



Review Article

AYUSH digital initiatives: Harnessing the power of digital technology for India's traditional medical systems



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ARTICLE INFO

Article history:

Received 26 January 2021

Received in revised form

19 July 2021

Accepted 22 July 2021

Available online 27 December 2021

Keywords:

AYUSH

Traditional medicine

Medical informatics

Ayurveda

Siddha

ABSTRACT

The incorporation of digital technologies is recognized as one of the inevitable factors to achieve better health care services. Recently, Indian Ministry of AYUSH (MoA) embraced digitalization extensively for development, education and research in AYUSH. In this context, we describe India's digital initiatives for AYUSH systems of medicine for information, research, and academia at various levels. We reviewed the websites and documents available from the MoA and its research councils/institutes along with the plan documents. We described the identified digital initiatives under categories of (1) Health information system (2) Research database/library (3) Academic (4) Information Education and Communication (IEC). We specified the purpose and target group of the identified digital initiatives. We identified 19 key digital initiatives. The AYUSH hospital management information system (A-HMIS), National AYUSH Morbidity and Standardized Terminologies Electronic Portal (NAMASTE), AYUSH Suraksha, e-Aushadhi, e-Charak, Triskandha Kosha, SiddAR APP were categorized under health information system. The Traditional Knowledge Digital Library (TKDL), AYUSH research portal, DHARA, e-CHLAS, Research Management Information system (RMIS), e-Granthasamuccaya and AYUSH Sanjivani App were categorized under research database/library. The Ayurveda e-learning and Ayurvedic Inheritance of India were categorized as the academic initiatives. The Siddha-NIS App, Yoga locator, and Naturopathy-NIN App were categorized as Information, education and communication (IEC) initiatives. The digital initiatives from the MoA were a key to reform the traditional systems of medicines and could improve the education, quality of research and accessibility of the AYUSH healthcare services.

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1. Introduction

Digital innovations and technologies improve health through applications ranging from individual use to wider usage by health care systems. Digitalization of healthcare became unavoidable since medical knowledge grows rapidly in the form of Electronic Health Records (EHR)— archival of the patient data and documentation of clinical evidence. In fact, the World Health Organization (WHO) advocates harnessing the positive potential of digital technology to promote and protect the health of all people [1]. The

term digital health is often used to denote the use of digital technology in health that encompasses entities referred to as mobile health (m-Health), health Information Technology (IT), wearable devices, Tele-health or Tele-medicine, and personalized medicine [2]. Under the umbrella of digital health, advanced medical technologies and electronic communication provide efficient health care services and become a part of the best practices [3]. Delivery of high-quality and efficient health services is to achieving WHO's Universal Health Coverage (UHC) [4]. Digital technologies are recognized in the scientific communities to achieve the Sustainable Development Goals, health promotion, disease prevention, improving the accessibility of delivery care system, quality, and the affordability of health care services [5,6].

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Peer review under responsibility of Transdisciplinary University, Bangalore.

In India, the government has placed 'Digital India' as one of the flagship schemes for development and transparency. Under this scheme, India's National Digital Health Blueprint (NDHB) is encompassing the National Digital Health Eco-system (NDHE) that proposes to ensure the availability of healthcare services across the country. The NDHB envisages creating NDHE that supports UHC in an efficient, accessible, inclusive, affordable, timely, and safe manner by providing a wide range of data, information, and infrastructure services [7,8]. In addition to biomedicine (allopathy), India patronizes indigenous traditional medical systems extensively. India's Ministry of Health and Family Welfare promoted the status of one of its arms to the level of the independent department, namely, the Department of Indian Systems of Medicine and Homeopathy (March 1995) with the objective to promote such systems. Later on, this department was renamed as Department of *Ayurveda, Yoga and Naturopathy, Unani, Siddha*, and Homeopathy (AYUSH) in 2003. This department was ultimately given an exclusive Ministry status on 9th November 2014 and named as Ministry of AYUSH (MoA). In 2010, this Ministry added *Sowa-Rigpa* (a Tibetan medicine) to the AYUSH fold [9]. Currently, AYUSH is defined as "Traditional & Non-Conventional Systems of Health Care and Healing Which Include *Ayurveda, Yoga, Naturopathy, Unani, Siddha, Sowa-Rigpa and Homoeopathy etc.*" The MoA provides focused attention on the research and development of its education. In 2019, keeping in line with initiatives under 'Digital India', MoA proposed a landmark project called the AYUSH Grid, intending to incorporate information technology in all spheres of the AYUSH sector like healthcare delivery, academics, and research [9–11].

