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Quality and Content of Online Information Related to "Immunity Boosting"

Anu Shrivastava, Aparna Agarwal, Swati Jain*

Abstract

In this era of "infodemic," online health information has become a prime concern, and therefore, an analysis of studies on online health information, the reasons for which people seek online health information, its strengths and shortcomings, and the concept of E-health literacy has been done in this paper. Various tools to assess online health information and recent papers on assessment using DISCERN tool have been discussed. The concern for immunity boosting and its significance in the COVID era has grown manifold, especially for providers and consumers of health information. Online health information has become a vital part of healthcare in modern times; however, its quality seems to differ across domains. Online information on immunity boosting also seem to be misleading the people. This article provides an insight into the sphere of online health information and throws light over the hurdles that people come across face while retrieving health information online.

Keywords: COVID-19, Discern tool, E health, Health literacy, Online health information

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Introduction

The past century has seen numerous innovations in the field of science and technology, with a major breakthrough being the internet. Since its advent, sharing information has been the quintessence of the internet. It has become the most important mass medium for communication. It is estimated that around 4.13 billion people use internet globally.[1] Of these, India alone has 503 million users, making it a country with largest number of internet users, second only to China.[2] Nowadays, internet has become an integral part of one's life. Its evolution from web 1 in which the internet users could only read information available online, to web 2 where the user not only can read but also write in the form of comments, ratings, recommendations, etc., has cause significant changes in the sphere of online information transmission as in the case of latter, the consumers can collectively determine the value of the quality of the information that is presented online.[3]

Online Health Information

Internet – A New Dimension to Healthcare

The popularity of internet as a source of health information has been ever increasing, especially with increase in its penetration in all parts of the country. The penetration of internet has increased from 7.5% to 50% in the past decade in India.[1] An increasing number of people are now turning to internet to find health information. According to Google Health Vice President David Feinberg, everyday, about 7% of searches on Google are health related, reaching around 70,000 each minute.[4] Results of "India Health online survey" shows that 49% of Indians search for health information on the Internet.[5]

Composition of Online Health Information Consumers

It is estimated that males constitute about 75% of the total internet users in India,[2] and about 70% of online health-care information seekers.[5] The same survey showed that 44% of the health information seekers belong to the age group of 26–35 years, followed by 29% of 18–25-year-old people and around 12% of the people in the age group of 46–55 years.

Infodemic Amidst the Pandemic

The General Director of the WHO has rightly said "We're not just fighting a pandemic, and we're fighting a infodemic."[6] The term "infodemic" means overabundance of information, whether accurate or not, which makes it hard for health information seekers to find trustworthy and reliable guidance when they need it.[7,8] It has also been observed that the rate at which fake information has been spreading is much faster than the spread of the virus itself.[6] Public health experts are of the opinion that spread of correct health information at the right time, especially during a pandemic, has a great impact on how the people respond to such outbreaks.[9] The epidemic of misinformation, without proper scientific evidence, imposes formidable challenges on both the consumers as well as the health educators.[10]

Reasons for Searching Online Health Information

There are myriad of reasons, for which people prefer using internet for health information. These reasons differ according

Department of Food and Nutrition, Lady Irwin College, University of Delhi, Delhi, India.

Corresponding Author: Swati Jain, Department of Food and Nutrition, Lady Irwin College, University of Delhi, Delhi, India. E-mail: swati.jain@lic.du.ac.in

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to the age group, sex, and socioeconomic status of the individuals.[11] Convenience in accessing large volumes of information, with absolute anonymity and privacy on diverse topics in the blink of an eye and with minimal cost, is some of the common reasons, for which people look up web-based health information.

Data from the survey, "Surveying the Digital Future, Year 4" show that 75% participants reported searching information online about a health problem (actual or perceived) that they or their loved ones had, to gain better understanding of the problem, followed by ease of finding the information and wide availability of health information.[11]

In a study by Soni *et al*.[12] on the urban population of Chandigarh, nearly 53% respondents quoted easy accessibility and lack of trust in doctors as reasons for searching health information online and considered it economical. About one-fifth of the participants felt it necessary to gain some knowledge about their health condition from internet before visiting a doctor. And for 4.3%, people difficulty in getting doctor's appointment was the reason.

