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INTEGRATING HEALTH DISASTER RISK MANAGEMENT INTO URBAN RESILIENCE IN MALAYSIA: BARRIERS, PRACTICES AND CONSTRUCT VALIDATION

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ABSTRACT

The COVID-19 pandemic highlighted critical vulnerabilities in Malaysia's urban health systems and disaster risk management, particularly in responding to complex health emergencies in densely populated areas. This study examines barriers and current practices of Health Emergency and Disaster Risk Management (Health-EDRM) within the context of urban resilience. A quantitative survey was conducted among 179 practitioners across multiple agencies. Descriptive analysis identified key barriers, including overwhelmed healthcare capacity (M = 3.29, SD = 0.957), low public compliance (M = 3.20, SD = 0.925), and insufficient resource allocation (M = 3.13, SD = 0.985). Confirmatory factor analysis (CFA) was used to assess the reliability and validity of the key constructs. The validated constructs, such as governance, risk assessment, preparedness, capacity building, and recovery demonstrated strong internal consistency and sampling adequacy. These findings highlight systemic gaps in current practices and provide empirical evidence that existing Health-EDRM approaches remain insufficient to address the complexity of urban disasters. By validating these constructs, this study lays the groundwork for an integrated framework to guide policymakers and practitioners in strengthening governance, multisectoral collaboration, and preparedness for future health emergencies.

Keywords: Disaster Risk Management, Urban resilience, WHO- HEDRM, Construct validation

1.0 INTRODUCTION

The COVID-19 pandemic has highlighted vulnerabilities in global health systems and urban governance, particularly in the management of health emergencies. Urban areas, characterised by high population densities and socioeconomic structures, faced unique challenges in addressing the virus's rapid spread. The Health Emergency and Disaster Risk Management (Health-EDRM) framework emphasises the need for coordinated efforts across sectors and community engagement to enhance urban resilience. This framework aligns with international initiatives, such as the Sendai Framework and the 2030 Agenda, underscoring the importance of integrating risk-reduction strategies into urban planning. However, current and future urban disaster risk management must address not only COVID-19 but also other large-scale health emergencies and compounded risks. In the urban risk literature, the interconnected "three C's" — climate change, COVID-19 (and other health crises), and conflict which are widely acknowledged as exacerbating urban vulnerabilities. Climate change intensifies extreme weather and health hazards, COVID poses ongoing pandemic threats, and conflict further complicates urban resilience. Therefore, a holistic, integrated approach is imperative for effective preparedness and response to these overlapping challenges (International Federation of Red Cross and Red Crescent Societies [IFRC], 2021; Sharifi, 2020).

In addition, policymakers must adopt a holistic approach to disaster management that involves diverse stakeholders and promotes resilient infrastructure. The interconnected challenges of climate change, COVID-19, and conflict exacerbate urban vulnerabilities, underscoring the need for effective preparedness and response strategies. Malaysia's Health Emergency and Disaster Risk Management (HEDRM) system during the COVID-19 pandemic exemplifies both strengths and challenges in addressing complex health crises. Therefore, this paper aims to explore Malaysia's experience with the COVID-19 pandemic through a holistic framework. It identifies key barriers, current practices, and integrative factors within Health Disaster Risk Management that contribute to urban resilience. Additionally, it presents the process of construct validation, providing a robust foundation for developing an integrated Health-EDRM and Urban Resilience framework for future application.

2.0 LITERATURE REVIEW

This literature review explores the barriers to effective health emergency management, the components of the Health-EDRM framework, and the need for an integrative approach that enhances urban resilience.

2.1 Barriers to Effective Health Emergency Management

The COVID-19 pandemic has revealed significant barriers to effective health emergency management, including insufficient resources, overwhelming healthcare capacity, inadequate policies, low public compliance, and poor inter-agency coordination, which were issues observed globally, not just in Malaysia (Kruk et al., 2020). Historically, pandemics such as the 1918 influenza, SARS, and cholera outbreaks have significantly impacted urban health systems and governance, affecting demographics and infrastructure resilience (Sharifi, 2020; Gallardo-Albarrán, 2025; UN-Habitat, 2024). In Malaysia, past cholera epidemics have influenced urban growth and socioeconomic recovery. Lessons from previous outbreaks have led to improvements in early warning systems and inter-agency collaboration, with countries such as South Korea and Singapore enhancing their response capabilities (Khatri et al., 2023; WHO, 2020; UNDRR, 2024). The rise of overlapping threats necessitates the integration of health risks into disaster management. While the Sendai Framework faces challenges such as vague guidelines and weak enforcement, Health EDRM can enhance resilience by integrating epidemiological data with risk assessments and community preparedness, making it essential for effective risk governance (UNDRR, 2024).

2.2 Health Emergency Disaster Risk Management (Health-EDRM)

The Health Emergency Disaster Risk Management (Health-EDRM) framework is a comprehensive approach developed by the World Health Organization (WHO) to guide countries and partners in reducing the risks and impacts of all types of emergencies and disasters, including epidemics and pandemics such as COVID-19, through a structured, multisectoral, and risk-based strategy (WHO, 2021). WHO identified ten core (10) components for effective Health-EDRM: i. Policy, regulation, and legislation; ii. Planning and coordination; iii. Human resources; iv. Financial resources; v. Information and knowledge management; vi. Risk communication; vii. Health infrastructure and logistics; VIII. Health and related services; ix. Community capacities; x. Monitoring and evaluation (WHO, 2021).

2.3 The Public Health Emergency

Health EDRM is a continuum of measures that emphasises managing the risks of potential emergencies or disasters, rather than solely responding to the event or crisis, and building the resilience of communities and countries (WHO, 2019).

The WHO Health Emergency and Disaster Risk Management (Health-EDRM) Framework **(Fig. 1)** prioritises people's Health during emergencies and disasters, providing both academic and practical solutions, while also addressing management aspects (Chan & Lam, 2020; Chan & Shaw, 2020; World Health Organisation, 2019). It also includes strengthening collaboration between health authorities and stakeholders to strengthen the country's capacity for disaster risk management (WHO, 2019).

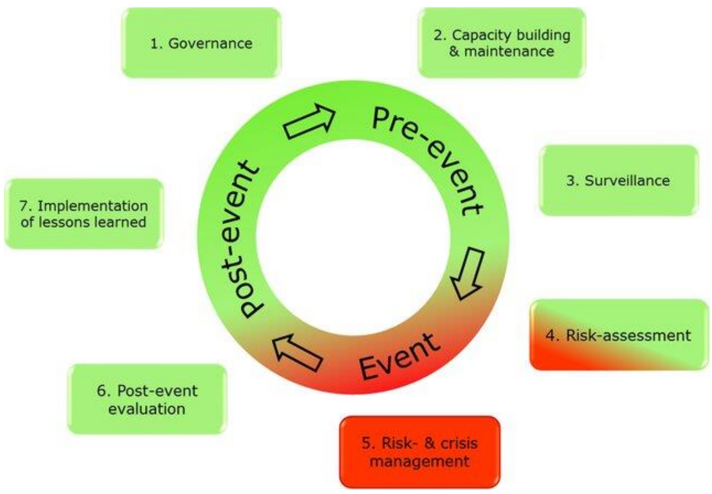

Fig.1: Public Health Emergency Preparedness Cycle
(Source: Belfroid et al., 2020).

2.4 Malaysia Disaster Governance and Pandemic Response

Malaysia's National Disaster Management Agency (NADMA) issued Directive No. 1 in 2024, establishing a multi-stakeholder framework for disaster risk management. This framework emphasises early coordination among government agencies, district councils, NGOs, and local communities (NADMA, 2024). As the primary agency, NADMA collaborates with federal, state, and district committees to provide disaster-specific early warnings and risk assessments (Sharifi-Sedeh et al., 2024; Abdullah, 2022). During the COVID-19 pandemic, this directive facilitated a coordinated national response led by the Ministry of Socioeconomic Affairs addressing transmission, treatment, and socioeconomic support. This framework highlights the importance of stakeholder cooperation in enhancing Malaysia's disaster resilience.