In absence of any systematic documentation to elaborate and explain the digital initiatives in the AYUSH sector, we reviewed the initiatives and described them under the categories of information systems, research, academia, and Information, Education and Communication (IEC).

2. Methods

The authors have reviewed information on the websites and plan documents made available by MoA and its research councils as well as its institutes. We listed the identified initiatives and categorized them as information systems, knowledge dissemination, research database and IEC based on their purpose. Information such as their purpose, objectives, target group, developer, and website links were collected as well.

The researchers used the following definitions for categorizing of these initiatives (1) *Health information system*: Any system that collects the data from the health sector and other relevant sectors, analyzes the data and ensures their overall quality, relevance and timeliness, and converts the data into information for health-related decision-making [12]. (2) *Research databases/library initiatives*: These are organized collections of computerized information or data such as periodical articles, books, graphics, and multimedia that can be searched to retrieve information. Databases can be general or subject-oriented with bibliographic citations, abstracts, and/or full text [13]. (3) *Academic initiatives*: The initiatives such as e-learning that provides computer-based or e-learning programme for AYUSH systems. (4) *IEC*: Any information regarding the institutes and that of the systems intended for usage by public.

3. Results

3.1. Categorization of the digital initiatives

Our review identified 19 key digital initiatives including mobile applications. Among them, A-HMIS [AYUSH - Hospital Management Information System], National AYUSH Morbidity and

Standardized Terminologies Electronic Portal (NAMASTE), AYUSH Suruksha, e-Aushadhi, e-Charak, Triskandha Kosha and SiddAR App initiatives were categorized as health information systems initiatives. The research database/library category included the Traditional Knowledge Digital Library (TKDL), AYUSH research portal, Digital Helpline for Ayurveda Research Articles (DHARA), e-Current Health Literature Awareness (e-CHLAS), Research Management Information System (RMIS), e-Granthasamuccaya, and AYUSH Sanjivani App. Ayurveda e-learning and Ayurvedic Inheritance of India course are categorized under academic initiatives. The Siddha–NIS App, Yoga locator, and Naturopathy–NIN App were categorized as AYUSH IEC initiatives. Most of the initiatives were started after 2010 (Table 1).

3.2. Description of the digital initiatives

3.2.1. Digital initiatives for health information systems

3.2.1.1. *A-HMIS - AYUSH Hospital Management Information System*. The A-HMIS is a customizable and comprehensive hospital information management system developed by the MoA. *Siddha* Central Research Institute (SCRI), functioning under Central Council for Research in *Siddha* (CCRS), has developed THERAN (THE Research Application Nexus) which was a comprehensive hospital information system for *Siddha* [5]. THERAN was scaled up to A-HMIS with customization for each system in AYUSH [14]. The objective was to integrate the processes and flow of the hospital in a single platform and provide better patient care and hospital management with proper documentation. There is a provision to create a unique AYUSH ID for each individual in the portal. This is a hassle-free application that provides automated patient and administrative care. The five different modules in A-HMIS have been named: DHANVANTARI for *Ayurveda*, PATANJALI for *Yoga & Naturopathy*, HAKKIM AJMAL KHAN for *Unani*, THERAN for *Siddha* and BABU RAJENDRA LAL for Homeopathy to retain the uniqueness of each system. This web application has a centralized database in which all the data of A-HMIS is stored. It can be used throughout India and across all systems of medicine [15].

