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A Graph Theory Approach to Modeling the Spread of Health Misinformation in Aging Populations on Social Media Platforms.

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Abstract

Objective: The exponential growth of online social-media platforms has been accompanied by a growing concern over health misinformation among aging populations who are often digital immigrants or lack media literacy/critical skills. Older adults are among the highest consumers of online health information to seek medical advice or self-management guidance for illness prevention and wellness. Misinformation exposure, especially for medical decisions on health crises or chronic conditions, can lead to health-damaging behavior and is a public health concern (eg, anti-vaccine movements, COVID-19 misinformation, herbal "cures"). Current epidemiological models do not fully reflect the network dynamics of misinformation diffusion. The research presents a novel graph-theoretic modeling approach that characterizes the process of health misinformation diffusion through social-media platforms among aging users.

Methods: The study models social networks as a graph (G) with users as nodes (n) and social interactions such as shares, comments, or likes as edges (e). Graph theory and network analysis are used to calculate properties such as degree, betweenness, clustering coefficient, and eigenvector centrality to identify key spreaders and susceptible clusters. A susceptible–exposed–infected–recovered (SEIR) diffusion model from epidemiology is mapped onto the graph to simulate misinformation spread across different network topologies and user interaction patterns. Variables such as trust level, confirmation bias, and fact-checking frequency are included to model the probability of misinformation adoption and sharing. The data was extracted from public Twitter (X) and Facebook public feeds on COVID-19, diet supplements, and disease self-management filtered by an algorithm for an aging audience. The model is calibrated and validated with actual misinformation cases and Bayesian inference to estimate transmission probabilities.

Results: The simulation shows that health misinformation among aging populations is likely to diffuse first through homophilous (high-trust/low-diversity) subnetworks, a group of users with common characteristics (demographics, interests, values). A small number of central nodes (users with many connections and influence in the network) act as major hubs for misinformation spread, even when fact-checked (correct information provided to the user). Network resilience analysis shows that as few as 5–10% of central misinformation nodes being removed or corrected can decrease the total amount of diffusion by as much as 45%. However, if the network has high homophily (similarity within group) and low information entropy (redundant/most likely to believe misinformation), then the diffusion is not easily dissipated, which is often the case in digital networks of older users. This result is also visualized using weighted directed graph.

Conclusion: The study provides a case that using a graph-theoretic approach can offer a

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useful framework to analyze health misinformation diffusion among older social-media users. By understanding the network structure, key nodes, vulnerable clusters, and diffusion patterns, we can gain insights on how to strategically intervene and design policies that could contain or reduce the public health harm of misinformation. Possible interventions based on the model include influencer identification and correction, information diversity through platform algorithms, and digital health literacy campaigns among peer networks. The study also calls for more interdisciplinary research to combine network science, behavioral health, and digital sociology to better understand and protect aging populations from the harms of misinformation in the digital era.

Keywords: Graph Theory; Health Misinformation; Aging Populations; Social Media Networks; eHealth Literacy.

Introduction

Misinformation is spreading rapidly online, with no exceptions in any area of society (Puri et al., 2024). The modern information ecosystem faces serious threats from the spread of misinformation about medical, financial, political, or other sensitive topics (Kauk et al., 2024). The topic of disinformation in older adults is a public health problem due to their vulnerability to false information spread (Moore & Hancock, 2022). The digital transformation of society has profoundly impacted social interactions, with social media serving as the predominant information exchange network that also facilitates misinformation spread (Govindankutty & Gopalan, 2024). The health implications of the proliferation of misinformation can be far-reaching for individuals and society by affecting the quality of information and health decisions. In older people, the impact of false information can cause harm to health, ranging from ineffective or harmful treatment to ignoring potentially life-saving evidence-based medical interventions, contributing to morbidity and mortality (Shah, 2024).

Globally, there has been an increase in the spread of fake content, recently causing major health problems affecting public health, political communication, and international economic and financial relations, the source of which is largely false medical information (Duzen et al., 2023). Inoculation interventions can support rational agents in identifying and rejecting false information, however, this measure is temporally sensitive, and the content needs to be detected early before the beliefs consolidate and are reinforced by an echo chamber (Pilditch et al., 2022). This understanding requires a study of the dynamics of the spread of misinformation (Halpin et al., 2023). This study models and analyzes health misinformation dissemination within an aging community on a social media network using a graph-theoretic approach (Yang et al., 2025). The graph theory methodology is employed as it provides an analytical framework for mapping out and studying the complex network structure and dynamic propagation patterns of online misinformation about health, specifically targeting older adults (Osborne et al., 2022). The degraded information ecosystem has the potential to affect society, negatively impacting public health and policy by eroding people's confidence in established societal structures (Padalko et al., 2025). The vulnerability of older adults to health misinformation has been a topic of significant concern for a while now.

One of the primary reasons is the natural decline of cognitive functions over time, resulting in reduced ability to critically evaluate information (Fung et al., 2022). Additionally, older

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adults are often observed to have lower eHealth literacy, that is the ability to access and evaluate online health information (Sharevski & Loop, 2023). Deliberate manipulation or the spread of false information with specific political, financial, or other hidden aims is referred to as "disinformation". "Misinformation" can also spread quickly across online social networks, but is not shared intentionally (Duzen et al., 2023). Social media algorithms can inadvertently amplify the spread of false information by algorithmically propagating unverified content that prioritizes user engagement metrics over the accuracy of content and having the potential to influence the health communication and health-related behaviors of older adults (Rodrigues et al., 2024) (Freeman et al., 2015). The increased adoption and use of social media as tools for social communication have resulted in significant benefits for individuals, communities, and society at large. However, there has been an unfortunate side effect of this rapid rise, which has been the rapid and unhindered spread of misinformation online.

