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Proposing a Model for the Evaluation of the Iranian Maternal Mortality Surveillance System: A Mixed Method Study

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Abstract

Objectives: The introduction of a suitable subjective model is the first step in drawing up an evaluation plan. This research was conducted to design an evaluation model for the National Maternal Mortality Surveillance System (MMSS) in Iran.

Materials and Methods: This mix method study was carried out in four phases. Firstly, the current status of the Iranian MMSS was analyzed, and secondly, various sources of information were examined to identify the guidelines on the evaluation of public health surveillance systems. The guidelines were compared to identify the evaluation steps and the actions required at each step. In addition, the components of the initial model were identified using an expert panel and through considering the results of previous phases. Two rounds of the Delphi method were employed to determine acceptance or rejection of the extracted components.

Results: The obtained model includes four axes: (a) the description of the surveillance system (b) the general evaluation planning (c) implementation of the evaluation and (d) post-evaluation follow-ups. Some components of this model are: the purpose and operation of the system, triggers, purpose and objectives of the evaluation, data collection methods and tools, the method of presenting the findings and giving feedback.

Conclusions: This model presents different indicators concerning the importance of the system, questions and indicators for the evaluation of system features, standards for assessment the quality of the evaluation activities, and other important components. Using this information to design the evaluations can lead to comparable evaluation results.

Keywords: Model theoretical, Public health surveillance, Maternal mortality

Introduction

There is a national, international, and political commitment to reducing of the preventable maternal mortalities (MMs) (1,2). Iran designed a national maternal mortality surveillance system (MMSS) in 2000 and implemented it nationally in 2001 to fulfill this commitment (2). The maternal mortality ratio (MMR) in Iran decreased from 51 to 25 from 2000 to 2015. introducing Iran as one of the successful countries in causing the maximum decrease of this index shows the success of this system (3). However, according to the results from the first phase of this study, the levels of the two performance indices of 'the timely formation of the MM committee' and 'the implementation of interventional plans for the prevention of similar deaths' performance criteria have been below 50% during these six-year periods (4).

Moreover, in the last few decades (1976 to 2016), the population growth rate in Iran has considerably decreased (from 3.91 to 1.24%) (5-7). According to demographic estimates, the population growth rate in Iran will be descending from 2031 (3). Hence, family planning policies in Iran have evolved along with population growth, so that the control of MMs has been considered to be significantly important. (8). Therefore, precise policies, measures as well as creative changes are required to increase the effectiveness of this system, and regular evaluations can lead to the attainment of this goal (9).

Since the complexities of surveillance systems (SSs) vary based on epidemiologic, sociological, and economic factors, various features, methods, and procedures are required to evaluate these systems. Although SSs are significantly different in terms of methods, limitations, and goals, Klaucke argues that 'every evaluation should be individually tailored' (10). The introduction of a suitable subjective model is the first step in drawing up an evaluation plan (11). Hence, the present research was carried out to propose a national model for the evaluation of the Iranian MMSS.

Materials and Methods

This mixed method study was carried out in four phases. In phase 1, the current status of the Iranian MMSS was analyzed. In phase 2, since the researchers did not find any frameworks, guidelines, and protocol about the MMSS

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Key Messages

- Evaluation of maternal mortality surveillance system indicate the effects of the interventions carried out to prevent maternal deaths with similar causes and increase the system's ability to respond.
- The proposed model could be used as a standard model for evaluation of the MMSS at different levels of system and the resulting comparable data could be used to make decisions.

evaluation, the existing guidelines, frameworks, and protocols for the evaluation of public health surveillance systems (PHSSs) were studied and compared to identify the phases and measures involved in the evaluation of these systems. It is worth noting that the term 'guidelines' will be used in the rest of this article to prevent the frequent use of 'the guidelines, frameworks, and protocols.