2.5 Disaster Risk Management Cycle

The UN Office for Disaster Risk Reduction (UNDRR) defines a disaster as "a serious disruption of the functioning of a community or society involving widespread human, material, economic, or environmental losses and impacts, which exceeds the affected community's ability to cope using its resources." The conventional risk and disaster management framework is shown in **Fig. 2.**

Fig 2: Disaster Risk Management Cycle
(Source: United Nations Office for Outer Space Affairs. (n.d.). Risks and disasters. UN-SPIDER. Retrieved October 14, 2025, from https://www.un-spider.org/risks-and-disasters)

2.6 Health Resilience in Disaster Risk Management Cycle

The COVID-19 pandemic has profoundly influenced urban planning, underscoring the critical need to integrate public health considerations within the disaster life cycle framework, which comprises prevention/mitigation, preparedness, response, and recovery phases. Below is the analysis of this relationship and its implications:

Table 1: Analysis of the Relationship of Disaster Risk Management Cycle Framework and Implications

Disaster life cycle framework	Analysis of Relationship and Implications	Sources
Prevention/Mitigation	Overcrowding and poor ventilation in urban planning can facilitate the transmission of illnesses. Green areas and active transit are essential for health-centric design. To lower pandemic risk, healthcare and sanitation networks must be resilient.	Afrin et al. (2021).
Preparedness	COVID-19 exposed weaknesses in urban healthcare access and public communication. To improve readiness, urban design should incorporate simulation models, capacity-building initiatives, and decentralised governance. Crisis response requires adaptable urban settings that accommodate health measures.	Okoli et al. 2024; Capolongo et al. 2020
Response	The "15-minute city" concept promotes local access to essential services, boosting economies and reducing travel. Temporary urban interventions improved mobility during lockdowns. Inclusive design and targeted investments in underserved areas are essential for equitable urban development.	Stoltenberg 2024; Jennings et al. 2021; Pineda & Corburn 2020
Recovery	Integrating health and disaster risk reduction into urban policy through cross-sector collaboration and community engagement fosters resilience, sustainability, and social equity.	UNDRR 2023

The COVID-19 pandemic has underscored the need for health-centric urbanism, prompting city leaders to prioritise public health in their design. Effective urban planning must integrate infrastructure, social factors, and stakeholder engagement to build resilient communities and ensure preparedness for future health crises through a comprehensive, health-centred approach.

2.6 Urban Resilience

Urban resilience has emerged as a critical priority for cities facing escalating natural and health-related disasters driven by climate change and rapid urbanisation (Wu et al., 2024). Resilience is broadly conceptualised along four key dimensions: planning, absorption, adaptation, and recovery, each integral to sustaining urban functionality and protecting public health during crises (Terblanche, 2022).

Planning as a dimension involves proactive governance, strong legal frameworks, and integrated risk reduction strategies that incorporate health disaster risk management (DRM). Effective planning requires multisectoral coordination, policy coherence, and risk-informed urban development, ensuring that cities are prepared for health emergencies and other hazards (Terblanche, 2022). Planning supports anticipating vulnerabilities and allocating resources to safeguard critical health infrastructure and populations. The WHO Health Emergency and Disaster Risk Management (Health-EDRM) framework emphasises the importance of integrating health risk considerations into urban resilience planning to reduce inequalities and enhance overall community well-being (WHO, 2022).

Absorption refers to the capacity of urban systems to withstand and buffer the immediate impacts of disasters without incurring significant functional loss. This includes robust health systems, the availability of emergency services, and effective risk communication that prevents health services from collapsing under strain (Terblanche, 2022). Urban areas with resilient health systems absorb shocks more effectively, ensuring continuity of care and minimising mortality and morbidity during disasters.

Adaptation emphasises the ability of urban systems and communities to learn from past events and progressively adjust protocols, infrastructure, and policies. This agility supports flexible responses to evolving risks, such as pandemics and climate-induced health hazards, by incorporating scientific knowledge and technological innovation (Wu et al., 2024). Adaptation also includes community engagement in health risk management, fostering local capacities, and behavioural changes that reduce vulnerabilities over time.

Recovery involves restoring and improving health and urban systems after a disaster, with a crucial focus on "building back better" to enhance future resilience (Terblanche, 2022). Health service rehabilitation, psychosocial support, and inclusive social policies are key elements that contribute not only to returning to normalcy but also to addressing systemic inequities exposed by disasters.

In sum, an integrative approach linking Health-EDRM and urban resilience highlights the interconnectedness of disaster risk factors and health outcomes. Inclusive governance and cross-sector collaboration are vital for comprehensive planning, enhancing adaptive capacity, and developing effective recovery strategies to safeguard cities from health emergencies and promote sustainable urban futures.

3.0 METHODOLOGY

3.1 Research Design and Data Collection

This study employs a quantitative research approach to explore the intersection of health resilience and urban planning in the context of health disaster risk management (HDRM). Initial data collection involved a comprehensive literature review of scholarly articles, official reports, and case studies on HDRM, urban resilience, and policy frameworks. This provided a contextual foundation for the research. A structured questionnaire was then administered to a purposive sample of practitioners, including urban planners, public health officials, and representatives from the armed forces, to gather insights into Health EDRM practices in Malaysian urban settings (Creswell, 2014). Data collection began with online surveys during the pandemic and continued face-to-face from October 2022 to January 2025.

3.2 Questionnaire Design

The questionnaire was developed by extracting variables from city resilience frameworks, including the Making Cities Resilient 2030, WHO's Health-EDRM, and UNDRR. Content analysis identified key constructs relevant to HEDRM in urban planning, with items tailored to the Malaysian context. Structured into four sections, the questionnaire uses a 5-point Likert scale: Section A: Respondent Profile, Section B: Respondent's Experience, Section C: Key Factors for Integrating Health and Urban Resilience, Section D: Urban Resilience for Cities
Item variables are detailed in the respective tables below.

Table 2: Barriers or challenges during COVID-19

No of item	Barriers or challenges	Sources
1	Resource allocation was insufficient	Kruk et al. (2020)
2	Public compliance was low.	Adebisi et al. (2021)
3	Healthcare capacity was overwhelming	Khan et al. (2022)
4	Policies and regulations were inadequate	Marmot et al. (2020)
5	Lack of coordination among agencies	Gooding et al. (2022)
6	Communication with the public was poor	Tambo et al. (2021)

Table 3: Health Disaster Risk Management Practices in Malaysia

No of item	Statement	Adapted and self-constructed from Sources
1	Health disaster risk management is adequately integrated into urban planning policies in Malaysia.	WHO (2019), Khan et al. (2022)
2	Local authorities actively involve health practitioners in disaster risk assessments	UNDRR (2023),(Kruk et al. (2020)
3	Community engagement is prioritised in urban resilience planning related to health disasters.	UNDRR (2023), Tambo et al. (2021)
4	There are sufficient training programs for local authorities on health disaster preparedness.	WHO (2021), Marmot et al. (2020)
5	Communication among stakeholders regarding health disaster risk management is effective.	WHO (2021), Gooding et al. (2022)
6	Funding for health disaster risk management initiatives is adequate in urban areas.	WHO (2019), Adebisi et al. (2021)
7	Policies promoting collaboration between health agencies and urban planners are in place.	UNDRR (2023), Pineda & Corburn (2020)
8	Monitoring and evaluation of health disaster preparedness plans are regularly conducted.	WHO (2021), Sharifi & Khavarian-Garmsir, 2020
9	Public awareness regarding health disaster risks is sufficient in urban communities	UNDRR (2023), Johnson & Lee, 2020
10	The current health disaster risk management framework effectively supports urban resilience efforts.	WHO (2021), UNDRR, 2023, Meriläinen et al. (2020).

Table 4: Key Integrative Factors Health Disaster Risk Management into Urban Resilience

Construct Code	Key Components Variables	No of items	Adapted and self-constructed from various sources
GPI	Governance And Policy Integration	7	WHO (2021), WHO (2023), UNDR(2023), Abbas, R. (2025), Pineo, H. (2020), Soalihin, S., Asmawi, A., Riyanto, D., Ariyani, I., Nur, H., & Sudiyasa, I. K. (2025)
RAM	Risk Assessment and Management	11	WHO (2021), WHO (2023), UNDRR (2023), Ingelbeen et al., (2025), Jeleff et al., 2022, Anand, 2024, Jeleff et al., 2022), Alharbi et al., 2025,
PRC	Preparedness And Response Coordination	10	WHO (2021), WHO (2023). UNDRR (2023), Abbas, R. (2025), Sydnes, M. (2025).
CB	Capacity Building	5	WHO (2021), WHO (2023), UNDRR (2023), Abbas, R. (2025), Soalihin, S., Asmawi, A., Riyanto, D., Ariyani, I., Nur, H., & Sudiyasa, I. K. (2025)
FP	Financial Preparedness	5	WHO (2021), WHO (2023), UNDRR (2023), Griffith-Jones, S., & Tanner, T. (2016), Iqbal, A., et al. (2024), Khan, A., et al. (2022)
IF	Infrastructure	5	WHO (2021), WHO (2023), UNDRR (2023), Ferguson, A. (2024), Lamberti-Castronuovo, A., Monaro, M., & Lami, F. (2022),
PDM	Post-Disaster Management	5	WHO (2021), WHO (2023), UNDRR (2023), Noboa-Ramos, C., et al. (2023), Wang, W., et al. (2023)

