Arctic Maritime Health Security: *A Scoping Review of the Literature*

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Abstract

As the Arctic maritime domain continues to increase in accessibility, so too do the health security threats associated with increased maritime commerce. Robust monitoring and risk assessments are needed to predict and prevent health security crises before they occur. In the Arctic maritime domain, coastal communities are largely characterized by small, remote, Indigenous villages, many of which are not connected to the road system, and have limited public health and medical infrastructure. In the event of a maritime emergency or disaster, these communities would likely be the first impacted, as well as potentially the "first responders" to such an event. Community-level indicators are therefore crucial to collecting accurate and relevant information regarding the health security risk environment of the Arctic maritime domain. A previous special report produced by the Ted Stevens Center for Arctic Security Studies, however, highlights that conventional health security frameworks lack the measurement capacity to assess community-level health security. This special report sought to build upon this work by conducting a scoping review of the existing peer-reviewed literature regarding the measurement of health security. This review included a total of 22 peer-reviewed journal articles. Of these articles, only two (9%) used measurement tools with the capacity to measure health security below the national level, and none included community-level indicators. In addition, no articles used tools with indicators of the health security risks associated with the maritime domain. This reveals two critical gaps in the health security literature, and in particular, in the tools needed to accurately reflect the health security of the Arctic region.

Keywords: health security, measurement, assessments, maritime domain, Arctic

Introduction

The World Health Organization defines "Global Health Security" as the "…activities required, both proactive and reactive, to minimize the danger and impact of acute public health events that endanger people's health across geographical regions and international boundaries" (WHO, 2022). Health security is a critical component of national, regional, and global stability, and has become increasingly important within the context of enhancing resilience and disaster response capabilities. This is particularly relevant to the Arctic, where the impacts of climate change are exacerbating the frequency and intensity of multi-hazard events that significantly threaten regional stability and resilience. From a health security perspective, these increasing and ever-changing threats have significant implications for the defense and security of the Arctic region, as they have the ability to induce a cascade of interdisciplinary and multifaceted consequences on the region's limited health security infrastructure.

At the same time, diminishing sea ice as a result of climate change has facilitated an increase in the number of vessels operating in the Polar Code area by roughly 25% in the last decade (Huntington et al., 2023). This increase in mobility is coupled with an increased risk of multi-hazard events, both natural and manmade. In the Arctic, these events exist at the interplay between the built, social and natural environments, particularly in remote areas where many communities have limited infrastructure, disaster response capabilities, and law enforcement, in addition to maintaining mixed cash/subsistence-based economies. While attention has been given to the ways in which increased shipping may impact the economic security (Borgerson, 2008), environmental security (Berkman & Vylegzhanin, 2013; Eicken et al., 2011; Greaves, 2016), and political stability (Peters et al., 2021) of the Arctic region, less has been focused on the nexus of maritime commerce and health security (Bhatt et al., 2024).

Decision-makers, authorities, emergency responders, and local communities need to be able to assess and monitor maritime-related risks to health security in order to implement mitigative or adaptive responses. Indicators are measures that, when operationalized, can provide a tool to assess, monitor, and quantify health security to aid in the development of effective interventions, while also measuring the effectiveness of the mitigation and preparation activities. In the Arctic maritime domain, coastal communities are largely characterized by small, remote, Indigenous villages, many of which are not connected to the road system, and have limited public health and medical infrastructure. In the event of a maritime emergency or disaster, these communities would likely be the first impacted, as well as potentially the "first responders" to such an event. Community-level indicators are therefore crucial to collecting accurate and relevant information regarding the health security risk environment of the Arctic maritime domain. A previous special report produced by the Ted Stevens Center for Arctic Security Studies, however, highlights that conventional health security frameworks, namely the Joint External Evaluation (JEE) tool, the Global Health Security Index (GHSI), and the International Health Regulations' (IHRs') States Parties Self-Assessment Annual Report (SPAR) use national-level indicators, and lack the measurement capacity to assess community-level health security. This special report therefore sought to build upon this work by conducting a scoping review of the existing peer-reviewed literature regarding the measurement of health security, and in particular, to answer the following two questions:

1. What tools, if any, are being used to measure subnational-level health security?
2. What indicators, if any, are used to focus on maritime-related health security risks?