Strengths and Shortcomings of Online Health Information

Just like "there are two sides to every coin," the wealth of information on Internet also has its own bright and dark sides. The Internet has played a commendable role in making people more aware and better informed about their health condition which leads to better health outcomes, increased compliance to treatment regimes, and builds a positive patient-physician relationship.[13] Individuals empowered with good quality health information are likely to make better informed health-related decisions jointly with the health-care providers.[9,14] Web enables individuals to investigate almost any topic they want to, along with comparing it from diverse sources.[15] Access to health information quickly and conveniently can help individuals lead healthy lifestyles, making them proactive in tracking their symptoms, and detecting problems in advance, along with seeking timely help and better management of the health problem.[16]

However, a major concern of the health-care providers has been the quality of information that people read online which largely remains unregulated with wide variability in accuracy, quality, and readability.[17] Inaccurate, overabundant and incomplete information can cause confusion and can lead to either false or over optimistic expectations from the treatment choices opted or from the health-care providers. This can also hamper the patient-doctor relationship and trust between them especially when the misinformation contradicts the health-care professionals.[18,19] In the sea of information, finding good quality information may take a lot of time and filtering out accurate from inaccurate information might even be impossible for laymen lacking the skills to do so.[18]

Therefore, many times, virtual access to the topmost health information is counterbalanced by the inaccurate information, leading to wastage of precious resources such as money and time.[16] Infodemic, impregnated with misinformation in the face of a pandemic, can, further, lead to increase in deaths, delays in treatment, and wastage of resources along with adding to further chaos and confusion among the masses.[20]

E-Health Literacy

Health literacy is the extent to which a person is capable of acquiring, processing, and comprehending the health-related information which is required to make decisions appropriate for their health condition.[10] This ability is particularly lower in certain sections of the population such as older adults, disadvantaged individuals, and people with limited or no education. When such people look for information, they are more likely rate information with good picture quality, sites appearing first during web searches, and with celebrity endorsements as more trustable information.[10,21]

Modern society faces the health decision-making paradox. Without adequate knowledge and skills to find, assess, and utilize health information, people are bombarded with tons of information on health and lifestyle information. This has led to "health literacy crisis." Poor competencies in health literacy have resulted in inaccurate health choices, degradation of health, and loss of human and financial resources.[22]

Similar gap exists between online health information and the skills of the consumer in using them for their health-care needs.[23] Other than basic literacy, it also requires knowledge about using computers, and an understanding of how and why online information is created, shared, and received.

E-Health Literacy Model

E-health literacy is the use of modern technology and communication systems for better health and healthcare. A person with adequate E-health literacy levels is capable of using electronic sources for seeking, finding, understanding, and appraising information that is related to and applying the same in solving health problems.[23]

The E-health literacy model by Norman and Skinner[23] is an amalgamation of six core literacies [Figure 1]. These can be broadly divided into analytic (applicable to diverse range of topics or contexts) and context-specific (which is specific to every situation).

1. Traditional Literacy – It refers to ability of a person to read, write, and speak any one language. With more than 65% of content in English, internet-based health information is more likely to be better understood by English speaking populations worldwide[24]

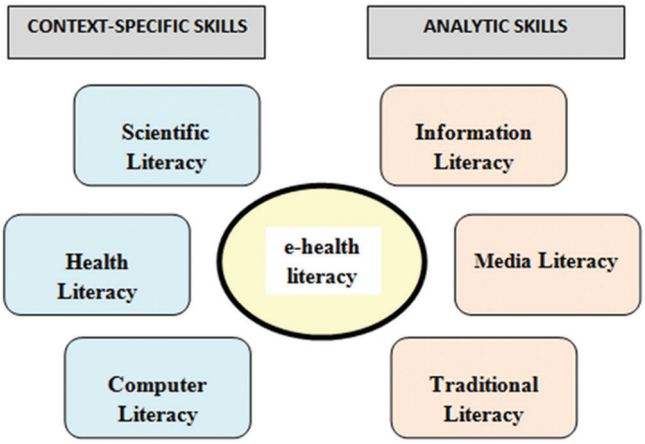

Figure 1: Core literacies that make up E-health literacy

2. Health Literacy – It refers to the ability of the person to read, interpret, and act on health information. Its inadequacy may result in difficulty in following the instructions provided, taking decisions and in engaging in self-care activities
3. Computer Literacy – It refers to ability to use computers and adapt to changes in technology along with access and utilization of E-health of information
4. Information Literacy – It refers to the ability of a person to find and use information
5. Media Literacy – It is a combination of cognitive processes that enable people to understand how media shapes messages that are conveyed
6. Scientific Literacy – It refers to exposure to and understanding of scientific thoughts and online health information.