Construct Code	Key Components Variables	No of items	Adapted and self-constructed from various sources
ME	Monitoring And Evaluation	5	WHO (2021), WHO (2023), UNDRR (2023), Global Preparedness Monitoring Board (GPMB). (2021), Khan, Y., O'Sullivan, T., Brown, A., Tracey, S., Gibson, J., Généreux, M., et al. (2018)
PL	Planning	4	WHO (2021), WHO (2023), UNDRR (2023), Chen, X., et al. (2020), Guan, X., & Gao, H. (2022), Shang, B., & Huang, X. (2020)
AB	Absorption	4	WHO (2021), WHO (2023), UNDRR (2023), Hao, Y., Tie, Y., Zhang, L., Zhang, F., & Sun, C. (2024), Kapucu, N. (2011), Liu, Y., Wang, J., & Chen, K. (2023), Rong, L., Zhang, T., & Wang, H. (2024)
RE	Recovery	4	WHO (2021), WHO (2023), UNDRR (2023), Abbas, R. (2025), Kapucu, N. (2011), Sydnes, M. (2025)
AD	Adaptation	4	WHO (2021), WHO (2023), UNDRR (2023), Luchi, K., & Mutter, J. (2020), Setiadi, A., Rudwiarti, L. A., Langer, I. J., & Wardhani, M. K. (2021), UNDP, 2020

3.3 Respondent sample size

A purposive sampling technique was employed to select participants based on their specific roles, expertise, and involvement in disaster governance and urban planning, ensuring representation of key stakeholder groups relevant to the study objectives (Stratton et al., 2019). Selection justification based on practitioner representative roles and responsibilities that cover Malaysia's three-tier disaster governance, as follows:

- Search and Rescue: For pandemics, lead agencies, including the Ministry of Health, the Crisis Preparedness Response Centre (CPRC)
- Health and Medical: Ministry of Health (MOH)
- Support agencies assisting operational responses include District Officials, Municipal/Town Councils, and the Royal Malaysian Police.
- Technical agencies provide scientific and technical expertise. (Eg: NADMA, National Security Council (NSC), Urban Planners from Town and Country Planning Department (JPBD), Plan Malaysia)
- Assistance and recovery agencies handling welfare, counselling, logistics, and rebuilding (Eg, such as a Welfare officer from the Welfare Department)
- Volunteer organisations and individuals are participating in relief and recovery. (Eg, the Private sector, NGO and academic institutions)
- Security control (Eg, Royal Malaysian Police Officers)

The sample size for this study was set for 179 respondents, following guidelines for statistical adequacy in multi-group research (Bujang, Omar, & Foo, 2024; Julious, 2005). Proportional allocation reflected the significance of stakeholder groups, with urban planners comprising approximately 28% and minority groups ranging from 1% to 8%. This stratified purposive sampling ensures a reliable foundation for construct validation while capturing diverse perspectives.

3.4 Data Analysis

Content analysis of relevant literature, World Health Organisation (WHO) reports, and urban policy documents were conducted to align current urban planning practices with the WHO Health Emergency and Disaster Risk Management (Health-EDRM) framework. To quantify perceptions of barriers and the adoption of Health-EDRM practices, descriptive statistical analysis (means and frequencies) was conducted on survey responses. This approach is intended to inform the refinement of survey instruments and theoretical frameworks, rather than to test hypotheses or produce generalisable conclusions (Field, 2018).

SmartPLS-SEM was used to assess the measurement model, focusing on construct reliability and validity by evaluating indicator loadings, internal consistency, convergent validity, and discriminant validity (Hair et al., 2021). Structural model testing was not performed, as the primary goal was to confirm the soundness of indicators and latent variables. PLS-SEM is well-suited for this analysis, as it accommodates small to medium sample sizes, such as the 179 respondents in this study, and handles both reflective and formative constructs under non-normal data conditions. Bootstrapping techniques were employed to test the statistical significance of indicator loadings. **Fig. 3** presents a simplified framework for integrating Health Disaster Risk Management into Urban Resilience in Malaysia.

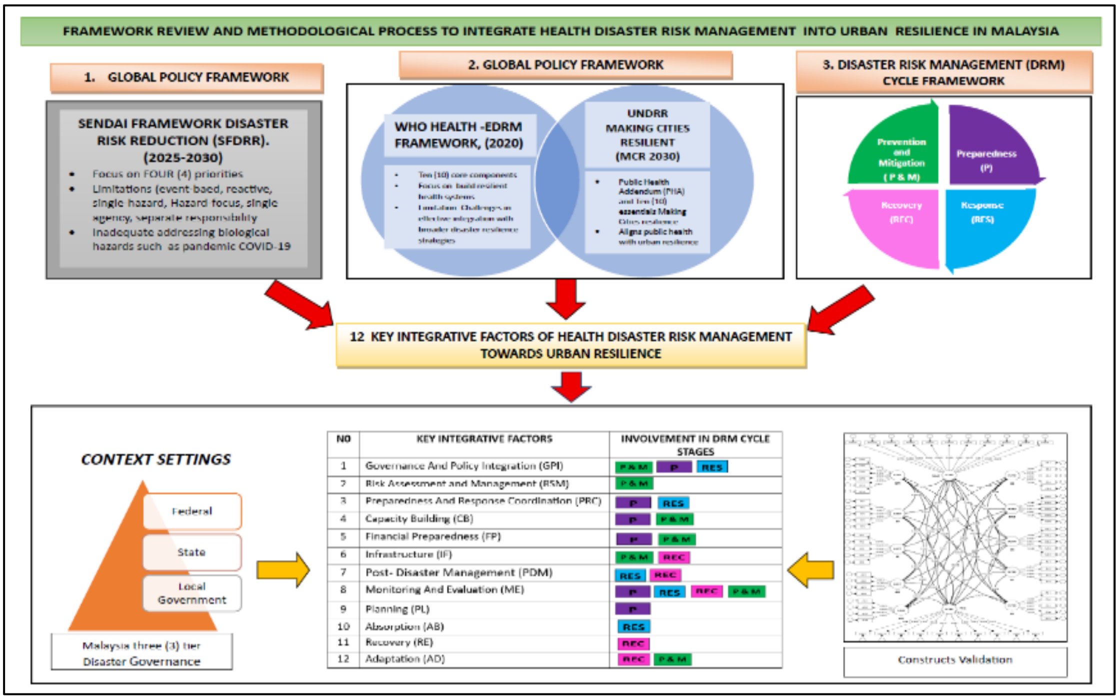

Fig 3: Simplified Diagram of Framework Review and Methodological Process to integrate Health Disaster Risk Management into Urban Resilience in Malaysia
(Source: Author's work)

4.0 RESULTS AND ANALYSIS

This section presents findings from a survey on health disaster risk management practices during the COVID-19 pandemic in Malaysia. It includes respondents' demographic profiles, key barriers encountered, and current management practices. 179 respondents responded.

4.1 Practitioner Demographics

Table 5, which lists 179 health disaster risk management professionals in Malaysia, reveals a predominantly experienced workforce, with 63.1% having over 10 years of experience, emphasising expertise in urban resilience. Urban Planners constitute the largest specific group (27.9%), highlighting the critical role of urban planning. Most hold a Bachelor's degree (33.5%), while the "Others" category (35.2%) suggests reliance on practical, non-traditional qualifications. Regional distribution is concentrated in Sabah (44.1%) and the Eastern Region (25.1%), indicating a regional focus in disaster management. The data highlights the vital role of experienced professionals and urban planners in fostering resilient urban environments, emphasising the need for ongoing professional development to address regional disparities in urban resilience challenges. This profile underscores the importance of multi-agency collaboration and diverse expertise in enhancing urban health resilience (UNDRR, 2023).

