Information management in Iranian Maternal Mortality Surveillance System

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Abstract

Background: Maternal mortality is preventable by proper information management and is the main target of the Maternal Mortality Surveillance System (MMSS).

Aim: This study aimed to determine the status of information management in the Iranian Maternal Mortality Surveillance System (IMMSS).

Methods: The population of this descriptive and analytical study, which was conducted in 2016, included 96 administrative staff of health and treatment deputies of universities of medical sciences and the Ministry of Health in Iran. Data were gathered by a five-part questionnaire with confirmed validity and reliability. A total of 76 questionnaires were completed, and data were analyzed using SPSS software, version 19, by descriptive and inferential statistics. The relationship between variables "organizational unit" and the four studied axes was studied using Kendall's correlation coefficient test.

Results: The status of information management in IMMSS was desirable. Data gathering and storage axis and data processing and compilation axis achieved the highest (2.7±0.46) and the lowest (2.4±0.49) mean scores, respectively. The data-gathering method, control of a sample of women deaths in reproductive age in the universities of medical sciences, use of international classification of disease, and use of this system information by management teams to set resources allocation achieved the lowest mean scores in studied axes. Treatment deputy staff had a more positive attitude toward the status of information management of IMMSS than the health deputy staff (p=0.004).

Conclusion: Although the status of information management in IMMSS was desirable, it could be improved by modification of the data-gathering method; creating communication links between different data resources; a periodic sample control of women deaths in reproductive age in the universities of medical sciences; and implementing ICD-MM and integration of its rules on a unified system of death.

Keywords: Information management; Maternal mortality; Public health surveillance; Data collection; Quality assurance; Data processing

1. Introduction

According to the World Health Organization (WHO), the maternal mortality index in 2013 was 210 per 100,000 live births, and 289,000 women died due to pregnancy and its complications in this year in the world. This index had a 45% decrease from 1990 to 2013. In Iran, this index was reported at 23 per 100,000 live births, and the mortality rate was 340 persons in 2013 (1). Maternal mortality is considered a preventable mortality (2-5), and there is a national, international, and political commitment to decrease it (6). Thus, an appropriate strategy to prevent maternal mortalities is the most important program in most countries, including in Iran (5). In response to this commitment, Iran designed a national maternal mortality surveillance system (MMSS) in 2000, and the final system started

officially by holding multiple meetings and expert opinions of authorities and experts of universities since 2001 throughout the country (7). The primary target of the MMSS is the elimination of preventable maternal mortalities by obtaining information of each case of maternal death to manage public health functions and monitoring of their impact (8). Although the maternal mortality rate decreased in Iran, according to the quantitative targeting of policy council on decreasing the amount of maternal mortality to 15 per 100,000 live births until the end of fifth development program (2015), the responsibility of the Ministry of Health to plan for improvement of this significant index has been added, and more efforts and implementation of more interventions than the available and repetitious programs are needed (9, 10). As the MMSS has four main processes, including data gathering, assessment of mortality causes, planning more interventions, and evaluations (5) and given that the source of all managerial activities, particularly in health and treatment area, is having comprehensive, related, and on-time information (11), health data must be considered by policymakers. These data are important in planning, monitoring, and evaluation of health policies and are only helpful when complete because incomplete data can distort the true image (5). To access true information, proper management is required at the level of health care systems, and information management contains a set of activities and processes focused on organizational information needs. The information management goal is organizing and using information to increase and improve the individual and organizational function in patient care, monitoring, management, and support processes (12). Improving information management skills has become one of the main concerns of most governmental and private organizations, and many organizations try to provide an integrated information system (12, 13). Considering the results of Zolala's study, obstetric wards in hospitals and health houses are the most important data sources in urban and rural areas, and the loss of maternal mortality data in other hospitals and non-obstetric wards occur. Also, lack of a special classification of maternal mortality in forensics and unawareness of necessity for emergency announcement of maternal deaths were concluded in this research (5). Rahimi showed that the questioning about population information of the deceased and his or her family are not appropriately performed and categorized. Also in the data-gathering process, the location of death and different categories of health staff who needed education were not separated appropriately (14). Thus, considering the importance of MMSS in identification and planning for prevention of similar maternal mortality occurrence and given that this identification and planning must be based on correct information to have an appropriate performance and effectiveness, correct management of this information has a great importance; therefore, this study aimed to determine the status of information management in the Iranian Maternal Mortality Surveillance System (IMMSS).

