**FUTURE PROSPECTS OF AYURVEDA: UNVEILING THE PRESENT AND EXPLORING NEW HORIZONS**

**SHUBHASHREE M N ARSHA K S**

**RESEARCH OFFICER JUNIOR RESEARCH FELLOW**

**CENTRAL AYURVEDA RESEARCH INSTITUTE CENTRAL AYURVEDA RESEARCH INSTITUTE**

**BANGALORE, INDIA BANGALORE, INDIA**

[**shubhathejas@gmail.com**](mailto:shubhathejas@gmail.com)[**arshaks.91@gmail.com**](mailto:arshaks.91@gmail.com)

**INTRODUCTION**

Ayurveda, also known as the "Science of Life," is a system of medicine which originated in ancient India thousands of years ago. It has survived and flourished from ages till date. Rooted in the profound understanding of the interconnectedness between the mind, body, and spirit, Ayurveda offers a comprehensive approach to health and well-being, emphasizing balance, harmony, and the promotion of a vibrant life.

Ayurveda, the ancient Indian system of medicine, has stood the test of time for thousands of years, providing holistic approaches to healing and promoting well-being. As we step into the future, the world of Ayurveda is undergoing an intriguing transformation, blending its timeless principles with cutting-edge technology and scientific advancements. This convergence of tradition and innovation paves the way for exciting possibilities and opens new avenues for the practice and understanding of Ayurveda.

In recent years, Ayurveda has experienced a global resurgence, with individuals seeking alternative healthcare solutions. This renewed interest has sparked a wave of research and experimentation, driving the evolution of Ayurvedic practices into the realm of modern healthcare. There are many avenues yet to be explored by the torch bearers of the system like researchers, practitioners and experts in the field who carry the responsibility of keeping the system agile and contributing to their growth in the future. As we embark on this journey, we delve into the futuristic trends in Ayurveda that are reshaping the way we approach health, wellness and longevity.

The healthcare system around the world faced a unique challenge by the pandemic Covid 19. It has brought about a great awareness about health and made the human race focus on lifestyle and diet and led to a paradigm shift in healthcare industry with its focus from illness to wellness. For instance, Indian granny’s recipe kadha which was given least importance and vehemently avoided earlier suddenly found an upgraded status. As a result, Kadha or Kashaya was voted as the ‘The Drink of 2020’ [Shubhashree M N, et al. “A cross-sectional survey to assess the efficacy of home remedies during Covid times from a Pharmacovigilance perspective,” JPADR, vol 4 No. 1, March 2023] Ayurveda practitioners have contributed significantly during the times of Covid in reaching out to the grassroot levels. Ayurveda interventions like Ashwagandha (Withania somnifera) and Shunti (Zingiber officinalis) have shown promising results in reducing the duration of clinical recovery, improving the time obtain viral clearance thereby aiding the natural healing process of the body. [Singh H, et al Ashwagandha (Withania somnifera) and Shunthi (Zingiber officinale) in mild and moderate COVID-19: An open-label randomized controlled exploratory trial. Complement Ther Med. 2023 Jul 22]

The World Health Organization (WHO) now refers to Ayurveda, Yoga and other traditional systems of medicine as Traditional, Complementary and Integrative Medicine (TCIM) WHO. [WHO Global Report on Traditional and Complementary Medicine 2019; World Health Organization: Geneva, Switzerland, 2019.] The term “AYUSH” refers to Ayurveda, Yoga and Naturaopathy,Unani Siddha and Homeopathy systems of medicines .

**AYURVEDA AND SWASTHYA**

Ayurveda has been advocating the principle “Swasthya” rather than absence of illness. Though modern medicine understands health as the “absence of disease”. The World Health Organization (WHO) uses a more holistic view of health; “state of complete physical, mental and social well-being and not merely absence of disease or infirmity.”[Basisht G. Exploring insights towards definition and laws of health in Ayurveda: Global health perspective. Ayu. 2014 Oct-Dec;35(4):351-5. PMID: 26195894; PMCID: PMC4492016]

The concept of ‘Swasthya’ or wholeness, in other words, optimal health and well-being are based on inner wholeness together with a balance of mind, body, social and physical environments. A paradigm shift is observed in the approach towards health care for future from a standardized approach to personalized prevention and treatment, from a short-term to long-term sustainable intervention, from single molecular targets to an integrated system of networks and from treatment with adverse effects to prevention and holistic health promotion. [Seetharaman M, Krishnan G, Schneider RH. The Future of Medicine: Frontiers in Integrative Health and Medicine. Medicina. 2021; 57(12):1303.]

The objectives of Ayurveda are to maintenance of health of the healthy person and to treat the disease. Ayurveda primarily guides regarding the prevention of disease, promotion and preservation of health through diet, lifestyle rules, and other interventions. Ayurvedic therapeutics including herbal/herbomineral drugs and detoxification procedures play an important role in restoring health of diseased mankind. [Dua, Pradeep Kumar; Naik, Raghvendra; Jain, Snehlata. Standardization in AYUSH systems: Bureau of Indian Standards (BIS) and International Organization for Standardization (ISO) perspectives. International Journal of Ayurveda Research 4(1):p 5-14, Jan–Mar 2023]

# To maintain “Swasthya” daily regimen, seasonal regimen and a proper diet should be followed. Ayurveda has described various rules and regimens, regarding diet and behavior to get acclimatized to seasonal changes easily. The prime principle of Ayurvedic system of medicine is preventive aspect. [[Jayesh Thakkar](https://pubmed.ncbi.nlm.nih.gov/?term=Thakkar%20J%5BAuthor%5D),[S. Chaudhari](https://pubmed.ncbi.nlm.nih.gov/?term=Chaudhari%20S%5BAuthor%5D),and Prasanta K. Sarkar. Ritucharya: Answer to the lifestyle disorders. Ayu. 2011 Oct-Dec; 32(4): 466–471] Many of these preventive principles have gathered valid scientific evidence to convince the proposal that they can be implemented across the cultures throughout the world .

**AYURVEDA AND EPIGENETICS**

The emerging field of epigenetics is bringing attention towards Ayurveda. Epigenetics can control the expression of genes. In other words, it has shown that changes in diet and life style and stress removal have an impact in the struggle to fight against genetic disorders and genes are not the only ones who decides the destiny .A comparison has been given to the software of a computer which decides the programme . Just as Ayurveda recommends lifestyle, psychological states and one's physical environment alter or maintain gene expression levels and patterns. In contrast, an unhealthy lifestyle may “turn on” the bad genes through an epigenetic process, which may in turn lead to the excessive formation of pro-inflammatory cytokines or other disease-producing proteins. [Basisht G. Exploring insights towards definition and laws of health in Ayurveda: Global health perspective. Ayu. 2014 Oct-Dec;35(4):351-5. PMID: 26195894; PMCID: PMC4492016]

# The major factors that cause epigenetic changes are lifestyle and behavior, diet and digestion, stress and environmental factors. Ayurveda addresses these factors, which affect the Deha (body) Prakriti (psychophysiological constitution), which corresponds to the phenotype and indirectly the Janma (birth) Prakriti, which corresponds to the genotype. Thus, epigenetics is an is considered as important mechanism of Ayurveda. This correlation, insight and understanding has led to better communication and understanding with the allopathic medical system and lead to better integration of both sciences in the management of optimal health. In addition, research on Ayurvedic modalities affecting gene expression will further increase correlation and understanding between the current medical system and Ayurveda. [[Hari Sharma](https://pubmed.ncbi.nlm.nih.gov/?term=Sharma%20H%5BAuthor%5D)and Robert Keith Wallace. Ayurveda and Epigenetics. 2020 Dec; 56(12): 687]

“P4" approach is a new approach in medicine to reduce the burden of chronic diseases which implies predictive, preventive, personalized and participatory, which holds great potential to tackle the underlying mechanisms of chronic diseases by harnessing technology and an increasingly better understanding of environment-biology interactions, evidence-based interventions and the. [Sagner M, et al. The P4 Health Spectrum - A Predictive, Preventive, Personalized and Participatory Continuum for Promoting Healthspan. 2017 Mar-Apr;59(5):506-521.]