Table 5: Demographic Profile

Factors	Group	Frequency	Percent
A1. What is your role or position?	Health Practitioner	11	6.1
	Crisis Preparedness Response Centre (CPRC) Representative	1	0.6
	National Disaster Management Agency (NADMA) Representative	14	7.8
	Urban Planner/Planner from PLANMalaysia	50	27.9
	Local Government Official (City Councils, Municipal Councils & District)	13	7.3
	Royal Malaysian Police (RMP) Officer	9	5.0
	Social Welfare Officer	1	0.6
	Academia/ Institute Researcher	1	0.6
	Others (please specify);	79	44.1
A3. How many years of experience do you have in your current field?	1- 3 years	25	14.0
	4-6 years	12	6.7
	7-10 years	29	16.2
	More than 10 years	113	63.1
A4. What is your highest level of education?	High School Diploma	32	17.9
	Bachelor's Degree	60	33.5
	Master's Degree	23	12.8
	PhD (Doctor of Philosophy)	1	0.6
	Others (Please specify)	63	35.2
A5. In which state or region do you work?	Central Region (e.g., Selangor, Kuala Lumpur, Putrajaya)	30	16.8
	Eastern Region (e.g., Pahang, Terengganu, Kelantan)	45	25.1
	Northern Region (e.g., Perak, Kedah, Penang)	5	2.8
	Southern Region (e.g., Johor, Malacca, Negeri Sembilan)	19	10.6
	Sabah	79	44.1
	Sarawak	1	0.6
	Total	179	100.0

4.2 Barriers to Effective Health Disaster Risk Management

The COVID-19 pandemic presented unprecedented challenges to global health systems, exposing vulnerabilities and barriers that hindered effective response and management. Understanding these barriers is crucial for informing future public health strategies and improving preparedness for similar crises.

Table 6: Significant barriers or challenges during the COVID-19 disease outbreak

Barriers or challenges	Mean	SD	Level
Resource allocation was insufficient	3.13	0.985	Moderate
Public compliance was low.	3.20	0.925	Moderate
Healthcare capacity was overwhelming	3.29	0.957	Moderate
Policies and regulations were inadequate	2.97	0.927	Moderate
Lack of coordination among agencies	2.85	1.012	Moderate
Communication with the public was poor	2.93	1.014	Moderate

Table 6 reveals that barriers during the COVID-19 outbreak were rated as moderate, with the highest being overwhelmed healthcare capacity (M = 3.29, SD = 0.957), reflecting the global strain on healthcare (Kruk et al., 2020). Key challenges included low public compliance (M = 3.20, SD = 0.925) and insufficient resource allocation (M = 3.13, SD = 0.985), highlighting the need for improved public health communication. Inadequate policies (M = 2.97, SD = 0.927) and poor public communication (M = 2.93, SD = 1.014) underscore the importance of transparent messaging (Tambo et al., 2021). Coordination challenges among agencies (M = 2.85, SD = 1.012) point to institutional fragmentation, suggesting that these manageable challenges can be addressed through targeted improvements.

4.3 Current Health Disaster Risk Management Practices

Current practices in health disaster risk management are crucial for enhancing urban resilience. Table 7 highlights the findings from Malaysia, showing a mix of moderate to high agreement on integrating health strategies into urban planning and community engagement, while also identifying areas that require improvement.

Table 7: Current practices of health disaster risk management in Malaysia

Statements	Mean	Std. Deviation	Level
Health disaster risk management is adequately integrated into urban planning policies in Malaysia	3.64	0.898	Moderate
Local authorities actively involve health practitioners in disaster risk assessments	3.85	0.862	High
Community engagement is prioritised in urban resilience planning related to health disasters	3.84	0.886	High
There are sufficient training programs for local authorities on health disaster preparedness	3.51	0.979	Moderate
Communication among stakeholders regarding health disaster risk management is effective	3.72	0.861	High
Funding for health disaster risk management initiatives is adequate in urban areas	3.46	0.931	Moderate
Policies promoting collaboration between health agencies and urban planners are in place	3.60	0.914	Moderate
Monitoring and evaluation of health disaster preparedness plans are regularly conducted.	3.56	0.943	Moderate
Public awareness regarding health disaster risks is sufficient in urban communities	3.35	0.974	Moderate
The current health disaster risk management framework effectively supports urban resilience efforts	3.62	0.855	Moderate

Table 7 shows mixed moderate-to-high agreement on integrating health disaster risk management into Malaysia's urban resilience planning. Respondents moderately agree that such management is included in urban policies (M = 3.64, SD = 0.898), with strong confidence in the roles of local authorities in disaster risk assessments (M = 3.85, SD = 0.862) and community engagement (M = 3.84, SD = 0.886). However, training (M = 3.51, SD = 0.979) and funding (M = 3.46, SD = 0.931) received moderate ratings, indicating areas for improvement. Public awareness of health disaster risks (M = 3.35, SD = 0.974) is insufficient, highlighting gaps in preparedness and response. Overall, while the framework is deemed adequate (M = 3.62, SD = 0.855), it requires strengthening to enhance urban resilience.

4.4 Construct Reliability and Validity for the Health Disaster Risk Management Practices

The following table presents the confirmatory factor analysis (CFA), common method bias (CMB) assessment, and reliability results after exploratory factor analysis (EFA) for Health Disaster Risk Management Practices.

Table 8 CFA, Common Method Bias (CMB), Extraction Method: Principal Component Analysis and Reliability Analysis after EFA for Domain B (N=179)

				Bartlett's Test of Sphericity		Initial Eigenvalues (CMB)				
Construct	ID	Loading >0.6	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	Approx. Chi-Square	P	Total	% of Variance	Cumulative %	Cronbach's Alpha	N of Items
BOC	BOC1	0.766	0.83	432.43	0.00	3.46	57.64	57.64	0.85	6
	BOC2	0.750								
	BOC3	0.656								
	BOC4	0.787								
	BOC5	0.788								
	BOC6	0.799								
St (Health-EDRM Practices)	St1	0.785	0.93	1215.88	0.00	6.28	62.80	62.80	0.93	10
	St2	0.754								
	St3	0.716								
	St4	0.819								
	St5	0.817								
	St6	0.776								
	St7	0.784								
	St8	0.865								
	St9	0.753								
	St10	0.844								

Table 8 presents the factor loadings for Barriers or Challenges (BOC) and Statement (St) on Health EDRM Practices constructs, all of which exceed 0.6, indicating strong item-construct associations. BOC loadings range from 0.656 to 0.799, confirming the reliability of both constructs. Kaiser-Meyer-Olkin (KMO) measures indicate perfect sampling adequacy: 0.83 for (BOC) and 0.93 for (St). Bartlett's Test of Sphericity, which is highly significant ($p < 0.0001$) for both, validating the data's suitability for factor analysis. Principal Component Analysis reveals eigenvalues above 1 for both constructs, with BOC's first factor explaining 57.64% and St's first factor explaining 62.8% of variance, indicating dominant factors and minimal common method bias. Cronbach's alpha shows good reliability for BOC (α = 0.85, 6 items) and excellent reliability for St (α = 0.93, 10 items). Both constructs demonstrate strong internal consistency and are deemed reliable for subsequent analyses.

4.5 Construct Reliability and Validity for Integrative Factors of Health Urban Resilience

The following table presents the confirmatory factor analysis (CFA), common method bias (CMB) assessment, and Extraction Method: Principal Component for integrating Health Urban Resilience

Table 9 CFA, Common Method Bias (CMB), Extraction Method: Principal Component Analysis and Reliability Analysis after EFA for Domain C (N=179)

				Bartlett's Test of Sphericity		Initial Eigenvalues (CMB)				
Construct	ID	Loading>0.6	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	Approx. Chi-Square	P	Total	% of Variance	Cumulative %	Cronbach's Alpha	N of Items
GPI	GPI1	0.848	0.89	1380.21	0.000	5.56	79.41	79.41	0.96	7
	GPI2	0.916								
	GPI3	0.912								
	GPI4	0.929								
	GPI5	0.883								
	GPI6	0.904								
	GPI7	0.842								
RAM	RAM1	0.861	0.95	2936.99	0.000	9.18	83.43	83.43	0.98	11
	RAM2	0.895								
	RAM3	0.882								
	RAM4	0.915								
	RAM5	0.915								
	RAM6	0.945								
	RAM7	0.914								
	RAM8	0.956								
	RAM9	0.911								
	RAM10	0.917								
	RAM11	0.933								
PRC	PRC1	0.904	0.94	2992.00	0.000	8.67	86.70	86.70	0.98	10
	PRC2	0.904								
	PRC3	0.917								
	PRC4	0.949								
	PRC5	0.956								
	PRC6	0.926								
	PRC7	0.908								
	PRC8	0.952								