Quality of Online Health Information

The uncontrolled explosion of health information of the web in the recent decades has raised the concerns over the quality of such information.[14] In the face of the COVID-19 pandemic, people are relying more on the internet to quench their thirst for information. With no mandatory quality standards and filters on quality and accuracy, internet has enabled myths and pseudoscience to proliferate rapidly.[25,26]

Three basic necessities for quality information[9,27] are that it should –

1. Be objective, free from any misinformation or propaganda
2. Be complete, and not just partial information
3. Be plural, and present all aspects of the subject and not limited to a particular outlook.[9]

History of the Research Field

In its conception, during the mid-90s, the early studies focused only on imparting knowledge about the internet to the health-care providers. Gradually, the transition began, and studies focusing on more specific health topics, evaluating the information available to the patients began to emerge. Among these, the first was a study by Impicciatore *et al.*,[28] in which the web-based information on fever management in children was assessed. Its authors reported that, out of 41 websites evaluated only four had appropriate accuracy and were complete. This study turned out to be a milestone, providing a framework for later studies by researchers of various disciplines conducting assessment of quality of information in their own fields.[29]

Inconsistent Quality of Internet-Based Health Information

Blogs and website contents can be written by anyone, and often by people presenting themselves as subject experts without any formal qualifications or credentials related to the same.[25,26] Findings of several studies conclude that largely unregulated web content varies widely in quality, accuracy, and readability.[17]

According to Kaicker *et al*.,[17] the chances of encountering a substandard website are dependent on the proportion of poor quality websites and a person's ability to filter out such websites. These can lead to adverse health outcomes in target populations. However, the use of standardized evaluation tools can enhance the user's ability to locate trustworthy sites.[17,30] Various indicators in the form of quality evaluation tools have been developed to score the websites with the most common ones being the DISCERN tool, JAMA benchmarks, and HONcode.[16]

According to a systematic review by Eysenbach *et al*.,[30] around 70% of the reported studies concluded that the quality of information was a major problem; with incompleteness, inaccuracy, and difficulty in locating high-quality websites being of prime concern. Content quality was one of the most significant problems in most studies. Inaccuracy in the web content was also found to differ across domains, like inaccurate information on diet and nutrition sites were found to be in the range of 45.5–88.9% in the studies as compared to around 5.7% for the cancer-related websites, suggesting that diet-related information is poorer than cancer-related information on net.

Recent studies assessing COVID-related health information[6,9,19] have found that a large proportion of information was of low quality. In the study by Joshi *et al*.,[9] the websites were categorized on the basis of their extensions, and the results showed that most of the.com and.edu websites scored the lowest. About 70% of the total websites got an overall low quality score and the remaining scored moderately with none of the sites achieving a high quality score[6] using DISCERN tool which is a standardized tool for evaluation of quality of health information on the internet.

Several other studies have been done on various search engines about diverse health-related topics, some of which are shown in Table 1. The results indicate that there is variation in quality of information on the internet depending on the topic and quality parameter being assessed.

Table 1: Other studies using discern tool on diverse health-related topics

Topic	*Authors*	*Search engines*	*Overall quality*
Chronic pain	[17]	Google, Yahoo, and MSN	Moderate
Childhood epilepsy	[13]	Google	Moderate (64%);10% good and 26% poor
Asthma	[31]	Google, AOL, Yahoo, Ask, Lycos, Bing, and Blekko	Moderate
Colorectal cancer	[18]	Google and Hotbot	Low (38.1%), Moderate (36.6%), High (15.3%)
COVID-19	[19]	Google	Low
COVID-19	[6]	Google	Low (70.0%)
Coronavirus	[9]	Google	Variable
Esophageal cancer	[32]	Yahoo, Google, and Bing	Low (50%)
Diverticulitis	[33]	Google, Bing, and Yahoo	Moderate
Colorectal Cancer	[34]	Google	Moderate
Migraine	[35]	Google	Low to moderate
Breastfeeding	[36]	Google, Bing, and Yahoo	High - 77.8%
Fibroids	[37]	Google	Moderate to low (88%)
Nutritional information	[38]	Google and Yahoo	Variable
Metabolic syndrome	[39]	Google, Yahoo, and Bing	Low to moderate
Diabetes	[40]	Google, Yahoo, and Bing	Variable