3.2.1.2. *National AYUSH Morbidity and Standardized Terminologies Electronic Portal (NAMASTE)*. Allopathy, the mainstream medicine, follows the International Classification of Diseases (ICD) which defines all the diseases, disorders, injuries, and related health conditions in unique codes across the globe. The entire healthcare sector is keen to adopt ICD-11 within the year 2022 with the objective of making better use of the digital revolution [16]. Whereas, the Indian traditional medicine system lacks uniform diagnostic terms and does not have any standard unique codes of its own. In this regard, the MoA initiated a project to bring out uniform morbidity terms and codes for AYUSH, which resulted in the implementation of NAMASTE. It has a provision to quote ICD-10 and ICD-11 along with AYUSH morbidity code (Dual code) for reference. This dual coding (ICD-10/11) will enhance the reporting of morbidity and enable the integration of AYUSH into insurance coverage and reimbursement systems to achieve universal health coverage, which is one of the priority objectives of WHO. The NAMASTE portal also provides standardized terminologies of *Ayurveda, Siddha*, and *Unani* system of medicine and a dedicated data entry module for updating morbidity statistics in consolidated form in a real time basis [17].

3.2.1.3. *AYUSH-Suraksha*. MoA established a National level pharmacovigilance programme to document adverse drug reactions (ADR) attributable to *Ayurveda, Siddha, Unani*, and Homeopathy (ASU and H) drugs [18]. The main objectives of AYUSH-Suraksha are to collect, collate, and analyze the clinical safety data of ASU & H

Table 1
Categorization of AYUSH digital initiatives.

Name	Purpose	Objective	Target groups	Year of initiation	Developed and funded	Web link/last updated (dd/mm/yyyy)
Health information system initiatives						
1.1 A-HMIS (portal)	Dedicated portal for AYUSH Electronic Health Records (EHR)	To improve patient care, work efficiency, research, efficient management of hospital, documentation, and collect the morbidities codes	Hospitals and researchers	2018	CCRS, MoA	https://ehr.ayush.gov.in/ayush/ (NA)
1.2 NAMASTE (portal)	A comprehensive web-portal for AYUSH terminologies	To provide the standardized terminologies and national morbidity codes of ASU medicine and WHO-ICD-10 and ICD-11.	Health care system, researchers	2017	CCRAS, MoA	http://namstp.ayush.gov.in/#/about_us/ (NA)
1.3 AYUSH Suruksha (portal)	Pharmacovigilance portal for ASU drugs	To generate evidence for clinical safety, drugs and surveillance of misleading advertisements.	Hospitals, Patients, Health care professional	2010	MoA	https://www.ayushsuraksha.com/NA
1.4 e-Aushadhi (portal)	A complete supply chain management System for AYUSH	To make a transparent system for procurement, storage and distribution of quality drugs, supplies and equipment's etc	Practitioners, manufactures and consumers	2019	MoA	http://www.e-aushadhi.gov.in
1.5 e-Charak (portal and mobile app)	An electronic channel of market for herbs, aromatic and raw materials	To provide an online market portal for trade of medicinal plants	Farmers, traders, manufactures and exporters	2016	MoA	https://echarak.in/echarak/ NA
1.6 Triskandha Kosha	Integration of Ayurveda, information technology and Sanskrit.	To create an electronic database of information in easily accessible format and to develop a diagnostic and treatment software	Physicians, Researchers, Students	NA	MoA	http://www.tmv.edu.in/pdf/Ayurved/TriskandhaKoshaProject.pdf/NA
1.7 SiddAR APP (Application)	An Android mobile application for documenting ADE.	To report and document of any suspected ADEs	Physicians, Researchers, and health care system	2018	SCRI, MoA	https://play.google.com/store/apps/details?id=siddha.drug.documentation&hl=en_IN/(06-03-2018)
Research databases/Library initiatives						
2.1 TKDL (portal)	Documenting the traditional knowledge in digital format and prevention of bio-piracy	To protect the ancient traditional knowledge from exploitation through bio piracy and unethical patents.	Health care system and researchers	2001	CSIR, MoA	http://www.tkd1.res.in/tkd1/langdefault/common/Home.asp?GL=Eng/NA
2.2 AYUSH research portal (Portal)	Database for AYUSH research articles	To index and disseminate of research findings in the AYUSH	Health care system, Researcher and Practitioners	2011	CCRAS, MoA	http://ayushportal.nic.in/(02-03-2021)
2.3 DHARA (Portal)	Providing online indexing services for Ayurveda articles	To index Ayurveda research articles	Health care system, Researcher and Practitioners	2010	CCRAS, MoA	http://www.dharaonline.org/Forms/Home.aspx/NA
2.4 RMIS (Portal)	Archive of AYUSH post graduate students (PG) thesis and dissertations	To assist in the Research methodology and carrying out research, data analysis and publications.	Researcher, Students, and Institutes	NA	CCRAS, MoA	https://rmis.nic.in/#/home/(NA)
2.5 eCHLAS (portal)	Electronic library to bring forth the index of research publications of various journals.	To index the research publications published in homeopathy.	Researcher and Students	2016	CCRH, MoA	https://www.ccrhndia.nic.in/index1.aspx?Isid=6681&lev=2&lid=4619&Regid=0&langid=1/(15/07/2021)
2.6 Ayurvedgranthasamuccayah (portal)	Electronic platform to access Ayurveda classical books	To provide the Ayurveda classical books in e-format	Students, practitioners, academicians and researchers	NA	CCRAS, MoA	http://ccras.res.in/ccras_ebooks/n NA
2.7 AYUSH Sanjivani App (Application)	Measures adopted by public for enhancing immunity for COVID-19	To generate data on usage of AYUSH advocacies and measures in prevention of COVID-19.	Students, practitioners, patients, researchers and health system	2020	MoA	https://play.google.com/store/apps/details?id=com.negd.ayushfeedback&hl=en&gl=US/(02-06-2021)
Academic initiatives						
3.1 Ayurveda e-learning (portal)	An electronic online learning program designed for Ayurveda	To sensitize the Ayurveda principals to the medical fraternity scholars.	Students and researchers	2010	MoA	http://www.ayurvedaelearning.com/NA