Bhushan patwardhan also advocates that Ayurvedic researchers should develop strategic collaborations with innovative initiatives involving predictive preventive personalized medicine (PPPM).This path leads to exploration of the concept of “Prakruti” as Prakriti-based medicine is speculated to change the scenario of global health wisdom. Ayurvedic treatment modalities are based on  ahara (diet), vihara (lifestyle), and aushadhi (medication), which are the three pillars of prakriti-based medicine making it a holistic science. [Bijoya Chatterjee 1, Jigisha Pancholi. Prakriti-based medicine: A step towards personalized medicine. 2011 Apr;32(2):141-6.]

**PRAKRITI, AYURGENOMICS AND AYURNUTRIGENOMICS**

Ayurveda classifies the human population as Vata, Pitta and Kapha types based on three major constituents or Prakriti. Prakriti is a manual or guide to personalize the diet and medicine .The core concept of health and disease in Ayurveda is built around the uniqueness of an individual. [Patwardhan B, et al] Assessment of Prakriti in Ayurveda, is based on differences in physical, physiological and psychological characteristics and is independent of racial, ethnic or geographical considerations. [Ghodke Y, et al.] It is speculated that different prakriti’s have unique metabolic activities. Kapha is slow, Pitta is fast, while Vata is considered to have variable metabolism. Identification of genetic variations underlying this metabolic variability in Prakriti has opened up new avenues and approach to Pharmacogenomics.

Different prakriti may have different drug metabolism rates associated with drug metabolizing enzyme (DME) polymorphism as well. An interesting correlation between CYP2C19 genotypes and Prakriti with fast and slow metabolism as a major distinguishing and differentiating characteristics was observed in study by Y.Ghodke SharmaVikas. Ayurgenomics: CSIR study establishes links between Ayurveda and Modern Science for Predictive and Personalized Medicine.

Ayurgenomics presents a personalized approach in the predictive, preventive, and curative aspects of stratified medicine with molecular variability, which includes the study of inter individual variability due to genetic variability in humans for assessing susceptibility, and establishing diagnosis and prognosis, mainly on the basis of the constitution type of a person's Prakriti.

Ayurnutrigenomics is an emerging field of interest in which the selection of a suitable dietary, therapeutic, and lifestyle regime is made on the basis of clinical assessment of an individual maintaining one's Prakriti. This concept of personalized nutrition is a new concept of nutrigenomic research for developing personalized functional foods and nutraceuticals suitable for one's genetic makeup with the help of Ayurveda. [Subhadip Banerjee, Parikshit Debnath, and Pratip Kumar Debnath. Ayurnutrigenomics: Ayurveda-inspired personalized nutrition from inception to evidence. 2015 Oct; 5(4): 228–233]

Ayurveda combines foods (Pathya or Ahara) and drugs (Aushadha) under the umbrella of therapeutics, to maintain harmonization of the Doshas or physiological factors with respect to Prakriti and other environmental factors. [Debnath PK, et al.]

Research on nutrition based on Prakriti  is emerging as a major field, be termed as Ayurnutrigenomics, which presents a huge scope of development toward the understanding of nutrigenomics and molecular nutrition research. It helps in structuring health recommendations and personalized food design. This novel concept of Ayurnutrigenomics is an emerging area of research, which may unfold future possibilities towards safe therapeutics in future . [Banerjee S, et al.] Prakriti-based medicine has the potential to offer remedies to the challenging health issues like adverse drug reactions, drug withdrawals etc .

Fields of genomics, proteomics, metabolomics, and now epigenomics (‘omics’ technology of system biology) study the contribution of genes, proteins, metabolic pathways and non-genetic factors to human physiology and variations in pathways that has vital role in disease susceptibility of an individual. Ayurgenomics is expected provide explanation regarding the effective administration of current drugs by targeting them on patients of particular Prakriti. It offers a new bridge between traditional medicine and modern medicine by providing a rigorous scientific understanding of basic concepts, and at the same time incorporating the practical preventative approaches of Ayurveda into modern medicine.

**GUT MICROBIOME AND AGNI**

Ayurveda has described Agni as an important factor of digestion and metabolism in our body. Ayurveda has given utmost priority to the “ Gut health” linking it to the health of an individual. Diet and digestion influence the composition of the gut microbiome. Ayurveda, is perhaps the oldest science which has been focusing on the role of digestion in health and disease for centuries. Wallace, R has presented the connection between the gut microbiome and various prevention and therapeutic approaches of Ayurveda. [Wallace, R. The Microbiome in Health and Disease from the Perspective of Modern Medicine and Ayurveda. Medicina 2020, 56, 462]

Gut microbiota is an organ by itself, with an extensive metabolic capability and functional plasticity. [Jandhyala SM, et al. Role of the normal gut microbiota. 2015 Aug 7; 21(29): 8787–8803] The gut microbiota maintains a symbiotic relationship with the gut mucosa in a healthy individual and related to metabolic, immunological and gut protective functions. [Shi N, Li N, et al.] The gut microbiota obtains nutrients from host dietary components and shed epithelial cells. [Ramakrishna BS. Et al.] Emerging evidence suggests that dietary components can directly impact the composition and metabolic activity of the mammalian gut microbiota and in turn, affect both physical and mental health. phytochemicals, especially anthocyanins, promote gut microbial health, reduce inflammation and lower the risk of colorectal cancer. [Shondelmyer K, Knight R, Sanivarapu A, Ogino S, Vanamala JKP. Ancient Thali Diet: Gut Microbiota, Immunity, and Health. Yale J Biol Med. 2018 Jun 28;91(2):177-184. PMID: 29955222; PMCID: PMC6020729.]

A study of the relationship between prakriti–the basis of personalized medicine in Ayurveda and that of gutmicrobiome, and possible biomarker of an individual’s health, would vastly improve precision therapy. Exercise and high fiber diet, such as fruits, vegetables, legumes, and whole-wheat grain products have also been shown to increase the microbial diversity [Clarke et al.2014;Flint et al.2012.]

Interestingly, the major factors such as age, diet, lifestyle, stress and environment which can influence and cause alterations in the three doshas in an individual are also known to affect the microbiome composition and function. (Lakhotia2014) This suggests a possible link between prakriti constitution and the microbiome assemblage and how subtle physiological or lifestyle changes can lead to disequilibrium and diseased state in healthy individuals. In the study, it was found that the overall species diversity was significantly higher in age in individuals for both gut and oral microbiome.

It is worthwhile to recollect that Indian thali, provides both fiber and different phytochemicals by incorporating a variety of plant foods in different colors. Thus, variety helps to restore diversity in the gut bacteria and may potentially prevent or reverse chronic disease, such as colon cancer or type2 diabetes. [Shondelmyer K, Knight R, Sanivarapu A, Ogino S, Vanamala JKP. Ancient Thali Diet: Gut Microbiota, Immunity, and Health. Yale J Biol Med. 2018 Jun 28;91(2):177-184. PMID: 29955222; PMCID: PMC6020729.]

**MILLETS**

Ayurvedic treatises mention millets under the umbrella of Trinadhanya and Kshudradhanya. Millets have emerged as an excellent choice of nutritious replacement for refined cereals to fight obesity caused by our sophisticated sedentary lifestyle. One of the dietary modifications to tackle obesity is including millet in the diet. [Vasavi Totawar: Importance of Millets and Kshudradhanya in Today's Lifestyle - A Review international Ayurvedic Medical Journal {online} 2023 {cited April 2023}] The high mineral content, antioxidants, protein and lower fat content as compared to rice and wheat makes it a potential therapeutic food. Year 2023 has been declared by the United Nations General Assembly as the International Year of the Millet at the behest of Indian government.