Key Indicators of Quality

Since the dawn of the era of World Wide Web, concerns over the quality and its parameters for online health information have been persistent.[10] However, accuracy of information is not the only quality criteria to embrace a piece of health information to be of appropriate quality.[38] Several other important indicators are currency, referencing, design and esthetics, navigability, functionality, etc.[38]

With no stringent method to identify quality web-based information, several authors have devised their own set of quality indicators for such information. According to Silberg *et al*.,[41] essential measures of information quality are "authorship" which refers to all the authors and contributors to the information and their affiliations, "attribution" which means all the sources which have contributed to the information being provided, "disclosure" of the ownership of the website and of funding agency (if any), and "currency" which means when the information was posted and updated.[42]

Sarah Blakeslee has given five categories which indicate quality of health information, which are, "currency**"** (or timeliness) of the information, the "relevance" of the information to the topic, as per the intended audience, "authority" which refers to source of the information author's credentials or organizational affiliations, "accuracy" which includes reliable, true and correct information free from bias and supported by evidence, and "purpose" with an indication of whether it is a fact, opinion or propaganda.[43]

Närhi *et al*.[44] emphasis on five points for assessing the health information, which are the date on which the information was updated, the author of the article and whether the author was qualified enough to write it, whether valid sources and references used to create it, the purpose of the site and who is sponsoring it.

Approaches for Quality Control of Health Websites

Two approaches have been recommended for ensuring good quality health information to the masses, that is, the top-down approach and the bottom-up approach. In the top-down approach**,** the central authority handles the information being proliferated with the help of electronic filtering[14,17] and legal interventions, such as ethical code of conduct.[3] Bottom-up approach is a downstream level, decentralized method of handling health information[3] such as use of quality evaluation tools by the consumers of health information.

Tools to Assess Quality of Online Information

DISCERN Tool

Developed at Oxford University, it is the first standardized quality index.[6,45] Initially, this tool was developed to enable patients, consumers, and health-care providers to determine the quality of written health information.

DISCERN tool includes 15 questions, to allow consumers to evaluate whether the quality of information is reliable, current, and unbiased and 1 question to rate the overall publication. The first section, that is, questions 1–8, of the tool address the reliability along with dependability and trust worthiness [17] of the source of health information. The second section, that is, questions 9–15, assesses the details of treatment options (which means the range of possible options to deal with a health problem and includes conventional and alternative treatment options, self-care, and psychological and emotional treatment options) and the last question is for rating the overall quality of the publication which is based on the rater's judgment of the publication as a source of health information. A Likert scale ranging from 1 to 5 is used for rating, where 1 implies that the quality criteria has not been fulfilled by the publication, scores 2–4 indicate that the quality criteria has been partially fulfilled and five indicates that the quality criteria have been completely fulfilled.[36,46] It is the most used quality rating tool for websites and can be used for any written piece of health information.

JAMA Benchmark

Published in 1997, it consists of a set of four quality criteria suggested by Silberg *et al*.,[41] that is, authorship, attribution, disclosure, and currency, which are to be answered either yes or no for any piece of information. Although considered a very useful tool which can be easily administered, it is not sufficient to assess the content reliability of the information.[6,19,42] Moreover, it does not have a scoring criteria and, therefore, cannot tell the extent of misinformation on a website.

Other than these tools, a voluntary code of conduct has also been developed to help consumers locate high quality information.

HONcode

It was developed by the Health on the Net (HON, Geneva, Switzerland) Foundation and is used to evaluate the quality of websites. HON is an NGO that certifies websites with their logo if they fulfill their eight quality criteria, that is, authority, complementarity, confidentiality, attribution, justifiability, transparency, financial disclosure, and advertising.[42]

Immunity Boosting in the Times of Covid-19

Immunity can be defined as the ability of the body to fight-off pathogenic microbes by the immune system.[47] Immune system does so with the help of:

- Physical and biochemical barriers (such as skin, mucus, and gastric acid)
- Immune cells (such as T- and B-cells)
- Antibodies (like immunoglobulins).

