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Strengthening Disaster Risk Communication: Insights from Emergency Operation Centres in Saudi Arabia

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Abstract—Background: **Effective risk communication is critical in disaster management to ensure that emergency operation centre (EOC) leaders can coordinate responses efficiently. In Saudi Arabia, challenges such as inconsistency and lack of transparency hinder effective communication during crises**

Aim: **This study aimed to assess the perceptions of EOC leaders regarding key challenges in disaster risk communication, focusing on clarity, transparency, consistency, and trust, and to identify areas for improvement.**

Method: **A structured survey was distributed to 110 EOC leaders from various regions of Saudi Arabia. Quantitative data were analysed using descriptive statistics and correlation analysis, while qualitative responses were thematically analysed to identify recurring patterns and challenges.**

Result: **A total of 95 leaders responded, achieving a response rate of 86.4%. Participants rated clarity and accessibility of information highly, whereas transparency and consistency scored lower, indicating significant gaps in inter-agency communication. Correlation analysis revealed strong relationships between trust, reliability, and transparency. Qualitative insights highlighted the need for standardised communication protocols, real-time updates, and culturally adaptive messaging.**

Conclusion: **Centralised communication channels, designated spokespersons, and tailored training programs for EOC leaders can address identified gaps.**

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These findings provide actionable recommendations to strengthen disaster risk communication and enhance resilience in Saudi Arabia's disaster management framework.

*Keywords—***Disaster Management, Emergency Operation Centres, Risk Communication, Information Dissemination**

I. INTRODUCTION

Effective risk communication is a cornerstone of disaster management, ensuring that timely and accurate information reaches all stakeholders to facilitate informed decision-making and appropriate action [1]. In Saudi Arabia, the need for robust disaster management strategies has grown due to the increasing frequency and impact of natural and human-made disasters [2]. For leaders within emergency operation centres (EOCs), effective communication strategies are crucial not only for dissemination of public information, but also for internal coordination. These strategies significantly enhance preparedness, response, and recovery efforts by providing clear, consistent information to the public and to emergency responders.

Previous studies have recognised the critical role of EOC leaders in disaster response, highlighting their need for clear communication strategies to coordinate effectively during crises. Research on EOC operations in Saudi Arabia has emphasised the importance of leadership in managing response efforts under challenging conditions [3].

Internationally, recent studies have examined the unique challenges of risk communication in emergency management, stressing that reliable, transparent communication is essential for successful disaster preparedness and public safety [4]. In the Middle East, emerging research underscores that, while advances are being made in disaster management, there remains a need for focused efforts to enhance

communication protocols in order to address sociocultural and logistical complexities unique to the region [5]. However, there is limited research specifically examining how EOC leaders perceive and address risk communication challenges, an area that is crucial for the success of disaster response and recovery.

This study addresses a gap in understanding how EOC leaders perceive and manage risk communication challenges in disaster management. By assessing the perspectives of EOC leaders across Saudi Arabia, we aim to identify specific areas for improvement and offer evidence-based recommendations for enhancing communication strategies. These insights contribute to the literature on disaster management by advancing a more comprehensive understanding of the preparedness and communication needs of EOC leaders, ultimately supporting more resilient and effective disaster response frameworks.

II. METHODOLOGY

Study Design and Population

This descriptive survey study aimed to assess the perceptions of EOC leaders regarding risk communication challenges in disaster management across Saudi Arabia. The target population included 110 EOC leaders, with 90 from various health regions and 20 from the National Health EOC. A purposive non-probability sampling approach was employed to focus on key decision-makers in disaster response, though this approach limits the generalisability of findings. This sampling method was selected to ensure that individuals with the most relevant experience in disaster response were included, maximizing the study's practical insights despite potential sampling limitations.

Development of Survey Instrument

The survey instrument was developed following a comprehensive review of literature on risk communication in disaster management, drawing on key sources (6,7). The questionnaire was designed to capture a range of risk communication factors critical to effective disaster response, including clarity, trustworthiness, transparency, consistency, and per-

ceived effectiveness. It was divided into two sections: demographic data (e.g., age, years of experience in emergency management) and targeted questions addressing the aforementioned aspects of risk communication as they pertain to disaster scenarios. The survey instrument, translated into English for clarity, is included in Appendix A for reference.