To access the above guidelines, mixed searches were carried out using several keywords on search engines as well as on the scientific databases. A descriptive-qualitative analytic method was used to analyze and identify different phases and measures required for the evaluation of PHSS. All English guidelines for the evaluation of PHSS, communicable diseases, and epidemiologic surveillance, which were available in the text format, were included in this study.

In phase 3, the initial model for the evaluation of the national MMSS was designed, and a report containing a summary of the findings from phase 1 and the comparison tables of phase 2 was presented to the experts. The report was presented by the researcher showing slides at the beginning of an expert panel meeting to let the experts offer their suggestions about the axes, dimensions, and components of the initial model, based on these findings. In this phase, the study population included the managers and experts working at different levels of the MMSS, and the experts in the research subject. In this phase, a non-random purposive sampling technique was used.

The opinions presented in the meeting were written down by a facilitator and recorded using an electronic recorder after obtaining informed' consent from the participants. In this phase, data analysis was carried out through negotiations and discussions made by the expert panel, and a consensus was reached. The axes, primary and secondary dimensions, and components of the initial model were identified for the evaluation of the MMSS. After applying the expert opinions stated in the expert panel on the initial model, the components of the model were identified and were validated in the fourth phase of the study using two rounds of the Delphi method.

The research sample consisted of 40 participants who were selected using the purposive non-random sampling technique. A total of 36 and 34 participants took part in the first and second rounds of the Delphi method, respectively. Since the Delphi method was used in two rounds, a different data collection tool was used in each round. In round one, a questionnaire with closed-ended questions and one open-ended question about each axis was used. This questionnaire was developed based on the components confirmed by the expert panel. The validity of components was assessed based on the five-point Likert scale, with scores one to five assigned to options 'extremely low' to 'extremely high'. Since no suggestions were offered in the first round of the Delphi method and only four components did not obtain the median, the questionnaire consisted of four questions for the second round of the Delphi method.

The responses were rated from one to five, with the median of 3.75 or higher for each component considered as the measure of consensus. Components with medians smaller than 2.5 were omitted, and components with medians within the range of 2.5-3.75 were selected for the next round of the Delphi method.

Results

Phase 1

The results from the first phase of this study, which analyzed the current status of the MMSS in Iran was published in the 34th issue of *Acta Medica Mediterranea*.

Phase 2

Most articles in scientific databases reported results from the evaluations of different SSs using the existing guidelines and proposed no specific models or framework. Two review articles published in 2011 and 2015 helped the researcher find the existing guidelines to a great extent. Most guidelines were published by WHO and the Center for Disease Control and Prevention of United States. Hence, the researcher visited the websites of the mentioned two organizations to carry out additional searches, with the following five guidelines studied in this phase. Given the long title of each guideline, an abbreviation was attributed to each guideline as follows inserting in front of the full title of each guideline in parentheses to prevent the repeated use of the titles and facilitate their understanding.

1– Data quality monitoring and surveillance system evaluation (DQMSSE)
2– Communicable disease surveillance and response systems: guide to monitoring and evaluating (CDSRS)
3– Framework and tools for evaluating health surveillance systems (FTEHSS)
4– Updated guidelines for evaluating public health surveillance systems: recommendations from the guidelines working group (UGEPHSS)
5– Protocol for the evaluation of epidemiological surveillance systems (PEESS)

According to our findings, each guideline suggested a different number of evaluation phases and titles. There were four evaluation phases in most guidelines (DQMSEE, CDSRS, and PEESS), while there were six of them in

Table 1. The Comparison of the Numbers and Titles of Different Phases of the Evaluation of Public Health Surveillance Systems According to Different Guidelines

Guidelines	The Titles of Steps Listed for Public Health Surveillance Systems Evaluation
DQMSSE	Describe the system Plan the evaluation Perform the evaluation Propose an action plan
CDSRS	Plan to evaluate Prepare to evaluate Evaluate (collect, analyze, and interpret data) Disseminate and use evaluation results
FTEHSS	Establishing the context of the surveillance system Developing evaluation questions Designing the process for data collection and management Collating and presenting the findings Reviewing an evaluation report Following up on the use of findings
UGEPHSS	Engage the stakeholders in the evaluation Describe the surveillance system to be evaluated Focus the evaluation design Gather credible evidence regarding the performance of the surveillance system Justify and state conclusions, and make recommendations Ensure use of evaluation findings and share lessons learned
PEESS	Preparation for the evaluation Documentation and evaluation of the system Evaluation of the capacity of the surveillance system Outcome of the evaluation

other guidelines. These phases were introduced under 22 different titles that are compared in (Table 1).

