

# Chapter 11

## Translational Effectiveness in Ayurvedic Medicine: Implications for Oral Biology and Medicine

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### 11.1 Introduction: Oral Health—The Absence of Disease in the Oral Cavity

The World Health Organization (WHO) defines that health is a state of complete physical, mental, and social well-being, not merely the absence of disease or infirmity. From that viewpoint, the clinician works toward assisting the patients regain a state characterized by freedom from disease and of overall well-being of the mind and of the body.

In the Western health care tradition, two fundamental epochs can be roughly traced, which are fundamentally different in philosophical viewpoints and practical implications [1]. At the root of the Western health care tradition, we find the Egyptian, Greek, and Roman cultures, which all emphasized an intimate intertwining between the mind and the body. Alterations in psychocognitive and emotional well-being were believed to have grave consequences on physiological health; alternatively, alterations in physiological balance were recognized to be associated with profound mental ill-health.

These interrelationships are clear and evident in the writings of Aristotle and many of his followers in the Western tradition for centuries. It is not until the seventeenth and the eighteenth centuries, leading to the philosophical writings of Kant and his followers in the modern era, that the view of health and disease, physiology and anatomy, both in the normal health state and in the pathological state, began to be disarticulated, fragmented, and—some would argue—disjointed.

Whereas in the older and traditional models of universities, medicine was taught as a unified concept, now schools of medicine were emerging, endowed with specific faculties of psychiatry, physiology, anatomy, and the like. As our views of

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health and disease became more oriented toward understanding the fundamental elemental principles of the scientific mechanisms that underlie health and disease in the West, our perspectives became more reductionistic. That emphasis consequentially engendered a dissociative process between the mind and the body, and no longer was the patient seen as a whole organism, but more often than not, mental diseases were treated separately from endocrine diseases, and from bone diseases, and so forth. Systemic disease, that is, diseased state—essentially—from the neck down, were considered separately from diseased state of the head and neck region, and even within that region, neurologists and psychiatrists typically addressed pathologies within the caudal or cranial aspect of the head and neck, and dentists and specialists in oral medicine concentrated in stomatopathology, that is, oral diseases [2, 3].

The “non-Western” medical dogmas, which in the West is referred to as “complementary and alternative medicine (CAM)” —meaning to say, complementary or alternative to the modern Western medical approach—actually consists of several and distinct traditions, of which Ayurvedic medicine and traditional Chinese medicine are prime examples [1].

Integrative medicine is the combination of the practices and methods of complementary and alternative medicine with conventional Western medicine. Important health benefits and cost savings can be realized throughout the health care system by balancing fundamental integrative strategies, as determined by the needs of the patient, such as integrating lifestyle changes (e.g., mindful stress reduction), integrating East–West interventions (e.g., use of traditional Chinese herbal medicine), and integrating preventive programs that promote wellness (e.g., Qigong).

It is fair to say that all of the “non-Western” viewpoints on health and disease share a commonality, which makes them actually more affine to the first epoch of Western medicine, as briefly outlined above, than its developments in the last two centuries. That commonality, very briefly sketched out, could be summed up as the conceptualization of health as the absence of disease in the patient as a complete psychobiological entity that interacts with its social and physical environment, and that view is akin to the WHO perspective noted above.

In Ayurvedic medicine, as in all other “non-Western” traditions of health care, the patient is not treated for a specific organ disease per se (e.g., “oral” disease), as much as the treatment is designed to heal the patient as a whole: in that medical tradition, it is understood that the manifestation of disease in the oral cavity, for instance, is reflective of a diseased state pervasive to the entire organism, systemically. “Non-Western” health care approaches in general, and Ayurvedic medicine in particular, cannot and does not separate the oral cavity from the rest of the patient and cannot and does not separate the manifestation of loss of balance and health—that is, disease—in the oral cavity from loss of a state of health in the patient as a total person.

The remainder of this chapter continues and expands the concepts introduced in our previous chapter (cf., Chap. 1) and subsequent chapters in this book, and examines these similarities and these distinctions in further details. It then seeks to reconcile pioneering work currently done in Western health care that seeks to emphasize

translational effectiveness through research synthesis of the best available evidence, with the fundamental tenets of Ayurvedic medicine, specifically with respect to disease manifestations that primarily erupt in the oral cavity.

## 11.2 Oral Diseases Across Medical Traditions

### 11.2.1 *Western Oral Medicine: Early Views*

In today's parlance, a disease is an abnormal condition that affect the body of an organism and that is construed as a medical condition associated with specific symptoms and signs. Specifically with respect to oral diseases, the anatomical region of interest pertains to the oral cavity, the pharynx, and the larynx. Modern Western medicine attributes diseases to external factors, such as infectious agents, or to internal dysfunctions, including autoimmune diseases. As of late, in the Western view of health care, four main types of diseases can be conceptualized:

- A *pathogenic* disease is caused by a pathogen of some sort
- A *deficiency* disease results from the lack of some essential mineral or nutrient
- A *hereditary* (or genetic) disease
- A *physiological dysfunction* disease

A disease is often associated to collateral conditions, including pain, discomfort, lethargy, mental exhaustion, and psychoemotional difficulties. Similarly, the state of disease often affects people not only physically but also emotionally; contracting and living with many diseases can alter one's perspective on life, personality, and psychoemotional well-being. These interrelationships were well recognized in antiquity and are today in CAM, generally speaking, and in Ayurvedic medicine, in particular.

