Metaverse & Virtual Transformation. 2025, 1(2): 21-37.

The International Journal of Metaverse & Virtual Transformation (IJMVT)

https://mvt.artahub.ir

ORIGINAL RESEARCH ARTICLE

Defining Knowledge Logistics Indicators in Telemedicine: A Systematic Review

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ARTICLE INFO

Article History:
Received: 2024-08-25
Revised: 2024-11-27
Accepted: 2025-03-12
Published Online: 2025-06-01

Keywords:
Knowledge logistics, Telemedicine, Medical knowledge logistics, Telemedicine knowledge logistics, Indicators of knowledge logistics in telemedicine

Number of Reference: 65
Number of Figures: 1
Number of Tables: 3

DOI:

ABSTRACT

The technological developments of the 20th century led to the increasing popularity of technology in all fields, including medicine, resulting in the emergence of telemedicine. The present study aims to examine the components of knowledge logistics in telemedicine. This applied study was conducted using a systematic review method, adopting the PRISMA model for article selection. Inclusion criteria comprised all open-access relevant sources. Data were collected from the Scopus database, and all selected sources were analyzed. The reviewed sources covered the period from 2005 to 2022. The thematic focus shifted over the years from e-health to mobile health, addressing issues such as travel, chronic disease monitoring, and particularly maternal health and pregnancy. The identified components of knowledge logistics in telemedicine included knowledge-based, infrastructural, logistical, policy-related, and demographic factors. Additionally, systemic components such as inputs, processes, outputs, outcomes, and impacts were identified. Knowledge logistics and telemedicine are two emerging topics. Telemedicine, due to its longer history, benefits from richer resources. According to the findings of this study, attention to logistical aspects is essential for the implementation and execution of telemedicine. **©authors**

►**Citation:** Dehkhodaei, R., Hassanzadeh, M., Sharif, A., & Ahmady, S. (2025). Defining Knowledge Logistics Indicators in Telemedicine: A Systematic Review. *The International Journal of Metaverse & Virtual Transformation (IJMVT)*, 1(2): 21-37.

Introduction

As a result of developments in the 21st century, we have witnessed the increasing popularity of technology across all fields and professions, including medicine. One of the impacts of technology on medicine is the emergence of telemedicine, or remote medical care, with research in this area dating back to 1970 and continuing to grow rapidly (1). More precisely, the term telemedicine appeared in the medical sciences lexicon in 1920, and NASA was the first organization to use satellites to establish communication between physicians on Earth and astronauts for medical consultation.(۲)

Telemedicine can be defined as the use of information and communication technology to create, enhance, or accelerate healthcare services in combination with networks and computer systems. This involves the transmission of text, images, audio, video, or converted electrical signals. By leveraging multimedia tools, telemedicine provides a certain temporal and spatial independence in medical services and therefore requires robust infrastructure.(۳)

The British Telemedicine Association defines telemedicine as the provision of healthcare services using information and communication technologies by professional specialists to exchange information related to the diagnosis, treatment, and prevention of diseases, as well as conducting research, in a correct manner (2). Similarly, the Iranian Telemedicine Association defines telemedicine as "performing all medical processes between a physician and a patient when a geographical distance exists between them, which accelerates medical services. In this method, using the Internet, satellite networks, videoconferencing systems, and other communication tools, tests and medical diagnoses regarding a patient are sent to the relevant physician in different parts of the world for consultation on treatment.(۴) "

Telemedicine aims to improve healthcare services and accessibility through remote diagnosis, remote consultation, remote monitoring, remote coaching, remote conferencing, and remote treatment prescription (5). Its benefits include improving the quality of healthcare, enhancing access in rural and underserved areas, promoting professional interactions and knowledge exchange between specialists in rural and urban centers, reducing costs, minimizing unnecessary travel and time, enabling specialists to work in multiple hospitals and healthcare centers, facilitating information sharing—especially expert opinions—increasing efficiency, reducing mortality and disability, promoting health equity, and many other advantages.(۶)