To ensure content relevance and clarity, the questionnaire underwent a validation process that included review by two disaster management experts, who provided feedback on item phrasing, cultural applicability, and completeness. This process also aimed to identify and minimise potential biases, such as culturally inappropriate language or ambiguous phrasing, which could hinder the accurate capture of leaders' perceptions. Based on this feedback, minor adjustments were made to improve the questions' clarity and contextual relevance, ensuring that the instrument effectively captured the perspectives of EOC leaders in Saudi Arabia.

Data Collection and Analysis

Data collection was conducted electronically to facilitate ease of participation and to reach a broad sample of EOC leaders. The survey link was distributed via the WhatsApp network, which helped to achieve the high response rate of 86.4%. Quantitative data from the survey responses were analysed using descriptive statistics, summarising the demographic characteristics of respondents and their responses to questions on various aspects of risk communication.

In addition to the descriptive analysis, Pearson's correlation was used to examine relationships among core variables, such as the trustworthiness of information sources, frequency of updates, clarity, and perceived effectiveness of communication. This analysis aimed to identify any significant associations between key aspects of risk communication, providing insight into factors that might impact the effectiveness of communication strategies in disaster management.

For qualitative insights, open-ended responses were reviewed manually to identify recurring themes related to disaster risk communication challenges.

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Using an iterative reading process, responses were categorised into key themes such as standardised protocols, real-time updates, and cultural adaptation. This systematic approach ensured that the analysis captured meaningful insights into the perceptions of EOC leaders. The resulting themes were synthesised into a thematic table to provide a clear and structured presentation of the qualitative findings.

Ethical Considerations

Participants provided informed consent, and confidentiality was maintained throughout the study. Approval was obtained from the Institutional Review Board prior to commencement of the study via IRB log No: 24-55 M, Dated 29-5-2024.

III. RESULTS

Participant Demographics

Out of 110 leaders contacted, 95 responded, yielding a response rate of 86.4%. Most respondents were male, aged 24 to 44 years, representing a range of experience levels in emergency management, from less than 5 years to over 20 years. Leaders with over 15 years' experience formed a smaller subgroup, offering perspectives on long-term operational challenges.

Quantitative Findings

• *Clarity and Ease of Information:* Clarity of disaster risk information was rated relatively high (mean = 4.14, SD = 0.74). Instructions were also generally easy to understand (mean = 3.99, SD = 0.74). Leaders with over 15 years' experience rated clarity slightly higher, though differences were not statistically significant (Figure 1a). Gender analysis showed consistent ratings across groups.

• *Detail and Frequency of Information:* The detail of information received scored moderately (mean = 3.68, SD = 0.80), while update frequency was rated higher (mean = 3.91, SD = 0.89). Younger leaders (24-34 years) reported greater satisfaction with update frequency, suggesting generational differences in expectations for real-time information (Figure 1b).

• *Trust, Reliability, and Transparency:* Trust in information sources was rated at 3.67 (SD = 1.04), with reliability slightly higher at 3.73 (SD = 0.99). Transparency scored lower (mean = 3.64, SD =

0.93), with younger leaders rating it lower than their older counterparts (Figure 1c).

Consistency of Information: Consistency across sources scored 3.42 (SD = 0.91), highlighting room for improvement, particularly in cross-agency communication. Leaders with over 10 years' experience and female leaders identified this as a critical area for improvement.

• *Understanding and Usefulness of Information:* Participants rated understanding of risks high (mean = 4.28, SD = 0.69). Information was deemed useful for decision-making (mean = 4.02, SD = 0.76) and effective for action-taking (mean = 4.31, SD = 0.77). These aspects were rated higher by those in management roles than by field-based leaders.