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Table 1 (continued)

Name	Purpose	Objective	Target groups	Year of initiation	Developed and funded	Web link/last updated (dd/mm/yyyy)
3.2 Ayurvedic Inheritance of India (portal)	The course provides the comprehensive view of basic concepts and procedures and scientific research in Ayurveda	To provide the roots and procedures of Ayurveda to students and general people	Students, researcher and General people	2013	CCIM, MoA	https://www.ccimindia.org/video.php
Information, Education and communication initiatives						
4.1 Siddha –NIS app (Application)	Mobile application consists information about Siddha, its therapies, types of medications, and details about NIS	To provide the basic information about Siddha and NIS services	Students. Patients and researchers	2018	C-DAC, MoA	https://play.google.com/store/apps/details?id=cdac.org.siddhaapp&hl=en_IN/(02-07-2018)
4.2 Yoga locator (Application)	Specially designed to record and to show Yoga events across the world.	To provide the location, trainers of yoga in one place	Public and trainers	2019	MoA	https://play.google.com/store/apps/details?id=yogatracker.np.com.yogatracker&hl=en/(19-06-2021)
4.3 Naturopathy NIN app (Application)	Provides basic information of Yoga and naturopathy system	To provide the principles, different modalities and techniques of yoga and naturopathy	Patients/General people/students	2017	CCRYN, MoA	https://play.google.com/store/apps/details?id=com.cdac.naturopathy&hl=en/(27-08-2015)

CCRS-Central Council for Research in Siddha; CCRAS-Central Council for Research in Ayurvedic Sciences; C-DAC- Centre for Development of Advanced Computing; SCRI-Siddha Central Research Institute; CSIR- Council of Scientific and Industrial Research; CCRH-Central Council for Research in Homoeopathy; CCRYN - Central Council for Research in Yoga & Naturopathy; CCIM - Central Council of Indian Medicine; NAMASTE - National AYUSH Morbidity and Standardized Terminologies Electronic Portal; A-HMIS-AYUSH Hospital Management Information System; TKDL-Traditional Knowledge Digital Library; DHARA - Digital Helpline for Ayurveda Research Articles; RMIS- Research Management Information system; ASU- Ayurveda, Siddha and Unani; ADE- Adverse drug events; NIS- National Institute of Siddha; MoA- Ministry of AYUSH.

drugs and to monitor the misleading advertisements. The All India Institute of Ayurveda is the National Pharmacovigilance Co-ordination Centre (NPvCC) for AYUSH to implement the Pharmacovigilance program in India. The NPvCC will receive the inputs from the Intermediary Centres [19,20].