Table 2 demonstrates the compared results of different measures involved in designing evaluations according to different guidelines. There are some explanations provided about each measure in (Table 2), which were extracted from each guideline. For example, the authorities at all levels, participants in the evaluation, epidemiologists, the followers of the system, and healthcare providers were identified as evaluation stakeholders. Moreover, the findings have been removed from this section due to their wide range, but the components of the proposed model have been mentioned in the supplementary data (Supplementary file 1).

Phase 3

Eleven participants with the mean age of 40.64 ± 5.46 and average work experience of 14.18 ± 5.7 years took part in this phase. Most of the participants were women (75%), who had graduated in forensic medicine, medicine, midwifery, reproductive health, epidemiology, and health information management. In addition, they worked at the medical sciences universities of Zahedan, Iran, Tehran, and the Ministry of Health. The experts reached a consensus on four axes, namely the description of the surveillance system, overall evaluation planning, evaluation implementation, and post-evaluation follow-ups, as the main axes of the national MMSS. The axes as well as the primary and secondary dimensions of the initial model have been listed in (Table 3).

Phase 4

In the first and second rounds of the Delphi method, a total of 36 and 34 experts were involved in the fields of gynecology, internal medicine, midwifery, reproductive health, epidemiology, health education, health information management, and health informatics, respectively. The specialists were mostly women in both rounds (75.8% on average) who had graduated in midwifery (27.2%). The participants in both rounds of the Delphi method had a PhD degree (48.6% on average).

In the first round of the Delphi method, all components but four, including 'Excessive data collection', 'Is it necessary to send MM reports to many organizations?', 'Does the system require many staff with different skills to operate the system?' and 'The percentage of held abroad meetings about the system', achieved consensus with the median scores of four and five. In the second round of the Delphi method, these four components were examined and two components, including 'Excessive data collection' and 'The percentage of held abroad meetings about the system' did not achieve a consensus with the median of two. Therefore, they were omitted from the model. In the end, the proposed model was designed with four axes, 26 primary dimensions, 30 secondary dimensions, and 279 components.

Discussion

This model is more similar to DQMSSE, CDSRS, and PEESS guidelines in the number of main phases, while it is more similar to UGEPHSS and DQMSSE guidelines

Table 2. The Comparison of the Actions Involved in Designing the Evaluation of Public Health Surveillance Systems, According to Different Guidelines

Guidelines Determination of …	PEESS	UGEPHSS	FTEHSS	CDSRS	DQMSSE
Evaluation triggers	✓	-	-	-	✓
Evaluation objectives	✓	✓	✓	✓	-
Expected results of evaluation	✓	✓	✓	-	-
Uses of evaluation results	-	✓	✓	-	✓
Evaluation Stakeholders	✓	✓	✓	✓	✓
Features of system to be evaluated	✓	✓	✓	✓	✓
The members of evaluation team	✓	✓	✓	✓	✓
Required trainings for members of evaluation team	✓	-	-	✓	✓
Evaluation scope	✓	✓	✓	✓	✓
Evaluation level	✓	✓	✓	✓	-
Type and method of evaluation	-	-	-	✓	✓
Evaluation time schedule	✓	-	✓		✓
Amount of funds required for evaluation	✓	✓	✓	✓	✓
Source of funding required for evaluation	-	-	-	✓	✓
Other resources required for evaluation	✓	-	✓	✓	-
Standards for assessment the quality of evaluation activities	-	✓	-	-	-
Evaluation questions	✓	✓	✓	✓	✓
Evaluation indicators	-	✓	-	✓	✓
Data gathering method	✓	✓	✓	✓	✓
Data gathering tools	✓	-	-	✓	-
Data analyses method	-	-	-	✓	✓
The method of presenting the findings and giving feedbacks	✓	✓	✓	✓	✓
The criteria for writing evaluation report	-	-	✓	✓	-
The method of following-up on the use of the evaluation results	✓	✓	✓	✓	-