Additionally, telemedicine provides benefits in managing chronic diseases, prevention, diagnosis, treatment, consultation, and remote education, connecting all health-related entities such as patients with healthcare centers, centers with hospitals, and hospitals with specialized hospitals. This technology improves access to healthcare in various regions, especially underserved and rural areas, increases efficiency, reduces mortality and disability, and promotes health equity (2). The scope of telemedicine ranges from a simple conversation between two physicians about a patient to more complex scenarios, such as using satellite technology for evaluation, prevention, diagnosis, or even treatment of a patient. Overall, telemedicine ensures rapid access to healthcare services with higher quality and lower cost, regardless of the patient's geographical location, and significantly optimizes the use of available financial and human resources.(۷)

Despite the existence of a favorable implementation culture in the field of telemedicine, the inadequate current infrastructure and the present level of specialists' awareness make the provision of remote medical services extremely difficult. The responsibility of the current generation is to utilize technological advantages to improve the quality of care and treatment. Unfortunately, health system managers and planners are often not familiar with this technology, its areas of application, or the benefits and added value it can provide to the healthcare system.(۸)

Furthermore, developing countries face numerous challenges in healthcare provision, including financial constraints, limited resources, lack of expertise, physician shortages, poor roads and transportation facilities, and difficulties in safely transporting patients, especially in rural areas. Many villages lack even basic medical facilities, leaving residents without access to medical care even in emergencies, forcing them to travel long distances away from their homes and workplaces to receive care. This issue is particularly significant for a country like Iran, which suffers from a dispersed population, weak infrastructure, limited access to specialized medical centers, and an aging population requiring specialized care. Rapid therapeutic strategies and reducing time wasted in timely diagnosis are crucial in such contexts.(۲)

Logistics is a concept that facilitates access to and provision of the necessary knowledge. In this regard, knowledge logistics can offer an integrated approach to supporting the supply of required knowledge. Smirno (2004) argues that to create awareness and properly manage any organization, knowledge must be shared, and it is essential that knowledge is delivered to the right person, at the right time, with the right purpose, and from integrated distributed sources. These aspects are collectively addressed in knowledge logistics. Therefore, in knowledge logistics, based on three objectives—specific user requirements, available knowledge resources, and current situational analysis—support for user activities is provided intelligently.(۹)

Among the benefits of knowledge logistics in healthcare organizations are the reduction of medical errors, collaboration and innovation for participatory diagnosis, creation of knowledge transfer networks, improvement in care quality, and cost reduction (10). Considering the importance of telemedicine, especially during the emergence of the COVID-19 pandemic (11), which reduced physical presence and consequently increased engagement in digital environments, the importance of organizations aligning with digital transformation is evident (12). One outcome of this trend in healthcare has been the emergence and development of telemedicine.

However, it should be noted that this field requires receiving or sharing tacit knowledge and converting it into explicit knowledge. Since tacit knowledge is personal and individuals may not be aware of their tacit knowledge or may hesitate to share it, and because information and communication technology relies on collective participation, which can sometimes limit the capacity to absorb, grow, and maintain the personal identity of involved actors, this becomes a critical factor in establishing connections among individuals and utilizing their tacit knowledge (13). Another challenge for physicians in this environment is dealing with patients in the information age, where it is often unclear how patients obtained their information or conducted their searches, which affects clinical practice and poses significant challenges for treating physicians.(۱۴)

The aforementioned challenges, combined with insufficient awareness of the importance, usability, and potential of knowledge management and logistics in healthcare, lack of motivation and commitment among staff, absence of trust, confidentiality and security measures, and the lack of integration among IT-based systems such as telemedicine, electronic health records, decision support systems, etc., necessitate overcoming these challenges through appropriate knowledge management strategies (10). Knowledge logistics is an emerging concept in knowledge management that effectively supports the provision of necessary knowledge to overcome telemedicine challenges. Therefore, the present study aims to conduct a systematic review of published resources in this field, focusing on the indicators of knowledge logistics in telemedicine from a systemic perspective. The main objective of this research is as follows:

Research Objective

The main objective of this study is to conduct a systematic review of knowledge logistics indicators in telemedicine.

Sub-objectives

-To examine the thematic focus of selected studies over the years.

-To identify knowledge-based, infrastructural, logistical, policy-related, and demographic factors in telemedicine.