3.2.1.4. e-Aushadhi. e-Aushadhi is a complete supply chain management system for AYUSH. The MoA has launched this portal to increase the transparency and accountability of AYUSH medicines. It deals with the management of stock of the drugs and logistics required from India's district drug warehouses [21]. The primary objective of e-Aushadhi portal is to ensure the availability of the drugs to the beneficiaries without any delay in the transport from one district to another district. The portal has a facility like *track-n-trace* to monitor the procurements [22].

3.2.1.5. e-Channel for herbs, aromatic, Raw material and knowledge-e-Charak. The e-Charak is a virtual market place that aims to connect the various stakeholders of medicinal and aromatic plants supply chain in India. The beneficiaries are small farmers, co-operatives, service providers, experts, input agencies, processing centres, and small traders [23]. This is a joint project by Centre for Development of Advanced Computing (C-DAC), National Medicinal Plants Board (NMPB), and MoA.

3.2.1.6. Triskandha Kosha. The *Triskandha Kosha* project is aimed to integrate the *Ayurveda*, Information technology, and *Sanskrit* in one platform. This project was developed to retrieve the information of *Ayurveda* in an easy way. It has two components: (1) *Ayuta nidan*-diagnostic software developed in collaboration with *Ayurveda* physicians. The diagnosis from this application is based on the symptoms, diseases manifestation and other key factors which stored in the backend (2) *Ayuta Upachar* – This treatment software was developed based on *Aushadha Kosha*. The main purpose of this application is to aid physicians to diagnose and treat the diseases [24].

3.2.1.7. SiddAR APP. An Android-based SiddAR App was launched by SCRI, CCRS for documentation of ADR in *Siddha* treatment [25]. This application can be used for real-time documentation of ADR for healthcare professionals, and consumers. It is an essential initiative under Pharmacovigilance Program of India (PvPI).

3.2.2. Digital initiatives for research databases/library

3.2.2.1. Traditional Knowledge Digital Library (TKDL). India's traditional knowledge has been vulnerable to patent claims. Government and non-government institutions/agencies of India have made several bio-piracy claims in the recent years [26]. One of the significant steps taken by the Government of India regarding the protection of traditional knowledge under intellectual property rights is called the TKDL. The key function of TKDL is to scientifically convert and structure the available contents of the ancient texts of *Ayurveda*, *Siddha*, and *Unani* in the digital format. Traditional Knowledge Resource Classification (TKRC) was evolved to alleviate the lack of a classification system for traditional knowledge documentation. It is a modern classification based on the structure of the International Patent Classification. It is also foreseen that the TKRC will be helpful to prevent the grant of wrong patents for non-original discoveries in traditional knowledge systems. Information technology tools, availability of contents in five international languages such as German, English, French, Japanese, and Spanish and format barriers are unique features of TKRC [27].

3.2.2.2. AYUSH research portal. The credibility of the evidence base from the AYUSH is always under scrutiny. The solution to sort this scenario was to publish the research findings from AYUSH systems of medicine in peer-reviewed journals. Although various research publications were published in the recent years, there was no AYUSH database to store everything in a place. Hence, there was a high demand to pool the existing literature of AYUSH on a single platform. The conceptualization of the AYUSH Research portal was introduced to overcome this lacuna. It was designed and developed by the National Institute of Indian Medical Heritage (NIIMH),

Hyderabad. Research abstracts, dissertations, theses, and peer-reviewed academic online journals were archived in the AYUSH research portal. This repository contained 30,178 articles until December 2020 [28,29]. The portal allows the users to search for articles that are available for a selected medical systems in AYUSH. It has various options to search and retrieve the articles such as title, author's name, journal name, institute, AYUSH terminologies, and diseases codes (ICPC/ICD) [30]. There is a provision to search and retrieve research articles in this portal by an individual without any login credentials.

3.2.2.3. Digital Helpline for Ayurveda Research Articles (DHARA). The AYUSH systems of medicine required an online indexing service for research articles. The DHARA was the first step which was an online indexing service for *Ayurveda* research articles [31]. This was a collaborative project between the CCRAS, New Delhi, The *Ayurveda* Trust Coimbatore, and Swiss *Ayurveda* Medical Academy, Switzerland [32–34]. This online portal includes research articles from the AYUSH. The qualities of the articles are reviewed before indexing in the DHARA online portal.

