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Information Behavior Model of e-Health Literacy for Online Health Information-seeking Effectiveness

Wang Xuewen [a], Masrah Azrifah Azmi Murad [b,*], Wu ZhangLi [a], Ismi Arif Ismail [a],
Hayrol Azril Mohamed Shaffril [c]

[a] Faculty of Educational Studies, Universiti Putra Malaysia, Serdang, Malaysia
[b] Faculty of Computer Science and Information Technology, Universiti Putra Malaysia, Serdang, Malaysia
[c] Institute for Social Science Studies, Universiti Putra Malaysia, Serdang, Malaysia
Corresponding author: *masrah@upm.edu.my

Abstract—This study examines the growing imbalance between the availability and demand for medical resources, rising healthcare costs, and the critical role of accessible health information in disease prevention and public health. The rapid advancement of information technology has established the Internet as a primary source of health information, leading to an overload that surpasses users' processing capacity and causes significant cognitive and emotional challenges. This phenomenon profoundly affects users' health information behavior and decision-making, particularly in self-health management. To address these challenges, eHealth literacy must incorporate an understanding of users' information behavior. This research analyzed the literature on eHealth literacy through a systematic review, identifying key components and categorizing them using Squiers' method. The findings reveal that current definitions fail to address the variability in online health information quality and lack a comprehensive model for understanding information behavior in an overloaded environment. As a solution, this study proposes a new definition of eHealth literacy: the capacity to efficiently search for, access, evaluate, and apply relevant information based on physiological, emotional, and cognitive needs when using electronic health resources. This new definition emphasizes discernment, proactive engagement, personalized use, and practical application of information in health management. The Information Behavior Model of eHealth Literacy (IBeHL) highlights eHealth literacy's multifaceted and dynamic nature, influenced by environmental factors, and recognizes both active information seeking and passive information exposure. Future research should focus on refining this model and exploring its potential to enhance health information behavior and decision-making.

Keywords—e-health literacy; health information behavior; information overload; information technology.

I. INTRODUCTION

With the advancement of society and the growth of the population, the disparity between the supply and demand for medical resources has become increasingly pronounced, resulting in numerous individuals encountering challenges in accessing affordable medical treatment. Proactively identifying and preventing diseases through utilizing diverse health information is essential for achieving national health objectives. In the rapidly evolving digital era, the Internet and electronic technologies have become pivotal platforms for disseminating health information [1]. Research on the Internet as a vital source of health information for patients, promoting the adoption of positive health behaviors was highlighted [2]. However, the online environment presents several challenges, notably information overload, where individuals are inundated with more information than they can effectively process [3]. This phenomenon can lead to various negative consequences, including cognitive burden, emotional barriers, and adverse impacts on health information behavior and decision-making. The excessive volume of available information can overwhelm individuals, making it difficult to identify, process, and retain relevant data. Such cognitive burdens can diminish the efficiency of information search and comprehension, resulting in frustration and potential abandonment of the search process. Continuous exposure to an overwhelming amount of health information may induce stress and anxiety, causing users to feel incapable of managing their health effectively. This feeling can decrease confidence and motivation to engage in health-promoting behaviors. Furthermore, information overload adversely affects how individuals seek, evaluate, and utilize health information.

Overwhelmed by the sheer volume of data, users may struggle to distinguish between credible and non-credible sources, resulting in reliance on unreliable information during their decision-making processes. The presence of dense, ambiguous, and conflicting health information complicates users' efforts to find information that accurately meets their needs, potentially leading to ineffective or erroneous health decisions. This situation undermines the anticipated effectiveness of self-health management [4]. Research indicates that despite the abundance of health information available on the Internet, only 8% of respondents believed they could find information that ultimately met their needs [5]. In the field of public health, the overwhelming volume of dense, ambiguous, and conflicting health information further complicates users' ability to locate information that accurately addresses their needs. This can result in ineffective or even erroneous health decisions, undermining the expected effectiveness of self-health management [4]. Information overload is prevalent in online health information seeking, with consequences extending beyond just the final health decisions. Therefore, eHealth literacy encompasses health literacy and users' information behavior.