Methods

This special report followed methods established by the Joanna Briggs Institute's (JBI's) 2015 "Reviewers' Manual," which includes four steps to conduct a scoping review: (1) retrieval of articles, (2) screening of all retrieved articles, (3) charting the data (also referred to as "extracting the results"), and (4) analysis of the data (Peters et al., 2021). A search for peer-reviewed literature was conducted through the academic databases of ScienceDirect, Web of Science, JSTOR, Science.gov and Google Scholar using the search strategy outlined in Table 1. For Science.gov and Google Scholar, only the first 100 records were screened for potential relevance, based on title and abstract.

Documents eligible in this review included English-language peer-reviewed literature published in or after 2014 to ensure relevance to the current health security landscape until the end of the research period (January 2024). Sources were selected if they explicitly used an indicator-based health security measurement tool, whether using it to collect primary data or analyzing secondary data. Sources were excluded if they only discussed a tool, or the theoretical development of an indicator-based tool, but did not actually implement or utilize the tool.

After the exclusion of duplicate titles, the first stage of screening involved the review of all titles and abstracts for relevancy using the above inclusion and exclusion criteria. The full text of all articles included after the first stage of screening were then reviewed for relevancy during the second stage of screening. All articles included after the second stage of screening were then evaluated for data extraction. The data extracted included (1) article title, (2) author(s), (3) publication year, and (4) journal title, as well as content-specific data, such as (5) what health security measurement tool was used, the (6) indicator scale of the tool (national, subnational, community), the (7) type of data, and (8) location of the study.

Table 1: Scoping Review Database Search Strategy
• "Health security" AND (measure OR metrics OR assessment OR evaluation) • "Health security" in title (TI)

Results

Inclusion/Exclusion Process

The initial search yielded a total of 230 academic journal articles from ScienceDirect (n=74), Web of Science (n=25), JSTOR (n=39), Science.gov (n=39) and Google Scholar (n=53). Twenty-three duplicate records were eliminated, leaving 207 articles to be screened during the first stage of screening. A total of 147 articles did not meet the eligibility criteria after review of titles and abstracts and were removed from the study, leaving 60 full-text articles to review during the second stage of screening. Thirty-eight articles were excluded during the second stage of screening, leaving a total of 22 academic journal articles included in this scoping review (Figure 1). All results of the data extraction are listed in Table 2 in the Appendix, the details of which will be described in the following sections.

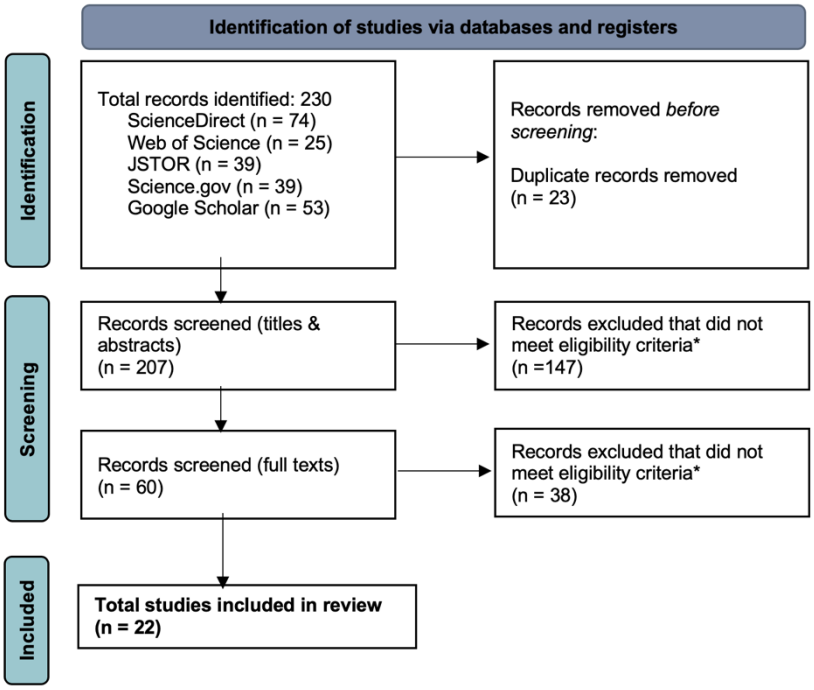

Figure 1 - PRISMA Diagram of Search Strategy Results.

Technical Characteristics of the Articles

Of the 22 articles reviewed for this study, 20 (91%) were published in, or after, the year 2020, with one study published in 2014, and another published in 2018. The majority (n=16, 73%) of the studies used secondary data, while five (23%) collected primary data, and one study

used a combination of both primary and secondary data. The majority (n=16; 73%) of studies focused on a global context, whereas one (5%) article focused on the health security of three nations, specifically Pakistan, Nigeria, and Ethiopia. The remaining articles focused on one country per study, including Nigeria, Uganda, Sierra Leone, the United States, and New Zealand.