3.2.2.4. e-Current Health Literature Awareness (e-CHLAS). The Central Council for Research in Homeopathy initiated the e-Current Health Literature Awareness (e-CHLAS) to archive the homeopathy journals. This electronic library is committed to bringing forth the index of research publications of various journals subscribed by the council. The council used previously current health literature awareness services to disseminate the index. The library has launched this e-service to enhance the index of articles' visibility and accessibility [35].

3.2.2.5. Research Management Information System (RMIS). The *Ayurveda* institutes offer postgraduate/doctoral courses such as MD/MS and Ph.D. in several disciplines. The thesis is a part of the curriculum that scholars must submit during that study period. This research study's quality depends on the formulation of the hypothesis and objectives in the initial stage, following the research steps and utilizing appropriate statistical methods. To achieve this, the CCRAS has launched a programme called the RMIS. This initiative provides the suggestions/inputs for planning/designing and protocol writing of the study for the scholars and guides *Ayurvedic* Institutes/Colleges across India [36].

3.2.2.6. Ayurveda grantha samuccayah. *Ayurveda* grantha samuccayah is a complete portal where all the *Ayurveda* classical books such as *Charaka Samhita*, *Suśruta Samhita*, *Mādhavanidāna* and various *Nighantu* are accessible. This e –portal is helpful for students, practitioners, academicians, and AYUSH researchers. This has the facility to read in eight Indian languages and have options to search and retrieve the information from this portal [37].

3.2.2.7. AYUSH Sanjivani App. MoA has launched the 'AYUSH Sanjivani' App during this ongoing COVID-19 pandemic to collect data from 5 million people on the usage of AYUSH medicines, and preventive measures released by the Ministry [38].

3.2.3. Academic related digital initiatives

3.2.3.1. Ayurveda E-learning. 'Ayurveda E-learning Course' is an online computer-based learning program for *Ayurveda* [39,40]. The MoA launched the computer-based e-learning programme, Government of India in 2010 and it is now available on the internet for all. The course is designed for medical fraternity scholars interested in learning and for those interested in *Ayurveda* knowledge.

3.2.3.2. Ayurvedic Inheritance of India. This online course is not currently active and was provided by the Indian Institute of Technology – Madras (IITM) under National Programme on Technology Enhanced Learning (NPTEL). It was intended to provide the comprehensive view of *Ayurveda* roots, concepts and procedures, philosophy, and history of *Ayurveda* to the students of medicine, *Ayurveda*, and biological and social sciences [41].

3.2.4. Information, Education and Communication (IEC) initiatives

3.2.4.1. Siddha –NIS app. The app was launched in 2018 at the National Institute of Siddha (NIS) [42]. This application has basic *Siddha*-related information such as various types of medicines, preventive medicines, and the information related to education and research status. This application was jointly developed by NIS and C.P.R. Environmental Education Centre (CPREEC).

3.2.4.2. Yoga locator app. The MoA developed the *Yoga* locator App to Promote *yoga* to all beneficiaries (Public, Trainers and *Yoga* centres) and promotion of events all around the globe [43,44]. This app has the facilities such as registration of *yoga* trainers, submitting the feedback, promotion of the events, and navigation information to reach *Yoga* centers, trainers, and events.

3.2.4.3. NIN naturopathy APP. Naturopathy, otherwise known as nature cure is a drugless, non-invasive method of treatment with natural elements. This application provides basic information of *Yoga* and Naturopathy. It has information's of the Naturopathy therapies such as fasting therapy, mud therapy, and air therapy etc. [45].

4. Discussion

We did a desk review to categorize and describe digital initiatives of AYUSH sector in India. We identified that certain initiatives at the National level (e.g TKDL, A-HMIS, NAMASTE) are paving way for improving research and practices. Deployment of AYUSH *Sanjivani* application to collect millions of users data on AYUSH practices during COVID-19 pandemic demonstrated responsiveness of the digital initiatives to an emerging situation.

The TKDL was a pioneer initiative and has been a major tool to protect traditional knowledge and bio-piracy [46]. This was a trendsetter digital initiative in the AYUSH system of medicine. Traditional knowledge was found to be free in the past, and pharmacies acquired traditional knowledge to manufacture drugs. The utilization of herbal medicine has increased significantly in recent years. The WHO report indicates that nearly 70–80% of the global population entirely depends on the herbal base for their treatment [52]. Herbal drugs generate huge profits and the Market Research Future stated that the herbal medicine market is estimated to reach USD 1,29,689.3 million by 2023 [47]. TKDL provides information about available traditional medical knowledge in a digital form. It bridges the existing information of traditional knowledge in local languages with that of patent examiners at IPOs. More than 3.6 lakhs formulations have been transcribed into TKDL [27].