-To identify systemic components of knowledge logistics in telemedicine.

Research Questions

1 .What has been the thematic focus of telemedicine studies over different years?

2 .What knowledge-based, logistical, infrastructural, policy-related, and demographic components have been considered in telemedicine?

3. From a systemic perspective, what components have been emphasized in telemedicine?

Method

This study employed a systematic review approach focusing on knowledge logistics in telemedicine. The terms 'Knowledge logistics' and 'Telemedicine' were searched in the Scopus and PubMed databases. Keywords were selected using MeSH subject headings and expert consultation in healthcare and knowledge management. Due to the lack of relevant resources in Persian databases, these were excluded from the study. Inclusion criteria comprised all relevant open-access sources. Article selection followed the PRISMA framework.

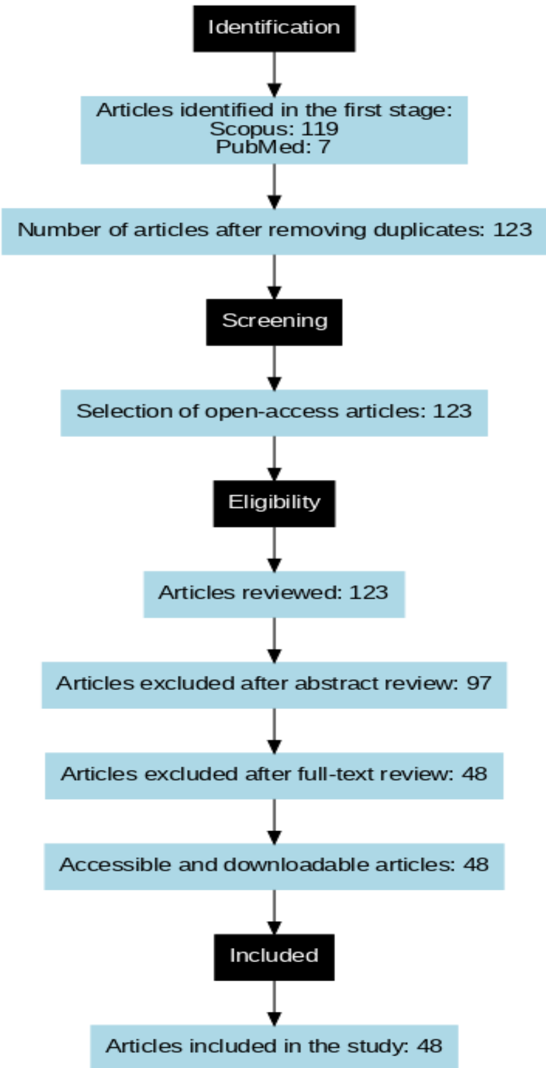

Figure 1. *Prism pattern for article selection*

Findings

***Research Question 1*:** How has the research focus on topics evolved over the years among the reviewed sources?

The sources ultimately selected for review and study were published between 2005 and 2022. Table 1 shows the general research focus of topics, as well as specialized health topics, over the years in telemedicine.

***Table 1.* Research focus of topics over the years**

Column	Column	Column	Column	
Row	4	29	51	52
Row	4	26	50	
Row	1	13	17	
Row	4	20	25	
Row	3	17	23	
Row	1	53	88	
Row	5	35	63	
	3	20	25	
Row	4	20	30	

Year	General Topics	Specialized Health Topics
2005	Surveys	–
2006	Monitoring and Ophthalmology	Chronic diseases such as heart disease and diabetes, Surgery, Ophthalmology
2007	Use of Health Services	–
2009	Education and Technology	Surgery, Urology, Radiology, and Nuclear Medicine
2010	Online Health Information Seeking and Health Assessment	Chronic diseases such as heart disease and diabetes, Surgery, Sexual Health
2012	Elderly	Chronic diseases such as heart disease and diabetes, Ophthalmology, Women’s health, Pregnancy and Abortion
2013	Occupational Therapy, Quality of Life	Chronic diseases such as heart disease and diabetes, Women’s health, Pregnancy and Abortion, Epilepsy
2014	Health	–
2015	Mothers, Acceptance of Remote Services	Chronic diseases such as heart disease and diabetes, Women’s health, Pregnancy and Abortion
2016	Home Health	Chronic diseases such as heart disease and diabetes
2017	Gender, Financial, Attitudes, Triage	Chronic diseases such as heart disease and diabetes, Women’s health, Pregnancy and Abortion, Cancer, Physiotherapy, Depression, Urology, Sexual Health
2018	Travel, Use of Health Services, Preparedness for Remote Services	Women’s health, Pregnancy and Abortion, Cancer, Rheumatology, Smoking Cessation
2019	Attitudes, Veterans, Tool Validation, Health Literacy	Depression, Surgery and Organ Transplant, Cancer, Chronic diseases such