British information scientist T.D. Wilson is a key figure in information services and information users. He introduced his information-seeking behavior model in 1981 and continued to refine it over time as shown in Fig. 1.
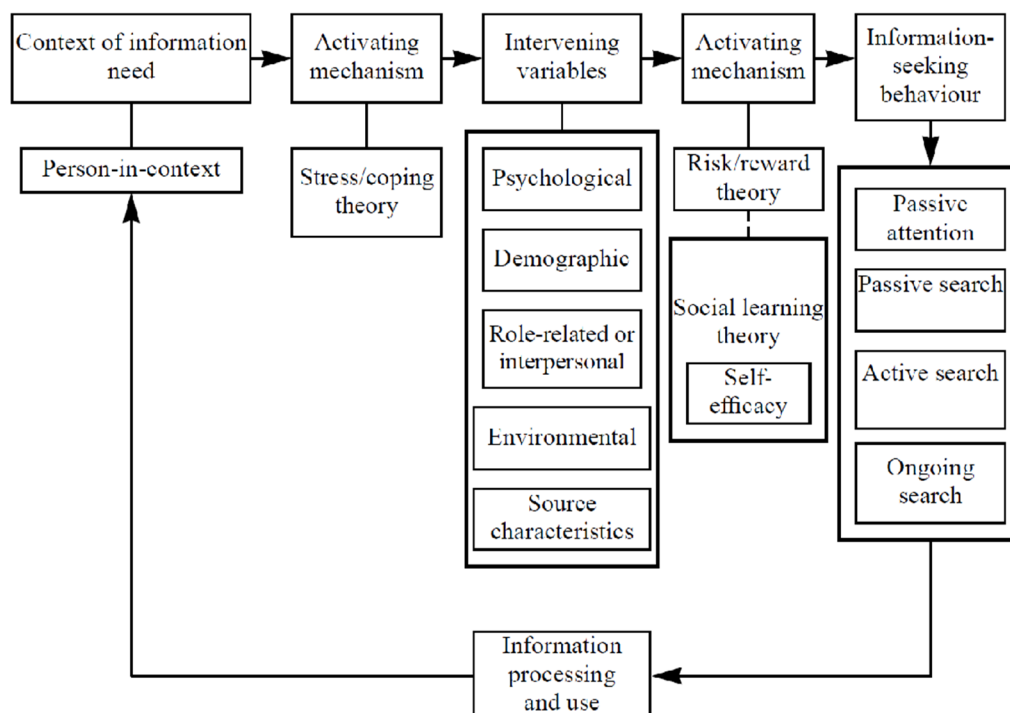

Fig.1   Wilson's 1996 Model of Information Behavior

In 1996, he proposed the well-known general model of information behavior, commonly called the model of information behavior [6]. According to Wilson's model, individuals employ various information-seeking strategies, such as active searching, passive monitoring, and serendipitous discovery, based on their context and objectives when faced with information needs. These strategies enable individuals to seek and acquire relevant information purposefully, minimizing the impact of irrelevant information. Once information is acquired, individuals evaluate and select it to determine its alignment with their expectations and requirements. This evaluation process is influenced by factors like individual information needs, information evaluation, and information preferences, which aid individuals in assessing the quality, credibility, and relevance of information based on specific criteria [7]. Subsequently, the model emphasizes individuals' processing and utilization of selected information, involving activities like information evaluation, integration, and application [8]. This utilization process is shaped by individual knowledge structure, cognitive style, and learning objectives. These help individuals effectively process and utilize selected information to fulfill their learning, work, or life needs and goals [9].

By offering a comprehensive theoretical model, the model provides insight into and guidance for individuals' information behavior in environments characterized by information overload. The model highlights individuals' various behaviors and strategies at different stages to effectively acquire, evaluate, select, process, and utilize pertinent and beneficial information. As a result, the model proves beneficial for individuals in managing the challenges presented by health information overload.