Immune system is a complex entity and its competence is dependent on many factors. A bidirectional relationship exists between immunity, infection, and nutrition with each one affecting the other.[47]

Factors Affecting Immune System Functioning

A large number of factors are presumed to be affecting the functioning of the immune system. Optimal nutrition, along with lifestyle, age, heredity, environment, stress levels, etc., impacts the immune competence of an individual.[47]

Role of Micronutrients

An ever-growing interest has been seen among people for immunity boosting nutrients and food items, which most probably stems from articles by Linus Pauling, suggesting higher than

recommended intake of vitamin C for prevention of infection.[48] Since then, several micronutrients and bioactive compounds have been determined to be having immunomodulatory effects and enhancing the immunocompetence, thereby, helping body fight infections and foreign invaders [Tables 2 and 3].

Role of Other Factors

Other factors that are responsible for the functioning of the immune system [Figure 2] are poor lifestyle, chronic stress, lack of exercise, excessive consumption of high fat, salt and sugar foods, health condition and diseases, etc.[47]

Rise in Searches and Sales for Immune Boosting Products during COVID

Nowadays, boosting the immunity has become synonymous with preventive measures from COVID, with many such products and practices being presented online as strategies to avoid or help fight the virus.[20] An analysis of Google trends (a tool which tracks the searches people make online) shows a spike in searches during the pandemic for "immunity bosting" by 500% compared to the pre-COVID times.

In a pan India survey by Pronto Consult Firm, it was found that of every 100 medicinal bills, 92 were for immunity boosting products with about 82% of them being for "immunity boosting drinks" which were <40% during pre-COVID times.[50] The same survey revealed that, about 45% of consumers bought products containing Vitamin D and Zinc along with an increase in demand for products containing amla, tulsi, haldi, honey, ginger, lemongrass, etc.[51]

Previous Studies Assessing Immunity Boosting Related Online Information

In the COVID era, immunity boosting has become the new buzzword. Due to the rise in Infodemic, myths and pseudoscience surrounding immunity boosting and extravagant claims on its potential in preventing and fighting COVID have been spreading like a wildfire. The idea that more active the immune system, healthier the person is being promulgated across various platforms.[52] However, experts warn, that a hyperactive immune system may be responsible for allergic reactions and may even prove to be fatal, as is being seen in the case of cytokine storm associated with many COVID-related deaths.[53] Although many micronutrients have been considered important for proper functioning of the immune system, there are no studies which support the claims that taking them in large amount above the RDAs will confer any additional health benefits.[52]

Results of a study by Rachul *et al*.[20] show that vitamin C, diet, sleep, and exercise are the most common strategies recommended for boosting immunity. Over 85% webpages presented immunity boosting as beneficial compared to only ten critiquing it. About 40% claimed supplements to be necessary for boosting immunity without providing any scientific basis for the same. However, another study which assessed the immune boosting content on Instagram found that all the posts sampled for the study had portrayed immunity boosting as beneficial for reasons such as protection against diseases, skin health, better mood, etc.[54] Furthermore, most popular posts which were hashtagged with #immunebooster were commercial content lacking sound science. Here also, food and diet, supplements, essential oils, and exercise were the common approaches suggested for boosting the immune system.

Table 2: Micronutrients and their immune system functions

Micronutrient	*Function*
Copper	Intracellular antioxidant
	Inflammatory response
	Production of antibody and cellular immunity
Iron	Helps in free radical formation which react against bacteria and viruses
	T lymphocyte proliferation and differentiation
	Takes part in enzymatic action against pathogens
Magnesium	Improves lung functioning
Selenium	Important for T cells proliferation and natural killer cells activity
	Improves antiviral immunity and antiviral vaccine responses
	Decreases virulence of certain influenza strains and some viruses
Vitamin A	Resistance to infections
	Synthesis of T lymphocyte and maintains lymphocyte pool
	Plays a role in treatment and prevention of infections of the respiratory tract
Vitamin B12	Immunomodulator
	Lymphocyte production
	Indirect role in antibodies production and metabolism
Vitamin B6	Inflammation regulator
	Synthesis of amino acids cytokines, antibodies
	lymphocyte proliferation, differentiation, and maturation
Vitamin B7	T lymphocyte formation
	maturation of immune cells
Vitamin B9	Maintenance of innate immunity
	Antibody response to antigens
	T-cell proliferation
Vitamin C	Positively modulates immunosenescense and aging
	Positively modulates low-grade inflammation
	Improves the levels of antibodies, and their proliferation
	Prevention and treatment of respiratory infections
	Reduces pathogenicity of microbes
Vitamin D	Stimulates response of innate immunity in bronchial epithelial cells
	Stimulates differentiation of monocytes to macrophages
	Stimulated systems involved in pathogen elimination
Vitamin E	Helps in cell protection as it is membrane antioxidant
	Lymphocyte proliferation
Zinc	Regulated inflammatory cytokines
	Participates in anti-inflammatory pathways
	Helps in immune cell maturation and differentiation
	Its deficiency associated with impaired innate immunity