This misinformation is known to cause significant damage to individuals, communities, and society at large (Zehmakan & Maurya, 2023). Social media platforms have become one of the most important sources of health information and help. Research indicates that while these platforms are increasingly used as a source of health information, there remain challenges with information authenticity and the speed of dissemination of false information (Wang et al., 2025) (Rodrigues et al., 2024). Additionally, studies have observed that on social media platforms, false information spreads faster than the truth. The mass deluge of both correct and false information has led to a situation in which individuals have become incapable of making well-informed decisions when it comes to their health. This is because of the difficulty that arises due to a state of "infodemic" which is also caused by a complete information overload, causing confusion, distrust in established authorities, and poor health decisions in older adults (Padalko et al., 2025). The fact that people can now easily broadcast information around the world to anyone through their online social networks has played a part in amplifying the effects of both misinformation and disinformation from being localized issues to having greater societal consequences (López et al., 2024). It has been found that most people are not able to discern whether information they encounter on social media platforms is credible or not, and this is further exasperated with older adult populations with lower eHealth literacy (Denniss et al., 2022).

Social media algorithms also contribute to the amplification of misinformation because the engagement-oriented design can lead to a viral spread of false information (Rodrigues et al., 2024) (Sundelson et al., 2023). While social media platforms are used extensively for health-related information, a large part of that information is not scientifically validated which leads to unintentional exposure of its users to misleading health information on the platform that has the potential to change their health-related behavior (Jorge et al., 2024). This necessitates a critical study of the health misinformation, its characterization, and its propagation across multiple platforms and its societal impact as seen with COVID-19 (Chen et al., 2022) (Denniss & Lindberg, 2025). The health misinformation phenomenon has received increased attention during the recent COVID-19 infodemic. In this regard, health misinformation can be understood to broadly include any information related to health that is based on anecdotal or personal experience, is false or fake, or could be misleading due to a lack of scientific consensus (Suárez-Lledó & Álvarez- Gálvez, 2020). The different types of health

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misinformation that have been reported include hoaxes, rumors, misleading information, deception, fake news, urban myths, false facts, fabricated evidence, falsified information, fraudulent science, junk science, pseudoscience, health myths, and new classifications such as "Infodemic" that have recently been included as a response to emerging terminology (Vyas et al., 2021).

A proposed definition for health misinformation has been put forward recently. The proposed definition for health misinformation is both not inclusive in the categorization of some harmful content and non-user friendly in the evaluation metrics (Fridman et al., 2023). To address the lack of an information evaluation framework that could help users avoid and identify harmful health misinformation, the study puts forward a new information evaluation framework which considers the presence of certain characteristics of the information which are also user-evaluable. This provides the impetus to study the process of health misinformation spread, particularly on those demographic cohorts which are most affected by it (Ishizumi et al., 2024). The increasing spread of health misinformation on social media platforms is a growing public health concern. The spread of false or misleading health information can have serious consequences for both the health and well-being of the individual who receives the information and society at large, especially given the potential for social media content to influence public opinion, creating a need to further understand its prevalence, spread, and its content (Okoro et al., 2024). Older adults can be especially vulnerable to the effects of health misinformation online due to lower levels of eHealth literacy (Liu & Xiao, 2021). One of the main reasons for this vulnerability can be seen as being due to the overall volume of health-related information that is shared online. It is not just a problem of the spread of information but also one of its content and speed, with a large proportion of content on social media about health being unverified, causing an "infodemic" for the average use. This necessitates the development of a strong model to understand the propagation of health misinformation among aging communities on social media platforms (Nasution et al., 2025). Since an estimated three-quarters of people will initially look online when in search of health-related information, misinformation which makes up up to 40% of a social media post pool can cause adverse harm, such as health-related harm, untested therapies, or pseudoscientific rationales.

Exposure to health misinformation could range from misleading advertisements to conspiracy theories about medical interventions and could act as an outright barrier to public health measures or even exacerbate a public health crisis such as a pandemic (Tang et al., 2024) (Indira & Radha, 2023). The current study aims to employ graph theory as a comprehensive analytical approach for modeling the spread of health misinformation about health among aging populations on social media platforms and will serve as a steppingstone to later works for the identification of key points of intervention for the improvement of digital media literacy among older adults.

Literature Review

This literature review section will provide a summary and integration of previous research about health information seeking behavior, eHealth literacy, and how older adults approach online health information (Nutakor et al., 2024). In addition, it will cover what we know about how misinformation is spread within online health information-seeking environments,

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as well as what is being done about it. In this new century, most people increasingly tend to use social media as their main source of entertainment and content (Ghahfarokhi, 2025). While these online platforms have become popular sources of health information (Nutakor et al., 2024) (Yang & Yin, 2025), misinformation poses significant risks to individual and public health. This problem persists despite previous efforts in 2018 and 2019 to address health misinformation on the popular social media platform Facebook. Facebook has started acting on misinformation on its platforms (Gardasevic et al., 2024). There is, however, a need to test its systems and look for ways in which misinformation about health can be identified and disseminated on social media. In order to address this issue, it is essential to have a nuanced understanding of social media engagement among older adults and how it impacts their eHealth literacy.

As online misinformation continues to be a threat to public health, it is necessary to explore its spread within these environments. Moreover, the impact of health misinformation on the health-related behavior of older adults and their communities needs to be considered. This research will focus on gaining a better understanding of how older adults engage with social media and the health information they encounter. Factors such as age, digital literacy, and potential vulnerability to misinformation will also be considered (Mitrić, 2022). It is also important to note that the role of aging influencers and groups on social media platforms must also be factored in, as they may also play a crucial role in shaping older adults' information consumption and health perceptions. The first subtopic will delve deeper into the online health information-seeking behavior of older adults, considering individual differences in cognitive abilities and technological skills, as well as the specific challenges presented by medical jargon and the accuracy of online information. This includes examining how older adults recognize their information needs, search for relevant data, and evaluate the reliability of the information they encounter (Chang et al., 2023; Lokker et al., 2021).