II. Materials and Method

A. Research Methods

The research employed a systematic review approach, systematically collecting and screening relevant articles to comprehensively define 'eHealth literacy'. Information was extracted from the articles based on their fundamental details, methodology, and the definition of 'eHealth literacy'. The concept of 'eHealth literacy', as per Squiers' review method, is categorized into four components: Moderators, which are factors influencing the development and level of electronic

health literacy; Attributes, the central dimension of electronic health literacy; Mediators, the link between the core dimension of electronic health literacy and the outcome indicators of electronic health literacy; and Outcomes, indicators utilized to elucidate the outcomes of electronic health literacy. The quality of the included articles was assessed using the Critical Appraisal Skills Program (CASP) Qualitative Research Checklist. The content related to electronic health literacy in the included documents was extracted and subjected to a detailed thematic analysis involving initial coding, theme identification, and synthesis. Each document sentence was analyzed as a unit, dissecting the sentence structure through semi-semantic analysis. The sentences were then coded into six parts: core, action, object, target, background, and method. Subject identification focused on classifying topics based on the core content of each sentence. Following two rounds of thematic analysis, qualitative research synthesis was completed.

B. Literature Search Strategy

Literature searches were systematically conducted in Scopus, the Web of Science (WOS), and PubMed databases. The search strategy included terms such as 'eHealth literacy,' 'electronic health literacy,' 'Internet health literacy,' and 'digital health literacy,' combined with keywords like 'definition,' 'concept,' 'framework,' 'theory,' and 'model' across all fields including titles, abstracts, and keywords.
Literature screening involves reserving any research on the definition, connotation, and conceptual model of eHealth literacy for the full-text screening stage. During this stage, inclusion criteria consist of research objectives focused on conceptualizing or expanding electronic health literacy and content that addresses various aspects of the review model. Exclusion criteria include research unrelated to electronic health literacy, simply using existing concepts without further development, lack of explanation for electronic health literacy concepts, inaccessible documents, and non-English literature.

III. RESULTS AND DISCUSSION

This synthesis and review of eHealth literacy definitions, models, and measures suggest that the multidimensional construct is a reciprocal intrapersonal skill influenced by individual context, goals, and task-oriented factors. This aligns with the theoretical underpinnings of Wilson's 1996 model of information behavior, which emphasizes the varied behaviors and strategies individuals employ at different stages to effectively acquire, evaluate, select, process, and utilize relevant and useful information [6]. The rapid evolution of the Internet has created a new public health information environment offering convenience, interactivity, personalization, social support, and anonymity, alongside potential drawbacks such as exposure to conflicting health information [10]. The unstable health information quality issue is particularly pronounced in the online public health information landscape [11]. Despite this, existing concepts of eHealth literacy do not directly address this concern. Choosing to anchor the concept of eHealth literacy on Wilson's model is justified as it provides a comprehensive theoretical model that elucidates individuals' information behavior in an information overload scenario. This model delves into individuals' information needs, retrieval strategies, evaluation and selection processes, and information utilization, all core components of eHealth literacy.

A. Existing Definitions of eHealth Literacy

The definition includes health and computer literacy [12], [13]. The importance of a diverse skill set for effective use of technology-based health tools was mentioned [14]. The empowerment of consumers in health decision-making through eHealth resources. Subsequent revisions reflected changes in network technology, while eHealth literacy was leveraging emerging technologies for health [12]. The focus on tailoring eHealth resources specifically for teenagers and Werts highlighted the importance of gathering and analyzing online health information [14]. The influence of cultural and social factors on eHealth literacy and emphasized the critical assessment of electronic health information. The alignment of technology with individual needs and security, the context-specificity and limitations of technology in eHealth literacy [15]. The dynamic nature of eHealth literacy and its dependence on contextual factors [16]. Despite the widespread citation, there remains a lack of consensus and gaps in understanding its impact, highlighting the need for further research [17].

Despite extensive citations related to eHealth literacy, a lack of consensus on its definition and measurement continues to pose challenges for developing effective interventions and accurately assessing their impact across diverse populations [18]. Additionally, gaps still exist in understanding how eHealth literacy influences health behaviors and outcomes in various settings, such as chronic disease management or pandemic response [19]. Therefore, further research must explore the theoretical foundations, empirical evidence, practical implications, and ethical considerations surrounding eHealth literacy in a networked world.

B. Moderators of eHealth Literacy

Various demographic and socio-economic factors influence eHealth literacy. Research indicates that gender, age, race, income, family disease history, education level, language, cultural background, and immigration status can impact an individual's ability to access and utilize online health information [20], [21], [22]. We classify them according to five aspects: psychological factors, environmental factors, source characteristics, role-related or interpersonal factors, and demographic factors.