The other major digital initiatives from AYUSH systems of medicine were the A-HMIS and NAMASTE portal. The A-HMIS is being implemented nationwide in all AYUSH hospitals of research councils and its national institutes. The effective implementation of A-HMIS has created a tracking database of AYUSH beneficiaries by replacing the old and time-consuming paper-based system. The centralized database of unique morbidity codes for AYUSH system of medicine has streamlined the classification of diseases and standardized the diagnoses. In this context, the NAMASTE portal was established and it has a database of morbidity codes for all AYUSH systems. The NAMASTE portal brought unique code for all

the diseases using ICD codes [17]. Recently, many critiques have expressed that traditional systems do not have sufficient scientific evidence for treatment and poor in documentation of patient data [48]. There is no exclusive database to store and retrieve the AYUSH systems-related research articles. The AYUSH research portal and DHARA are two significant and much-needed initiatives to fulfill this gap. However, to obtain more relevant search results for these websites, they can be upgraded by providing uniform search options, adapting Boolean operators, providing full text or PDF of the articles, and by linking it to the journals like PubMed [29].

In parallel to allopathy systems of medicine, to document the drug's adverse events, the AYUSH initiated the AYUSH Suraksha, which is an important step towards ensuring patient safety. However, it needs to be more user-friendly to access to drug safety information. Capitalizing on the contributions from several of the digital initiatives individually, as stated earlier, the MoA has recently created an umbrella project bringing all such initiatives under the AYUSH Grid. The objective of the Grid is to provide effective and better AYUSH care to citizens of India. The nationwide digital platform for AYUSH aims to bring all its hospitals, institutions, and laboratories on board in digital healthcare. Subsequently, it has co-opted A-HMIS, Tele-Medicine, and Yoga locator Application. In the COVID-19 context, the AYUSH *Sanjivani* mobile application of the MoA was a perfect example of the responsive project under the AYUSH Grid. A customized IT course was recently developed along with C-DAC for AYUSH professionals under the AYUSH Grid [11]. Further to such developments, the MoA announced awards to promote and recognize the IT initiatives in AYUSH sector research and education [49].

AYUSH-based e-learning programmes have been taking the popular mode of Massive Open Online Courses (MOOCs) for teaching. The MOOCs can reach millions of people and offer them opportunities for interacting with subject experts [50]. Infact, initiatives such as Ayurveda Network run by Banaras Hindu University provides teaching resources meant for Ayurveda teachers under the scheme supported by Ministry of Education [51]. AYUSH-based MOOCs can be modelled on the basis of such initiatives and can be offered for a wider reach and use.

4.1. Limitations

Our review has certain limitations of coverage and depth since it was a desk review based on the available information in the public domain.

5. Conclusions and recommendations

We concluded that the digital initiatives taken up by the MoA were a key feature in transforming the education, research, and services offered by the AYUSH sector. We recommend the fine-tuning of these initiatives by obtaining better user experience and improving visibility as well as utilization.

Source of funding

None.

Author contributions

Sendhilkumar Muthappan: Conceptualization, Methodology, Formal analysis Writing - Review & Editing. **Rajalakshmi Elumalai:** Conceptualization, Methodology, Formal analysis Writing - Review & Editing. **Natarajan Shanmugasundaram:** Conceptualization, Methodology, Writing - Review & Editing. **Nikilniva Johnraj:** Data Curation, Methodology, Writing - Review & Editing. **Hema**

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Conflict of interest

None.

Acknowledgments

We thank the Tamil Nadu Directorate of Indian Medicine and Homeopathy and Prof. R. Meenakumari, the then Principal, Govt. Siddha Medical College (GSMC), Chennai for deputing Siddha Medical Postgraduates (PGs) for research methods training at ICMR-NIE.

The authors thank Dr. Manoj Murhekar, Director, ICMR-NIE for facilitating the training for the Siddha PGs of GSMC, Chennai and supporting this publication.

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