2. Material and Methods

This descriptive and analytical research was performed at the national level in 2016. The research population contained 96 maternal health staff at Health and Treatment deputy of Ministry of Health and 47 universities of medical sciences (two staff in each university; one from health and one from treatment deputy, responsible for issues related to the system) as well as documents in the Maternal Health department in the Ministry of Health, which is a part of the population, family, and school health office, a subset of health deputy. The main trustee of IMMSS is the health deputy of the Ministry of Health; the documents reviewed in this office include the guideline of IMMSS, analysis of maternal mortality in Iran between the years 2001 to 2006, assessing the risk factors and classification of provinces, and performance reports during 2010 to 2014 (7, 9, 10, 15-18). Criteria for the selection of 47 universities of medical sciences was the number of years reporting statistical indicators related to the IMMSS by the universities. In the latest report on MMSS performance (2014), the system indicators over a five-year period (2010 to 2014) was presented by universities of medical sciences, universities selected as study population with reported indicators for at least four sequential years. For data gathering, a researcher-made questionnaire was used, which was designed based on similar previous studies (7, 8, 19-21) as well as a fourth edition of an assessment tool for country health information systems provided by Health Metrics Network of the World Health Organization (22). The available global standard tool, related to Health Metrics Network of world Health Organization is created to assess a national health information system. A national health information system is an extensive system that contains all systems of surveillance, registration, hospital information, and all other systems gathering health information in that country (23), and, because in this research, we only assessed the information management status of MMSS, a part of this tool was changed and used considering other literature related to MMSS (7, 8). This questionnaire has five sections and a total of 42 questions. The first seven questions were about demographic characteristics of the study population and the second to fifth sections with 35 questions were related to data gathering and storage (eight questions), data quality assurance (10 questions), data processing and compilation (seven questions), and data dissemination and use (10 questions) axes. It should be noted that each question had four specific answers that were answered by stating very appropriate, appropriate, relatively appropriate, and inappropriate, thus obtaining scores three, two, one and zero. For confirmation of content validity of the questionnaire, opinions of five experts (three PhD of health

information management and two midwifery experts of MMSS) were used and the number, relevance, simplicity and clarity of items were discussed. For this assessment, the designed questionnaire was given to the above-mentioned persons, and the final version has been finalized based on their comments. To confirm the reliability of this questionnaire, the test–retest method was used. The questionnaire was given and completed twice with an interval of four days by 12 experts working in MMSS (in the universities outside the study population), and the correlation between their answers in two sessions was calculated 84% (r=84%). The researchers collected the data through visiting and using e-mail. Data of the Ministry of Health and universities of medical sciences in Tehran City (Iran, Tehran, and Shahid Beheshti) were obtained through presence of the researcher, and data of other universities were collected through a questionnaire by e-mail. Before sending the questionnaires, the researcher attempted to make phone calls to each of the study subjects to describe the aim of the study and clarify the voluntarily participation in the study. The introduction letter was released by the vice chancellor for Research and Technology of Iran University of Medical Sciences and sent via official automation system for 47 universities. The researcher resent the questionnaire with a copy of the introduction letter by e-mail for the research community. Due to the inability to refer to all subjects, as a limitation of the study, despite multiple follow-ups, only 76 questionnaires were completed and evaluated. Data were analyzed by of SPSS, version 19 (SPSS Inc. Chicago, Illinois, USA), and mean scores of each domain were calculated. Given that the range of scores for each option was from 0 to 3, to judge the information management status, the data in four axes of the study were considered as follows: score 1 and less = undesirable, 1.1 to 2 = intermediate, and 2.1 to 3 was considered desirable. The relationship between variables "organizational unit" and the four studied axes was studied using Kendall's correlation coefficient test.

3. Results
The demographic characteristics indicated that the total study population (n=76) was female because in Iran, which is an Islamic country, only women could be educated in midwifery and the vast majority of maternal health department staff are graduated in midwifery. Fifty-four participants (71.1%) were working in the health and 22 in the treatment deputy of universities. The average age and work experience of study population were 43.18±5.24 and 20.32±5.36 years, respectively. The majority of participants (54.4%) had a bachelor's degree, and the rest had a master's degree. Mean scores obtained for information management status in IMMSS was 2.5 ± 0.50 and desirable; the different axes are separately presented in Tables 1-4.