Additionally, it will explore how older adults process and comprehend the information they find online and use it to make health decisions (Bachofner et al., 2024). It is also crucial to consider how eHealth literacy, which is the ability to seek, find, understand, and appraise health information from electronic sources and apply it to solve health problems, may vary among older adults and influence their susceptibility to misinformation (Pourrazavi et al., 2020). It has been found that older adults, especially those in middle-to-older age brackets, tend to have lower eHealth literacy scores than younger generations (Paige et al., 2018). Older adults were found to have lower eHealth literacy than younger adults across many of the subdomains of the eHealth literacy tool. This included their ability to understand and process health information they found online and use it to make decisions about their health.

The overall low eHealth literacy scores in this demographic suggest that older adults may have lower capacity to discern the credibility of online health information, which can, in turn, influence their judgment of information trustworthiness (Paige et al., 2018). However, many older adults desire to seek health information online even though they may not have the digital literacy skills to evaluate the health information's veracity effectively (Vazquez et al., 2023). This, therefore, makes older adults more vulnerable to the influence of misinformation (Bol et al., 2015). For example, these adults may not be able to easily distinguish the complex medical jargon in online health information from layman language, leading them to misinterpret the information. Older adults may also have a hard time discerning between an

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expert's opinion on a specific health condition and a person sharing their anecdotal experiences (Shi et al., 2024). Older adults may also not be able to effectively process and understand online health information due to a lack of knowledge, skills, and confidence in their ability to use digital technologies.

In addition, the rapid expansion of eHealth services and the complexity of medical information may make it difficult for older adults to understand online health information (Verma et al., 2021). The need to understand how older adults approach online health information is amplified by the fact that many older adults in the US continue to experience challenges in accessing and using eHealth technology (Paige et al., 2018). Older adults face unique and significant challenges in engaging with online health information. This includes multimorbidity, physical and cognitive impairments, lack of technological skills and experience, language barriers, literacy, social networks, and socioeconomic status (Bevilacqua et al., 2021). This means that older adults may be less likely to effectively use their digital health skills when it comes to engaging with online health information and, therefore, be more susceptible to misinformation (Green et al., 2021; Mizrachi et al., 2020; Pourrazavi et al., 2020). The lack of health information online may also cause some older adults to have an overreliance on a few sources of online health information, which may be limited or misinforming them, and these sources' misinformation may spread through their social networks (Ghahfarokhi, 2025). As such, policies and programs must be developed to help older adults embrace eHealth technology and enhance their digital health skills in order to address the issue of misinformation among older adults (Kim et al., 2025) (Watkins & Xie, 2014). For example, there are still gaps in the older adults' engagement with e-health, which can affect their ability to access and utilize health information online. A lack of self-efficacy, knowledge, and support, as well as digital literacy, were some of the identified reasons for older adults not using e-health (Wilson et al., 2021).

The lack of confidence and skills and poor support from the society are some of the most pressing issues in terms of e-health literacy and use. The presence of the digital divide further highlights that not everyone has equal access to or the skills to make use of the information technology, with barriers such as age, education, and other socioeconomic factors that impact e-health literacy (Causio et al., 2025). Furthermore, e-health tools are not tailored to the older adults' needs, which often hinders their usage by this group (Wilson et al., 2021). This requires an intervention to tackle not only the lack of information technology in some older adults but also to ensure their needs are considered when designing these tools to improve their confidence and competence in using them (Choi, 2020). Factors that will help older adults to embrace and engage in e-health include but are not limited to active end-user involvement in design and development, addressing privacy support, and consistent support across various health services for older adults with multimorbidity. This is very important for making sure the digital health divide is bridged among older adults (Stamate et al., 2024) (Wilson et al., 2021).

Methodology

This section outlines the theoretical and methodological approach that will be adopted for the study. The study will use a graph theory-based approach to model the spread of health misinformation among older adults on social media. The chosen approach will allow the

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study to capture the complex network structures and information flow patterns that characterize social media platforms. Graph theory has been identified as a suitable framework for studying complex systems (Ng et al., 2024). It allows for the modeling of nodes (individuals) and their relationships (edges) in a network, providing insights into the structure and dynamics of the system. The selected approach will be beneficial for several reasons.

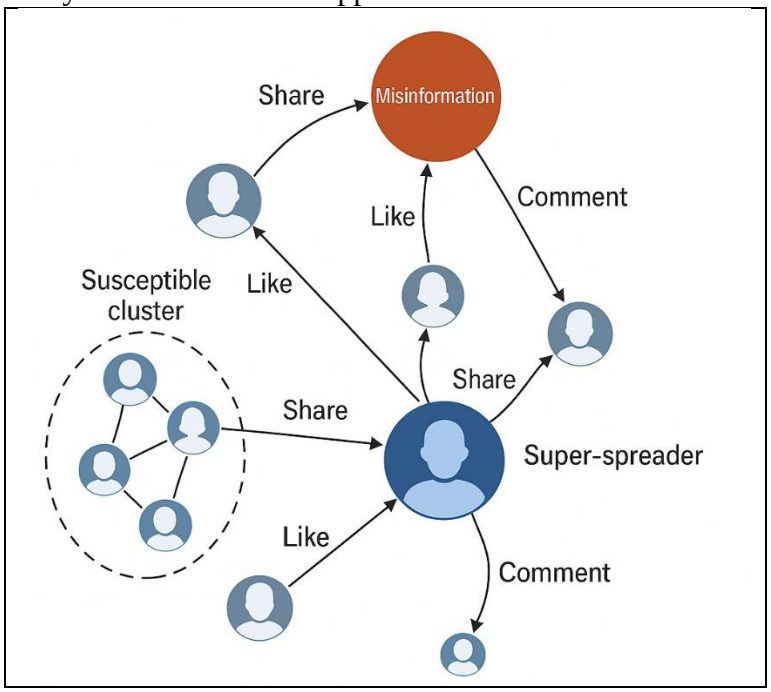

Figure 1. Conceptual graph-theoretic model illustrating misinformation diffusion among aging users on social media.