As Table 1 shows, from the beginning of the reviewed period in 2005 until 2013, the focus of the sources was on electronic health. During this period, most discussions were on basic topics such as education, technology, and monitoring. The main goal in these years was to monitor individual health in various areas such as diabetes, pregnancy, ophthalmology, elderly care, and the utilization of telehealth services.

From 2013 onward, mobile health (mHealth) emerged, and researchers focused on assessing the success of delivering various services such as occupational therapy, quality of life, maternal and pregnancy care, travel, triage, physiotherapy, cancer, organ transplantation, and similar areas. Additionally, examining knowledge, attitudes, and acceptance of this technology in healthcare delivery was an important objective. mHealth remained a prominent topic in the reviewed research until 2021.

After 2021, this focus weakened, and attention returned to the broader theme of electronic health. This shift is partly explained by events around that time, notably the emergence of the COVID-19 virus, as research that began around 2019 and was subsequently published reflected these developments. In these years, children’s health and issues related to abortion, likely trending topics, received attention in the context of electronic health. Additionally, since 2019, health literacy has been discussed to a limited extent.

Overall, chronic diseases and women's health and pregnancy were consistently highlighted across most years, followed by cancer and surgery as recurring topics. It is also noteworthy that from 2017 onward, the research focus broadened, encompassing a wider range of subjects.

Research Question 2**:** Which knowledge, logistical, infrastructural, policy, and demographic components have been considered in telemedicine?

A review of the selected articles led to the identification of knowledge, logistical, infrastructural, policy, and demographic components in telemedicine. Table 2 presents these components in detail.

Table 2. Knowledge, logistical, infrastructural, policy, and demographic components in telemedicine

Component	Indicator	Studies
Knowledge	- Personal and clinical knowledge of patients and healthcare providers- Health information based on verified scientific evidence- Experience of long-term illness- Knowledge of online resources and computer literacy- Familiarity with technology and use in telehealth- Understanding information provided by healthcare staff- Information about a specific treatment or medical procedure- Health habits and social determinants of health	15-29
Infrastructure	- Access to websites and cultural differences in health professions- Online and telecommunication support- Vital signs monitoring tools (weight, blood pressure, oxygen saturation, etc.)- Acceptance, high literacy, and public access to internet and mobile technology- Effectiveness of specific programs and flexibility- Use of adult learning theories, creation of communities of practice, patient-centered evaluation- Communication and remote monitoring technologies, simulation, virtual reality, networking, mobile health	15, 16, 18, 19, 24, 25, 26, 30-41
Logistics	- Transportation in special conditions and deployment facilities- Geographic and temporal access to centers- Provision of urgent care, timely diagnosis, and alerts- Risk prediction and local/regional/global coverage- Urgency and method of information transfer, bandwidth, time from symptom onset to treatment	15, 22, 28, 31, 35, 37, 40, 42, 43
Policy	- Physician performance and country regulatory policies- Relevant regulations, time management, organizational support- Perceived effectiveness for care quality and intention to use telemedicine- Remote monitoring, connection to electronic health records- Technological and motivational readiness, resources, cost-effectiveness- Trust-building, data security, legal accountability, equity, and quality systems	15, 16, 25, 34, 36-38, 44-49
Demographic	- Income, education level, occupation, gender, socio-economic status- Age group, cultural and behavioral factors, language diversity, place of residence, marital and health status- Distance, presence of one or more chronic conditions, ethnicity, insurance status	18, 19, 22, 25-30, 36, 37, 50, 51

Table 2 provides a detailed overview of the various components considered in telemedicine, extracted from the reviewed sources. A review of these sources revealed that certain knowledge and awareness are essential for the effective use of telemedicine, and these were categorized as **knowledge components**.