	PRC9	0.953								
	PRC10	0.939								
CB	CB1	0.938	0.88	1271.63	0.000	4.50	90.02	90.02	0.97	5
	CB2	0.949								
	CB3	0.937								
	CB4	0.962								
	CB5	0.957								
FP	FP1	0.956	0.91	1182.42	0.000	4.46	89.28	89.28	0.97	5
	FP2	0.951								
	FP3	0.927								
	FP4	0.934								
	FP5	0.955								
IR	IR1	0.958	0.89	1273.75	0.000	**4.51**	**90.14**	**90.14**	0.97	5
	IR2	0.934								
	IR3	0.942								
	IR4	0.958								
	IR5	0.955								
RRB	RRB1	0.958	0.91	1262.56	0.000	4.52	90.36	90.36	0.97	5
	RRB2	0.959								
	RRB3	0.922								
	RRB4	0.958								
	RRB5	0.955								
ME	ME1	0.921	0.88	1264.06	0.000	4.49	89.88	89.88	0.97	5
	ME2	0.960								
	ME3	0.963								
	ME4	0.939								
	ME5	0.955								
PL	PL1	0.916	0.83	622.79	0.000	3.35	83.63	83.63	0.93	4
	PL2	0.898								
	PL3	0.909								
	PL4	0.935								
AB	AB1	0.916	0.86	694.68	0.000	3.45	86.18	86.18	0.95	4
	AB2	0.947								
	AB3	0.941								
	AB4	0.908								
RE	RE1	0.908	0.89	873.00	0.000	4.15	82.91	82.91	0.95	5
	RE2	0.915								
	RE3	0.923								
	RE4	0.903								
	RE5	0.904								
AD	AD1	0.944	0.84	799.27	0.000	3.55	88.65	88.65	0.96	4
	AD2	0.932								
	AD3	0.947								
	AD4	0.944								

Table 9 presents **twelve (12)** factor loadings for risk management and urban resilience constructs, all exceeding the 0.6 threshold, indicating strong reliability. Constructs such as Governance and Policy Integration (GPI), Risk Assessment and Management (RAM), and Preparedness and Response Coordination (PRC) show notably high loadings (mostly above 0.9). Kaiser-Meyer-Olkin (KMO) values range from 0.83 to 0.95, confirming sampling adequacy, while Bartlett's Test of Sphericity is significant ($p < 0.0001$). Principal component analysis reveals eigenvalues above 1.0, with RAM explaining the highest variance (9.18). Cronbach's alpha coefficients range from 0.93 to 0.98, confirming excellent internal consistency and robustness of the measurement model.

4.6 Assessment of Convergent Validity in the Pilot CB-SEM Measurement Model Using Standardised Factor Loadings, Composite Reliability, and Average Variance Extracted

The pilot CB-SEM measurement model demonstrated strong convergent validity, with standardised factor loadings ranging from 0.68 to 0.89, all of which were significant ($p < .001$). Composite reliability (CR) values of 0.83-0.90 indicate high internal consistency, while average variance extracted (AVE) values of 0.57-0.65 confirm that the constructs explain the majority of the variance in their indicators. Factor loadings for constructs like Absorption (0.867–0.943), Capacity Building (up to 0.961), and Financial Preparedness (up to 0.951) were particularly high. Cronbach's Alpha values exceeded 0.70 for all constructs, with Preparedness and Response Coordination leading at 0.983. These findings validate the measurement model, confirming that it reliably captures the intended latent constructs in risk management and urban resilience, thus reinforcing the model's overall robustness and applicability for future research and framework development. Hence, **Fig. 4** illustrates how different factors are interrelated and how constructs contribute to the overall model.

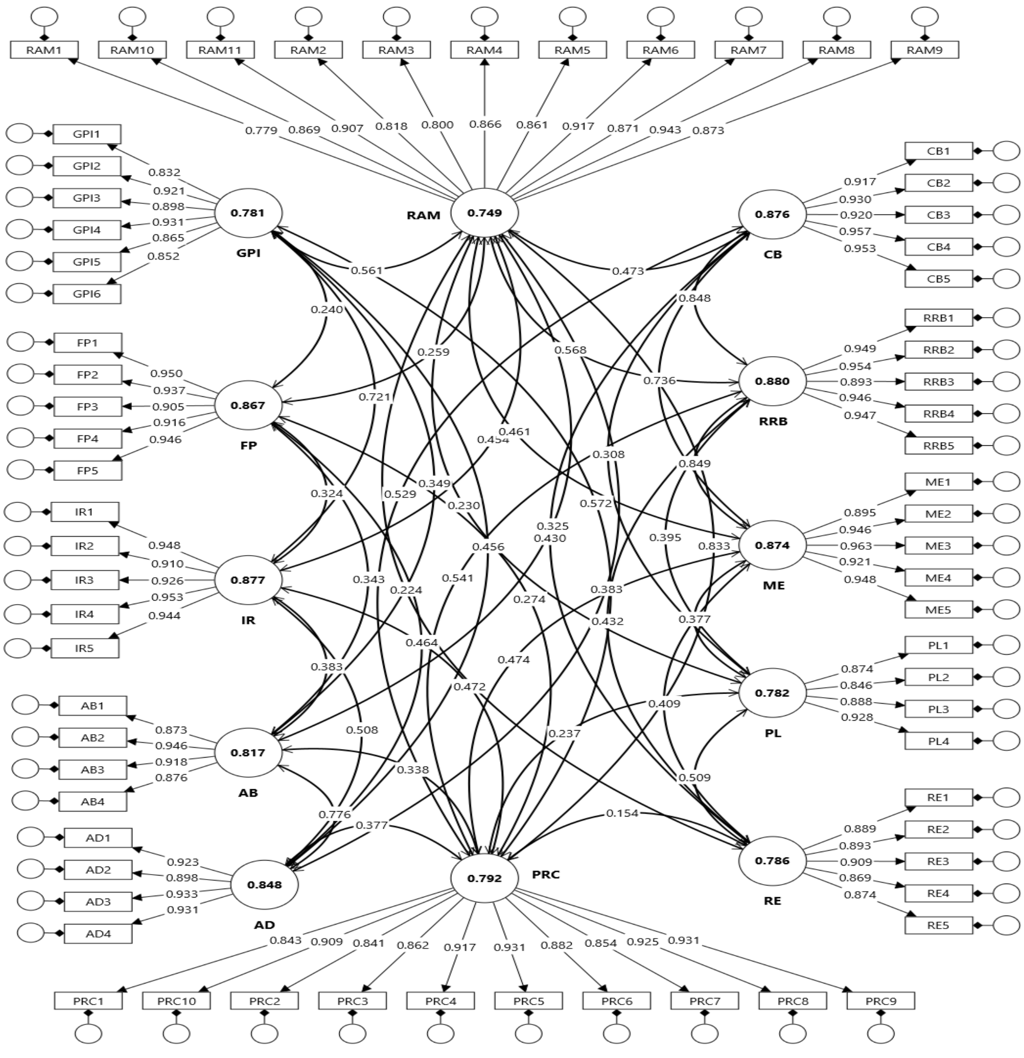

Fig 4: CB-SEM Measurement Model Diagram
(Source: Author's work)

4.7 Model Fit Statistics for the Estimated and Null Models in Risk Management and Urban Resilience

Table 10 Model Fit

	Estimated model	Null model
Chi-square	7073.239	24762.74
Number of model parameters	199	70
Number of observations	179	n/a
Degrees of freedom	2286	2415
P value	0.000	0.000
ChiSqr/df	3.094	10.254
RMSEA	0.108	0.227
RMSEA LOW 90% CI	0.105	0.225
RMSEA HIGH 90% CI	0.111	0.23
GFI	0.517	n/a
AGFI	0.475	n/a
PGFI	0.476	n/a
SRMR	0.161	n/a
NFI	0.714	n/a
TLI	0.774	n/a
CFI	0.786	n/a
AIC	7471.239	n/a
BIC	8105.529	n/a

Table 10 presents the model fit statistics, which indicate that the estimated model fits the data significantly better than the null model, evidenced by a much lower Chi-square (7073.239 vs. 24762.74) and a favourable Chi-square/df ratio of 3.094 (within the acceptable range). Although the RMSEA of 0.108 is slightly above the ideal threshold, it indicates a reasonable fit compared to the null model's 0.227. However, fit indices such as GFI (0.517), AGFI (0.475), NFI (0.714), TLI (0.774), and CFI (0.786) indicate moderate fit, highlighting room for improvement. The high SRMR (0.161) also suggests divergence between observed and predicted correlations. Overall, while the model explains the relationships better than the null model, further refinement is needed to enhance its explanatory power and fit.

5.0 DISCUSSIONS

5.1 Statistical Interpretations and Significance of Barriers

The findings from Table 6 reveal that respondents rated the barriers experienced during the COVID-19 outbreak as moderate, with mean scores ranging from 2.94 to 3.45 on a 5-point Likert scale. The most significant challenges identified include insufficient resource allocation (Mean = 3.13, SD = 0.985), overwhelming healthcare capacity (Mean = 3.29, SD = 0.957), and low public compliance (Mean = 3.20, SD = 0.925). Other challenges, such as inadequate policies and poor inter-agency coordination, also scored in the moderate range.