• *Confidence and Training Needs:* Confidence in understanding communicated risks was high (mean = 4.26, SD = 0.69). However, newer leaders (<5 years) expressed a need for additional training, indicating a perceived skills gap.

Correlation Analysis

Pearson's correlation revealed significant relationships between key variables. Trust strongly correlated with reliability ($r = 0.87$, $p < 0.01$) and transparency ($r = 0.76$, $p < 0.01$). Consistency correlated positively with understanding of risks ($r = 0.58$, $p < 0.05$). The usefulness of information for decision-making correlated strongly with its effectiveness for action-taking ($r = 0.75$, $p < 0.01$), and frequency of updates was moderately correlated with clarity of information ($r = 0.51$, $p < 0.05$) (Figure 2).

Qualitative Insights

Open-ended responses highlighted themes such as the need for standardised communication protocols, real-time updates, and additional training in communication tools. A recurring theme was the importance of comprehensive guidelines to ensure consistency across scenarios. Respondents emphasised cultural sensitivity, with locally tailored messages increasing message acceptance. Female leaders emphasised this need more strongly, underscoring the importance of adapting communication to regional contexts. Thematic analysis also revealed a preference for concise, action-oriented messaging over ex-

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tensive background information. Limited community awareness and engagement were highlighted as significant barriers to effective disaster management. Table 1 provides a summary of these themes, including recommendations to address identified challenges.
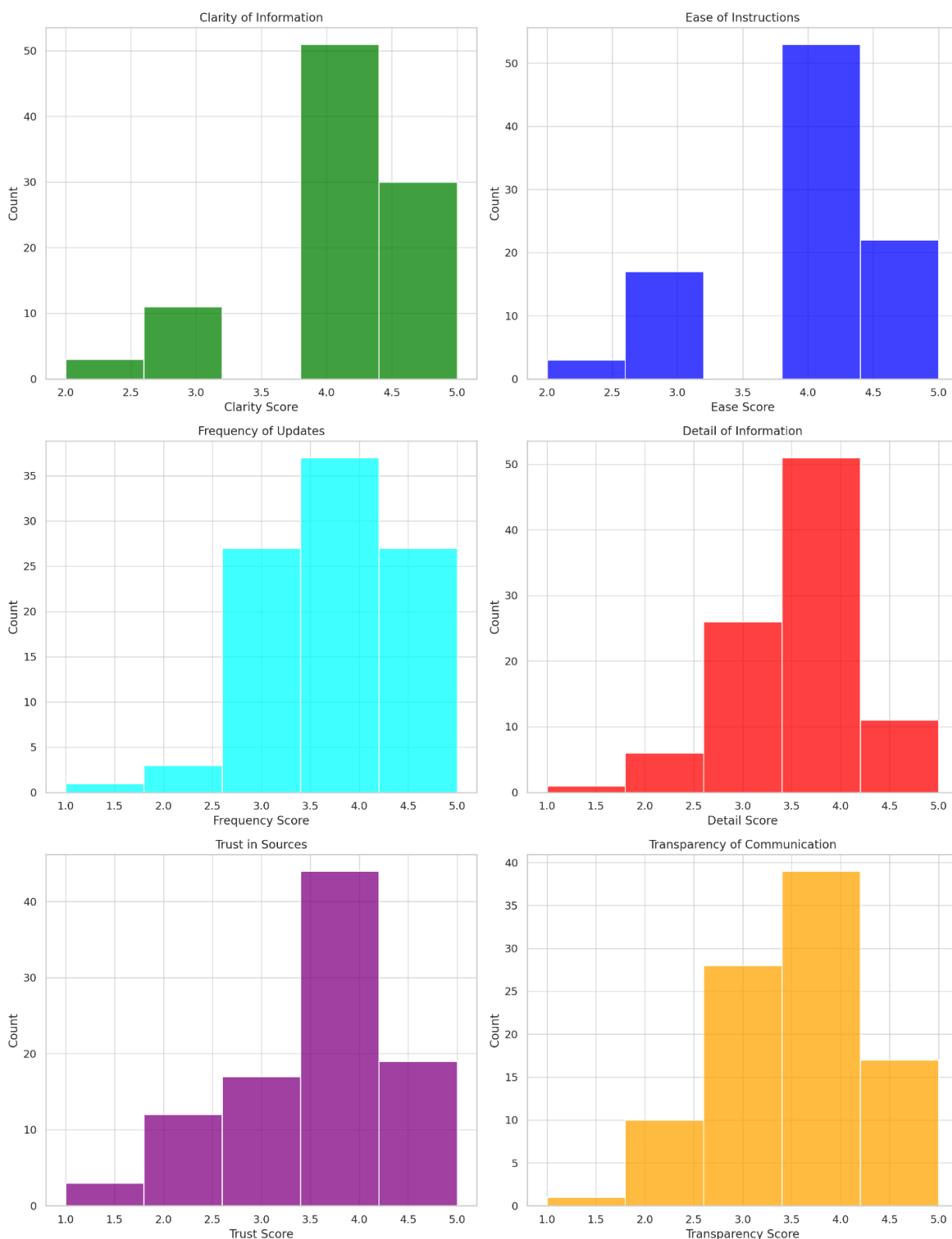
Figure 1. Shows the distribution of responses for various aspects of disaster communication: clarity of information, ease of instructions, frequency of updates, detail of information, trust in sources, and transparency of communication
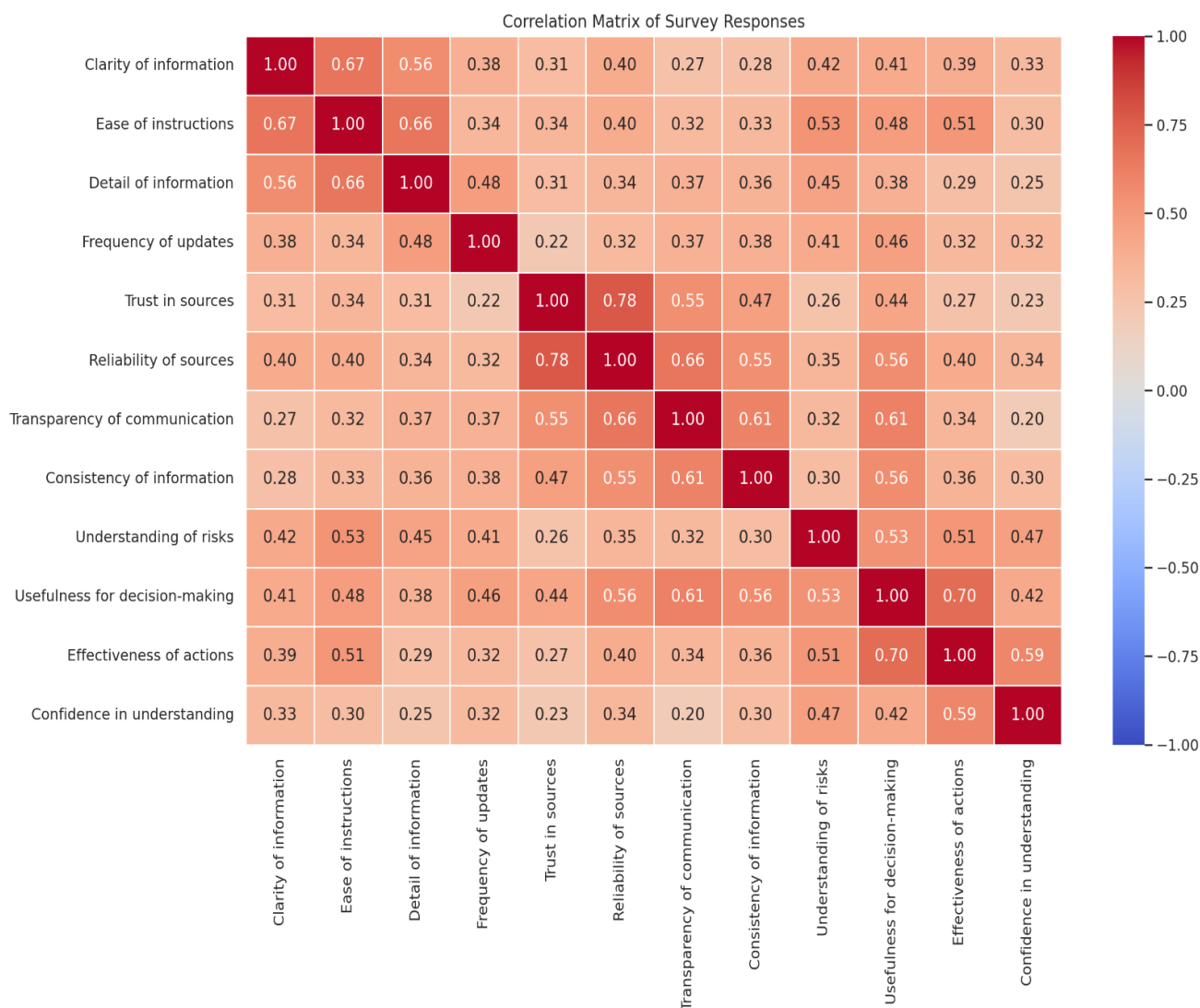
Figure 2. Illustrates the correlation matrix of survey responses, showing significant relationships between various aspects of disaster communication.