Additionally, some components play an infrastructural role in implementing telemedicine and were categorized as **infrastructure components**. **Logistical components** include indicators that are important from an operational and practical perspective in the delivery of telemedicine services. Some components, similar to infrastructure but with a policy perspective, were classified under **policy components**. Finally, **demographic components** include demographic information and indicators that have been examined in various studies to determine whether they influence telemedicine.

Research Question 3: From a systemic perspective, which components have been considered in telemedicine?

To answer this question, the **knowledge logistics components** that can be extracted from a systemic approach are presented in Table 3.

Table 3. *Knowledge logistics components in telemedicine from a systemic perspective*

Component	Indicator	Studies
Input	Contents: Health information, specific diseases and risk factors, evidence-based information, online resources, organizational and public hospital websites, blogs, emails and chats with relevant individuals, social media, user profiles, mobile applications, communication tools (apps and platforms), digital images, information on preventive health actions, primary health information sources like health professionals, TV programs, large integrated healthcare systems, health databases, secondary data sources, telecommunication links, related signals, simple data (temperature, location, pulse oximetry), audio (voice commands, electronic stethoscope), still or moving images (text, graphic files, video conferencing), one-way telemetry data, remote sensing and streaming data at precise locations or remote destinations (e.g., weather, temperature, nearby locations), secure interactive video visits, specialized forums	16, 21, 23, 25-28, 31, 32, 35, 40, 42, 47, 53, 57-59
Process	Routine patient–physician consultations, home care, tracking and maternal health via mobile before, during, and after pregnancy, visits, transport, and complication management, specialist interactions with sub-specialists, remote monitoring of elderly, health education, detection of ambiguous cardiac arrhythmias and chronic heart failure, continuous monitoring of chronic patients, post-operative/follow-up care, overall monitoring functions (heart rate, blood pressure, ST segment elevation, oxygen saturation, weight, respiration rate, temperature), monitoring intensity (event recording, "on-demand" vs continuous), ECG interpretation, exercise therapy, e-health training for health professionals and groups (e.g., neonatal resuscitation, self-care for diabetes, cancer, coronary artery disease, anxiety disorders, eating disorders, substance use), remote simulation for robotic and laparoscopic surgery, anesthesia, emergency medicine, and pediatric resuscitation, clinical decision-making, tele-treatment, emergency medical responses, healthcare provision, prescribing/referring to specialists or hospitals, mHealth services (health awareness, information dissemination like national vaccination via SMS), remote diagnosis via video and imaging, telephone triage, remote screening, preoperative planning	16-18, 21, 24, 35, 37, 38, 43, 44, 50, 51, 53, 55, 57, 60
Output	Campaign creation, dissemination and sharing of health/disease knowledge, evidence-based knowledge transfer, service adoption, preventive knowledge creation and behavior change, tele-triage, patient appointment scheduling, health education (e.g., dental), emergency recommendations, tele-orthodontics, better emergency case management, remote patient follow-up during pandemics, patient empowerment and self-management education, prescription of specific medical guidelines, improved adherence and engagement in healthcare, facilitation of patient participation in care, interactive lifestyle interventions and counseling based on individual disease characteristics and context, objective data on patients' daily health behaviors, interactive clinical telemedicine (CVT), home healthcare or home health provision systems, routine checkups, lab tests, specialist consultation, discussion and experience-sharing groups, heart failure risk assessment, remote diabetes care monitoring and visualization, referral and consultation platforms for experienced staff, outpatient remote care programs (phone, video, text interaction), drug adverse event monitoring, remote emergency services, SMS reminders for medication adherence and other services, maternal and child health improvement, dissemination of reliable information for diagnosis, treatment, and prevention, technological advancements aligned with logistical assumptions, flawless online physiological measurement for disease classification, global collaboration tracking for health capacity building and documentation of each interaction (e.g., teleconsultation, medical chatbots, AI usage)	15, 17-24, 26-28, 31-38, 46-48, 51, 52, 55-58, 61
Outcome	Identification and management of complications and risks, recognition by healthcare professionals, local post-intervention care, creation of proper diet/nutrition, web-based psychotherapy for depression, online disease and depression treatment, avoidance of some health issues during travel, behavior change, improved clinic appointments or medication reminders, data collection and tracking, enhanced communication among health professionals or between patients and providers, standardized quality care, tracking and supporting health data collection, clinical decision support, health record management and communication, better access to primary healthcare services (diagnosis, advice, treatment), public health information provision with emergency alerts and outbreak warnings	17, 18, 20-22, 24, 26, 28, 29, 33, 34, 37, 39, 41, 43, 44, 53-57, 59
Impact	Proper education of individuals, improved lifestyle, enhanced health information, health-related testimonies, better chronic disease management, health promotion, strengthened knowledge of disorders, patient empowerment for self-management to live with minimal restrictions, management of communicable and non-communicable diseases, health knowledge acquisition, knowledge exchange and transformation, continuous care and support, quality improvement and promotion of professional collaboration, expansion of valuable resources	15, 18-24, 26-28, 34, 35, 37, 39, 40, 42-44, 46-49, 50, 53, 56, 58, 59