Health Security Findings

Half of the studies (n=11, 50%) used the Global Health Security Index (GHSI) as their health security tool, followed by eight studies (36%) that used the Joint External Evaluation (JEE) tool. Three studies (14%) used the International Health Regulations' (IHRs') States Parties Self-Assessment Annual Report (SPAR), one study (5%) each used the National Health Security Preparedness Index (NHSPI) and the Biological Threat Reduction Program's (BTRP's) Biosurveillance/Biosafety and Biosecurity (BSV/BS&S) Assessment Questionnaire. Lastly, one study (5%) identified new local-level indicators to be used congruently with the JEE.

Of the 22 articles reviewed for this study, 20 (91%) used a measurement tool with indicators focused on national-level health security. Each of these studies utilized either the GHSI, JEE, SPAR, NHSPI, or BSV/BS&S Assessment tool. Two studies (9%) used a tool with the capacity to measure subnational-level indicators. Uzon Jacobson et al. (2014) summarized the development of the United States' NHSP. The NHSP is focused on both national and state-level health security, and was a project led by the Association of State and Territorial Health Officials (ASTHO) Center for Disease Control's (CDC's) Office of Public Health Preparedness and Response (OPHPR). The project designed the NHSP to have 5 domains, represented by 14 subdomains and 128 individual measures. Each of the measures are sourced from publicly available or pubic-use data.

Erondu et al. (2021) conducted a study to identify indicators of health security preparedness relevant to the local community level in Pakistan, Ethiopia, and Nigeria. Once the

local indicators were identified, the study further evaluated how the indicators compared with the JEE as the standard health security measurement tool used in all three nations. Using a scoping review of existing frameworks in addition to a Delphi consultative process, the study identified 14-16 indicators in each nation that were not already included in the JEE. The majority of the identified indicators would rely on routine data collection at the local level.

Of the 22 articles reviewed for this study, none are focused explicitly on the health security risks associated with the maritime domain, and in particular, none discuss the health security implications of increasing maritime commerce in the Arctic region.

Discussion

The health security landscape in the Arctic is characterized by extreme weather conditions, low population densities, limited infrastructure, and more than 28,000 miles of coastline. Approximately four million people reside in the Arctic, nearly one quarter of which live on the coastlines (Ramage et al., 2021). A substantial portion of coastal communities are small, with a median population size of 622 residents. Ten percent of Arctic residents are Indigenous, many of whom maintain a subsistence way of life that is inextricably intertwined with the health of marine resources (M. J. Brown et al., 2022). As such, ensuring the health security of the Arctic region is exceedingly complex, and requires correspondingly robust and multifaceted monitoring and evaluation tools for risk reduction and disaster preparedness. These tools additionally need to be able to interface with data at the local community-level in order to accurately reflect the health security landscape of the Arctic maritime domain. This scoping review revealed that there is a significant gap in the peer-reviewed literature regarding the development and use of tools focused on maritime-related health security, particularly in the

Arctic region. In addition, limited research is dedicated to the development and operationalization of community-level health security tools.

While this special report highlights a gap in research at the intersection of community health security and maritime commerce, particularly in terms of measurement tools, community-level indicators of health in the Arctic have been explored (Healey Akearok et al., 2019; Larsen et al., 2010; Nilsson, Berner, et al., 2013; Nilsson, Destouni, et al., 2013). These studies have highlighted the need for context-specific variables that take into account the intricacies of remote communities. For example, Healey Akearok et al. (2019) and Nilsson et al. (2013) both emphasize the importance of food and water security indicators to health in the Arctic, none of which are included in the GHSI, JEE, or SPAR. The NHSP, however, which is designed to measure health security at both the national and state level, does include indicators of both food and water security (Uzun Jacobson et al., 2014). Future research is needed to examine how these Arctic community-level indicators intersect, if at all, with existing frameworks, and how they interact with the health security risks of increased shipping. The involvement of local communities throughout this process is also critical to identifying the most relevant, accurate, and feasible indicators for health security measurement in this context.