Table 1. Status of data gathering and storage axis in IMMSS

Items	Very Appropriate	Appropriate	Relatively Appropriate	Inappropriate	Mean (SD)
The status of existence of a written guideline about data collection, storage, cleaning, quality control, analysis, and presentation for target audiences, which was implemented throughout the country	60.5	39.5	-	-	2.61 (0.49)
The status of data storage at national level (is there any integrated data warehouse containing data from all levels of maternal mortality surveillance system and has a user-friendly reporting utility accessible to various user audiences?)	-	59.2	40.8	-	2.41 (0.49)
Storage status of periodic and temporary reports extracted from surveys and statistical summary, epidemiological bulletins, specific research studies, and evaluation reports	40.8	28.9	30.2	-	2.11 (0.84)
The status of data collection method	28.9	19.7	51.3	-	1.78 (0.87)
The status of existing ICT facilities for data collection and storage	48.7	30.3	21.1	-	2.28 (0.79)
The status of health care institutions and national archive about existence of mandatory regulations for minimum period of documents retention	30.3	48.7	-	21.1	1.88 (1.07)
The status of respect to information confidentiality	80.3	-	-	19.7	2.41 (1.20)
The status of registries and report forms storage and archive (are they archive appropriately by date, geographic location and…)	80.3	-	-	19.7	2.41 (1.20)
Average (the status of data gathering and storage axis)	46.23	28.29	17.93	7.56	2.7 (0.46)

Mean score of all axes was greater than 2.1 and desirable. The status of data gathering and storage axis had the greatest mean score (2.7±0.46) (Table 1). The highest mean score (2.6±0.49) in data gathering and storage axis was related to existence of a written guideline about data gathering, storage, clearance, quality control, analysis, and presentation to the target audience and its implementation around the country (Table 1). The lowest score (1.78±0.87) was related to the status of the data-gathering method. Almost half of respondents (51.3%) declared the data-gathering method is a mixed method (paper and digital) and was diagnosed "relatively appropriate" based on questionnaire (Table 1). The highest mean score (3±0), in data quality assurance axis, was related to two questions: status of data periodicity and representativeness. The status of these two attributes was appropriate from the perspective of all study population (Table 2). The lowest mean score (0.91±1.38), in this axis, was related to the status of data control in MMSS, which was inappropriate according to 69.7% of the study population (Table 2). The highest mean score (2.80±0.40), in data processing and compilation axis, was related to status of control process of received data from various levels before using them, which was considered appropriate based on 80.3% of the study population. They have declared that the following actions are performed before using them: 1) control of the forms completeness; 2) elimination of the data elements defects; 3) concordance of data; 4) translation of the codes used in the forms; 5) remove the data redundancy; and 6) control of the suspicious data accuracy (Table 3). The lowest mean score (1.42±1.20), in this axis was related to the usage status of international classification for maternal mortality causes coding; only 3.30% of the study population considered it very appropriate. The IMMSS guideline mentioned that ICD-9 classification was used to define cases (maternal mortality), and ICD-10 will be used when the number of such mortality decreased to less than 10% of live births in developed countries. The highest mean score (2.71±0.63), in data dissemination and use axis, was related to the status of sending summarized reports; 80.3% of the study population considered it very appropriate and noted that the integrated reports are distributed regularly and at least annually to all related parts (Table 4). In examining the evidence and records in maternal health department on the performance reports (2010-2014), it was observed that, according to experts, these reports were sent for all the university centers. The lowest mean score (1±0.78), in this axis, was related to the usage status of IMMSS information by management teams at all levels to set resource allocations in the annual budget processes; that 39.5% of the study population considered it relatively appropriate (Table 4). The Kendall's correlation coefficient also showed a significant relationship between the workplace and staff attitude toward studied axis of information management. Treatment deputy staff had a more positive attitude toward the status of information management of IMMSS than health deputy staff (p=0.004) (Table 5).