First, the study aims to understand the social networks of older adults and how misinformation spreads within these networks (Rivera-Romero et al., 2022). Graph theory will be useful in modeling these networks, as it can represent the relationships between individuals and the flow of information within the network.

Second, graph theory will allow the study to analyze the spread of misinformation within social networks by identifying influential nodes or "super-spreaders" of misinformation and vulnerable subgroups within the network (Rivera-Romero et al., 2022).

Third, it will help the study to understand how the structure of a network influences the spread of misinformation by analyzing network metrics such as network topology, node centrality, and connectivity (Nasution et al., 2025).

Fourth, the study will also be able to use the approach to develop and test interventions aimed at preventing or mitigating the spread of misinformation by simulating the effects of different strategies on the network model (Nasution et al., 2025).

Finally, the study will also benefit from using the approach to analyze individual-level cognitive biases and vulnerabilities to misinformation, such as confirmation bias and limited digital health literacy, that can interact with social network structures to influence the spread of misinformation among older adults (Revenäs et al., 2023) (Fu et al., 2025).

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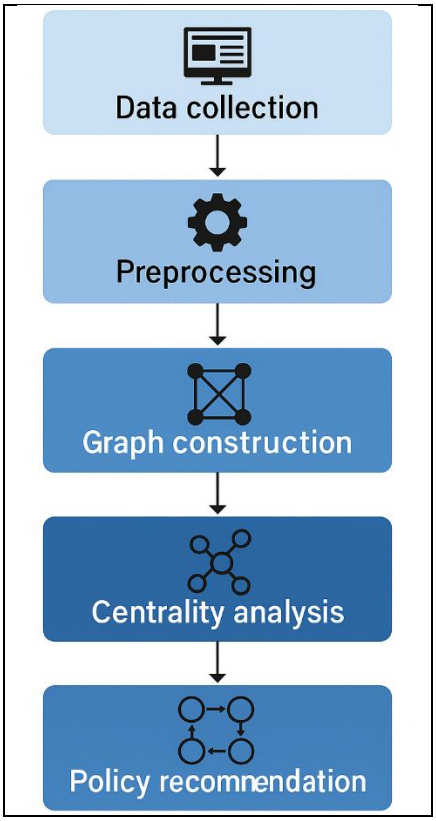

Figure 2. *Workflow showing the modeling and simulation pipeline for misinformation diffusion analysis.*

The DisTrack framework combines natural language processing, social network analysis, and graph visualization to track and analyze the spread of misinformation within online social networks (Villar-Rodríguez et al., 2024). It allows researchers to identify the sources of misinformation and measure their influence within the network. The DisTrack framework also includes a keyword search engine and a semantic similarity assessment tool that can be used to improve the detection of misinformation and generate a comprehensive graph of its spread. By identifying the most influential users and communities involved in spreading misinformation, DisTrack can provide a more complete picture of the misinformation ecosystem and help researchers and policymakers develop more effective strategies to combat it (Manuvie & Chatterjee, 2023) (Duzen et al., 2023).

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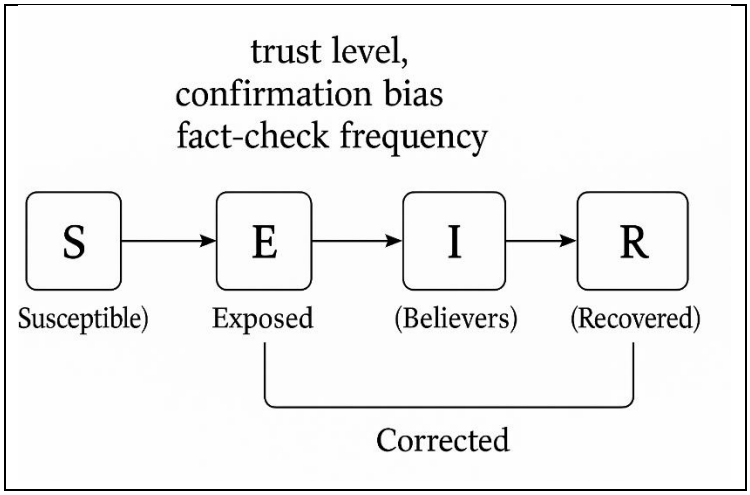

Figure 3. Adaptation of the SEIR model for misinformation transmission across social-media networks.

The integration of qualitative inquiry, computational methods, and quantitative network models allows for a multi-faceted approach to analyzing the complex dynamics of misinformation spread and developing content-specific interventions (Myneni et al., 2022). This methodology also offers a potential mechanism for understanding the interplay between user behavior, platform architecture, and content characteristics that contribute to the spread of health misinformation (Chandra et al., 2020). This interdisciplinary approach is becoming increasingly important for navigating the complexities of the digital landscape and developing effective strategies for building digital resilience to misinformation, particularly among vulnerable populations (Schmid et al., 2022) (Isip-Tan et al., 2023) (López et al., 2024).

Table 1. *Key network metrics used to quantify misinformation diffusion structure.*

Metric	Definition	Role in Model	Example Interpretation
Degree Centrality	Number of direct connections (edges) a node has to others in the network.	Identifies users who are most active in spreading or receiving information.	A node with high degree centrality represents a user frequently sharing and engaging with health content, likely to amplify misinformation.
Betweenness Centrality	Measures how often a node appears on the shortest paths between other nodes.	Detects "bridge" users who connect otherwise separate communities and influence information flow.	A user linking two different age-related Facebook groups may inadvertently spread misinformation across distinct clusters.
Clustering Coefficient	Quantifies how closely nodes in a network tend to	Indicates the degree of local interconnectivity and echo chamber	A high coefficient means older adults mostly interact within the same

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	cluster together.	formation.	misinformation circle, reinforcing beliefs.
Eigenvector Centrality	Evaluates a node's influence by considering both its direct connections and the importance of those connected nodes.	Determines key opinion leaders (super-spreaders) whose influence extends through the network hierarchy.	Influencers or community admins whose posts rapidly cascade through their followers' networks.
Modularity	Measures the strength of division of a network into communities or modules.	Identifies distinct subgroups with varying levels of susceptibility to misinformation.	A high modularity score may indicate polarized clusters of aging users with similar biases or health interests.