These results resonate with global observations of healthcare systems under unprecedented strain during the pandemic (Kruk et al., 2020). The moderate rating of public compliance highlights critical issues in risk communication and community engagement, which are essential components of the WHO Health Emergency Disaster Risk Management (HEDRM) framework (WHO, 2021). This suggests that while there is an awareness of the importance of public compliance, practical strategies to enhance community engagement remain lacking. The moderate score for coordination among agencies points to persistent gaps in multisectoral collaboration, a cornerstone of effective health emergency management. These findings suggest a partial resilience in the system, yet they also indicate significant stressors that compromise the effectiveness of health disaster risk management (HDRM). Overwhelmed healthcare capacity underscores the urgent need for surge strategies and scalable infrastructure, as outlined in health system resilience frameworks (Gupta & Nair, 2012). Moreover, the systemic siloing reflected in the moderate coordination scores indicates a failure to integrate disaster governance, a widespread issue during the pandemic (Gooding et al., 2022). Statistically, these findings reveal critical failure points in governance and social mobilisation, serving as leverage points for intervention.

By linking these challenges to the research objectives, which aim to explore Malaysia's experience with HDRM during the pandemic, it becomes evident that addressing these barriers is vital for enhancing urban resilience. The moderate ratings indicate areas that require urgent policy reforms and investment in communication strategies to foster community trust and compliance. Moreover, strengthening inter-agency collaboration is essential for creating a more cohesive and responsive health disaster framework. Furthermore, these findings not only highlight the barriers encountered during the pandemic but also provide new insights into the necessary steps to improve HDRM in Malaysia. By identifying and addressing these challenges, this research contributes to a deeper understanding of how to enhance resilience and preparedness for future health emergencies.

5.2 Policy and Practice Implications

Table 7 illustrates respondents' perceptions of current health disaster risk management (HDRM) practices in the urban planning context of Malaysia. Most items received moderate ratings; however, the involvement of health practitioners in disaster risk assessments was notably high (Mean = 3.85, SD = 0.862). This reflects a positive trend towards multisectoral collaboration, aligning with WHO HEDRM's focus on inclusive governance (WHO, 2021). Community engagement (Mean = 3.84, SD = 0.886) and effective communication among stakeholders (Mean = 3.72, SD = 0.861) were also rated moderately, indicating recognition of their importance but highlighting the need for improvement.

As societies transition beyond the immediate impacts of the pandemic, it is crucial to build on these foundations. The high rating for health practitioners' involvement confirms progress in integrating health expertise into urban planning. However, persistent challenges in community engagement and funding necessitate policy reforms that prioritise inclusive governance and dedicated financial resources for HDRM initiatives (WHO, 2019). Urban planners must embed health risk reduction into statutory plans, supported by capacity-building programs and participatory mechanisms (Sharifi & Khavarian-Garmsir, 2020). In this adaptive phase, which is aligned with the recovery and mitigation phases of the DRM cycle, effective coordination platforms, such as joint task forces or integrated emergency management centres, should be institutionalised to prevent fragmentation (UNDRR, 2023). The deficits in public awareness highlight the urgency for culturally relevant risk communication strategies and ongoing community education to enhance resilience and compliance (Tambo et al., 2021). Investing in digital health infrastructure and community-based monitoring systems will further strengthen preparedness and early response capabilities, ensuring that urban HDRM evolves to meet future challenges effectively.

5.3 Implications for Urban Health Resilience

The moderate levels of barriers and current practices observed in this study suggest that Malaysia's urban health disaster risk management (HDRM) is in a transitional phase, presenting critical opportunities for strategic integration and reforms as follows;

Governance Frameworks and Reforms

A primary implication is the need to strengthen governance frameworks to enhance inter-agency coordination and ensure the development of adaptive, comprehensive policies. The COVID-19 pandemic exposed systemic governance weaknesses in urban planning and policy-making, driving transformative reforms globally (Wilkinson et al., 2020). Decentralisation and local empowerment emerge as crucial; stronger urban local authorities with decision-making capacity can enable more effective health emergency responses. In addition, Malaysia's Disaster Risk Reduction (DRR) Policy 2030 serves as the cornerstone for coordinated, multi-level disaster governance in the country, guided by four core principles and aligned with the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030 (NADMA, 2024). This policy transitions from a recovery-centric approach under the earlier Hyogo Framework to a proactive, risk-informed strategy that prioritises prevention, mitigation, preparedness, response, and recovery. This integration provides a health-centred dimension to disaster risk reduction, strengthening health system preparedness and resilience (WHO, 2022). The blend of SFDRR and Health-EDRM in Malaysia's policy landscape illustrates an effective global-to-local policy translation, ensuring that disaster governance addresses multifaceted risks holistically. Such alignment underpins this research's adoption of international frameworks to critically examine and enhance urban resilience and multi-agency collaboration in the Malaysian context.

Health-Centric Policy Integration

The "Health in All Policies" approach must underpin urban planning to foster health equity and disaster resilience (WHO, 2019). Urban designs emphasising green spaces, walkability, and mixed-use development reduce transmission risks (Sharifi & Khavarian-Garmsir, 2020). Crisis-adaptive infrastructure, including flexible public spaces, pop-up bike lanes, repurposed streets, and a decentralised service hub that can support rapid adaptation during emergencies. Planners should prioritise health in zoning laws, land-use planning, and infrastructure development, ensuring equitable access to healthcare and fostering adaptive urban spaces that can serve as temporary healthcare or recovery zones. This requires sustained investment in health system capacity and infrastructure to enhance preparedness and financial resilience for future health crises (Gupta & Nair, 2012).

Community Engagement and Risk Communication

High ratings for community engagement (median = 3.61) underscore its crucial role in fostering urban health resilience. Engaging communities through participatory planning fosters local leadership and enhances collective capacity to respond effectively to health emergencies (Marmot et al., 2020). Strengthening risk communication strategies is equally vital to improving public compliance and trust, which are critical components emphasised in the WHO Health-EDRM framework (Tambo et al., 2021).

Preparedness and Response Coordination

Effective communication among stakeholders (median = 3.55) is essential for successful coordination of responses. Comprehensive, regularly updated disaster response plans must integrate health emergency preparedness within broader urban governance strategies. Digital communication platforms can facilitate transparent, timely information exchange between governments and citizens, which is indispensable for effective crisis management (Gooding et al., 2022).

Training, Interdisciplinary Collaboration and Innovation.

Regular training and simulation exercises for officials and community leaders enhance readiness for health emergencies. Fostering interdisciplinary partnerships across health, transportation, housing, and environmental sectors can lead to the development of holistic urban resilience strategies. Facilitating the exchange of best practices among cities accelerates collective learning and capacity building (UNDRR, 2023). Investing in innovative city initiatives and leveraging technology, such as data analytics for real-time health monitoring, further modernises urban health management (Sharifi & Khavarian-Garmsir, 2020). These recommendations align with global best practices and WHO guidelines, emphasising a holistic, multisectoral approach to urban health resilience (Wilkinson et al., 2020; WHO, 2021).

5.4 Construct Reliability and Validity

Validation procedures, including factor analysis and reliability testing, help identify suboptimal items and refine the instrument to improve clarity and construct representation (Aithal, 2020). The findings strongly support the construct validity and reliability of the measurement model. All factor loadings exceeded the 0.6 threshold, indicating meaningful relationships between observed indicators and latent constructs (Webster, Watson, & Anderson, 2020). High loadings (mostly above 0.9) for constructs such as Governance, Policy Integration, and Risk Assessment confirm their robustness. Kaiser-Meyer-Olkin (KMO) values ranged from 0.83 to 0.95, and Bartlett's Test of Sphericity was significant ($p < 0.0001$), supporting sampling adequacy. Cronbach's alpha values (0.93-0.98) indicate excellent internal consistency. These psychometric properties validate the measurement model, providing a solid foundation for developing an integrated Health-EDRM and urban resilience framework, essential for effective urban resilience planning. This strengthens both the academic rigour and the practical applicability of Health-EDRM in urban resilience planning, ensuring that future framework development is grounded in robust empirical evidence.

6.0 CONCLUSION

This study emphasises the significance of incorporating health disaster risk management (HDRM) into urban resilience frameworks, especially in Malaysia, amid shifting health crises such as COVID-19. Strategic policy alignment with global frameworks, such as the WHO Health Emergency and Disaster Risk Management (Health-EDRM) and the Sendai Framework for Disaster Risk Reduction (SFDRR), ensures that Malaysia's disaster risk governance is proactive, health-centred, and contextually relevant. This alignment between the international

Framework and national policies allows Malaysian urban characteristics to be addressed in prevention, readiness, response, and recovery efforts.