Table 2. Status of data quality assurance axis in IMMSS

Items	Very Appropriate	Appropriate	Relatively Appropriate	Inappropriate	Mean score	SD
The status of minimum data set of maternal mortality surveillance system (existence of uniform forms for data gathering at all level and use them for data collection)	89.5	10.5	-	-	2.89	0.30
The status of data definition (existence of metadata dictionary that offer comprehensive definitions on data)	51.3	30.3	-	18.4	2.14	1.11
The status of data-collection method used for report were published most recently or will be published	19.7	80.3	-	-	2.20	0.40
The status of data control in maternal mortality surveillance system	30.3	-	-	69.7	0.91	1.38
The status of providing update training and feedback to data collectors and users	69.7	-	-	30.3	2.09	1.38
The status of data timeliness. (How many years, the new report was published based on?)	30.3	28.9	30.3	10.5	1.79	0.99
The status of data periodicity. (How many indicators measurement was done in the past 10 years?)	100	-	-	-	3	-
The status of data consistency over past 10 years. (Is there any differences between same data and several datasets over the past 10 years?)	60.5	30.3	9.2	-	2.51	0.66
The status of data representativeness (number of deaths upon which the recent report is based)	100	-	-	-	3	-
The status of data disaggregation (recent report disaggregated by demographic characteristics, socioeconomic status and locality	90.8	9.2	-	-	2.91	0.29
Average (status of data quality assurance axis)	64.21	18.95	3.95	12.89	2.6	0.49

Table 3. Status of data processing and compilation axis in IMMSS

Items	Very Appropriate	Appropriate	Relatively Appropriate	Inappropriate	Mean score	SD
The status of data processing and integrating method	28.9	30.3	31.6	9.2	1.79	0.97
The status of control process of received data from various levels before using them	80.3	19.7	-	-	2.80	0.40
The status of data extraction and modification	39.5	60.5	-	-	2.39	0.49
The usage status of international classification for maternal mortality causes coding	3.30	10.5	30.3	28.9	1.42	1.20
The status of maternal mortality trends reporting (weekly, monthly, seasonal, or annual)	40.8	30.3	28.9	-	2.12	0.83
The status of maps and diagrams depiction from maternal mortality indicators (weekly, monthly, seasonal, or annual)	19.7	10.5	69.7	-	1.50	0.81
The usage status of information obtained from available data	50	30.3	19.7	-	2.30	0.78
Average (status of data processing and compilation axis)	37.50	27.44	25.74	5.44	2.4	0.49

Table 4. Status of data dissemination and use axis in IMMSS

Items	Very Appropriate	Appropriate	Relatively Appropriate	Inappropriate	Mean score	Standard deviation
The status of information demand from MMSS by senior managers and policymakers	50	19.7	30.3	-	2.20	0.88
The status of graphs are used at all levels	71.1	-	10.5	18.4	2.24	1.23
The status of maps are used at all levels	59.2	-	10.5	30.3	1.88	1.39
The status of sending integrated and summarized reports of MMSS	80.3	10.5	9.2	-	2.71	0.63
The usage status of MMSS information (death causes, evaluation interventions…) in the planning and resource allocation processes	51.3	39.5	9.2	-	2.42	0.66
The usage status of MMSS information by management teams at all levels to set resource allocations in the annual budget processes.	-	30.3	39.5	30.3	1	0.78
The usage status of MMSS information to advocate for equity and increased resources to disadvantaged groups and communities	10.5	28.9	39.5	21.1	1.29	0.92
The usage status of MMSS information by managers at health administrative offices at all levels for health service delivery management, continuous monitoring, and periodic evaluation	80.3	9.2	10.5	-	2.70	0.65
The usage status of MMSS information by care providers at all levels for health service delivery management, continuous monitoring, and periodic evaluation	51.3	18.4	-	30.3	1.91	1.32
The usage status of information on risk factors is used to advocate for the adoption of lower-risk behaviors by the general public or by targeted vulnerable groups	18.4	51.3	30.3	-	1.88	0.69
Average (status of data dissemination and use axis)	47.24	20.78	18.95	13.04	2.5	0.51

Table 5. Results of Kendall's correlation coefficient

Axes	Coefficient Correlation	p-value
Data gathering and storage	0.249	0.006
Data quality assurance	0.235	0.013
Data processing and compilation	0.278	0.003
Data dissemination and use	0.250	0.007