As shown in Table 3, the extracted components were classified into **inputs, processes, outputs, outcomes, and impacts**. The separation of these components was as follows: **inputs** include anything that can serve as an entry to the telemedicine system. Inputs are usually knowledge or experiences that can be recorded and reused. **Processes** include the procedures and events that can be executed in telemedicine and applied to the inputs. The result of applying processes to the inputs forms the **outputs**. Outputs represent knowledge flowing within telemedicine and must reach those who need it. Finally, **outcomes and impacts**, which reflect the effects of telemedicine on human lives and communities, are presented separately.

Discussion

This study was conducted to examine the **knowledge logistics components in telemedicine**. As mentioned earlier, following the chosen search strategy, **48 articles** were selected for the final review. The initial examination shows that the reviewed articles were published between **2005 and 2022**. Studying these articles led to the identification of various components across multiple dimensions. Notably, most studies discussing telemedicine applications relied on **mobile health technology**. Therefore, it can be concluded that mobile phones and mobile health may represent an initial step and, in fact, one of the early generations of telemedicine. The beginnings of telemedicine can also be traced back to simple **telephone consultations** between patients and basic healthcare providers.

As the findings of this study show, and as noted in previous studies (15, 22, 28, 32, 36, 38, 41, 51, 52), a key focus in telemedicine implementation concerns **logistical aspects**. Considering the general definition of logistics as the process of planning and controlling the flow of materials, services, and information (63), or specifically the definition of **knowledge logistics** as acquiring, integrating, and transferring correct knowledge from distributed sources within an information network so that it reaches the right person, at the right time, for the right purpose (64), it is clear that logistics supports telemedicine by ensuring **knowledge provision** and creating a supply chain from knowledge holders to those who need it.

In this study, challenges and benefits of telemedicine were also identified, which had previously been discussed in studies such as (13, 14) regarding standards, technical and cultural issues, as well as the education and acceptance of telemedicine by different communities, particularly among healthcare providers, showing alignment among the studies.

Challenges include technical problems, interaction issues, inability to perform physical examinations, lack of acceptance, risk of data misuse and confidentiality breaches, inability for face-to-face contact, incompatibilities in electronic health records (EHR), unclear legal responsibility regarding response protocols, low participation, legal and regulatory issues, administrative or organizational policies, reimbursement policies, lack of or limited access to ambulances, misjudgment and patient suppression, exposure of doctors to large amounts of uncertain information, internet disconnection, loss or theft of mobile phones, receiving negative results via SMS, manual recording of diseases and patient histories in public hospitals, lack of common standards for health information and communication technologies, data management and sharing issues across different databases, integration and software development challenges, over- or inappropriate medication prescribing, technological, attitudinal, and operational barriers, national regulations, country development status, insurance fraud, provision of non-evidence-based services, health anxiety, logistical challenges in healthcare delivery and patient retrieval, and bandwidth limitations for telemedicine implementation (15, 16, 18, 19, 24, 25, 28, 31–38, 40–42, 44, 53, 54, 65).