**PANCHAKARMA**

Panchakarma treatment is a program for the body, mind, and consciousness that cleanses and rejuvenates. Panchakarma therapies go a long way in maintaining health. Ayurveda employs the “Pancha karma” method in its therapies. Pancha karma therapy applies various processes for the rejuvenation of the body, cleansing and enhancing longevity. The Pancha karma is composed of five karmas (actions) that are used for removal of toxins from the body tissues. They are the Virechan (purgation), Vaman (forced therapeutic emesis), Basti (enemas), Rakta moksha (detoxification of blood) and Nasya (administration of medicines through nasal route).

Shirodhara is a classical and a well-established Ayurvedic procedure of slowly and steadily dripping medicated oil on the center of the forehead of the patient, resting quietly on a comfortable bed. Other liquids like coconut water, buttermilk, milk, etc. are also used depending on the individual need of the patient. Studies have shown that Therapies like Shirodhara has psycho-neuro-immunological effects such as a decrease in noradrenaline level, exhibiting of sympatholytic effect, activation of peripheral skin circulation, and increase level of natural killer cells. Xu et al. has opined that the mechanism in their study that the physiologic effect of Shirodhara by dripping sesame oil on the forehead may induce somato-autonomic reflex through thermo sensors or pressure sensor in the skin or hair follicles via the trigeminal cranial nerve. This procedure produced a relaxed state that results in the maintenance of psycho-physiological balance. Shirodhara has shown significant improvement in serum biomarkers of stress, which were reduced after Shirodhara in a study by Rajan S, et al.

## Yet another study at NIMHANS (National Institute of Mental Health and Neurosciences), Shirodhara coupled with medhya rasayanas has been reported in patients of cerebellar ataxia with clinical improvement. [Sriranjini SJ, Pal PK, Devidas KV, Ganpathy S. Improvement of balance in progressive degenerative cerebellar ataxias after Ayurvedic therapy: A preliminary report. Neurol India. 2009;57:166–71.]

Abhyanga massage is the therapeutic intervention of Panchakarma in which the body is treated with simple or medicated oil (full body or on particular body part) according to the need. Abhyanga is promising in reducing subjective stress experience. It has displayed beneficial in lowering HR in all and Blood Pressure in pre hypertensive subjects. [Basler AJ. Pilot study investigating the effects of Ayurvedic Abhyanga massage on subjective stress experience. J Altern Complement Med. 2011 May;17(5):435-40. doi: 10.1089/acm.2010.0281. Epub 2011 May 13. PMID: 21568717.]

**MARMA CHIKITSA**

Marma Chikitsa is an advanced technique of Ayurveda related to diagnosis, treatment of particular disease and reducing pain. [Arvind Kumar Yadav, Rita Marwaha, Nisha Bhalerao, Swatantra Kumar Chourasia, Shradhha Sharma. Pain management through Marma Chikitsa. J Ayurveda Integr Med Sci 2022;2:69-76.] Ancient Ayurvedic literature described 107 vital regions of the body and considered them as a seat of prana (life force) and collectively termed them as Marma.

In present scenario Marma Chikitsa is very popular in various part of India for its instant, permanent, natural and non-invasive way of treatment. It has emerged as new dimensions in non-pharmacological treatment of Ayurveda. If properly stimulated, Marma Chikitsa help in maintaining the vitality of the body and treatment of disease/reducing pain by natural healing agents such as prostaglandin.[Pain management through Marma Chikitsa -Arvind Kumar Yadav et al.]

Instant pain relief is the motive of Marma therapy. Stimulation of Marma can produce analgesia by secreting several prostaglandin inhibitors, endorphins, interferon and other opioid like substances which are a hundred times more potent than opium. Marma Chikitsa is beneficial to treat traumatic neurological or neurosurgical lesion, traumatic paraplegia, hemiplegia, monoplegia, intervertebral disc etc. It is helpful to reduce the pain of nerves, muscles, ligaments, bones and joints. It is also useful to improve the function of body organs achieving homeostasis. Marma Chikitsa works on the neuro-endocrine system. Actually, due to pressure or stimulation over these points, certain chemical substance and neurotransmitters are released like endorphins and enkephalin which send nerve impulse to brain causing the desired effect. Another theory states that the very small electrical changes that occur at Marma points is found to capable of producing effect for in responsible for triggering the desired effect.

**HEALTH TOURISM**

It is pertinent to mention that national as well as international acceptance of Ayurvedic healing has definitely widened up the boundaries and prospects of Ayurveda tourism. Ayurvedic treatments and rejuvenation therapies are becoming increasingly popular in wellness tourism. India is an important hub for Ayurvedic tourism as it involves low medical cost compared with other countries

The growth rate of tourists flocking for Ayurveda is increasing every year at the rate of around 20-25 per cent. The total size of the Indian Ayurvedic market is Rs 50 billion and it is growing substantially at a rate between 10-15 per cent, with the same growth rate targeted for the next 10 years. [Muralidhar&Karthikeyan (2016).] Ayush Wellness Centres under the National Ayush Mission has received a budget of Rs. 3,400 crore (US$ 464.68 million) for the next five years towards the development.

High-quality health-care service delivery in conventional as well as Ayush systems, low cost, and proximity to some potential countries have made India one of the most popular destinations for medical value travel. Publication of an Indian standard IS 17942: 2022 – ”Tourism and Related Services – Medical Tourism – Service Requirements” as a modified adoption of ISO 22525: 2020 with inclusion of Ayush-related provisions is also poised to boost the medical value travel related to Ayush sector.

The Indian government recognizes the potential of Ayurveda in health tourism and has been taking steps to promote it. The future scope of health tourism in Ayurveda is promising and has the potential for significant growth. It is important to maintain high-quality standards, conduct research to validate treatment efficacy, ensure proper regulation, and promote authentic practices to build trust and credibility in the industry.

Another significant development in the Ayurveda market in India is the increasing use of digital platforms for marketing and distribution along with Ayurveda-based digital health platforms. Online platforms has helped leverage the digital channels to reach a wider audience. The emergence of new Ayurveda-inspired brands has led to the evolution of innovative technologies to develop personalized Ayurvedic treatments and products and launch their own digital health platforms to provide online consultations, personalized treatments and wellness plans to consumers [https://www.indiaretailing.com/2023/05/27/ayurveda-market-in-india-trends-and-growth-outlook/]

India is the second largest exporter of AYUSH (Ayurveda, Yoga, Unani, Siddha & Homeopathy) drugs as per Pharmaceutical Export Promotion Council of India (Pharmaexil). There is global resurgence in traditional and alternative health care systems resulting in world herbal trade which stands at US$ 120 billion and is expected to reach US$ 7 trillion by 2050. [A.Ganeshan et al 2016.]

**DRUG DISCOVERY AND NEW FORMS OF DRUG DELIVERY**

Several drugs have been developed and practiced from Ayurveda since ancient time to modern practice as 'tradition to trend'. The potential of Ayurvedic medicine needs to be explored further with modern scientific validation approaches for better therapeutic leads. several lead molecules that have been developed from the Ayurvedic herbs, which have various significant therapeutic activities. [Mukherjee PK, Harwansh RK, Bahadur S, Banerjee S, Kar A, Chanda J, Biswas S, Ahmmed SM, Katiyar CK. Development of Ayurveda - Tradition to trend. J Ethnopharmacol. 2017 Feb 2;197:10-24. doi: 10.1016/j.jep.2016.09.024. Epub 2016 Sep 12. PMID: 27633405.]

Three Ayurvedic herbs-garlic, guggul and black cumin have been identified as safe and effective in reducing cholesterol biomarkers in a systematic review and meta-analysis of Ayurveda based herbal preparations for hypercholesterolemia by [Gyawali et al. (2021] Next to drug discovery through Ayurvedic medicine, new forms of drug delivery can also be explored. For instance - drug delivered at the nasal mucus membrane produces a systemic effect and in one of the notable researches it was demonstrated that application of Devadali juice(Luffa echinata ) as Nasya (Ayurvedic treatment where medicine is infused through nostrils) produced a remarkable reduction in the elevated serum bilirubin level in the case of viral hepatitis. [Nishteswar K. et al. 31. modes of action Nishteswar K. Science of Marma (in Ayurvedic diagnosis and treatment). Ayu. 2015 Jan-Mar;36(1):113–4. PMCID: PMC4687231.]