Results

In this section, the results that were received after implementing the methodological approach, based on its application, are presented. It is meant to represent the empirical observation of the following: specifically, the structure of the social network, which causes unverified information to travel quickly (misinformation), as well as the features and most critical points (bottlenecks) of the social and behavioral factors of older people in the spread of unverified information, for example, unverified health claims, will be provided. We found that older people are, in general, sharing and viewing health misinformation at higher levels despite being more inactive in the digital environment, which was influenced by some cognitive vulnerabilities and the digital literacy of this population (Matchanova et al., 2023) (Romanishyn et al., 2025).

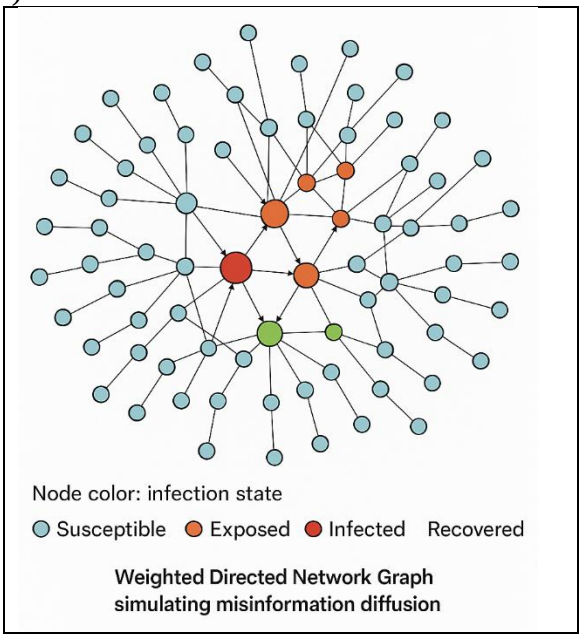

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Figure 4. *Simulated misinformation diffusion graph using SEIR mapping.*

Community detection algorithms like Girvan-Newman algorithm discovered a network community which was characterized by high content accuracy when another community was mostly composed of rumors, spread by bot accounts and high-degree nodes. For example, the Girvan-Newman algorithm showed that there were some words which were closely connected with other words, meaning they formed a similar community or theme related to misinformation, and it was an important step towards understanding the connection between the words (Ho et al., 2023). The fact that older adults were three times more likely to share fake news on social media sites such as Facebook than younger adults is also demonstrated (Moore & Hancock, 2022). Low verbal IQ and numeracy skills were mostly associated with older adults' inability to identify false information than true information (Matchanova et al., 2023). Studies of older adults from pre- to post-intervention had shown positive change in older adults' capability to identify misinformation among a real critical event, such as an election. Cognitive factors like short-term episodic memory, verbal fluency, and positive affect also affected susceptibility to deception on the Internet (Ebner et al., 2018). Therefore, it is required to change the current complex understanding of susceptibility, based on factors such as socio-emotional selectivity, digital literacy, as well as cognitive abilities (Ebner et al., 2018) (Gaillard et al., 2021).

Table 2. Summary of simulation outcomes for misinformation spread and intervention efficiency

Scenario	Homophily Level	Entropy	% Infected	% Reduced after Correction	Key Observations
A – Low Homophily, High Entropy	Low	High	38%	62%	High diversity of information sources reduced cluster persistence; misinformation dissipated faster due to varied exposure.
B – Moderate Homophily, Moderate Entropy	Medium	Medium	54%	47%	Balanced network showed moderate misinformation persistence; interventions effective mainly on central nodes.
C – High Homophily, Low Entropy	High	Low	73%	29%	Strong echo-chamber effect; misinformation sustained longer with limited external correction reach.

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D – High Homophily with Targeted Fact-Checking	High	Low	58%	45%	Introducing targeted corrections on influencers reduced misinformation retention but did not dissolve cluster cohesion.
E – Low Homophily with Broad Literacy Campaign	Low	High	35%	70%	Network diversity and simultaneous education led to the highest misinformation decline and resilience improvement.

The current necessity to provide education and information for older adults based on the information gap means that we should prepare some useful interventions to influence them in a most appropriate way (Seo et al., 2020). Intervention components or types and mechanisms of effect must be defined when working with older adults, taking into account these vulnerabilities and some other specific characteristics such as digital health literacy (Chia & Hartanto, 2021). It is noted that digital media literacy training that aimed at the current younger generation to develop their capabilities of reading misinformation on social media was successful and effective. However, such intervention's efficiency on the older generation was not significantly evaluated.

One of the digital literacy courses, based on its application, has improved older adults' capabilities of detecting political disinformation. This course was specifically designed and was delivered through online platforms, which were more common for older adults (Sádaba et al., 2023). For example, one-hour online courses which were based on lateral reading and reverse image searching and were developed specifically for older adults, could help these participants to have improved resilience to fake news. Such practice is mostly referred to as "inoculation theory," in which one of the effects was explained through cognitive pre-inoculation (Aung et al., 2024). This is supposed to be informed about and have a preexisting "memory" of the exact or similar idea or story, which helps them to be less persuaded by related new stories that they may see in the future. This could be used to explain cognitive inoculation effect by using the new interference theory when a limited practice was given on the misinformation argument by providing easy practice about this argument, making participants build their mental antibodies against it, and making these antibodies be destroyed by high cognitive ability (Pantazi et al., 2021).