Adapted from de Souza Monnerat *et al*.[49]

Table 3: Effects of certain foods and their bioactive compounds on the immune system

Food	*Bioactive compounds*	*Effects*
Citrus fruits	Vitamin C	Improves phagocytic capacity of neutrophils Helps in lymphocyte proliferation
	Polyphenols	Antioxidant Anti-inflammatory
Cocoa	Flavonoids	Antioxidant Anti-inflammatory Protects against certain influenza strains
Garlic	Allicin and thiosulfinates	Antiviral, protective against flu virus, antibiotic, anti-inflammatory
Ginger	Gingerols	Anti-inflammatory, antioxidant, improvement in respiratory function
Grapes	Resveratrol	Immunomodulatory, prevention of infectious diseases, reduces viral replication at higher doses
Linseed	PUFAs (omega 3)	Anti-inflammatory, decrease inflammatory cytokines
Propolis	Phenolic compounds	Antimicrobial, antiviral, antifungal, anti-inflammatory
Turmeric	Curcumin	Anti-inflammatory, antioxidant, protects against pathogens

Adapted from de Souza Monnerat *et al*.[49]

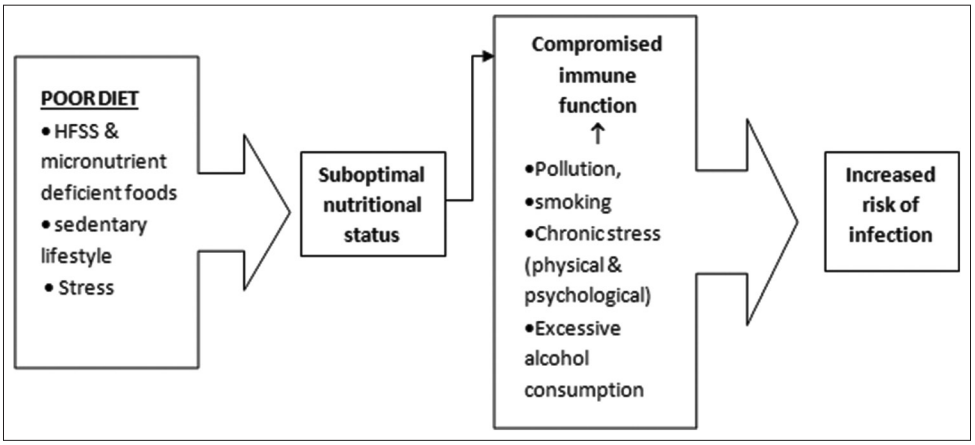

Figure 2: Lifestyle factors affecting the immune function. Adapted from Maggini *et al*.[47]

Conclusion

The sphere of online health information is evolving continuously. The information available to users varies widely in its quality which is of great potential danger, especially in case of health related misinformation. The arrival of the COVID-19 pandemic has, further, added fuel to the fire. People are being bombarded with information about the need to boost immunity, along with numerous ways to do so. Various products such as mattresses, shirts, and herbal supplements are being advertised as immunity boosting or preventive against COVID infection.[55] With limited health literacy, people are more likely to fall pray to these misinformation being circulated as can be seen in cases of doctors reporting increase in patients with toxicity due to over consumption of certain nutrients or herbal preparations.[56] This also arouses a need for assessment of information present on various online platforms to find out the proportion of false information and development of ways to enhance the ability of people to spot these and collect only good quality information for decision-making related to their health.

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