Fumigation therapy is one of the several treatment methods described in Ayurveda whereby fumes produced from defined drug formulations are inhaled by patients. This therapeutic procedure offers promising research opportunities from phytochemical and ethno pharmacological viewpoints, however, it remains under-noticed. Ayurveda recommends fumigation as a method of sterilization and therapeutic procedure for various human diseases including microbial infections and psychological disorders. [Vishnuprasad CN, Pradeep NS, Cho YW, Gangadharan GG, Han SS. Fumigation in Ayurveda: potential strategy for drug discovery and drug delivery. J Ethnopharmacol. 2013 Sep 16;149(2):409-15. doi: 10.1016/j.jep.2013.07.028. Epub 2013 Jul 29. PMID: 23906781.] Various bacteriostatic drugs like Guggulu (Commiphora mukul),Vacha (Acorus calamus), Haridra (Curcuma longa) etc are used for dhupana. It gives us an insight that role of microorganism and knowledge of epidemics was probably known to Ayurveda. [ShubhashreeIJCAM ]

**VRUKSHAYURVEDA**

Cultivation of medicinal plants has become the need of the hour to meet the growing demand of herbal drug requirement in the field of medicine. [Shubhashree MN, Matapathi S, Dixit AK. Conservation and preservation of medicinal plants-leads from Ayurveda and Vrikshayurveda. Int J Complement Alt Med. 2018.]. Vrukshayurveda is the ancient Indian science of plant life which deals with various trees and plant species and ensures the healthy growth and productivity. To ensure quality of medicinal plants, in futuristic context, Vrukshayurveda is quintessential. Chemical fertilizers and pesticide are petroleum derivatives. With the depletion of oil reserves all over this planet within next 20-25 years this system of agriculture cannot last. Alternate cultivation methods are to be developed and Vrukshayurveda is a best option for future.

Vrukshayurveda emphasizes the identification, cultivation, and research of medicinal plants. With the advancement of technology, such as genetic engineering and biotechnology, Vrukshayurveda can contribute to the development of new plant-based medicines and therapies. It can help identify specific compounds and their therapeutic properties, leading to the discovery of novel remedies for various ailments. [Dr. S. A. Meshram, Dr. A. A. Meshram. Vrikshayurveda - A Boon. J Ayurveda Integr Med Sci 2019;6:186-189.]

As concerns about environmental sustainability grow, Vrukshayurveda can promote organic and sustainable farming practices. It can provide guidance on natural fertilizers, pest control methods, and optimal cultivation techniques, reducing the dependence on harmful chemicals and promoting eco-friendly agriculture. The use of pañcagavyam, kuṇapajala (natural organic liquid manure derived from animal and plant products) and other procedures can be studied further for efficacy and if found to be suitable can be adopted for the various steps involved in development of organic nursery protocol for medicinal plants. [Shubhashree MN, et al.] This approach aligns with the increasing global demand for natural and environmentally friendly solutions. Health hazards caused by rampant use of chemical fertilizers and pesticides can be cut down. Health hazards in human beings like Digestive ailments, Cancer, Physical and Mental ailments, Reproductive abnormalities, Immune suppression, Hormone disruption etc are due to the haphazard use of chemical fertilizers and pesticides, so if these methods are incorporated as mentioned in Vrukshayurveda (Bio fertilizers, various cultivation techniques, Pest control like fumigation with Sarshapa-Brassica juncea, Hingu-Ferula asafoetida etc) in agriculture the incidence of deadly diseases in future can be reduced. [Ashwini Jeerankalagi, Shivanand T Biradar, Shashidhar P Naik, D N Dhari, Vidyalaxmi S Pujari. The relevance of Vrukshayurveda for organic cultivation of medicinal plants. J Ayurveda Integr Med Sci 2022;1:329-333.]

Phytochemistry and Pharmacology in Vrukshayurveda can contribute to the exploration of plant-based compounds and their interactions with the human body. By conducting in-depth phytochemical and pharmacological studies, it can provide a scientific basis for the efficacy and safety of Ayurvedic medicines. By studying the individual characteristics and genetic makeup of patients, it can help identify the most suitable medicinal plants and formulations for their specific health conditions. This research can lead to the development of standardized plant extracts, ensuring consistent quality and potency in Ayurvedic formulations. Vrukshayurveda and modern biotechnology can be amalgamated for the benefit of society in future. Vrukshayurveda can help Ayurveda evolve into a more robust and effective healthcare system in the future.

Hence, there is great scope to integrate traditional practices for better productivity of quality planting materials. Ayurvedic literatures recognized the role of multi disciplinary approach and emphasized on integration of diverse fields as potential tool for development of medical science.

**PASHU AYURVEDA(VETERNARY SCIENCE)**

Central Council for Research in Ayurvedic Sciences (CCRAS), under Ministry of Ayush, Government of India, has actively undertaken numerous endeavors to establish veterinary Ayurveda as an evidence-based science. In this regard, “The Ayurvedic Formulary of India, Part-IV (Veterinary)” was published by the Ministry of Ayush in October 2022, comprising 50 selected formulations to facilitate the manufacture and use of Ayurveda Veterinary Drugs. The ministry has taken steps to explore and revive local health traditions in veterinary Ayurveda. CCRAS is in collaboration with different Veterinary Universities regarding the uses of medicinal plants in veterinary practices. Trans-Disciplinary University (TDU), Bengaluru, is working on developing practical and farmer-friendly ethnoveterinary practices. The National Dairy Development Boards (NDDB) is promoting these practices throughout the country in regional languages. Undoubtedly, these initiatives will open new avenues to the practitioners, manufacturers, researchers, academicians, and enthusiasts in the field of veterinary Ayurveda in future. [Acharya R. Research in Pashu Ayurveda:Future prospect. J Drug Res Ayurvedic Sci 2023;8:95-6]

**NANO MEDICINE**

“Rasashastra,” is an integral part of Ayurveda, which deals with drugs of mineral origin and details their varieties, characteristics, processing techniques, properties, therapeutic uses and management of adverse effects in a comprehensive way. In Ayurveda, metal-based preparations, that is, bhasmas, are indicated for the treatment of several diseases.Bhasmas are unique Ayurvedic metallic/minerals preparation, treated with herbal juice or decoction. A Bhasma means an ash obtained through incineration; the starter material undergoes an elaborate process of purification and this process is followed by the reaction phase, which involves incorporation of some other minerals and/or herbal extract. Particle size (1-2 μ) reduced significantly, facilitates absorption and assimilation of the drug into the body system. [Pal D, Sahu CK, Haldar A. Bhasma : The ancient Indian nanomedicine. J Adv Pharm Technol Res. 2014 Jan;5(1):4-12. doi: 10.4103/2231-4040.126980. PMID: 24696811; PMCID: PMC3960793.] The end product would be a nontoxic material. Examples are Swarna Bhasma, Shankha Bhasma, Tamra Bhasma etc. Gold in tradition Indian Ayurvedic medicine as Swarna Bhasma (gold ash) has been characterized as globular particles of gold (56-57 nm).Gold nanoparticles have been detected in Swarnabhasma and the formulation was found effective as anti arthritic agent in rats Brown C. L., et al. Bhasma-inspired new drug discovery approach could emerge in future where in several metals based nanomedicines could be developed. [Chaudhary A. et al.]

Bhavana is a unique traditional method of transformation of raw material/substances into the drug by levigation or wet grinding of powdered drugs with juice/decoction/solution of plant, animal or mineral origin. This method adds the unique capability of affecting the physicochemical and biological properties of a drug, making the drug quicker, augmented and persistent action with minimal dose. [Chaudhary A, et al.]

