact the necessary logical investigations of the data entered to the database in comparison to the predefined rules. These investigations focus on the domain of the values or logical consistency by taking other fields of the patient's data into account (23). Thus, the authorities should consider development of data validation document as a priority; so that the software can be prepared and the data can be cleaned. Primary and periodical evaluation of the software and applying the necessary modifications lead to data quality improvement, as well.

4.4. Data modification

Data cleaning refers to the elimination of problems regarding the

missing values, incorrect or out of domain measures, and incompatibilities (23). In fact, data anomalies can be revealed by automated data cleaning at data entry (20). In this way, utilizing the parameters of the software program on number values is a method for reducing the errors and in case a number is entered incorrectly, it is revealed by an alarm (17). Of course, all the errors cannot be revealed through automated examination and it is not possible to discover the data errors which exist in the predefined domain. Thus, in addition to automated investigation of the data, a visual examination is recommended, as well (24). For instance, discharge diagnoses can be matched with the medical

records in order to manually investi-

gagers identify the errors and pose questions to be sent to the healthcare institute in order to be solved. Lawrence et al. also believe that as the data are received from the hospitals, their quality should be investigated and in case there are a large number of errors, the data should be returned for correction (4).

4.5. Data quality control

Studies have shown that to ensure the usefulness of the hospital discharge data system for achieving scientific goals, it is necessary to evaluate the accuracy and coverage of the related databases (25). Data quality can be controlled by visiting the healthcare institutes and performing data audits in which a sample of the central database data is compared to the source data (14, 26). Moreover, assessment of data collection methods for reducing the probability of bias and error, paying attention to the existing errors, and management of the missing data are other measures which lead to data quality improvement (17).

Furthermore, to validate the data, it is necessary to investigate the monthly activity of healthcare centers in sending data to the national database and compare it to the previous months' activities. According to Buffum, the measures which have highly increased or decreased compared to the previous ones can be errors. He also believes that comparison of the findings with other databases of the same region or similar organizations can validate the data, as well (17). According to World Health Organization (WHO), if the healthcare institutes or the ministry of health aim to take serious actions about the data quality, they have to develop a plan for improving the quality of the data as well as the information resulting from the data (27). Consequently, the authorities have to approve and implement a plan for improving the quality of these data, determine an accurate guideline about investigation and controlling the data quality, and monitor its execution.

4.6. Documentation and reporting the data quality

According to WHO, documenta-

Category	Strategies	Source					Used in Iran
		Canada	England	New Zealand	Experts' suggestions		
5- Investigation and controlling the data quality	5-1 Evaluation of the quality of medical diagnoses and procedures codes and other data in healthcare institutes	*	*	*			No
	5-2 Investigation of national monthly activity in sending the data and comparing it with the previous profiles	*	*				No
	5-3 Investigation of the fields completion level		*				No
	5-4 Following the previous data quality problems and identifying the providers who have not modified their previous data	*	*				No
	5-5 Holding data quality tests during and at the end of the year and performing re-abstracting	*					No
	5-6 The collected data's being related to the definitions through consultation with the region's representatives	*		*			No
	5-7 Developing the plan of data quality improvement					*	No
	5-8 Obligating the data providing institutes to correct the data errors and improve the data quality					*	No
	5-9 Recording the abstractor's information for identifying the errors related to the individuals and presenting the appropriate reaction					*	No

Table 6. Strategies related to category of Investigation and controlling the data quality

gate the data (17).

In other words, in spite of using automated data cleaning, some manual data cleaning are still utilized, as well (23). Of course, since manual cleaning is quite time-consuming and requires resource consumption, it is only used for special cases. In any event, after manual and automated data cleaning, data man-

tion of data quality and publication of the related documents for the users play a critical role in improving the data quality (27). National great databases usually publish documents regarding the accuracy of their data and present explanations about the data source, data collection methods, and reliability and validity of the instruments in these documents (17). By documentation of the data quality, the users will be provided with the opportunity to evaluate the data. According to Schoenman et al., it is possible to assess the strengths and weaknesses of hospital discharge data according to the existing details, data completion and coverage, consistency over time, accuracy, and data accessibility (3).

To improve the data quality, the data quality reports should be sent to local data collecting centers for error correction and these centers should correct the data errors after receiving the reports (20). Moreover, quality control authorities should effectively involve in and discuss the quality reports; such a way that they read the reports and timely act according to the recommendations (27). Therefore, documentation of data quality and presentation of the results to the data providers can affect the improvement of data quality.

5. CONCLUSION

In this research, a model was presented in six categories for improving the data quality of the national hospital discharge data system. The proposed model was a combination of the experiences of the studied countries completed by the suggestions of the experts taking part in the Delphi technique. The model provides some strategies for guiding the authorities of national hospital discharge data system to develop and complete the system regarding the data quality. Overall, establishing a national committee for developing the policies and standards and organizing a

Category	Strategies	Source			Used in Iran	
		Canada	England	New Zealand		
6-documentation and reporting the data quality	6-1	Documentation of data quality and publishing the related documents for the users	*	*	*	No
	6-2	Presenting data quality reports to the data provider	*	*	*	No
	6-3	Automatic production and maintenance of documents for all data processing and modifications	*	*	*	No
	6-4	Identifying each error with a message, number, and description and sending the related file to the provider	*	*	*	No
	6-5	Presenting annual reports which show the data quality		*		No
	6-6	Providing descriptive notes about data quality when publishing the data		*	*	No
	6-7	Existence of data quality dashboard and the possibility of comparing the institutes' data quality with the national and regional average through the website		*		No
	6-8	Documentation and reporting the data coverage	*	*	*	No
	6-9	Reporting the duplicate events		*	*	No
	6-10	Documentation of the changes applied to the database over time	*	*	*	No
	6-11	Clear statement of the reference population in all publications	*			No
	6-12	Reporting the validity of the key fields based on the provider		*		No

Table 7. Strategies related to category of documentation and reporting the data quality

team for regularly auditing the data quality can provide the ground for execution of the proposed model. It is hoped that by using this model, the data quality of the national hospital discharge data system will be improved and the system's objectives will be achieved.

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