Table 1. Themes in disaster risk communication challenges, supporting details, and proposed recommendations based on qualitative analysis.

Suggestion	Details	Recommendations
Intensive training and continuous education	Lack of adequate disaster communication skills, including active listening and crisis management.	• Conduct intensive training courses and continuous drills involving all levels of leadership and external entities. • Focus on disaster communication skills, including active listening, negotiation, and crisis management. • Provide continuous training on communication tools and techniques.
Enhanced communication mechanisms	Inconsistent communication platforms and delayed updates during emergencies.	• Create a 24/7 communication platform. • Develop mobile applications with disaster notifications and immediate meeting capabilities. • Ensure transparency and provide regular updates on disaster developments.

		• Set clear algorithms for communication mechanisms.
Collaborative networks	Poor collaboration and trust among agencies and stakeholders.	• Build support networks among government entities, NGOs, media, and other stakeholders. • Share experiences and strategies with neighbouring countries. • Conduct regular meetings and workshops with risk owners and stakeholders.
Technological integration	Limited use of modern tools for effective communication.	• Use modern technology and risk analysis models. • Ensure high-quality wireless networks for reliable communication. • Develop visual communication systems linking crisis management centres and affiliated facilities. • Utilise the latest technologies and intensify drills for various disaster scenarios.
Strategic planning and evaluation	Lack of standardised communication protocols and frameworks.	• Analyse past crises to derive lessons for improving future strategies. • Regularly evaluate and improve communication strategies after each disaster. • Prepare risk lists with confrontation strategies and share them with relevant entities.
Effective information dissemination	Messages not tailored to regional sociocultural contexts.	• Provide accurate, reliable, and transparent information using simple and clear language. • Ensure rapid communication at the onset of a disaster with clear, confirmed information about the risk.
Community awareness and involvement	Limited public engagement in disaster preparedness and communication.	• Raise awareness of risk concepts and the importance of disaster communication. • Engage in social media awareness campaigns. • Conduct workshops on the importance and sensitivity of disaster work to educate the community and encourage active involvement.

IV. DISCUSSION

This study examined the perceptions of EOC leaders in Saudi Arabia regarding risk communication challenges in disaster management. High ratings for clarity and understanding of risk information indicate that leaders generally perceive disaster communications as accessible. However, moderate ratings for transparency and consistency highlight areas for improvement. Correlations among trust, reliability, and transparency reveal the interconnected nature of effective communication, emphasising that trust-building through reliable and transparent information enhances decision-making during emergencies. Leaders in management roles rated the usefulness of information higher, reflecting the practical value of effective communication for strategic decision-making.