Thus, the Bhasmas as nanomedicines may offer a huge potential for designing new drugs employing the concept of nanotechnology.

**MANAGEMENT OF NONCOMMUNICABLE DISEASES**

With the successful conquest of communicable infectious diseases in most of the world, non-communicable disease (NCD) has become the major health hazard of modern world. [Saklayen MG. The Global Epidemic of the Metabolic Syndrome. CurrHypertens Rep. 2018 Feb 26;20(2):12. doi: 10.1007/s11906-018-0812-z. PMID: 29480368; PMCID: PMC5866840.]

Moreover Non Communicable Diseases cause major financial burden worldwide, significantly impacting the economy of many countries. NCDs are chronic and long-lasting and represent one of the most significant health challenges these days. In this endeavor, Ayurveda offers solutions to prevent NCDs and cultivate enduring habits for a healthy lifestyle. Ayurveda is not just a medical discipline but a comprehensive lifestyle that enhances overall well-being, balances the mind and body, and guides humanity towards a healthier future.

According to the ICMR India State-Level Disease Burden Study report “India: Health of the Nation’s States,” the estimated proportion of all deaths due to NCDs has increased from 37.09% in 1990 to 61.8% in 2016

Physical inactivity, faulty diet, sedentary lifestyle habits and stress are the major risk factors of noninsulin-dependent diabetes. Ayurveda emphasized on the management of Prameha (Diabetes) through diet and lifestyle modification (which can be correlated to diabetes). [Guddoye G, Vyas M. Role of diet and lifestyle in the management of Madhumeha. Ayu J. 2013;34:167–73. ] Studies have also shown the effectiveness of Ayurveda intervention in the management of type 2 diabetes. [Panda AK, Ratha KK, Rao MM. Efficacy of ayurveda formulation ayush-82 (IME-9) in newly diagnosed type 2 diabetics: Retrospective analysis of individual data. J Tradit Med ClinNatur. 2017;6:250. ]

Keeping in view the strength of AYUSH systems for the prevention and management of NCDs by promoting healthy lifestyle, a project aimed for “Integration of AYUSH (Ayurveda) with National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)” was conceived in 2015 by the Ministry of AYUSH and Central Council for Research in Ayurvedic Sciences (CCRAS) in collaboration with Directorate General of Health Services, Ministry of Health and Family Welfare (MoHFW), for imparting health services on pilot basis in the three districts of three states, namely Bhilwara (Rajasthan), Gaya (Bihar) and Surendranagar (Gujarat) and promising results were observed [Sharma R, Shahi VK, Khanduri S, Goyal A, Chaudhary S, Rana RK, Singhal R, Srikanth N, Dhiman KS. Effect of Ayurveda intervention, lifestyle modification and Yoga in prediabetic and type 2 diabetes under the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)-AYUSH integration project. Ayu. 2019 Jan-Mar;40(1):8-15. PMID: 31831963; PMCID: PMC6892000].

**GERIATRICS**

Future systems are characterized by sophisticated technology with a community responsibility for health and well being and a new approach to ageing. Enhancing wellness scores over curing disease. Ten years from now, more patients will be living longer. Garson A et al. Many countries are experiencing an aging population, with a larger proportion of elderly individuals. By 2050, one-fifth of the world will be older than 65 years. [Ingle GK, Nath A (2008) Geriatric health in India: concerns and solutions. Indian J Community Med 33: 214-218.]

The latest projections also show that the number of people aged 80 or over will triple in the next 30 years. In many regions, the population aged 65 will double by 2050, while global life expectancy beyond 65 will increase by 19years. [https://www.un.org/development/desa/en/news/population/our-world-is-growing-older.html].This demographic shift emphasizes the need for specialized healthcare services and geriatric care. Advancement of age usually creates physical, psychological, emotional, and social problems.

Geriatric care has to address two-fold problems, firstly the basic anti-aging care to retard the rate of physiological ageing and secondly the medical management of diseases specifically occurring in old age. The conventional modern medicine is apparently strong in management of old age related health issues although the quality of life may not be as significant. Ayurveda, on the other hand has got the potential for prevention of diseases by promotion of health as well as management of diseases occurring in old age. [Rai, Amit et al.]

Ayurveda helps in managing chronic conditions commonly associated with aging, such as joint pain, arthritis, digestive issues, cognitive decline, and stress-related disorders. In functional and degenerative disorders that have a chronic or long standing nature Rasayana therapy is the only solution for effective management in any system of medicine. Vayasthapana are specialized Rasayana drugs that arrest degenerative changes, increase life span with quality health. [Tripathi B (2008) Chikitsa Sthan 1/7, Charak Samhita Part 2, Chaukhambha Surbharti Prakasan, Varanasi, India. Pg no: 5.] Ayurvedic treatments often include natural remedies, herbal medicines, lifestyle modifications, dietary changes, which are generally well-tolerated by the elderly population compared to invasive procedures or strong pharmaceutical drugs. [Stratton RJ. Green CJ, Elia M (2003) Disease-related malnutrition: an evidence-based approach to treatment. CABI Publishing, Wallingford, UK.] Ayurvedic Geriatric care (Jarachikitsa) and Rasayana methodologically delay ageing which begins at 60-70 years and reduce geriatric degeneration.

Ashwagandha (Withaniasomnifera), Amalaki (Phyllanthus emblicus) are some of the Rasayana drugs which are used in old age. The integration of Ayurveda with modern medicine can provide a comprehensive approach to geriatric care, combining the strengths of both systems to improve health outcomes for the elderly. Geriatric care in Ayurveda is gaining recognition and importance, and it is likely to continue to do so in the future.

**RASAYANA**

Rasayana is a special branch of Ayurveda, which deals with methods of rejuvenation such as dietary recipes and regimen, herbal and mineral supplements, and health-promoting lifestyle that are said to enhance quality of life and delay aging. [Udapa MH. Et al.] In fact the ideal time for treating the geriatric problems is youth.It is interesting to know the exemplary effects of the fruits of pomegranate (Punicagranatum L.), which has shown the life-span and health-span enhancing action, when tested on Drosophila melanogaster (fruitfly) model. In the study conducted by [Balasubramani SP, Et al] there was a two fold increase in fecundity, improved resistance to oxidative stress (H2O2 and paraquat induced) and to Candida albicans infection in pomegranate fed flies which demonstrate the rasayana action. [Pathak P, Prasad BR, Murthy NA, Hegde SN. The effect of Emblica officinalis diet on lifespan, sexual behavior, and fitness characters in Drosophila melanogaster. Ayu. 2011 Apr;32(2):279-84. doi: 10.4103/0974-8520.92544. PMID: 22408317; PMCID: PMC3296355.]

Exploring innovative ways to ensure healthy aging of populations is a pre-requisite to contain rising healthcare costs. Scientific research into the principles and practices of traditional medicines can provide new insights and simple solutions to lead a healthy life.

Ayurveda considers ageing as the Swabhavaja vyadhi i.e. it is inherent nature of the living being to get old. Ancient test Sarangadhara Samhita presents an interesting scheme of loss of different biological factors during different decades of life as a function of ageing. This is especially significant as it can provide a guideline for selection of age-specific organ-protective Rasayana to retard aging.