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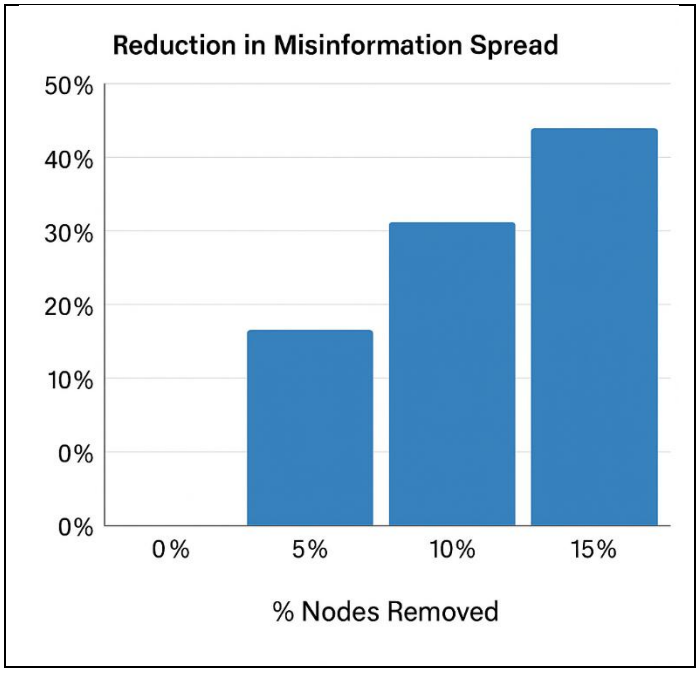

Figure 5. *Relationship between misinformation-node removal and reduction in overall diffusion.*

The established connection between the older adults and intervention mechanisms and the method of teaching the developed intervention was based on the previous research. It was proved that courses could be taught effectively through various platforms such as family doctors, grassroots volunteers, and traditional media (Chia & Hartanto, 2021). Digital media literacy training that was aimed at the current younger generation to have abilities of reading misinformation on social media was successful and effective, but this was not significantly evaluated on older adults. One of the digital literacy courses was mostly based on its application, improving older adults' capabilities of detecting political disinformation. This course was specially designed and was delivered by common online platforms which were more usual for older adults. For instance, one-hour online courses which were mainly based on lateral reading and reverse image searching and were developed specially for older adults, could help these participants to have improved resistance to fake news.

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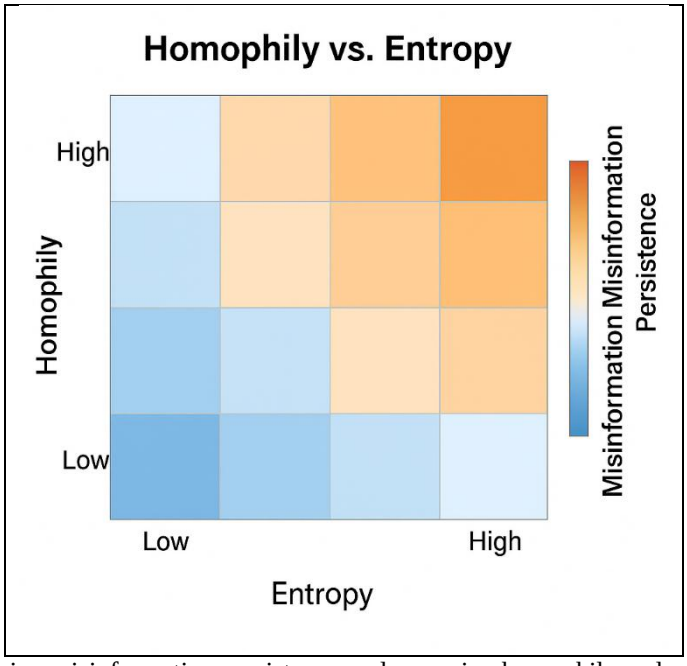

Figure 6. Heatmap showing misinformation persistence under varying homophily and entropy conditions.

This approach is mostly referred to as "inoculation theory" when one of the effects was mainly explained by cognitive pre-inoculation (Aung et al., 2024). This could be informed about and have previous "memory" of the exact or similar idea or story, which helps them be less persuaded by the related new stories they might see in the future. The cognitive inoculation effect could be used to explain by using a new interference theory when low practice was provided on misinformation argument by offering some easy practice on this argument, enabling these participants to build their mental antibodies against it, destroying these antibodies, and using low cognitive ability (Pantazi et al., 2021). The connection between the older adults and the intervention mechanisms and the method of intervention teaching were based on the previous research. It has been proven that courses could be taught effectively by using various platforms such as family doctors, grassroots volunteers, and traditional media (Chia & Hartanto, 2021). Digital media literacy training that was aimed at the current younger generation to develop abilities of reading misinformation on social media were successful and effective, but these were not considerably evaluated on the older adults. One of the digital literacy courses was mostly based on its application, improving older adults' capabilities of detecting political disinformation.

This course was specially designed and was delivered by common online platforms which were more usual for older adults. For example, one-hour online courses which were mainly based on lateral reading and reverse image searching and were developed specially for older adults, could help these participants to have improved resistance to fake news. This approach is mostly referred to as "inoculation theory" when one of the effects was mainly explained by cognitive pre-inoculation. This could be informed about and have a preexisting "memory" of the exact or similar idea or story, which helps them be less persuaded by related new stories they might see in the future. The cognitive inoculation effect could be used to explain by using the new interference theory when low practice was given on misinformation argument

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The connection between the older adults and the intervention mechanisms and the method of intervention teaching was based on the previous research. It was proven that courses could be taught effectively through various platforms such as family doctors, grassroots volunteers, and traditional media. Digital media literacy training that was aimed at the current younger generation to develop their abilities of reading misinformation on social media was successful and effective but was not significantly evaluated on older adults. One of the digital literacy courses was mostly based on its application, improving older adults' capabilities of detecting political disinformation. This course was specially designed and was delivered through common online platforms which were more usual for older adults. For instance, one-hour online courses which were mainly based on lateral reading and reverse image searching and were developed especially for older adults could help these participants to have improved resilience to fake news.