These factors underscore the importance of further research to explore and compare the influences on eHealth literacy across different contexts and population groups. To systematically analyze the influencing factors of eHealth literacy, this study utilized Wilson's 1996 model of information behavior as a theoretical model [6]. The model posits that information behavior is affected by psychological, demographic, role-related or interpersonal, environmental, and source characteristics. By conducting a thorough literature review, this study compiled and categorized the factors influencing eHealth literacy based on the five aforementioned categories of intervening variables. The goal is to offer valuable insights and guidance for future research and practical applications in the field of eHealth literacy. These factors underscore the importance of further research to explore and compare the influences on eHealth literacy across different contexts and population groups as shown in Fig. 2.

Psychological characteristics (Attitudes, beliefs, and personal characteristics)
Personal experience
Health status, awareness and motivation
Self-management skills and behaviors
Health knowledge and literacy
Learning ability and adaptability
Emotional factors and self-efficacy
Basic literacy (reading and computing ability)
Other literacy(operational literacy, mutual dynamic literacy, self-management literacy, information literacy, background literacy, cultural literacy)

Psychological Factors

Educational opportunities
Trustworthiness and credibility of health information sources
Reliability of electronic health resources and tools
User-friendly design and usability of eHealth platforms
Privacy and security awareness in using digital health tools
Cultural appropriateness of health information
The ability of society to provide appropriate health information
Social changes and initiatives

Source Characteristics

Influencing factors

Complexity of health service system
Complexity of information
Social support
Social culture and patient education
Network environment
Education system
Media

Environmental Factors

Social skills and communication abilities
Ability to handle conflicting information
Patient-provider communication satisfaction
Health literacy of healthcare professionals
Patient engagement and empowerment
Social support and influence
Family and Friends

Role-Related or Interpersonal Factors

Gender
Age
Race and ethnicity
Income
Family disease history
Education level
Language proficiency
Cultural background
Immigration status
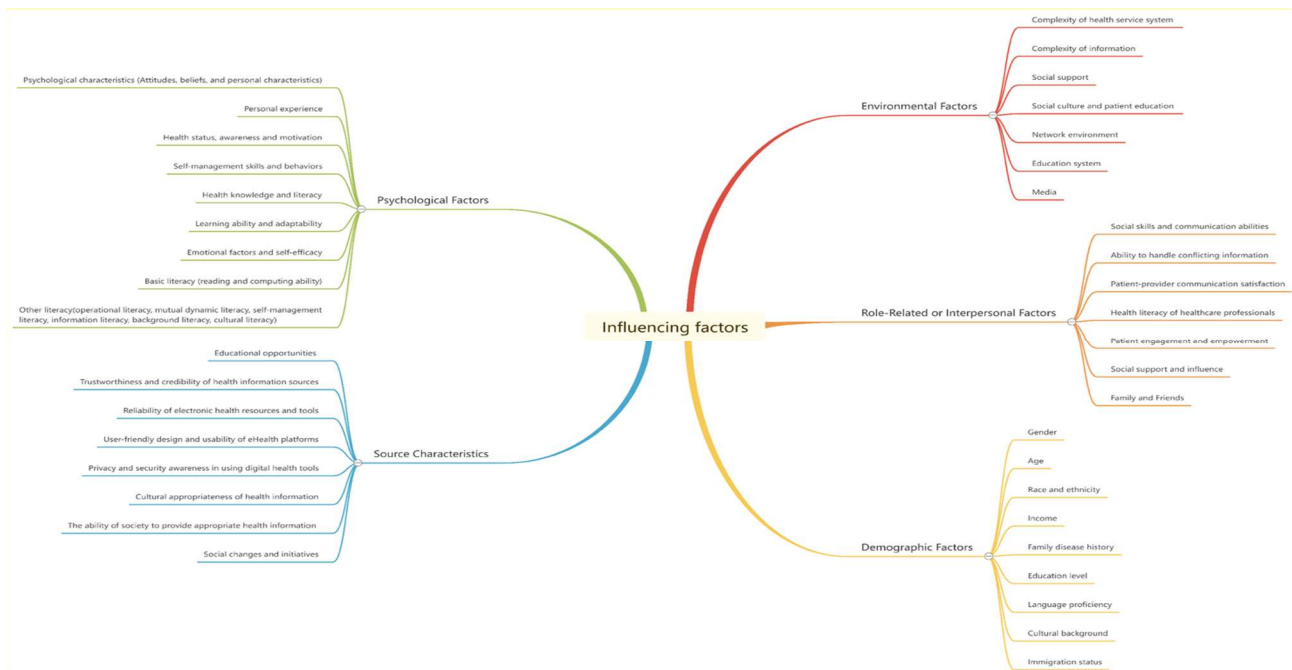
Demographic Factors