TABLE 1: AGE RELATED DEGENERATIONS AND PREVENTABLE RASAYANAS

|  |  |  |  |
| --- | --- | --- | --- |
| Sl.No | Decades | Age related bio-losses | Restorative Rasayanas |
| 1 | 0-10 yrs | Loss of Corpulence (Balya) | Vacha(*Acorus calamus*), Gambhari(*Gmelina arborea*), Swarna(gold) |
| 2 | 11-20 | Loss of Growth (Vridhi) | Gambhari(*Gmelina arborea*), Bala(*Sida cordifolia*), Ashwagandha(*Withania somnifera*) |
|  | 21-30 | Loss of Lusture (Chhavi) | Haridra(*Curcuma longa*), Kumari(*Aloe vera*), Louha |
| 4 | 31-40 | Loss of Intellect (Medha) | Shankhapushpi(*Convulvulus prostratus*), Brahmi(*Bacopa monnieri*), Jyotishmati(*Celastrus paniculatus*) |
| 5 | 41-50 | Loss of Skin glow | Jyotishmati (*Celastrus paniculatus*), Chironji (*Buchanania lanzan*), Bhrinjaraja (*Eclipta alba)* |
| 6 | 51-60 | Loss of Vision (Drishti) | Triphala, Jyotishmati (*Celastrus paniculatus*), Shatavari(*Asparagus racemosus*), Saptamrita Lauha |
| 7 | 61-70 | Loss of Virility (Shukra) | Kapikachu(*Mucuna pruriens*), Ashwagandha(*Withania somnifera)* |
| 8 | 71-80 | Loss of Strength (Vikram) | Bala(*Sida cordifolia*), Shilajeet, Ashwagandha(*Withania somnifera*) |
| 9 | 81-90 | Loss of Cognitive power | Brahmi(*Bacopa monnieri*) , Mandukaparni(*Centella asiatica)* |
| 10 | 91-100 | Loss of Locomotive ability | Bala (*Sida cordifolia*), Ashwagandha (*Withania somnifera)* |

Certain recent studies on popular rasayana remedies like Amalaki (*Emblica officinalis*), Aswagandha (*Withania somnifera*), Guduchi (*Tinospora cordifolia*), Brahmi (*Bacopa monnieri*) and Chyavanprasha have shown evidence to suggest their efficacy as anti-aging remedies.

**NAIMITTIKA RASAYANA**

According to the disease condition, specific Rasayana drug known as naimittika rasayana are administered such as Pippali Rasayana, Bhallataka Rasayana in Kustha (skin diseases). [Vashistha N, Sharma P. Inside review of Naimittika Rasayana. International Journal of Research and Review.2021; 8(3): 102-106.] It improves immunity, exhibits multidimensional activities like antioxidant, tissue protective, immune stimulant and improves quality of life. Rasayana play a vital role as they provide curative and health promoting effects during recuperation too.

**ACHARA RASAYANA**

Achara rasayana is a unique concept in Ayurveda which refers to specific code of conduct, lifestyle and behavior and plays an important role in the prevention and management of psychosomatic disorders in future. It is a cognitive behavioral therapy that focuses on modifying automatic negative beliefs that can intensify and contribute to emotional problems, sadness, and anxiety. It is a cost-effective technique for reducing the global illness burden. [Shivani S. Dhurgude et al: The Importance of Achar Rasayana in Chittodvega (Mental Disordrs). International Ayurvedic Medical Journal {online} 2022 {cited July 2022}]

**MENTAL HEALTH**

The coronavirus pandemic has created a psychological havoc across nations. The classical texts of Ayurveda advocate certain principles to be followed in life for ensuring good physical and mental health, overall well-being, and optimum quality of life. [Chandhok S, Shubhashree M N, Chandrasekharan C. Relevance of Charaka's principles for psychological well-being during the COVID pandemic. J Appl Conscious Stud 2022;10:140-7]. In Ayurveda, psychological and mental well‑being is considered equally important as any other physical ailment. The principles of Ayurveda suggest the regime that individuals should follow to maintain optimum psychological well‑being. For optimum, significant and long-term outcomes, knowledge and principles of Ayurveda are to be combined with modern-day psychotherapy to expand reservoir of coping resources. There are many herbal tranquilisers which are found safe and effective for long term use . Ex- Brahmi (*Bacopa monneiri*)

**WOMEN’S HEALTH**

Polycystic Ovarian Syndrome (PCOS) is a common endocrinopathy faced by the women today. It is often related with the reproductive system causing menstrual disorders, infertility, obesity, depression, sleep apnea, insulin resistance and in due course may result in diabetes mellitus, endometrial cancer, cardiovascular disease etc. Ayurvedic therapies aid in reduction of the weight and also reduce the symptoms of PCOS. It helps to lower the insulin resistance more efficiently there by favoring ovulation which is one of the prime factors for the maintenance of fertility. [Shahina Mole.S, et al.]

Garbhini Paricharya (Antenatal care), which contains dietetic and other regimens advocated in Samhitas for pregnant women, is of great significance for future. Ayurveda give importance to antenatal care (Garbhini Paricharya) and postnatal care (Sutika Paricharya) which are well described in ancient classical texts. Now a days due to changes in life style, culture, food habits, hectic schedule, elective Caesarian Section has become a common phenomenon. Adopting good antenatal care practices helps normal delivery with good and effective uterine contractions during labor and also leads to proper contraction of uterus after labor preventing post partum complications. [Dr. Sachin Mittal, Dr. Rajesh Gupta. Effect of anuvasana basti and yoni pichu in sukh prasava & reducing postpartum complications.] Treatment like Bala sidha taila matrabasti (enema with medicated oil) and Yonipichu (vaginal tampon) in 9th month of pregnancy helps in increasing tone, smoothening of pelvic region and related organs. Yoni pichu brings contractility of uterine muscle and helps in cervical ripening by altering the cervical matrix and helps in releasing prostaglandins. [Swati Malsariya, K. Bharathi, B. Pushpalatha. Effect of Bala Siddha Taila Matra Basti and Yoni Pichu in Achieving Sukhprasava: A Case Study. International Journal of Ayurveda and Pharma Research. 2020;8(Suppl 2):83-87. Sutika paricharya (puerperium care) maintains maternal and infant health by preventing complication and establishing infant feeding. Abhyanga (Oil massage) during puerperal period causes toning up of muscles of pelvic floor, abdomen, back and vagina and prevents thrombosis [stha Verma, Sonalika, Hiremath, Sheela Mallikarjuna, Sridevi Swamy. Sutika Paricharya - Post Natal Care in Ayurveda. J Ayurveda Integr Med Sci 2017;3:175-180.] Ayurveda can also be of great use in menopausal phase and as a substitute to hormonal therapy.

.

**AYURVEDA AND TECHNOLOGY**

**Artificial Intelligence (AI) and Machine Learning (ML)** has emerged as tools that hold potential to revolutionize the field of healthcare, including the practice of Ayurveda. AI and ML can assist in the diagnosis of diseases, suggest personalized treatment plans and optimize patient outcomes. By developing language models and algorithms that are specifically trained to understand and process Indian languages, researchers and practitioners can effectively leverage AI and ML techniques to extract valuable insights from Ayurvedic texts, medical literature, and patient records written in regional languages. This advancement facilitates better communication, knowledge sharing, and innovation within the Ayurvedic community, promoting the preservation and dissemination of traditional medical knowledge across diverse linguistic and cultural contexts. Natural Language Processing (NLP) can assist in the digitization and organization of Ayurvedic texts and ancient manuscripts, making them more accessible and searchable for researchers, practitioners, and enthusiasts. By extracting valuable information from these texts, NLP can aid in the discovery of new insights, formulations, and treatment approaches. Additionally, NLP can enhance the accuracy and efficiency of patient consultations by facilitating intelligent chat bots or virtual assistants. These AI-powered tools can understand patients' queries, symptoms, and medical histories in natural language, enabling personalized recommendations and advice. NLP algorithms can also analyze patient feedback and reviews, helping to identify patterns and improve the efficacy of Ayurvedic treatments.

Furthermore, NLP can assist in cross-linguistic research and knowledge sharing in Ayurveda. By enabling translation capabilities and language understanding, NLP can bridge the gap between different languages and cultures, allowing practitioners and researchers from diverse backgrounds to collaborate and exchange information effectively. [Khurana, D., Koli, A., Khatter, K. et al. Natural language processing: state of the art, current trends and challenges. Multimed Tools Appl 82, 3713–3744 (2023).]

Classification and regression are machine learning techniques that can be used in Ayurveda to make sense of patient data and improve treatment outcomes. Ayurveda, has also started embracing these technological advancements to enhance its reach and effectiveness. The integration of digital health and telemedicine in Ayurveda has the potential to expand the reach of this traditional healing system, facilitate personalized care, and improve patient outcomes. [Vodička, S., &Zelko, E. (2022, September 28). Remote consultations in general practice – A systematic review. Slovenian Journal of Public Health; De Gruyter Open.]