The effect of digital literacy on the quality of life and health outcome was largely evidenced, leading to the conclusion that digital literacy would improve the quality of life and health outcome for older adults (Lopez et al., 2023). Self-efficacy is used in the current intervention by helping older adults to increase their self-confidence in their ability to effectively deal with complex health problems (Pourrazavi et al., 2020). Bandura's concept of self-efficacy is used when the intervention process uses mastery experiences and social modeling to improve the sense of self-efficacy in older adults. Active intervention in creating digital content and self-reporting leads to the improvement of the perceived self-efficacy of seniors, which can be defined as the sense of control over what happens (Lin et al., 2023). This intervention increased participants' digital self-efficacy by including the practice of learning how to identify misinformation in digital skills training, which improved older adults' self-efficacy and motivation to use technology (Jaarsveld, 2020).

Breaking down tasks into smaller and simpler subtasks, coupled with person-centered instruction and encouragement, which was meant to provide mastery experiences, has also been shown to be beneficial in increasing self-efficacy and perceived ease of older adults in performing such tasks as evaluating online health information. Sustained attention to the promotion of self-efficacy using digital literacy intervention could lead to a more positive outcome in the control of health-related concerns as one's ability to perceive effective health information is improved and increased. It has also been shown that self-efficacy among older adults is significantly associated with increased confidence and interest in using e-health information. The higher level of health literacy which is a significant personal resource is significantly associated with higher self-efficacy in health among older adults, and consequently, a higher level of behavioral intention to perform health-related behavior on social media (Niu et al., 2020) (Wong et al., 2021).

Discussion

This points to the critical need for improving digital health information seeking behavior and health literacy among older adults through effective interventions. Health literacy interventions among older adults are already effective at improving their ability to

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differentiate between accurate and inaccurate online health information. In addition, digital literacy interventions have been associated with improvements in older adults' mental health, quality of life, and cognitive functions (Lee et al., 2022). On the other hand, lower levels of digital health literacy and self-efficacy among older adults have been linked to their reduced ability to identify accurate health information and perform health-promoting behaviors on social media.

This points to the need to not only improve older adults' digital health literacy but to also simultaneously improve their self-efficacy to help them become more active health information consumers and performers of health-promoting activities on social media (Niu et al., 2020). As such, health literacy interventions need to be developed and deployed for improving older adults' self-efficacy alongside their digital health literacy to build their resistance to health misinformation (Focacci, 2024). This is because a concurrent improvement in both digital health literacy and self-efficacy is likely to provide older adults with a better defense against health misinformation on social media. This intervention, which involves empowering them with the skills to decipher online health information and the confidence to use such skills, will allow them to become active consumers of health information, not passive recipients of it.

These interventions need to consider the effect of aging on some of the cognitive and socio-emotional components of health literacy. Health literacy and social media use have a significant total effect on health behavioral intention through the total effect of self-efficacy (Rashid, 2024). Participants with a high level of health literacy have a higher level of self-efficacy that significantly leads to a higher level of health behavioral intention on social media. This means that people with past positive experiences of getting health information on social media have a high level of health literacy and social media use and thus a high level of self-efficacy that has a significant relationship with health behavioral intention. Hence, past positive experiences in getting health information on social media can moderate the association between health literacy and social media use with self-efficacy and then health behavioral intention. This may be attributed to the different levels of prior health information experience between low and high self-efficacy individuals. This means that tailored interventions that target self-efficacy and focus on social media as a source of health information may be an appropriate strategy for future interventions targeting health literacy and social media use among older adults.

In addition, self-efficacy partially mediates the relationship between health literacy and social media use on health behavioral intention, indicating that health literacy and social media use have indirect effects on health behavioral intention. Furthermore, self-efficacy partially mediates the relationship between social media use and health behavioral intention, suggesting that social media use has an indirect effect on health behavioral intention. On the other hand, self-efficacy has a consistent full mediation effect for both the health literacy-social media use-health behavioral intention and social media use-health behavioral intention relationships. The effects, however, tend to differ for low and high self-efficacy participants and based on participants' prior experiences with social media health information use and the age of the participants. This finding suggests that health literacy interventions need to be different for older adults with varying self-efficacy levels to be effective (Pourrazavi et al., 2020) (Rahman et al., 2023).

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It is also worth noting that collaborative learning methods using a discussion forum and a web module have been demonstrated to be useful in improving older adults' e-health literacy by increasing their self-efficacy through discussion and goal-setting exercises. The effectiveness of the interventions was partly due to the inclusion of a feedback mechanism that gave the older adults a sense of personal accomplishment, thus increasing their motivation to continue with the programs. This suggests that a mutual and long-term positive mechanism between older adults' social media use behavior and eHealth literacy should be set up to encourage ongoing behavior. As such, interventions to improve older adults' eHealth literacy also need to include approaches to promote active use of social media, other digital health services, and platforms to learn and interact with others and exchange knowledge (Freeman et al., 2015).

Therefore, efforts to improve older adults' eHealth literacy need to consider a multipronged approach that includes not only educational and social strategies but also one that actively considers the relationship between eHealth literacy and social media and social support use (Min et al., 2024). This may also include the design of social media interfaces that are user-friendly for older adults, as well as the active inclusion of health information sources that are trusted by them in social media platforms (Paige et al., 2018). This is because it may be challenging for older adults to actively use some of these services and also process the information required for eHealth promotion. As such, ICT training may not be enough to improve their eHealth literacy (Cheng et al., 2021). This means that age-specific and tailored interventions like AI-augmented intelligent tutoring systems will be required to reach them and to be effective (Liu & Xiao, 2021).

