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Network Analysis in Global Emergency Medicine: Mapping Collaborative Structures and Enhancing Connectivity

Introduction

Network analysis, which draws from fields including mathematics, sociology, and public health, is essential for interpreting complex data relationships within healthcare information systems. This approach not only highlights intricate care patterns but also enhances the navigability of systems, making complex healthcare information more accessible [1]. Our study builds on previous applications of network analysis in healthcare, specifically examining its use in structuring

academic health center websites in the U.S. to improve user-oriented spaces. Our research explores the digital ecosystem of emergency medicine organizations globally, focusing on the International Federation for Emergency Medicine (IFEM). By employing a systematic, automated approach to network mapping, we aim to uncover collaborative patterns and enhance the online presence of emergency resources. This effort supports greater global collaboration and information sharing among emergency medicine organizations, leveraging the strong networks and insights provided by IFEM to ensure universal access to high-quality emergency services.

Methodology

We utilized a four-step process for mapping and analyzing the global network of emergency medicine organizations:

1. Web Crawling: We collected data from the IFEM website using the Screaming Frog SEO Spider tool. The crawl depth was set to three to ensure comprehensive data capture from IFEM and its connected links.
2. Content Filtering: BeautifulSoup was used to parse HTML content. We filtered the extracted data for relevance to emergency medicine organizations. The data was further refined using the Gemini 1.0 Pro model to isolate pertinent information about the organizations' names and locations.
3. Geolocation Resolution: Location data extracted from the web pages was converted into geographical coordinates using the Geopy library’s Nominatim tool to accurately map of each organization's position.
4. Network Visualization: We constructed a directed network graph using the NetworkX library, with nodes representing organizations and edges representing their interconnections. This graph was visualized with Matplotlib to illustrate the relationships and distribution patterns among the organizations.

Results

We identified 4,775 external links on the IFEM website and refined them to 156 unique base URLs for in-depth content analysis. Out of 55 countries listed, there were 41 functional links, 10 non-functional, and 4 missing. We effectively isolated 41 relevant multilingual URLs from the functional links, achieving a 100% accuracy rate in identifying pertinent content (Table 1). Additionally, our analysis uncovered 30 URLs linked to emergency medicine organizations not listed on the IFEM member page, including the American College of Osteopathic Emergency Physicians and the Swiss Society for Emergency and Rescue Medicine.

Organization Name	Country	URLs	Status
associação brasileira de medicina de emergência	Brazil	https://abramede.com.br	Match
canadian association of emergency physicians (caep)	Canada	https://caep.ca	Match
taiwan society of emergency medicine	Taiwan	https://www.sem.org.tw	Match
korean society of emergency medicine	South Korea	https://emergency.or.kr	Match
asociación colombiana de especialistas en medicina de urgencias y emergencias (acem)	Columbia	https://www.acemcolombia.com	Match
emergency medicine college of thailand	Thailand	http://www.tceps.org	Match
the royal college of emergency medicine	United Kingdom	http://www.rcem.ac.uk	Match
belgian society of emergency and disaster medicine, belgium	Belgium	https://www.besedim.be	Match
emirates society of emergency medicine	United Arab Emirates	https://esem.ae	Match
sociedad mexicana de medicina de emergencia	Mexico	https://smme-ac.com	Match
suomen akuuttilääketieteen yhdistys ry	Finland	https://www.akuuttilaaketiede.fi	Match
saudi society of emergency medicine	Saudi Arabia	https://sasem.org.sa	Match
philippine college of emergency medicine (pcem)	Philippines	https://pcem.ph	Match
danish society for emergency medicine	Denmark	http://www.dasem.dk	Match
iranian society of emergency medicine	Iran	https://www.isem.ir	Match
sociedad chilena de medicina de urgencia	Chile	http://www.sochimu.cl	Match
nepalese society of emergency physicians	Nepal	https://www.nsep.org.np	Match
japanese association for acute medicine	Japan	https://www.jaam.jp	Match
bahrain medical society	Bahrain	https://www.bhmedsoc.com	Match
norwegian society for emergency medicine	Norway	https://www.norsem.org	Match
asociación panameña de medicina de emergencias	Panama	https://www.aspame.org	Match
irish association for emergency medicine	Ireland	https://iaem.ie	Match
american college of emergency physicians	United States	https://www.acep.org	Match
vietnamese society of emergency medicine	Vietnam	http://www.vsem.org.vn	Match
de nederlandse vereniging van spoedeisende hulp artsen (nvsha)	Netherlands	https://www.nvsha.nl	Match
hong kong college of emergency medicine	Hong Kong	https://hkcem.org.hk	Match
libyan emergency medicine association	Libya	http://lema.org.ly	Match

Discussion

Our study highlights the utility of network analysis in understanding the digital networks of emergency medicine organizations globally, revealing essential connectivity patterns and their implications for healthcare systems. The methodology used is adaptable for other healthcare areas, enhancing collaboration and addressing language barriers. Findings indicate dynamic changes in digital connectivity, pointing to evolving collaboration and resource sharing. This research provides a foundation for exploring digital connectivity's broader impacts across various sectors.

References

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