Fig. 2 Influencing Factors

To systematically analyze the influencing factors of eHealth literacy, this study utilized Wilson's 1996 model of information behavior as a theoretical model [6]. The model posits that information behavior is affected by psychological, demographic, role-related or interpersonal, environmental, and source characteristics. By conducting a thorough literature review, this study compiled and categorized the factors influencing eHealth literacy based on the five aforementioned categories of intervening variables. The goal is to offer valuable insights and guidance for future research and practical applications in eHealth literacy.

C. Attributes of eHealth Literacy

The concept of skill-based eHealth literacy is a prominent focus in current research. It emphasizes that eHealth literacy is a personal ability or skill [23]. Various theoretical models for eHealth literacy have been identified, including the Lily Model, the Comprehensive Model of eHealth Literacy, the Transactional Model of eHealth Literacy (TMeHL), and the Expanded User-Task-Context Matrix for eHealth Literacy. The Lily model, proposed by Norman et al. 24], outlines general analytical skills applicable to diverse information sources and contexts and specialized skills focused on specific content and contexts. Analytical skills encompass traditional media and information literacy, while professional skills include computer science and health literacy. Although the Lily model is widely used in eHealth literacy research, subsequent studies have identified limitations. In 2011, Norman acknowledged that the model lacked a description of the environment in which it was applied and was not fully compatible with Web 2.0 websites [25].

The existing model fails to adequately account for the influence of cognitive, social, and environmental factors. The comprehensive model of eHealth literacy outlines strategies for facilitating effective communication between patients and service providers across diverse backgrounds, intending to enhance eHealth literacy. This model primarily focuses on addressing health-related issues, emphasizing the importance of contextual, cultural, and communication skills. The interactive model of eHealth literacy posits that patients must trust and utilize electronic health services, engaging in active communication with relevant personnel to enhance their abilities in acquiring, understanding, communicating, evaluating, and applying electronic health information. In addition to patient perspectives, Kayser et al. [26] considered the needs of eHealth product developers and developed an eHealth literacy user-task-background expansion model. This model suggests that eHealth literacy should be enhanced by addressing the needs and skills of healthcare consumers. By delineating users' needs, skills, and backgrounds, this model can assist IT professionals working in the healthcare sector in understanding and designing health service products better, thereby aiding users in improving their eHealth literacy. However, these later-stage models lack formal evaluation and testing, necessitating further research.

D. Mediators and Outcomes of eHealth literacy

Twelve papers explore the impact of eHealth literacy, with some suggesting that it can enhance health through intermediary factors, while others argue that it can directly influence health outcomes [27]. There is inconsistency among studies regarding the classification of specific outcome indicators [28]. Some studies view certain indicators, like improving medical service utilization, as intermediary factors [29], while others consider them as the final results of eHealth literacy. This study distinguishes between two levels of eHealth literacy outcomes: individual and social (system). At the individual level, eHealth literacy is seen to enhance health by improving understanding and use of electronic health information, increasing medical knowledge, facilitating informed health decisions, encouraging participation in health activities, enabling effective use of health services, enhancing doctor-patient interactions, influencing behaviors, improving self-health management skills, and boosting self-efficacy [30].

On the social or health system level, eHealth literacy is believed to enhance the accessibility and quality of medical services, improve individual quality of life, enhance social capital, promote health equity and sustainability, drive social and policy changes, reduce healthcare costs, empower individuals, increase health service satisfaction, and foster community participation [31].

E. Proposed Definition

The following definition of eHealth literacy is proposed:

The capacity of individuals to effectively search, access, evaluate, and apply relevant information based on their physiological, emotional, and cognitive needs for maintaining or improving health when utilizing electronic health resources and technologies.