This study examined the barriers and current practices of Health-EDRM in Malaysia's urban settings and validated key constructs through confirmatory factor analysis. The findings highlight significant barriers, including insufficient resource allocation, overwhelmed healthcare capacity, and coordination challenges, that remain critical obstacles to effective disaster governance. The validated constructs comprising governance, risk assessment, preparedness, capacity building, and recovery demonstrated strong reliability and validity for assessing Health-EDRM integration into urban resilience. These validated constructs provide a foundation for the future development of an integrated Health-EDRM and urban resilience framework. Such a framework would enable policymakers and practitioners to address systemic weaknesses, strengthen governance, and enhance multisectoral collaboration. By grounding urban resilience strategies in robust, validated constructs, Malaysia can better prepare for complex health-related disasters and safeguard urban populations against future emergencies.

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REFERENCES

Abdullah, N.M., Sulaiman, N., Nazir, U., Ismail, M., Latib, S.K.K.A. & Mahmud, N.P.N., 2022. Geographical Information System (GIS) and Remote Sensing (RS) applications in Disaster Risk Reduction (DRR) in Malaysia. *International Journal of Integrated Engineering*, 14(5), pp.25-37.

Abbas, R. (2025). Exploring communication inefficiencies in disaster response. *Journal of Emergency Management*.

Adebisi, Y. A., Rabe, A., & Lucero-Prisno III, D. E. (2021). Risk communication and community engagement strategies for COVID-19 in 13 African countries. *Health Promotion Perspectives*, 11(2), 137.

Afrin, S., Chowdhury, F. J., & Rahman, M. M. (2021). COVID-19 pandemic: Rethinking strategies for resilient urban design, perceptions, and planning. *Frontiers in Sustainable Cities*, 3, 668263.

Afrin, S., et al. (2021). Urban planning and health resilience: Lessons from COVID-19. *Journal of Urban Health*, 98(4), 567–579.

Aithal, A., & Aithal, P. S. (2020). Development and validation of survey questionnaire & experimental data – A systematical review-based statistical approach. *International Journal of Management, Technology, and Social Sciences, 5*(2), 233–251. https://doi.org/10.2139/ssrn.3724105

Al Qassimi, N. (2024). Urban health resilience in pandemic contexts. *Journal of Urban Health*, 12(3), 215-230.

Alharbi, N. K., et al. (2025). Methods and Tools for Rapid Risk Assessments for Acute Health Events. *International Journal of Public Health*, 68(1).

Anand, S. P. (2024). Estimating Public Health Risks of Infectious Disease Events. *Epidemiology*, 35(9), 123-130.

Belfroid, E., Roβkamp, D., Fraser, G., Swaan, C., & Timen, A. (2020). Towards defining core principles of public health emergency preparedness: Scoping review and Delphi consultation among European Union country experts. *BMC Public Health, 20*(1), 1482. https://doi.org/10.1186/s12889-020-09307-y

Bujang, M.A., E.D. Omar, and N.A. Baharum. 2018. A review on sample size determination for Cronbach's alpha test: A simple guide for researchers. *The Malaysian Journal of Medical Sciences: MJMS* 25 (6): 85–99. https://doi.org/10.21315/mjms2018.25.6.9.

Capolongo, S., Rebecchi, A., Buffoli, M., Appolloni, L., Signorelli, C., Fara, G. M., & D'Alessandro, D. (2020). COVID-19 and cities: From urban health strategies to the pandemic challenge. A decalogue of public health opportunities. *Acta Bio Medica: Atenei Parmensis*, 91(2), 13.

Corburn, J. (2009). *Toward the healthy city: People, places, and the politics of urban planning*. MIT Press.

Chan, E. Y. Y., Kim, J. H., Lo, E. S. K., Huang, Z., Hung, H., Hung, K. K. C., ... & Wong, S. Y. S. (2020). What happened to people with non-communicable diseases during COVID-19: implications of H-EDRM policies. *International journal of environmental research and public health*, *17*(15), 5588.

Chan, E. Y. Y., Ho, J. Y., Wong, C. S., & Shaw, R. (2020). Health-EDRM in International Policy Agenda III: 2030 Sustainable Development Goals and New Urban Agenda (Habitat III). In *Public Health and Disasters: Health Emergency and Disaster Risk Management in Asia* (pp. 93-114). Singapore: Springer Singapore.

Chen, X., et al. (2020). A simulation model to analyse urban resilience under different disaster scenarios. *Journal of Urban Management*, 9(2), 123-138.
Creswell, J. W. (2014). *Research design: qualitative, quantitative and mixed methods approaches* (Vol. 54). United States of America: Sage Publications.
Field, A. (2018*). Discovering statistics using IBM SPSS Statistics (5th ed.)*. Sage Publications
Ferguson, A. (2024). What is known about resilient healthcare systems in the context of natural disasters? *Health Policy and Planning*, 39(2), 105-113.
Gallardo, A. R., Djalali, A., Foletti, M., Ragazzoni, L., Della Corte, F., Lupescu, O., Arculeo, C., Von Arnim, G., Friedl, T., Ashkenazi, M., & Fisher, P. (2015). Core competencies in disaster management and humanitarian assistance: A systematic review. *Disaster Medicine and Public Health Preparedness, 9*(4), 430–439.
Gao, T. (2024). Risk Analysis and Assessment Method for Infectious Diseases. *Scientific Reports*, 14(1), 245–260
Global Preparedness Monitoring Board (GPMB). (2021). Annual report. WHO.
Gooding, K., Bertone, M. P., Loffreda, G., & Witter, S. (2022). How can we strengthen partnership and coordination for health system emergency preparedness and response? Findings from a synthesis of experience across countries facing shocks. *BMC Health Services Research*, 22(1), 1441.
Gupta, A. K., & Nair, S. S. (2012). Environmental Extremes Disaster Risk Management-Addressing Climate Change. *National Institute of Disaster Management, New Delhi, P*, *40*.
Guan, X., & Gao, H. (2022). Application of resilience theory in urban development: A bibliometric review. *Sustainability*, 14(10), 6007.
Griffith-Jones, S., & Tanner, T. (2016). Scaling up disaster risk finance in developing countries: Experiences and lessons. *International Journal of Disaster Risk Reduction*, 21, 319-330.
Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modelling (PLS-SEM) using R: A workbook* (p. 197). Springer Nature.
Hao, Y., Tie, Y., Zhang, L., Zhang, F., & Sun, C. (2024). Research on the evaluation of emergency management capability for urban public health emergencies under resilience perspective: A case study of Henan Province, China. *Frontiers in Public Health*, 12, 1431158.
International Federation of Red Cross and Red Crescent Societies (IFRC). (2021). *The three C's: Covid, climate, conflict*. Annual Report 2021. https://www.climatecentre.org/wp-content/uploads/RCCC_AR_2021.pdf
Iqbal, A., et al. (2024). Mainstreaming disaster risk reduction investment into development planning: Evidence from Pakistan. *Frontiers in Environmental Science*, 12, 1474344.
Ingelbeen, B., et al. (2025). Embedding Risk Monitoring in Infectious Disease Surveillance. *Global Health*, 10(2), e016870.
Jennings, V., Rigolon, A., Thompson, J., Murray, A., Henderson, A., & Gragg, R. S. (2024). The dynamic relationship between social cohesion and urban green space in diverse communities: opportunities and challenges to public health. *International journal of environmental research and public health*, *21*(6), 800.
Johnson, N. R., & Lee, J. K. (2020). Social capital, disaster recovery, and Health: A systematic review and meta-analysis. *International Journal of Environmental Research and Public Health*, 17(16), 5784.
Jeleff, M., et al. (2022). Vulnerability and One Health Assessment Approaches for Emerging Infectious Diseases. *One Health*, 14, 100375.
Julious, S. A. (2005). Sample size of 12 per group rule of thumb for a pilot study. *Pharmaceutical Statistics: The Journal of Applied Statistics in the Pharmaceutical Industry*, *4*(4), 287-291.
Kapucu, N. (2011). Disaster and emergency management systems in urban settings: A governance perspective. *International Journal of Public Administration*, 34(1), 13-30.
Khan, M. A. (2022). *Cities and Mega Risks: COVID-19 and Climate Change*. Springer Nature.
Khan, Y., O'Sullivan, T., Brown, A., Tracey, S., Gibson, J., Généreux, M., ... & Schwartz, B. (2018). Public health emergency preparedness: A framework to promote resilience. *BMC Public Health*, 18, 1-16
Khatri, R. B., Endalamaw, A., Erku, D., Wolka, E., Nigatu, F., Zewdie, A., & Assefa, Y. (2023). Preparedness, impacts, and responses of public health emergencies towards health security: qualitative synthesis of evidence. *Archives of public health*, *81*(1), 208.
Kruk, M. E., et al. (2020). Building resilient health systems: Lessons from COVID-19. *The Lancet*, 395(10227), 1324–1332.
Lamberti-Castronuovo, A., Monaro, M., & Lami, F. (2022). Primary health care disaster preparedness: A review of the literature. *Disaster Medicine and Public Health Preparedness*, 16(3), 1159-1166.
Liu, Y., Wang, J., & Chen, K. (2023). Flexibility and innovation in urban policy for resilience. *Urban Studies*, 60(4), 789-805.
Luchi, K., & Mutter, J. (2020). Enhancing community participation in post-disaster recovery in Miyagi Prefecture. *Journal of Rural Planning Association*, 39(2), 165-182.