It is additionally notable that of the 22 articles reviewed for this study, 20 (91%) were published in, or after, the year 2020. Of these articles, 11 (55%) discussed the measurement of health security in the context of the COVID-19 pandemic (Abbey et al., 2020; Alhassan et al., 2023; S. M. Brown et al., 2021; Chang & McAleer, 2020; Durmus, 2022; Erondu et al., 2021; Haider et al., 2020; Ji et al., 2021; Kandel et al., 2020; Khalifa et al., 2021; Rose et al., 2021). This finding suggests that the COVID-19 pandemic not only unsurprisingly heightened interest in the concept of health security, but particularly in the sufficiency of its measurement. The

findings from these articles highlighted that the results of the GHSI and the JEE in particular, were not predictive of a nation's successful response to the COVID-19 pandemic, and in some cases, a higher score on these assessments (representing a higher level of health security) reflected a higher rate of mortality from the disease (Ji et al., 2021). This result is indicative of the dire need to re-evaluate the ways in which health security is measured before the next crisis occurs.

Conclusion

Both the 2022 National Security Strategy and the National Strategy for the Arctic Region stress the need to increase Arctic domain awareness to fuel evidence-based decision-making (The White House, 2022a, 2022b). Indicator-based frameworks are valuable tools designed specifically to enhance awareness and decision-making capacity. However, this scoping review revealed a significant gap in the peer-reviewed literature regarding health security measurement tools focused on the maritime domain. Increased international activity in the Arctic maritime domain is inevitable. More research is needed to develop the critical tools required to build capacity and reduce the risk of the next health security crisis.

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Appendix I

Table 2 - Data Extracted from the Scoping Review

Author(s)	Title	Year	Location(s)	Type of Data	Source of Indicators	Scale of Indicators
Abbey, Enoch J.; Khalifa, Banda A. A.; Oduwole, Modupe O.; Ayeh, Samuel K.; Nudotor, Richard D.; Salia, Emmanuella L.; Lasisi, Oluwatobi; Bennett, Seth; Yusuf, Hasiya E.	The Global Health Security Index is not predictive of coronavirus pandemic responses among Organization for Economic Cooperation and Development countries	2020	Global	Secondary	GHSI	National
Alhassan, Robert Kaba; Nketiah-Amponsah, Edward; Afaya, Agani; Salia, Solomon Mohammed; Abuosi, Aaron Asibi; Nutor, Jerry John	Global Health Security Index not a proven surrogate for health systems capacity to respond to pandemics: The case of COVID-19	2023	Global	Secondary	GHSI	National
Bakiika, Herbert; Nabukenya, Immaculate; Lamorde, Mohammed; Bukirwa, Justine; Achan, Martha I.; Babigumira, Peter A.; Nakiire, Lydia; Lubanga, Timothy; Mbabazi, Enid; Taremwa, Roland B.; Mayinja, Harriet; Nakinsige, Anne; Makanga, Douglas K.; Muruta, Allan; Okware, Solome; Komakech, Innocent; Makumbi, Issa; Wetaka, Milton M.; Kayiwa, Joshua; Ocom, Felix; Ario, Alex R.; Nabatanzi, Sandra; Ojwang, Joseph; Boore, Amy; Yemanaberhan, Rahel; Lee, Christopher T.; Obuku, Ekwaro; Stowell, Daniel	Building National Health Security Through a Rapid Self-Assessment and Annual Operational Plan in Uganda, May to September 2021	2023	Uganda	Primary	JEE & NAPHS	National

Boyce, MR; Meyer, MJ; Kraemer, JD; Katz, R	Financial Assistance for Health Security: Effects of International Financial Assistance on Capacities for Preventing, Detecting, and Responding to Public Health Emergencies	2021	Global	Secondary	JEE	National
Boyd, Matt; Baker, Michael G; Nelson, Cassidy; Wilson, Nick	The 2019 Global Health Security Index (GHSI) and its implications for New Zealand and Paci c regional health security	2020	New Zealand	Secondary	GHSI	National
Boyd, Matthew J; Wilson, Nick; Nelson, Cassidy	Validation analysis of Global Health Security Index (GHSI) scores 2019	2020	Global	Secondary	GHSI	National
Brown, Sydney Morgan; Couture, Alexia; Krishnan, Sharanya; Shamout, Mays; Hernandez, Luis; Beaver, Jennifer; Gomez Lopez, Arianna; Whitson, Cassidy; Dick, Leah; Greiner, Ashley Lauren	Global Health Security Preparedness and Response: An Analysis of the Relationship between Joint External Evaluation Scores and COVID-19 Response Performance	2021	Global	Secondary	JEE	National
Chang, Chia-Lin; McAleer, Michael	Alternative Global Health Security Indexes for Risk Analysis of COVID-19	2020	Global	Secondary	GHSI	National

