QUANTITATIVE APPROACH TO HOSPITAL RESILIENCE BASED ON SYSTEM DYNAMICS: CASE OF SRI LANKA

J.H.P.R.U. Jayasekara

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Department of Civil Engineering

University of Moratuwa

Sri Lanka

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DECLARATION

I declare that this is my own research thesis, and this thesis does not incorporate without acknowledging any material previously published submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgment is made in the text.

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I have read the thesis and it is in accordance with the approved university proposal outline. I am willing to supervise the research work of the above candidate in the proposed area.

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Dr. C.S.A. Siriwardana

ABSTRACT

Past records depict that both the intensity and frequency of climatic-related hazards are increasing devastatingly. Although the number of deaths caused by these extreme events has been comparatively less recently, the economic losses have increased considerably. The complexity of the world with interconnected infrastructure systems has been the main catalyst of these huge losses. COVID-19 and concurrent hazards have set out a perfect example that shows hazards no longer affect discreet parts of the system but render the failure of the whole system. Out of critical infrastructure sectors, damages on health systems have attracted global concern more as the impacts on the health sector can cascade further to socio-economic aspects as well. Therefore, currently, health is considered an important part of disaster risk reduction. Sri Lanka, as a tropical country, experiences climatic-related hazards more frequently. Although Sri Lanka has a disaster management mechanism and public health system, a limited number of evidence exists on integrated systemic risk management mechanisms in the country. Most of the existing emergency and disaster management mechanisms have a hazard-by-hazard approach and fail to incorporate synergized impacts of compound hazard events. The levels of integration of public health and disaster risk management aspects into each other still needs to be enhanced. In a context where systems thinking approaches are more promoted in disaster resilience, this study aims at providing a framework for assessing the public health system disaster resilience for multi-hazard contexts amidst biological hazards. In this regard, this study has followed multiple steps to evaluate the existing health disaster management approaches in the country. Initially, a desk study was conducted to identify key drivers of effective response mechanisms for pandemics, which can affect the capacities of integrated disaster risk management approaches. It was followed by a stakeholder analysis, which used Social Network Analysis (SNA) to identify the stakeholder behaviour in the country for multi-hazard preparedness planning. Furthermore, field data collection was conducted under three phases, including forty-one key informants representing the sectors that are related to disaster management in the country. Qualitative information from this step was analysed using systems thinking and cascading effects were modelled for early warnings, evacuation, shelter management, and hospital functionality. Since functional continuity of healthcare facilities was identified as a key

driver of multi-hazard preparedness and response mechanisms, this study presents a model that captures interdependencies within a hospital during a hybrid hazard scenario. As the final outcome, the study presents a framework for enhancing public health systems resilience for multi-hazard contexts. The developed framework was tested for its applicability at the community level in Sri Lanka, through scenario workshops. Along with these outcomes, the study further presents a set of gaps that needs to be immediately addressed based on lessons from recent multi-hazard scenarios amidst the COVID-19 outbreak in Sri Lanka

Keywords: Public Health Systems; Multi Hazards; Biological Outbreaks; Multi-Sectoral; Systems Thinking; Cascading Impacts

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LIST OF ABBREVIATIONS

Abbreviation	Description
ADB	Asian Development Bank
CBO	Community Based Organizations
CDC	Centres for Disease Control
CI	Critical Infrastructure
CIDA	Construction Industry Development Authority
CRED	Centre for Research on the Epidemiology of Disasters
DDMCU	District Disaster Management Coordination Unit
DES	Discreet Event Simulation
DGHS	Director General of Health Services
DM	Disaster Management
DMC	Disaster Management Centre
DPRD	Disaster Preparedness and Response Division
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EMS	Emergency Medical Services
EOC	Emergency Operation Centre
EOP	Emergency Operation Procedure
EW	Early Warning
GHSI	Global Health Security Index
GN	Grama Niladhari
HCWs	Health Care Workers

HEDM	Hospital Emergency and Disaster Management
HEDRM	Health Emergency and Disaster Risk Management
HSI	Hospital Safety Index
IOM	International Organization of Migration
JEE	Joint External Evaluation
LA	Local Authority
LKR	Sri Lankan Rupees
MHEW	Multi-Hazard Early Warning
MOH	Medical Officer of Health
MOHSL	Ministry of Health Sri Lanka
NDRSC	National Disaster Relief Service Centre
NEOP	National Emergency Operation Procedures
NGO	Non-Governmental Organizations
NTI	Nuclear Threat Initiative
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PAHO	Pan American Health Organization
PHI	Public Health Inspector
PHM	Public Health Midwife
PPE	Personal Protective Equipment
RDHS	Regional Director of Health Services
SAR	Search And Rescue
SD	System Dynamics

SFDRR	Sendai Framework for Disaster Risk Reduction
SHI	Safe Hospital Initiative
SLR	Systematic Literature Review
SNA	Social Network Analysis
SOP	Standard Operation Procedure
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNICEF	United Nations International Children's Emergency Fund
USD	United States Dollar
WHO	World Health Organization