Marmot, M., Stuckler, D., & Hurst, J. (2020). The health inequalities in COVID-19: A global perspective. *The Lancet*, 395(10239), 1784-1786. https://doi.org/10.1016/S0140-6736(20)30482-3

Meriläinen, E. S., Fougere, M., & Piotrowicz, W. (2020). Refocusing urban disaster governance on marginalised urban people through the right to the city. *Environmental Hazards*, 19(2), 187-208.

Ministry of Health Malaysia. (2021). *COVID-19 Pandemic Response*. Available online: http://www.moh.gov.my/moh/resources/Penerbitan/Garis%20Panduan/Pengurusan%20KEsihatan%20&%20kawalan%20pykit/2019nCOV/Bil%204%20%202020/Annex%201%20case%20definition%20COVID%2026022020.pdf

Ministry of Health Malaysia. (2021). Malaysia's Health Systems Response to COVID-19. *Frontiers in Public Health*. https://doi.org/10.3389/fpubh.2021.710598

National Disaster Management Agency (NADMA). (2024). *National Disaster Risk Reduction Policy 2030 for a Safer Malaysia*. https://www.nadma.gov.my/bi/media-en/news/1359-nadma-national-disaster-risk-reduction-policy-2030-for-a-safer-malaysia

Noboa-Ramos, C., et al. (2023). Lessons learned from Hurricanes Irma and Maria for health system recovery. *Prehospital and Disaster Medicine*, 38(2), 153-159.

Norizan, M. N., Abdullah, N., & Alias, N. E. (2021). Research in health emergency and disaster risk management and its potential implications in the post-COVID-19 world. *International Journal of Environmental Research and Public Health*, 18(5), 2520.

Okoli, E. C., Hassan, S. M., Okoye, N. A., & Eradiri, B. M. (2024). Advancing public health resilience: A review of proposed strategies for enhancing emergency preparedness in rural and underserved communities. *World Journal of Advanced Research and Reviews*, 23(3), 045-062.

OECD.(2020). *COVID-19 spending helped to lift foreign aid to an all-time high in 2020* (Detailed Note). https://www.oecd.org/dac/financing-sustainable-development/development-finance-data/ODA-2020-detailed-summary.pdf

Pineda, V. S., & Corburn, J. (2020). Disability, urban health equity, and the coronavirus pandemic: Promoting cities for all. *Journal of Urban Health*, 97(3), 336–341.

Pineo, H., Zimmermann, N., & Davies, M. (2019). Leveraging the urban planning system to shape healthy cities. *Urban Health*.

Rong, L., Zhang, T., & Wang, H. (2024). Enhancing urban resilience: Multi-resource strategies during emergencies. *Journal of Urban Management*, 12(1), 55-66

Sharifi, A., & Khavarian-Garmsir, A. R. (2020). The COVID-19 Pandemic: Impacts on Cities and Major Lessons for Urban Planning, Design, and Management. *Science of the Total Environment*, 749, 142391. https://doi.org/10.1016/j.scitotenv.2020.142391

Sharifi-Sedeh, M., Ardalan, A., Torabi, S. A., & Khorasani-Zavareh, D. (2020). Factors behind the prepositioning of relief items in Iran: A qualitative study. *Injury, 51*(4), 906-912

Shaw, R., et al. (2022). *The health emergency and disaster risk management: An emerging framework for achieving synergies among the Sendai Framework, the 2030 Agenda for Sustainable Development, the New Urban Agenda and the Paris Agreement*. PreventionWeb. https://www.preventionweb.net/publication/health-emergency-and-disaster-risk-management-emerging-framework-achieving-synergies

Shang, B., & Huang, X. (2020). Urban public safety management system based on resilience theory. *Urban Studies Research*, 2020, 1-8.

Serra, M., Psarra, S., & O'Brien, J. (2018). Social and physical characterisation of urban contexts: Techniques and methods for quantification, classification and purposive sampling. *Urban Planning*, *3*(1), 58-74.

Setiadi, A., Rudwiarti, L. A., Langer, I. J., & Wardhani, M. K. (2021). Reconstructing post-earthquake settlements using community deliberation participation approach in Yogyakarta, Indonesia. *Planning Malaysia*, 19(15).

Soalihin, S., Asmawi, A., Riyanto, D., Ariyani, I., Nur, H., & Sudiyasa, I. K. (2025). The role of local communities in responding to health crises and disaster mitigation: A systematic literature review. *Journal of Health and Nutrition Research*, 4(1), 235–248.

Stratton, S. J., et al. (2019). Data Sampling Strategies for Disaster and Emergency Health Research. *Prehospital and Disaster Medicine, 34*(3), 245-250. https://doi.org/10.1017/S1049023X1900016X

Stoltenberg, D. (2024). *The spaces of public issues: How social media discourses shape public imaginations of issue spatiality*. Routledge.

Sydnes, M. (2025). Interorganizational coordination during emergencies. *International Journal of Disaster Risk Reduction*, 72, 102860.

Tambo, E., Djuikoue, I. C., Tazemda, G. K., Fotsing, M. F., & Zhou, X. N. (2021). Early-stage risk communication

and community engagement (RCCE) strategies and measures in response to the coronavirus disease 2019 (COVID-19) pandemic crisis. *Global Health Journal*, 5(1), 44-50.
Terblanche, T. (2022). Disaster resilience framework indicators for a city's disaster resilience strategy. *International Journal of Disaster Risk Reduction*. https://doi.org/10.1016/j.ijdrr.2022.102584
United Nations Development Programme (UNDP). (2020). Guidelines for community participation in disaster recovery.
United Nations Office for Disaster Risk Reduction (UNDRR). (2023). *GAR Special Report 2023: Mapping resilience for the sustainable development goals*. Retrieved from https://www.undrr.org/publication/gar-special-report-2023-mapping-resilience-sustainable-development-goals.
United Nations Office for Disaster Risk Reduction (UNDRR). (2024). *Integrating disease outbreaks and strengthening health in whole-of-society disaster risk management.*
United Nations Office for Outer Space Affairs. (n.d.). *Risks and disasters. UN-SPIDER*. Retrieved October 14, 2025, from https://www.un-spider.org/risks-and-disasters)
UN-Habitat. (2024). Urban regeneration and viruses: Historical insights and future pathways. *UN-Habitat Reports*.
Wang, W., et al. (2023). Strategies to mitigate impacts on healthcare systems during disasters. *Disaster Medicine and Public Health Preparedness*, 17(3), e120-e130
Wamsler, C. (2004). Managing urban risk: perceptions of housing and planning as a tool for reducing disaster risk. *Global Built Environment Review*, *4*(2), 11-28.
Webster, J., Watson, R., & Anderson, P. (2020). Factor analysis basics: Theory and practice in health research. *Journal of Clinical Research Methods, 22*(3), 214-225.
World Health Organization. (2019). *Health Emergency and Disaster Risk Management Framework*. Geneva: World Health Organization.
WHO. (2020). *COVID-19 response guidelines*. World Health Organization.
World Health Organization. (2021, December 6). *Health Emergency and Disaster Risk Management Framework - PAHO/WHO*. Retrieved from https://www.paho.org/en/documents/health-emergency-and-disaster-risk-management-framework
World Health Organization. (2021). Framework for strengthening health emergency preparedness in cities and urban settings. *In Framework for strengthening health emergency preparedness in cities and urban settings.*
World Health Organization. (2022). *Urban planning and Health*: A WHO framework. World Health Organization.
Wilkinson, A., Ali, H., Bedford, J., Boonyabancha, S., Connolly, C., Conteh, A., ... & Whittaker, L. (2020). Local response in health emergencies: Key considerations for addressing the COVID-19 pandemic in informal urban settlements. *Environment and Urbanisation*, 095624782092284.
Wu, W., et al. (2024). Urban resilience framework: A network-based model to quantify and analyse resilience. *Ecological Modelling, 464*, 109712. https://doi.org/10.1016/j.ecolmodel.2023.109712