Table 3. The Agreed-upon Axes, as well as the Primary and Secondary Dimensions of the Initial Model for the Evaluation of the Iranian MMSS

Axes	Primary Dimensions	Secondary Dimensions
The description of the surveillance system	The importance of maternal mortality to public health	-
	The purpose and operation of the system	-
	The resources used to operate the system	-
The overall evaluation planning	Evaluation triggers	Internal, external
	Evaluation objectives	-
	Evaluation type	-
	Evaluation method	-
	Evaluation stakeholders	-
	Expected results	-
	Application of the evaluation findings	-
	Level of evaluation	-
	Evaluation Scheduling plan	-
	Required resources for evaluation	-
	Budget sources of the evaluation	-
	The necessary trainings for members of the evaluation team	-
Evaluation implantation	Data collection methods	-
	Data collection tools	-
	Evaluation questions for the features to be assessed	Usefulness, completeness, validity, sensitivity, positive predictive value, timeliness, representativeness, simplicity, flexibility, acceptability, stability, data quality, compliance
	Evaluation indicators	Input, process, output, outcome, impact
	Available sources of data	-
	Quality assessment standards for evaluation activities	Utility, Feasibility, Propriety, Accuracy
	Data analysis method	-
Post-evaluation follow-ups	The method of presenting the findings and giving feedback	-
	The criteria for writing the evaluation report	Executive abstract, introduction and background, evaluation method, evaluation findings, key conclusions, recommendations
	The method of following-up on the use of the evaluation results	-
	Planning the next evaluation	-

in the description of the surveillance system axis. For other the other axes, a combination of the dimensions and components presented in the mentioned guidelines, which were extracted from the experts' opinions, was incorporated into the proposed model. In a survey research, Calba et al introduced four evaluation steps, including the description of the context, description of the evaluation process, implementation, and recommendations (9), which was partly consistent with our findings.

As described in UGEPHSS and DQMSSE guidelines, the 'description of the surveillance system or the evaluation scope' is one of the major evaluation steps in PHSSs, in several articles (11,12) on the evaluation of SSs, the SS is first described followed by the assessment of the system features according to the status quo, since many functional weaknesses of a system are determined in the system description phase (13). Hence, the inclusion of this axis in the initial model is a must. In this study, 'the importance of MM for public health', 'the purpose and operation of the system', and 'the resources used to operate system' were the primary agreed-upon dimensions of this phase. In addition, the experts reached a consensus over the use of the MM indicators in expressing the importance of MM for public health. 'The total number of MMs was one of the main indicators introduced in most studies on MM (11,14,15). The other important indicators of MMs had been introduced in relevant texts and approved by the experts (Figure 1).

Identifying different components of a system, including its processes, functions and resources helps identify its weaknesses and strengths (16), which may result in designing appropriate interventions to boost strengths and overcome weaknesses. For this purpose, the evaluation team has to be organized, and an evaluation protocol must be finalized, depending on the evaluation type. Moreover, the selected team should be trained in the protocol and financial and logistic resources required to be provided (17). The features to be evaluated (such as simplicity, acceptability, data quality, etc), data available, data collection method, analysis and interpretation methods, evaluation result propagation, and budget demands vary based on the evaluation scope (national, regional, provincial, or university levels). Hence, it is worth stating that numerous factors determine budget demands, and related issues should be considered in shaping the dimensions of the evaluation model.