4. Discussion

According to the results of the present study, the status of information management in IMMSS was desirable. According to (14), the data gathering in IMMSS was relatively desirable, which is not consistent with the results of this study; as mentioned for the study, the focus was only on one aspect of information management (data gathering) and did not take other aspects into account (14). According to IMMSS guideline, closed-open structured forms are used as data gathering tool, which are completed by three methods: verbal autopsy (statements of deceased family), confidential questioning (interview with related health surveillance workers), and clinical autopsy (the results of autopsy of Forensic Medicine organization). After identification of reasons and preventable factors, appropriate interventions were taken to prevent repetition of such cases in the committee of reducing maternal mortality in the province or city. Also, the committee determined the responsible personnel for the implementation of intervention and when and how to do it. The results were announced to the responsible level to determine funding and support of the intervention. In fact, the major part of data gathering is performed manually at lower levels without the use of new information technologies, but official automation system and the mortality registration system are used to inform at higher levels (7). Thus, it could be said that data gathering is performed combinational (manual and digital) at different levels and more than half of the study population confirmed the combination nature of data gathering methods and considered it a relatively appropriate system that matched the results of previous researches (14, 19, 24).

According to (5), the most important data sources in urban and rural areas were obstetric wards of hospitals and health houses, respectively. Data of mothers in non-obstetric wards of hospitals and after giving birth were not recorded, and their information was not gathered. Further, there was no specific classification in legal medicine for maternal mortality; for example, if maternal mortality was caused by infection after giving birth, infection was registered as death cause not as maternal mortality, and part of the information was not recorded (5). Also, lack of understanding of some research community was listed as an urgency of maternal mortality report, which means that, in the event of maternal mortality, this death also was reported like other deaths and reported with them to statistical units. Unavailability of guidelines for related offices was listed as another factor that can affect the completeness of the data (5). Rahimi also considered that the number and type of data-gathering forms in the IMMSS are complete, but the questions of some forms, such as socio-economic and demographic variables of the deceased and their families, required modification because of the difficulty of summarizing and assessing them (14). Also the data registration process in medical records of obstetrics departments was performed incompletely (25).

Thus, we can say that, to perform the process of gathering data in this system well, arrangements are required at various levels, including in hospitals, health houses, legal medicine centers, and medical universities across the country. Considering the effective role of information technology in accelerating data gathering and decision-making in health system management (26, 27) and the necessity of using information and communication technology for pregnant women (28), new information technologies such as mobile phones, personal digital assistants, tablets, and other portable devices can be used for issues related to system data gathering, recording, storage, and faster transferring with higher quality. Also, performing the following actions can help improve the quality of the process of gathering data in this system: 1) Reviewing data-gathering forms and adding the demographic and socio-economic variables of the deceased and their families to them; 2) establishing communicational links between different data resources and creating an integrated information system; 3) providing ongoing and updated training to the staff of the system on how to diagnose maternal mortality cases correctly (using international classifications and guidelines such as ICD-10 and ICD- MM); 4) providing all the national guidelines and international classification system to all levels and centers related with the system; 5) registration of data and immediate reporting of all maternal mortality cases; and 6) recording all the information related to mortality by health care providers in hospital or family records and accordingly in the system information forms.

Based on the review of data quality assurance axis, two attributes of IMMSS, including "periodicity" and "representativeness," were deemed very appropriate from the perspective of all research population, who noted that

measurement of indexes in the past 10 years were regulated three times or more, based on all the mortalities. In the evaluation of public health surveillance system guidelines, designed by the Centers for Disease Control and Prevention, the purpose of evaluating these systems was considered to ensure the effective monitoring of public health problems; these systems should be periodically assessed, and this assessment should include recommendations for improving quality, efficiency, and advantages (29). In reviewing the performance reports of IMMSS [2010–2014], it was observed that the system indicators are calculated annually and reflected to all relevant departments; these indicators include recommendations to improve quality, efficiency, and usefulness (9, 10, 15-17), which confirms the periodic attribute of IMMSS. A public health surveillance system is representative when it can properly describe the occurrence of a health-related event during the time and its spread in the population by location and person (30). Given that the main goal of the IMMSS is to identify all maternal mortalities and avoidable causes and designing interventions to prevent these mortalities (7) and objectives, and the performance of the system is designed to achieve this goal and is currently running, it indicates that this system has "representativeness" partly attributed. The term "partly" is used because different studies have shown that identification of all cases of MMSS is not fully performed (5, 31-33), which can be achieved by linking multiple data sources and creating an integrated information system and using the latest international classifications in this field, such as ICD-10 and ICD-MM, which could largely help to solve this problem.