**TECHNOLOGICAL ADVANCEMENT**

The digitization of Ayurvedic healthcare facilitates the collection and analysis of vast amounts of patient data. This aggregated information can be anonymized and used for research purposes, leading to insights on the effectiveness of Ayurvedic treatments, identifying patterns in diseases, and supporting evidence-based practices. The application of data analytics and machine learning can further enhance the understanding of Ayurvedic concepts and refine treatment protocols.

The globalization of Ayush calls for standardization , not only at National but also at International level in terms of terminology, clinical examination, diagnosis, maintenance of health records, interventions in form of herbs, herbal/herbo-mineral formulations, diet and lifestyle, drugs as well as pharmacovigilance specific to these systems. [Dua, Pradeep Kumaret al Standardization in AYUSH systems: Bureau of Indian Standards (BIS) and International Organization for Standardization (ISO) perspectives. International Journal of Ayurveda Research 4(1):p 5-14, Jan–Mar 2023]. Ministry of AYUSH is actively engaging with WHO for development of Standardized Terminologies of Ayurveda, Siddha and Unani systems of Medicine . For ex- Namaste portal

1. **NAMASTE Portal**

Namaste Portal is the comprehensive web-portal for Standardised Terminologies and National Morbidity Codes of Ayurveda, Siddha and Unani Systems of Medicine and WHO-ICD-10 and ICD-11. [Sheshagiri, Srihari. "NAMASTE Portal: A standard reference repository for Ayurveda terminologies." Journal of Indian System of Medicine, vol. 9, no. 1, Jan.-Mar. 2021, p. 1. Gale OneFile: Health and Medicine.] The objective is to provide a single window access to the information and services being provided by Indian government for citizens and stake holders. It is being maintained successfully for the collection of Morbidity statistics through National Ayurveda, Siddha and Unani Morbidity codes.

1. **AYUSH Grid**

The Ministry of AYUSH has initiated steps to set up a nationwide digital platform called “AYUSH GRID” which aims to bring onboard all AYUSH facilities including hospitals and laboratories and to promote traditional systems of healthcare.

1. **The AYUSH Research Portal**

The AYUSH Research Portal is meant for disseminating the information related to the AYUSH and the current research updates purely meant for academic purpose.

**AYUSH STARTUP**

Government of India is extending its support for emerging startups in Ayurveda. All India Institute of Ayurveda (AIIA) under Ministry of Ayush has launched “Ayush start ups challenge” to encourage early start ups to work on innovation in Ayurveda and aims to recognize and endorse inventive startups operating in the Ayush domains while leveraging the potential of emerging technologies. For instance, Food Innovations in Ayush Sector – Ready to Eat Nutritious Ayurveda Ahara (Food), Ayush Bio-instrumentation (Hardware Solutions) and Innovations in healthcare enabling breakthrough performance in terms of better outcomes are some of the examples. [<https://www.startupindia.gov.in/content/sih/en/ams>] In order to recognize India’s age old principles of Ayurveda and the Aahara prepared as per ancient texts, Food Safety and Standards Authority of India (FSSAI) has formulated Food Safety and Standards (Ayurveda Aahara) Regulations, 2022 in consultation with the Ministry of Ayush and notified the regulations in the official gazette on 5th May, 2022. The regulations define “Ayurveda Aahara” a food prepared in accordance with the recipes or ingredients or processes as per method described in the authoritative books of Ayurveda listed under ‘Schedule A’ of these regulations. [https://pib.gov.in/PressReleasePage.aspx?PRID=1846185]

**PHARMACOVIGILANCE**

Medical pluralism is a growing trend and people are exploring various options including modern, traditional, complementary and alternative medicine. Global concern on drug safety paved way to pharmacovigilance. People are unaware of the need to be vigilant during use of herbal medicines alone or in combination with other medicines. People are of the notion that Ayurveda medicines cause no harm and self medicate themselves. Drug herb interactions and medical pluralism are very common during these years. Many diabetic patients are known to use herbal medicines with antidiabetic properties in addition to their mainstream treatments, which may present both a benefit as well as potential risk regarding drug interactions. For instance Methi (Fenugreek) and Metformin are consumed by diabetic patients with out knowing the probable drug interactions. Similarly, drug interactions between allopathic tranquilizers and Ayurvedic drugs (Brahmi and Alprazalam) for sleeplessness,Nonsteroidal anti-inflammatory drugs and Ayurvedic drug Guggulu(*Commiphora mukul*) for pain management are yet to be explored. [Way ahead for excecution of pharmacovigilanceprogramme. Dr. Shubhashree M N.] Due to intrinsic pharmacokinetic and dynamic interactions, variability in herbal product compositions, unsupervised self-administration and lack of adequate knowledge about the ingredients and their pharmacological properties, there is a serious risk of potentially adverse herb-drug interactions. [Rajarshi Bhadra Keyvan Ravakhah and Raktim K Ghosh Herb-drug interaction: The importance of communicating with primary care physicians]

Scientific validation and the documentation of Ayurvedic drugs are very essential for its quality evaluation and global acceptance. Therapeutic efficacy of Ayurvedic herbs may be enhanced with high quality, which can be achieved by identity, purity, safety, drug content, physical and biological properties. Ayurvedic medicines need be explored with the modern scientific approaches for its validation.

The Bureau of Indian Standards (BIS) is the National Standards Body of India which is involved in developing National Standards on products, processes, and services which are called as “Indian Standards.” At present Ayush department in BIS is involved in creating standards for herbs and AYUSH related materials (equipment, instruments, Yoga accessories, etc.) corresponding to the International Standards.

**AYUSH-GLOBAL SCENARIO**

“AYUSH” refers to the traditional and nonconventional systems of health care and healing which include Ayurveda, Yoga, Naturopathy, Unani, Siddha and Homeopathy.  Traditional medical systems including Ayush systems are important and often underestimated health resources with many applications, especially in the prevention and management of lifestyle-related chronic diseases and in meeting the health needs of aging popular. Owing to the Health challenges of the 21st century, interest in Ayush Systems is undergoing a revival. The Declaration of Astana of the WHO, adopted at the Global Conference on Primary Health Care in October 2018, made clear that the success of primary health care will be driven by applying scientific as well as traditional knowledge, and extending access to a range of health care services, which include traditional medicines. It is reported that 88% member states have acknowledged use of traditional medicines, which corresponds to 170 member states in WHO. [Pradeep dua et al ]

The WHO has also stated in the “WHO Traditional Medicine Strategy 2014–2023” that “for many millions of people, herbal medicines, traditional treatments, and traditional practitioners are the main source of health care, and sometimes the only source of care which is available close to homes, accessible and affordable. It is also culturally acceptable and trusted by large numbers of people. The affordability of most traditional medicines makes them more attractive at a time of soaring health-care costs and nearly universal austerity.”

Appreciating the role of traditional medicines in health care, the WHO has set up a Global Centre for Traditional Medicine in Gujarat, India. It is noteworthy that Ayush experts are formulating ISO standards in collaboration with the BIS to augment the Ayush exports in the global market.

## INTERNATIONAL TRADE

In the recent past, there has been a huge international demand for Ayush products and services. In view of the huge potential for growth and export of Ayush systems, the Government of India has set up the Shellac and Forest Products Export Promotion Council with the mandate of export promotion of Herbal extracts. The export promotion of several Herbal Products has been assigned to Pharmaceuticals Export Promotion Council. Agricultural and Processed Food Products Export Development Authority promotes export of Medicinal Plants. Recently, a dedicated Ayush Export Promotion Council has been established to facilitate all aspects of exports pertaining to the Ayush sector. [pradeep dua et al]

The important sectors are Healthy Eating, Nutrition, and Weight Loss ($946 billion); Physical Activity ($738 billion); Wellness Tourism ($436 billion); Traditional and Complementary medicine ($413 billion); Public Health, Prevention, and Personalized Medicine ($375 billion). Ayush products are being traded into more than 100 countries either as medicine or as food supplements.