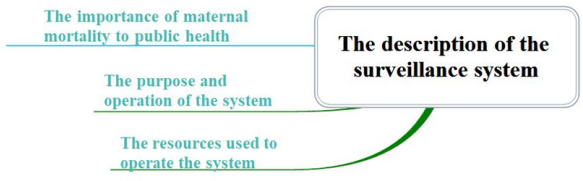

Figure 1. The Primary and Secondary Dimensions of "the Description of the Surveillance System' Axis Approved by the Expert Panel.

'Overall evaluation planning' was the second axis proposed by the experts. The evaluation process and path have to be planned so that the time and resources will be efficiently utilized (18). In the majority of study guidelines (16-18), evaluation planning is one of the primary steps of the evaluation design. Identifying evaluation stakeholders, objectives, and levels are the expert-approved measures introduced in most studies. The first major step in designing an evaluation process is to determine evaluation goals (19), which is simple or complicated depending on the primary evaluation goal (17). Therefore, evaluation goals have to be chosen from the primary dimensions of the designed model. It goes without saying that all goals must be specific, measurable, attainable, realistic, and time-based (17).

Studies done on the evaluation of MMSSs have been mostly carried out to identify the causes of MMs (15,20), analyze the trends of MMs, achieve the millennium development goals (21,22), assess the quality of the information collected on the system (23,24), and study the efficiency of designed system interventions (24,25). In addition, the aforementioned goals were verified as the components of this dimension (Figure 2).

'Evaluation implementation' was the third axis approved by experts in this study. This axis had been introduced as an evaluation phase in all studied guidelines. Determining the data collection method, evaluation questions, and available data resources were introduced as the actions required in this phase and constituted the primary dimensions of the initial model proposed by the experts. In addition, Experts reached a consensus on determining data collection tools, evaluation indicators, standards for assessment the quality of the evaluation activities, and data analysis methods as dimensions of this axis.

According to expert opinions, evaluation questions must be classified based on the features being evaluated. WHO guidelines also suggest evaluating the acceptability,

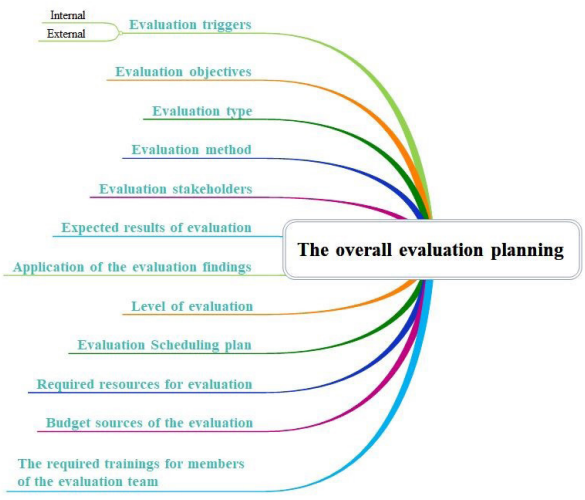

Figure 2. The Primary and Secondary Dimensions of "the Overall Evaluation Planning' Axis Approved by the Expert Panel.

timeliness, data quality, and stability of MMSSs (26). Moreover, usefulness, completeness, validity, sensitivity, the positive predictive value, representativeness, simplicity, flexibility, and compliance were the other features that experts considered necessary for the model. While one or several features may be evaluated in each study, other features such as data quality (14,23), usefulness (27), effectiveness (25,28), acceptability (14), timeliness (14,29), the positive predictive value, and sensitivity (30) were evaluated in past research on the evaluation of MMSSs, indicating the importance of evaluating these features in MMSSs. Following the approval of the features by the experts, the questions about each feature were extracted from the results of the first and second phases of the research and integrated into the model as components of the 'evaluation implementation' axis (Figure 3).