Controlling a sample of female deaths in reproductive age (15–49 years) obtained the lowest mean score among the questions related to data quality assurance axis. In completing the questionnaire, which was conducted at the level of the Ministry of Health by interviewing and observing documents, maternal health experts noted that such control is done in the investigation of the country's health ministry level; thus, low mean score of this question can be considered due to the lack of awareness of the study population regarding this subject and to further improve the data quality. This control should be performed at the level of universities of medical sciences in the country and before sending the indicators of the system from this level to higher levels. The status of data processing and compilation axis of IMMSS was appropriate but compared with other axes with a lower mean score. Most of the research community has considered the control process of data received from various levels (control of the forms completeness, elimination of the data elements defects, concordance of data, translation of the codes used in the forms, remove the data redundancy, and control of the suspicious data accuracy) as very appropriate. The usage status of international classification for maternal mortality causes coding that had the least mean score, compared with other items related to this axis. In review of the system guidelines, it was mentioned that ICD-9 classification was used in the case definition (maternal mortality), and ICD-10 will be used, when the number of such mortality decreased to less than 10% of live births such as in developed countries. Based on the researcher's experiences, coding diseases and death causes were mostly performed only in hospitals, especially hospitals affiliated with Universities of Medical Sciences in the country and were not usually performed in health centers. Despite the finalization of death causes registry and classification program since 2004 by health deputy of Ministry of Health, which is currently performed in 30 provinces in the country and the fact that a special section is considered for coding the cause of death on the death documents, unfortunately, this part was not completed.

Since early 2015, an integrated mortality system has been implemented in the country for improvement of this problem and for ensuring the correct coding of the death causes and recording all deaths with collaboration of civil registration, forensics, and municipalities (34) and if the proper monitoring and commitment exists for implementation of this program at all levels, it would be an effective help in solving this problem. WHO has designed a guideline to the International Statistical Classification of Diseases-Maternal Mortality (ICD-MM) in order to prevent under-reporting and specifying correct code to the maternal death causes and improve the data quality, which is the basis of the intervention design to decrease the incidence of these deaths (35).Thus, it is better that the guidance offered in this guideline be considered in the integrated mortality system of Ministry of Health and its implementation be emphasized, so that, according to the results of different studies (31, 33, 36-38), the classification of maternal mortality can be implemented properly and under-reporting be prevented. The status of data dissemination and use axis was desirable. Mean score of the status of summarized and integrated reports of this system was higher than other items, and the study population has stated that the integrated reports are distributed regularly and at least annually to all related sections. In assessment of records and documents of maternal health department, also, the performance reports of years 2010 to 2014 were observed, which was sent to all university centers, as the experts of this section declared. The usage status of IMMSS by the management teams at all levels to specify resources in annual budget processes had the least mean score in this axis, which should be considered by policymakers, and proper actions should be taken to resolve this problem. For instance, although most maternal deaths occur in hospitals, where on-time and successful questioning is possible with a sufficient number of human

resources, in most universities of the country, there is no organizational position of maternal health experts defined for it in the treatment deputies, and no human resources are considered to perform the tasks related to this system (14), which indicates improper usage of system data by the management teams and policymakers in the health system in annual budgeting processes. The study population distribution in different part of the country was a limitation of this study; despite multiple follow-ups (via phone and e-mail), only 76 questionnaires were completed and returned.

5. Conclusions

Although the status of information management in IMMSS was desirable, considering the significant importance of this process for designing and implementation of proper interventions, the following recommendations could be done to further improve the quality of IMMSS: modification of the data-gathering method using information technology; creating communication links between different data resources; periodic sample controlling of female deaths in reproductive age in the universities of medical sciences; implementing the International Classification of Diseases-Maternal Mortality and the integration of its rules on Integrated System of Death; and creating the expert positions of Maternal Health in the Treatment deputies. Also, the results of similar research topics in university levels could be useful to improve the performance of this system.

Conflict of Interest:
There is no conflict of interest to be declared.

Authors' contributions:
All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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