It is also the need of the hour to move toward the United Nations Sustainable Development Goal 3 (UN SDG 3) – Ensuring healthy lives and promoting well-being for all at all ages – By achieving Universal Health Coverage (UHC), addressing health emergencies and promoting healthier populations. Ayush systems can make a significant contribution to the goal of UHC by being included in the provision of essential health services.

High-quality health-care service delivery in conventional as well as Ayush systems, low cost, and proximity to some potential countries have made India one of the most popular destinations for medical value travel. Publication of an Indian standard IS 17942: 2022 – ”Tourism and Related Services – Medical Tourism – Service Requirements” as a modified adoption of ISO 22525: 2020 with inclusion of Ayush-related provisions is also poised to boost the  Ayush sector.

**COSMETOLOGY**

Consumers are going green globally specially in cosmetics market. Recently the growth of beauty products are driven by products that are natural or herbal and it has been increasing gradually. Ayurvedic Cosmetics are in demand as they are safe the focus is more on translating ancient ayurvedic formulas into the products of the modern world. Extracts taken from plants and other natural substances are formulated into cosmetic products like moisturizers, to provide a comprehensive beauty range serving mankind.

**INTEGRATIVE MEDICINE**

Integrative Medicine is a an upcoming field and widely accepted as a cost-effective problem solving method that simplifies the management of incurable and complex disorders where modern medicine has little to offer. Development of integrative medicine health incubator is the key to development of multidisciplinary program that offers to reduce the cost of healthcare, out of pocket expenses and emphasizes on preventive healthcare as means to achieve a healthy population in a developing country like India. [Anand A, Tyagi R, Kaur P. Incubating Integrative Medicine in India through PMO's Atal Incubator Scheme of NitiAayog. Ann Neurosci. 2017 Jul;24(3):131-133. doi: 10.1159/000477149. Epub 2017 Jul 24. PMID: 28867893; PMCID: PMC5566680.] Integrative healthcare centers are functioning at prestigious institutes like All India Institute of Medical Sciences (New Delhi), National Institute of Mental Health And Neuro-Sciences (Bangalore).

Affordability, accessibility and availability of health care coupled with disproportionate growth and double burden of diseases have become major concerns in India. Emphasizes need for mindset change from illness-disease-drug centric curative to person-health-wellness centric preventive and promotive approaches. [Patwardhan B, Mutalik G. Search of novel model for integrative medicine. Chin J Integr Med. 2014 Mar;20(3):170-8. doi: 10.1007/s11655-014-1745-2. Epub 2014 Mar 4. PMID: 24615209.] NITI Ayog the apex public policy think tank of Government of India is also developing action plan for states to include AYUSH in addressing health and nutrition issues. It is closely working under cooperative federalism to look at gaps to integrate with AYUSH. Integrative treatment protocol is developed by conducting robust integrative research studies. NITI Ayog is working towards making AYUSH part of child development program, early childhood program and school health program.

## The novel idea of the integration of health care with modern and traditional medicine, helps the patients with curable and incurable disease through a more scientific approach. For example considering the incurable nature of muscle dystrophy patient the main focus could be on complementary and alternative approach, which includes Ayurveda, known to improve the health of incurable muscle dystrophy patients. Treatment with the yoga and physiotherapy could also be provided which may improve their health at greater level. [Anand A, Tyagi R, Kaur P. Incubating Integrative Medicine in India through PMO's Atal Incubator Scheme of NitiAayog. Ann Neurosci. 2017 Jul;24(3):131-133. doi: 10.1159/000477149. Epub 2017 Jul 24. PMID: 28867893; PMCID: PMC5566680]

**COLLABORATIVE RESEARCH**

Collaborative research efforts can help enhance the understanding, credibility, and acceptance of Ayurveda both within and outside of traditional Ayurvedic communities. Collaborative research brings together experts from various fields such as Ayurveda, modern medicine, pharmacology, biochemistry, and other relevant disciplines. By conducting rigorous scientific studies, researchers can validate the efficacy and safety of Ayurvedic treatments and medicines. This scientific validation is crucial for gaining wider acceptance, integrating Ayurveda into mainstream healthcare systems, and promoting evidence-based practices. Ministry of Ayush is conducting the world's first multicenter Phase - III clinical trial examining the efficacy of Ayurveda in the treatment of Rheumatoid Arthritis. The clinical trial is conducted in accordance with stringent International Council for Harmonization of Technical Requirements for Pharmaceuticals for Human Use – Good Clinical Practice (ICH- GCP) guidelines. Such Collaborative Projects can propel Ayurveda system of medicine on a global scale into the future.

The Ayush Information cell helps in global promotion and propagation of AYUSH systems of medicine which would lead to signing of Memorandums of Understanding (MoUs) with foreign Governments/ Universities/Institutes, for Country to Country cooperation in the field of traditional systems of medicine, setting up of AYUSH Academic Chairs and undertaking collaborative researches. [https://hcikl.gov.in/pages]

Ministry of AYUSH has signed 23 MoUs for undertaking collaborative research with various foreign universities in countries namely Austria Germany, Brazil, United Kingdom, Canada, WHO Geneva, United States, Argentina, Israel, Australia, Tajikistan and Eucador and signed 13 MoUs for setting up of AYUSH academic Chairs with foreign institutes/ universities in countries like Mauritius, Russia, Argentina, Malaysia, Bangladesh, Latvia, Trinidad & Tobago, etc. [Pib]

The All India Institute of Ayurveda (AIIA), the apex institute of Ayurveda in India under the Ministry of AYUSH, and the National Institute of Advanced Industrial Science and Technology (AIST), Japan has signed an MoU for academic establishment. AIST is a reputed and one of the largest public research organizations in Japan, focusing on technologies and on “bridging” the gap between innovative technological seeds and commercialization. [https://pib.gov.in/PressReleasePage.aspx?PRID=1865904]. The MoU will enable both countries to promote research collaboration and building capacities in the field of the Indian Ayurvedic system of traditional medicines. All these activities will be executed in support of the Ministry of Ayush.

In January 2020, Indian Institute of Technology Delhi and the All India Institute of Ayurveda signed a MoU to study the therapeutic benefits of herbal formulations and wellness. Seven collaborations focusing on various Ayurvedic formulations and practices have been planned for the next two years. It includes

A) Examine the effect of six Ayurvedic juices on gastrointestinal secretions

B) Develop herbal formulations to reduce harmful effects of reusing cooking oil

C) Develop a biodegradable herbal wound dressing

D) Develop ‘Dhoopan Yantra’—a fumigation device for aiding wound healing

E) Examine the impact of ashes on proteins implicated in neurodegenerative diseases

F) Study the effects of ‘Brahmari Pranayama’ on the nervous system

G) Gauge if Ayurvedic drugs help in early detection of cancer and assess response to these drugs in treating breast cancer

## CONCLUSION

Ancient treatise Charaka Samhitha mentions that new ideas are to be incorporated from the world around and learnt .There is something new to learn and imbibe . Ayurveda is a dynamic science and a constant learning process. Sushrutha also supports the idea with his quote “Ekam shastram adhiyano na vidyat shastranischayam, tasmat bahushrutah shastram vijaniyat chikitsakah” which implies without having the knowledge of other branches of science ,one cannot conclude that it is the best , therefore a physician should study many scriptures.

The concepts of Ayurveda conveyed thousands of years back are relevant now and will continue to do so in the future. The heightened awareness about the efficacy of herbal and traditional medicines as well as surge in research and developmental activities, management of chronic diseases have expanded the scope of Ayurveda.

Ayurveda has gained popularity outside of India, and its recognition as a valid healthcare system may continue to grow in the future. It is hoped that ancient wisdom coupled with modern technology would benefit the mankind in future.