Durmus, V	Does the Public Health Security Capacity Provide Better Preparedness for Health Emergencies? A Cross-Sectional Analysis of 180 Countries During the COVID-19 Outbreak	2022	Global	Secondary	GHSI	National
Eaneff, Stephanie; Graeden, Ellie; McClelland, Amanda; Katz, Rebecca	Investing in global health security: Estimating cost requirements for country-level capacity building	2022	Global	Secondary	JEE and SPAR	National
Erondu, Ngozi A; Rahman-Shepherd, Afifah; Khan, Mishal S; Abate, Ebba; Agogo, Emmanuel; Belfroid, Evelien; Dar, Osman; Fehr, Angela; Hollmann, Lara; Ihekweazu, Chikwe; Ikram, Aamer; Iversen, Bjorn Gunnar; Mirkuzie, Alemnesh H; Rathore, Tayyab Razi; Squires, Neil; Okereke, Ebere	Improving National Intelligence for Public Health Preparedness: a methodological approach to finding local multi-sector indicators for health security	2021	Ethiopia, Pakistan, and Nigeria	Primary	Identified new indicators to supplement JEE	National and subnational
Fasominu, Olukayode; Okunromade, Oyeladun; Oyebanji, Oyeronke; Lee, Christopher T.; Atanda, Adejare; Mamadu, Ibrahim; Okudo, Ifeanyi; Okereke, Ebere; Ilori, Elsie; Ihekweazu, Chikwe	Reviewing Health Security Capacities in Nigeria Using the Updated WHO Joint External Evaluation and WHO Benchmarks Tool: Experience from a Country-Led Self-Assessment Exercise	2022	Nigeria	Primary	JEE	National

Haider, Najmul; Yavlinsky, Alexei; Chang, Yu-Mei; Hasan, Mohammad Nayeem; Benfield, Camilla; Osman, Abdinasir Yusuf; Uddin, Md. Jamal; Dar, Osman; Ntoumi, Francine; Zumla, Alimuddin; Kock, Richard	The Global Health Security index and Joint External Evaluation score for health preparedness are not correlated with countries' COVID-19 detection response time and mortality outcome	2020	Global	Secondary	GHSI & JEE	National
Ji, Ye; Shao, Jun; Tao, Bilin; Song, Huan; Li, Zhongqi; Wang, Jianming	Are we ready to deal with a global COVID-19 pandemic? Rethinking countries' capacity based on the Global Health Security Index	2021	Global	Secondary	GHSI	National
Kandel, Nirmal; Chungong, Stella; Omaar, Abbas; Xing, Jun	Health security capacities in the context of COVID-19 outbreak: an analysis of International Health Regulations annual report data from 182 countries	2020	Global	Secondary	SPAR	National
Khalifa, Banda A.; Abbey, Enoch J.; Ayeh, Samuel K.; Yusuf, Hasiya E.; D Nudotor, Richard; Osuji, Ngozi; Khan, Samiha; Nosakhare, Esosa; Oduwole, Modupe O.; Salia, Emmanuella L.; Lasisi, Oluwatobi; Karakousis, Petros C.	The Global Health Security Index is not predictive of vaccine rollout responses among OECD countries	2021	Global	Secondary	GHSI	National
Kharaishvili, N; Hudson, TML; Kannan, JK; Ettenger, V; Mirje, S	Global Health Security Risk Assessment in the Biological Threat Reduction Program	2020	Global	Primary	Biosurv./Bio-safety and Biosecurity Assessment Question.	National

Leichtweis, Bruno Grespan; De Faria Silva, Letícia; Da Silva, Felipe Lopes; Peternelli, Luiz Alexandre	How the global health security index and environment factor influence the spread of COVID-19: A country level analysis	2021	Global	Secondary	GHSI Data	National
Rose, Sophie M; Paterra, Michael; Isaac, Christopher; Bell, Jessica; Stucke, Amanda; Hagens, Arnold; Tyrrell, Sarah; Guterbock, Michael; Nuzzo, Jennifer B	Analysing COVID-19 outcomes in the context of the 2019 Global Health Security (GHS) Index	2021	Global	Secondary	GHSI	National
TsaiFeng-Jen; KatzRebecca	Measuring Global Health Security: Comparison of Self- and External Evaluations for IHR Core Capacity	2018	Global	Secondary	(JEE and IHR self-reported scores from 2016)	National
Uzun Jacobson, Evin; Inglesby, Tom; Khan, Ali S.; Rajotte, James C.; Burhans, Robert L.; Slemp, Catherine C.; Links, Jonathan M.	Design of the National Health Security Preparedness Index	2014	United States	Primary	NHSI	State and National
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