This definition enhances our understanding of eHealth literacy by placing it within the model of information behavior models. It clarifies that eHealth literacy is not a standalone concept but is closely linked to how individuals interact with health-related information. By incorporating Wilson's information behavior model, this definition highlights the mutual relationship between individuals and electronic health resources. It suggests that individuals, considering their physical, emotional, and cognitive needs, utilize strategies outlined in the information behavior paradigm to effectively navigate, acquire, evaluate, and utilize relevant information across various information environments. This explanation emphasizes the crucial role of individual eHealth literacy in skillfully searching, acquiring, evaluating, and applying relevant information. It suggests that individuals can assess the accuracy and credibility of information, enabling them to sift through a vast amount of data and identify trustworthy sources. Faced with an abundance of information, individuals can distinguish reliable sources from unreliable ones, reducing the harmful impact of excessive and untrustworthy data [32]. Moreover, the definition highlights individuals' proactive approach to utilizing electronic health resources and technologies. Instead of simply consuming information, individuals actively seek and gather information that meets their needs. This targeted strategy empowers individuals to access necessary information without feeling overwhelmed by the flood.

The definition emphasizes the importance of considering individuals' unique physiological, emotional, and cognitive characteristics when using eHealth resources. By customizing their approach, individuals can better address their information needs and avoid being overwhelmed by excessive information. Furthermore, it highlights the practical application of individuals' eHealth literacy skills. Apart from gathering and evaluating information, individuals are encouraged to translate it into actionable steps to enhance the quality and effectiveness of their health-related decision-making processes.

Overall, this definition offers numerous benefits in addressing the challenges of health information overload by promoting informed decision-making, proactive involvement, personalized information consumption, and the practical use of information in managing health effectively.

F. Proposed Model

Consistent with the definition above, Fig 3 presents the Information Behavior Model of eHealth Literacy (IBeHL), which is derived from a systematic review of the literature (i.e., concept analysis) and is theoretically based on Wilson's model of information behavior.
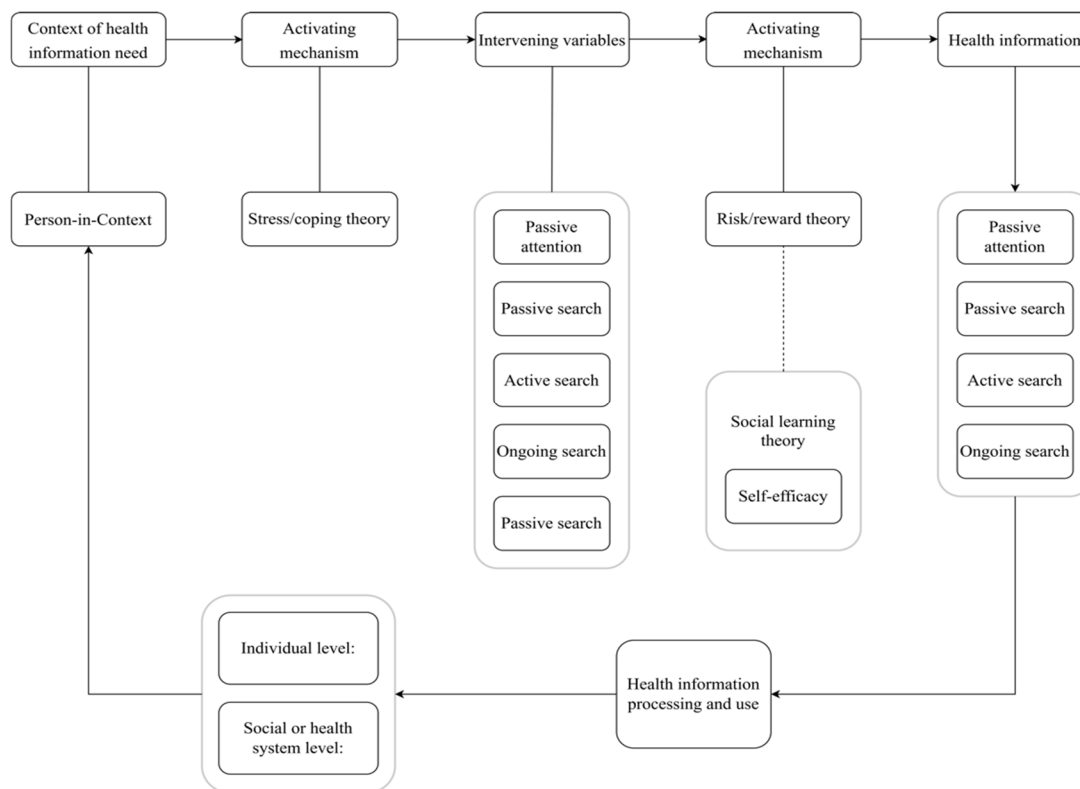