Stakeholders need criteria called standards to judge the performance of each plan. The joint committee on standards for educational evaluation has developed four groups of standards for the evaluation of each plan, which are used to evaluate public health plans. These standards, as practical guidelines contributing to the selection of the right evaluation option, result in explicit and fair evaluations (17). Hence, the experts reached an agreement on these standards for assessment the quality of evaluation activities (Figure 3).

'Post-evaluation follow-ups' formed the fourth agreed-upon axis in this study. This axis was introduced as an evaluation phase in studied guidelines with these titles: proposing an action plan, publishing and applying evaluation results, doing follow-ups, guaranteeing the use of evaluation findings, and sharing the learned lessons (17,18). In addition, two measures were listed in most guidelines, including presenting the findings and feedback as well as follow-up of the use of evaluation results. These measures constituted two dimensions of the initial model (Figure 4). In fact, the purpose of health information management is using them in decision-making. Therefore, this information must be available to the authorities who need it for planning.

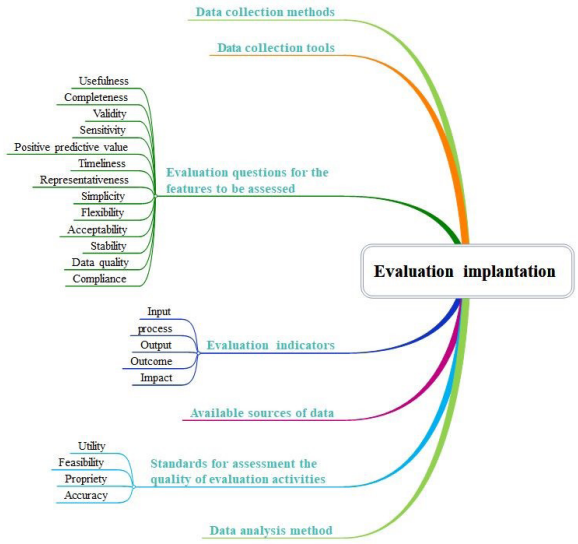

Figure 3. The Primary and Secondary Dimensions of "Evaluation Implantation" Axis Approved by the Expert Panel.

Limitations of the Study

Since this study was conducted as a PhD thesis and there was a time limitation to do it, the application of this model was not investigated, which was the limitation of the study.

Conclusions

This model presents different indicators concerning the importance of the system, questions and indicators for the evaluation of system features, standards for assessing the quality of evaluation activities, and other important components. In the end, the application of this information to design evaluations can lead to comparable evaluation results, thereby unveiling the weaknesses of this model.

Conflict of Interests

Authors declare that they have no conflict of interests.

Ethical Issues

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Iran University of Medical Sciences, Tehran, Iran (Code: IR.IUMS.rec.1394.9211563211).

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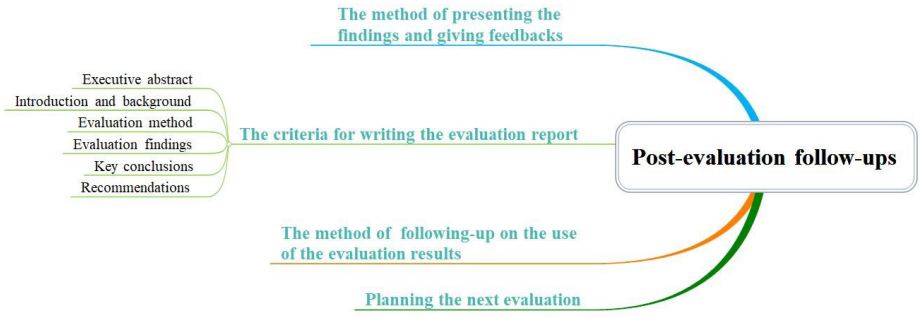

Figure 4. The Primary and Secondary Dimensions of 'Post-evaluation Follow-ups' Axis Approved by the Expert Panel.

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Supplementary files

Supplementary file 1 contains Tables S1-S4.

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