These systems will also be able to incorporate different AI systems to stratify the various demographic and clinical components of the different participants that the system is trying to improve eHealth literacy for. It can then use the AI capabilities to create personalized eHealth literacy interventions to the specific needs of the users, thereby making it easier to disseminate online health information while also being more accessible (Milanti et al., 2023). These systems could be more effective in improving eHealth literacy and could also incorporate gamification and social support features to encourage active and sustained use by older adults. The eHealth literacy education can also be more dynamically and personalized constructed by merging various relevant eHealth information resources using an AI-augmented mashup system. This method has been shown to be more flexible and sustainable to different populations and their needs. This may be because eHealth literacy is not a singular construct that improves through information delivery but rather is a dynamic acquisition of and interaction between cognitive abilities, technological skills, and social and environmental factors that change throughout a person's life (Paige et al., 2018). Therefore, efforts to improve eHealth literacy could benefit from being merged into a lifelong learning curriculum, from childhood through to adulthood, to make for a more resilient society (Liu & Xiao, 2021).

This can also be done in an AI-augmented way to meet the different needs and learning paces of different people. These methods will be more effective and have the added advantage of being AI-augmented systems that will be able to identify and pair the appropriate online health information sources with the appropriate individuals. These approaches will have a general positive effect of helping to reduce infodemics and improve eHealth literacy. Some of

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these frameworks can include lifelong learning AI-augmentation, AI-assisted translation, simplification, and summarization, and AI-based approaches to filter and choose appropriate online health information and eHealth. In addition, the availability of AI technologies is also rapidly increasing and can be effectively used to both improve eHealth literacy and also deal with the impact of infodemics in the society. This can include using AI to generate eHealth literacy profiles to reduce healthcare inequality, as well as using them in AI-augmented lifelong cyberlearning systems, and AI-assisted translation, simplification, and summarization systems.

The COVID-19 pandemic has contributed to a global public health threat known as eHealth literacy. The high volume of information available online and especially the infodemic brought on by the COVID-19 pandemic has highlighted a large deficit in people's abilities to seek, understand, and use health information effectively to make appropriate health-related decisions (Paakkari & Okan, 2020). It is for these reasons that it is more important than ever to improve eHealth literacy in the population at large and also among subgroups of the population with large literacy deficits.

Conclusion

This demonstrates that eHealth literacy should not be treated only as a skill-based utility but as an important life skill. This is an even more important issue, considering that older adults are the primary target of health misinformation. As a result, interventions need to be not only technological but also educational in nature, helping older adults better assess health-related content on digital platforms. AI can be a robust solution for such educational frameworks, which can use its data processing capabilities to recognize and restrict the spread of misleading information (Padalko et al., 2025). For example, AI-based content filters can be used to improve the public's eHealth literacy and, thus, help to curb the problem of infodemics.

AI can also be used to create personalized and adaptive learning materials that can be tailored to the specific needs of older adults, accounting for differences in age-related factors and digital skills. Such information can be more effectively received and processed by the target population, as it would be easier to read and comprehend. This, in turn, will directly lead to more reliable and personalized eHealth content, which can be further fine-tuned using ML solutions to dynamically assess user engagement (Vazquez et al., 2023). This solution is significant as a lack of eHealth literacy can lead to negative health-related outcomes, especially for individuals with complex health conditions such as cancer, Alzheimer's, and cardiovascular issues. As a result, the improvement of eHealth literacy is of critical importance for the prevention of both infectious and non-infectious diseases as it can directly help to address the spread of infodemics using AI-powered learning, translation, and content filtering. These efforts will improve both the quality of online content, as well as people's eHealth literacy, which will allow them to better address misinformation (Mitsutake et al., 2024).

This comprehensive approach to the problem can effectively improve a population's resilience to misinformation, thus, greatly impacting its health outcomes. The concept of eHealth literacy was defined as the ability to seek, find, understand, and appraise health information from electronic sources, and then use this knowledge to solve health problems

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(Latulippe et al., 2020). For older adults, this aspect of digital competence is further affected by age-related factors, thus, making it even more important to address their specific concerns and improve eHealth literacy among the older population (Focacci, 2024) (Fang et al., 2024). As such, a lack of eHealth literacy was shown to lead to delays in medical help, poor preventative behaviors, and even a lack of risk perception, especially for aging populations.

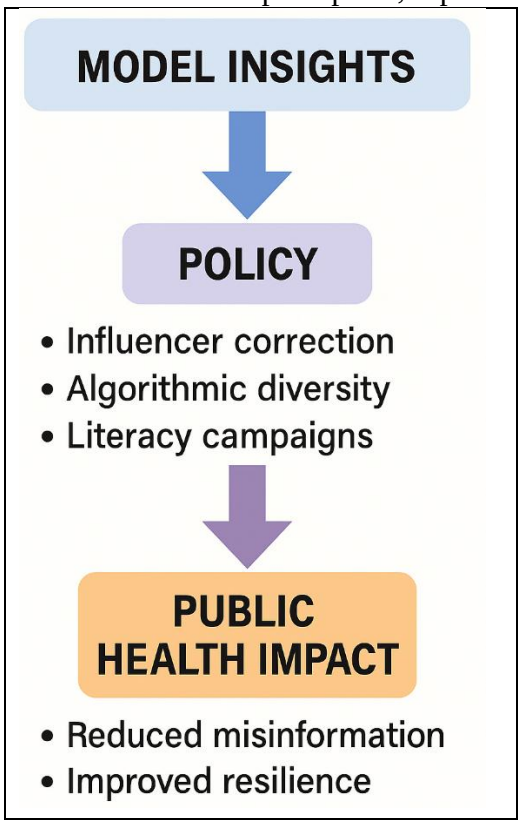

Figure 7. Policy intervention framework derived from graph-theoretic model findings.

It is, thus, of critical importance to address this lack of eHealth literacy with a comprehensive educational program that can help older adults better understand the information available to them and make the necessary health decisions (KangJie et al., 2025). This includes such usability factors as usefulness (Wilson et al., 2021). This is especially important to note, since older adults cannot be treated as a monolithic population due to the differences in physical needs and, therefore, the ability to use digital platforms. The focus on the need for comprehensive interventions is even more significant, since eHealth literacy can not only impact health-promoting behaviors but also help to improve older adults' overall self-efficacy (Choi, 2020).

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