The identified benefits include reduced readmission rates, cost reduction, facilitated screening, more comprehensive review of at-risk patients' records, timely intervention and diagnosis, increased access to physicians and specialists, reduced travel time, decreased health inequalities, improved equality in access to specialized services, shorter waiting lists, access to health information and services across geographical distances, timely feedback for patients, reduced prescription errors, bridging the gap between discovery and clinical care and knowledge gaps, reduced gap between clinical practice and population health, interactive monitoring, fewer medical complications or emergency visits, better management of chronic diseases, recognition of various scenarios involving similar symptoms for different diseases, the ability for patients to contact the system when concerned, reviewing past information and knowledge, tracking physician appointments, patient empowerment through online support groups and discussion forums, knowledge deepening, early diagnosis for patients with specific conditions, disease monitoring and prevention, healthcare staff adherence to guidelines, post-treatment follow-up and timely SMS tracking for specific conditions, creation of modern tools for acquiring and managing data, safer and more efficient healthcare knowledge management with access to networked data and improved quality in diagnosis, treatment, and post-treatment care, establishing a central service and information tool for monitoring data flow between patients, hospitals, and medical specialists, benefits of not taking leave from work, long-term patient health monitoring without interfering with their activities, saving resources such as paper, office supplies, and additional labor, reducing errors in medical and clinical reports, providing innovative ways for physicians to collect, filter, and review relevant patient information, reducing unnecessary travel, and minimizing unnecessary patient-doctor interactions (15–24, 27, 28, 31, 32, 35–44, 47–49, 53, 55, 58, 59, 61).

On the other hand, as previously mentioned, since 2019 the concept of health literacy has appeared in the literature. Among the selected articles, components and outcomes such as self-health management, improved health control and disease prevention, facilitation of early symptom identification and treatment choices, simplification of communication between healthcare professionals and patients, and e-health literacy—which includes a set of six core skills (traditional literacy, health literacy, information literacy, scientific literacy, media literacy, and computer literacy)—were identified. This also encompasses an individual's ability to search, find, understand, and evaluate health information from electronic sources and to apply the acquired knowledge to address or solve a health problem; basic diagnostic criteria such as high blood pressure and diabetes under specific conditions; recognition of side effects; reading and understanding health instructions for self-management; improvement of individuals' knowledge, motivation, and competence in accessing, understanding, evaluating, and using health information to make informed decisions in daily life regarding healthcare, disease prevention, and health promotion for maintaining or improving quality of life; digital competencies; users' digital skills and experiences; the ability to search, find, understand, and evaluate health information from electronic sources; application of acquired knowledge to address or solve health problems; and awareness of the Unified Theory of Acceptance and Use of Technology (UTAUT) (20, 26, 27, 33, 34, 38).

Finally, it should be noted that using a systemic approach—or a systems perspective—to extract knowledge logistics components in telemedicine is important because, from the viewpoint of (62), in a systemic or process-oriented approach, inputs, processes, outputs, outcomes, and impacts are separated. This provides a clearer picture of the evaluation for managers and policymakers. Evaluators can study each component precisely, thereby maintaining balance in assessment. Accordingly, in this study, the knowledge logistics components in telemedicine were extracted using a systemic perspective.

Conclusion

As the literature review showed, knowledge logistics and telemedicine are two emerging topics. Among these, telemedicine has a longer history and therefore a richer set of resources. However, previous studies have mostly focused on the feasibility and operational impact of telemedicine. No research was found that specifically examines the implementation and operational processes of telemedicine from a logistical perspective. It seems there is no study that looks at telemedicine from a process-oriented viewpoint, from initiation to full implementation, to address users' needs. Therefore, this study first aimed to examine the relationship between these two subjects to determine how much logistics can influence and be considered in this process. As this study showed, there are various distinguishable components that can be considered in the logistics process.