Fig. 3 Information Behavior Model of eHealth Literacy

eHealth literacy is a multidimensional concept encompassing cognitive, technological, emotional, and motivational aspects. It is not solely about accessing and understanding electronic health information but also about individuals' willingness, confidence, and satisfaction. This model considers eHealth literacy to be shaped by various environmental and situational factors and individual traits. It highlights that eHealth literacy is not fixed but dynamic, evolving with social, cultural, organizational, and individuals unintentionally in their daily lives. For instance, individuals may encounter health knowledge or advice while watching television, browsing social media, or conversing with others. This passively received health information can influence individuals' attitudes and behaviors, sparking interest and attention in specific health topics [34].

Therefore, the model acknowledges that the dissemination and reception of health information is a multifaceted process that considers both active seeking and passive exposure. The model views user health information behavior as a dynamic and cyclical process. After meeting certain health needs, users may develop new or more in-depth health needs, leading them to search for relevant health information once again. Thus, users' health information behavior forms an ongoing and expanding process. While existing eHealth literacy models also recognize the dynamic nature, they mainly focus on changes within eHealth literacy itself, highlighting its continuous improvement [35]. Expanding on the utilization of eHealth information, the model organizes relevant research findings and introduces a new conceptual model called eHealth information behavior. This model suggests that eHealth information behavior encompasses not only individual-level health literacy and decision-making but also societal-level health equity and collaboration. Going beyond the traditional definition of eHealth literacy, this model offers a more comprehensive and in-depth understanding of the impact of utilizing eHealth information on individuals and society.

IV. CONCLUSION

A. Principal Findings

In this study, a systematic review of the literature on eHealth literacy was conducted to develop a new model, the IBeHL model, which aims to overcome the limitations of existing models. The model posits that eHealth literacy is a dynamic, multidimensional, and context-dependent concept influenced by various factors, including individual characteristics, information sources, and the environment. It presents a continuous cycle model that systematically considers the impacts of different intervention variables on eHealth literacy, such as individual traits, information sources, and the environment. Integrating theories and concepts from diverse fields, the model provides a comprehensive perspective on eHealth literacy, encompassing psychological traits, demographic characteristics, social environment, and information sources. Moreover, it provides a practical model for studying and enhancing eHealth literacy, guiding intervention measures, and improving health information practices. The adaptable model can be tailored to specific research needs, allowing researchers to incorporate additional factors or theories based on their goals and contexts.

technological contexts and health challenges. Recognizing eHealth literacy as a process rather than a static outcome implies that interventions and support can enhance individuals' eHealth literacy, leading to improved health outcomes and quality of life [33].

The model posits that individuals not only actively seek out health information but also passively receive it. This means that people not only search for and select health information based on their needs and interests but also encounter health

B. Limitations

This study's limitations include its reliance on existing literature, which may not fully capture the rapidly evolving landscape of eHealth literacy. Additionally, the study did not address the impact of emerging technologies and digital platforms on eHealth literacy. Future research should consider longitudinal studies to observe the evolution of eHealth literacy over time and examine the effects of new digital tools and platforms. Furthermore, while this study employed rigorous extraction procedures and included gray literature, it is possible that not all eHealth literacy models, definitions, and measures were considered due to the constraints of our literature extraction timeline. The definition of electronic health literacy may also be overly broad, lacking clarity regarding which knowledge, skills, beliefs, and attitudes are most critical or fundamental, as well as how to measure an individual's level of electronic health literacy effectively.

NOMENCLATURE

eHEALS	e-Health Literacy Scale
IBeHL	the Information behavior Model of eHealth Literacy
TMeHL	Transactional Model of eHealth Literacy
CASP	Critical Appraisal Skills Programmer (CASP) Qualitative Research Checklist

CONFLICT OF INTERESTS

The authors declare that they have no competing interests.

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