These findings align with previous studies emphasising clarity and trustworthiness in risk communication [6, 8]. International research highlights the importance of clear instructions and frequent updates in disaster communication [7, 9]. While much of the global literature focuses on public communication needs, this study uniquely addresses the specialised communication requirements of EOC leaders. Consistent with Kapucu [10], clarity and consistency are essential components of effective disaster communication. The emphasis on inter-organisational trust and transparency observed here provides a nuanced understanding of internal communication dynamics within EOCs, rarely addressed in public-focused studies.

This study also supports Alshehri et al. [2], who highlighted the importance of culturally adaptive communication tailored to Middle Eastern contexts.

EOC leaders expressed a preference for region-specific approaches, emphasising that effective communication must account for local contexts and cultural sensitivities. This aligns with Al Kurdi [11], who advocated for frameworks incorporating cultural dynamics. Additionally, while previous studies often focus on public trust in disaster communication [12], this study shifts the focus to inter-organisational trust. Transparency within EOCs emerged as a foundational element for cohesive operations, reflecting the organisational need for effective cross-agency collaboration in Saudi Arabia. These findings support the IDEA model, which emphasises clear, consistent, and actionable communication strategies [13].

Building trust among organisations can further enhance effective communication. Veil et al. [14] highlight the potential of social media and dynamic platforms to foster transparency and reliability. Similarly, Wukich [15] emphasises the value of integrating leadership-focused models with advanced tools to improve preparedness and response. Combining modern communication technologies with traditional leadership practices can promote cohesive disaster response strategies.

Several practical recommendations emerge from these findings. First, implementing standardised communication protocols is essential to address inconsistencies across sources. Establishing clear inter-agency communication guidelines can reduce messaging discrepancies and foster cohesion. Enhanced transparency, achieved through regular updates and better information access, could further improve collaboration. Standardised practices can also reinforce trust, with centralised communication channels and designated spokespersons reducing discrepancies and promoting faster, more cohesive responses during emergencies. Training programs tailored to risk communication, particularly for newer leaders, could address skill gaps in transparency and consistency. Scenario-based training and mentorship programs would provide practical tools to enhance leaders' preparedness. Trust-building should remain a primary focus, with simulation exercises fostering communication strategies in controlled environments.

Finally, these findings align with global research emphasising the importance of tailored communication strategies. A systematic review highlighted the effectiveness of two-way communication channels in improving public understanding and response during emergencies [4]. Similarly, the World Disasters Report underscored the importance of trust and inter-agency collaboration in enhancing preparedness, particularly in regions with complex sociocultural dynamics [12]. By connecting these insights to global best practices, this study reinforces the universal need for clarity, consistency, and trust in disaster risk communication.

This study has several limitations. The use of purposive sampling may restrict the generalisability of the findings to all EOC leaders in Saudi Arabia, as regional differences in experiences and practices may exist. Additionally, the reliance on self-reported data introduces the potential for bias, as participants may have overestimated their familiarity and satisfaction with current communication tools. By focusing primarily on the perspectives of leaders, the study may not fully capture the experiences of frontline staff, who engage more directly with these tools during disaster scenarios. Lastly, the rapid pace of technological advancements means that findings related to current tools may lose relevance over time, highlighting the importance of ongoing evaluations and research.

V. CONCLUSION

This study underscores the critical role of effective risk communication among EOC leaders in Saudi Arabia. Findings highlight the importance of clarity, transparency, and trust as central pillars of successful communication. While leaders generally rated disaster communication as accessible and clear, moderate scores for transparency and consistency indicate areas for improvement to ensure cohesive response efforts. The strong correlations between trust, reliability, and transparency suggest that enhancing one element can positively reinforce others. Practically, the study emphasises the need for standardised communication protocols across agencies, supported by regular updates to enhance con-

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sistency. Training programs focusing on transparency, consistency, and trust-building are particularly critical for newer leaders, ensuring their preparedness for unified and effective disaster management. By implementing these recommendations, EOC leaders can strengthen inter-agency coordination and enhance overall resilience in disaster response.

Consent for participation: Participation in the survey was voluntary, and informed consent was obtained from all participants before their participation.

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