From a systems perspective, it was found that from the standpoint of knowledge logistics in telemedicine, there are always contents that act as inputs to the telemedicine system. These include patient health data and information on specific diseases and risk factors; evidence-based information obtained from clinical practice; resources shared online via organizational and public websites, hospital websites, blogs, emails, chats with relevant individuals, social media, user profiles, and mobile applications; communication tools; digital images such as patient radiology images; preventive health information through feedback from physicians; primary health knowledge sources such as expert knowledge; content from television programs; integrated health information databases; multimedia data; remote monitoring sources, and more. These inputs form the basis and foundation of knowledge flowing through this system (16, 21, 23, 25–28, 31, 32, 35, 40, 42, 47, 53, 57–59).

Once knowledge inputs enter the telemedicine system, data flows are created. Processing within this flow includes routine patient-physician consultations; home care; maternal health monitoring via mobile tools before, during, and after pregnancy; visits, transportation, and complication assessment; physician-to-physician interaction; remote monitoring for the elderly; health education; chronic disease monitoring and diagnosis; post-treatment follow-ups and nursing; general supervisory functions; therapeutic exercise; remote surgical simulation; clinical decision-making; remote treatment; telephone triage; remote screening; and surgical planning. These processes are applied to the inputs and constitute the operational cycle of the system (16–18, 21, 24, 35, 37, 38, 43, 44, 50, 51, 53, 55, 57, 60).

Consequently, the actions described involve systems, processes, and components such as launching various campaigns, sharing evidence-based health knowledge, tele-triage, patient appointment planning, health education in areas such as dentistry, providing emergency advice, tele-orthodontics, better management of emergencies, remote patient tracking during pandemics, prescribing remote treatment guidelines, improving adherence and patient engagement, facilitating patient participation in care services, interactive lifestyle counseling based on individual characteristics and conditions, collecting objective data on daily health behaviors, interactive clinical telemedicine (CVT), home health systems, routine checkups and laboratory tests, specialist consultations, discussion groups and experience sharing, assessing risks for heart failure patients, recording, transmitting, and visualizing key diabetes care variables, referral websites, remote emergency services, medication adherence reminders, transmitting reliable information for diagnosis, treatment, and prevention, technical advancements aligned with logistical assumptions, accurate online diagnosis of physiological measurement parameters for disease classification, fostering global collaboration for building health capacity, and documenting and transmitting results of each interaction (e.g., remote consultations, medical chatbots, AI-assisted care), which constitute the operational implementation of telemedicine (15, 17–24, 26–28, 31–38, 46–48, 51, 52, 55–58, 61).

The outcomes of implementing this system include identifying and managing complications and risks to reduce errors, better understanding of healthcare professionals, enabling local post-treatment care, monitoring and planning proper diet and nutrition, web-based psychotherapy for depression, online disease treatment, avoiding travel-related health issues, behavior and lifestyle changes, improving clinic appointments or medication reminders, data collection and tracking, enhanced communication between healthcare professionals or between patients and providers, standardizing quality care, supporting clinical decision-making, better access to primary healthcare services such as diagnosis, health recommendations, and disease treatment, providing health information to the public with emergency alerts, and more (17, 18, 20–22, 24, 26, 28, 29, 33, 34, 37, 39, 41, 43, 44, 53–57, 59).

Finally, the effects closely related to these outcomes include proper education, improved lifestyle, enhanced health knowledge, better supervision and management of chronic diseases, strengthening knowledge about disorders, empowering patients for self-management to live with minimal limitations, managing communicable and non-communicable diseases, acquiring health knowledge, knowledge exchange and transformation, continuous care and support, improving quality and promoting professional collaboration, and expanding valuable resources (15, 18–24, 26–28, 34, 35, 37, 39, 40, 42–44, 46–49, 50, 53, 56, 58, 59).

It is therefore evident that knowledge logistics in the context of telemedicine enables the system to properly collect knowledge inputs from their owners, process them through necessary operations and workflows, and deliver them as outputs to those in need. Given the positive outcomes and effects of this process, it is recommended that future research focus on developing a framework for telemedicine implementation from a knowledge perspective and within a logistics-based context to address the knowledge needs of the stakeholders involved.

Declaration of Competing Interest

The author declares that he has no competing financial interests or known personal relationships that would influence the report presented in this article.

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