Ancient documents recognize Hesy-Ra, perhaps the first official physician-dentist thusly recognized in Western history, to have lived during the Third Dynasty of Egypt, under the pharaoh Djoser (cca. 2650 BC). Henceforth, Egyptian medicine incorporated to a large extent supernatural beliefs and credence by the patients and the caregivers, with practical and pragmatic knowledge of anatomy, public health, and clinical diagnostics. The concept and practice of diagnostics was actually developed and elevated to an art form by the Babylonians, such that only well-formed and skilled physicians could engage in this process. This specialty reached its apex during the reign of the king Adad-apla-iddina (1069–1046 BC), with the writing of the *Diagnostic Handbook* by the physician-dentist Esagil-kin-apli in the city Borsippa on the east bank of the Euphrates, in today's Iraq (cf., Chap. 5).

For Esagil-kin-apli and his followers, as for Hesy-Ra and his followers, the recognition of the causes for the loss of health—the concept of “health” being conceived by both doctrines as a state of balance, akin to the concept of homeostasis introduced by the French physiologist Claude Bernard (1813–1878)—must rest on a careful examination of the patient and of the socioenvironmental forces that

impinge upon the patient's living conditions, as well as the use of empiricism (that is to say, the *best available evidence* from prior similar occurrences; cf., Chap. 1), logic, and rationality.

About the same time frame (cca. 700 BC), Ancient Greece witnessed the ascend of medicine as well in its first recorded medical school in Knidos, one of the principal metropolis of Caria, southwest of Anatolia, and one of the Greek Dorian Hexapolis. Alcmaeon formulated there the principles of ancient Greek medical intervention based on restoring the balance of humors (Earth—cold, Water—wet, Air—hot, and Fire—dry) within the body. The traditions of medicine in the ancient territories of Armenia and of ancient Greece were henceforth intertwined. Whence, Hippocrates of Kos (460–370 BC) developed his important and influential theory that the body contains within itself the power to rebalance the four humors and the ability to heal itself (*physis*) through rest and cleanliness. Aristotle (384–322 BC) added ether as the fifth essence since fire, earth, air, and water are earthly and thus viewed as corruptible. Aristotle reasoned that since no changes can be perceived in the heavens, therefore, stars must consist of a different, unchangeable, heavenly substance—ether.

The Aristotelian tradition was brought forward by Galen (129–199 AD), whose theories dominated and influenced Western medical science for nearly two millennia, excluding the contributions by Avicenna (980–1037), who was considered the Prince of Physicians in ancient Persia for his introduction of the conceptualization and of many of the protocols that we still used today in clinical trials, in evidence-based medicine, and in the experimental use and testing of drugs. Avicenna laid the foundations for practical and precise experimentation through what is recognized today as the scientific process of discovering and proving the effectiveness of medical treatments ([4]; cf. Chap. 5).

Indeed, Galen's views were not challenged before the great Muslim scientist Ibn al-Nafis (1213–1288), but these criticisms were largely ignored by the European medical elite (e.g., the School of Salerno) for centuries, due to the Crusades and the war of the Catholic Kings against the Moors. Western science had to wait past the Swiss scientist Paracelsus (1493–1541), whose hermetical views held, in brief, that sickness and health in the body rely on the harmony of man (microcosm) and nature (macrocosm). While Paracelsus is considered by many as one of the premier “fathers” of Western medicine, his views supported that because everything in the universe is interrelated, beneficial medical substances are to be found in herbs, minerals, and various alchemical combinations thereof that will benefit in preventing disease and in regaining health. We are part of, Paracelsus argued, the universe, one coherent organism that permeates with one uniting life-giving spirit, and our health derives from and depends upon our interrelationship with its entirety. Within the span of a hundred years, however, Western thought underwent a remarkable transformation with Andreas Vesalius' (1514–1564) *De humani corporis fabrica* (1543), William Harvey's (1578–1657) *De motu cordis* (1628), and Antonie Philips van Leeuwenhoek's (1632–1723) discoveries, and many other luminaries of science.

Meanwhile, the medicinal herbs of the Armenian highland were especially well known and cited by Xenophanes, Tacitus, Galen, Ibn Sina, al-Biruni, and others.

In fact, traditional texts indicate that medicinal plants of Armenia were cultivated in special gardens founded as early as King Vagharshak (cca. 220–150 BC) and at least until the Anatolian king of mixed Greek and Roman heritage, Artaxias III (i.e., Artashes, 18–35 AD) (first century AD), such as in particular the white bryony (*Bryonia alba*), a perennial vine of the cucumber family with characteristically stellate pale-white flowers and berries that induce vomiting, and the black cumin (*Nigella sativa*). The traditional Armenian medical paradigm was described by Eznik (a.k.a. Yeznik), the fifth century Christian writer and historian from Koghb in Northern Armenia, who ascended to become Bishop of Bagrevand and took part in the Synod in the ancient Armenian city of Artashat where the political and religious leaders of Christian Armenia gathered to discuss the threats of the Persian invasion in 449 BC. Eznik depicts a medical model that, as that of the Greek and the Romans described above, was grounded on the ancient theory of the four elements (earth, water, air, fire) and their corresponding four humors (blood, phlegm, yellow, and black bile).

It is clear that these three great cultures of antiquity—Armenia, Greece, and Persia—not only shared geographical proximity, but cultural foundations as well. Their history is intertwined not only in the wars and alliances they forged, but in the profound advances in scientific method and knowledge they proffered.

Within 100 years of Eznik’s erudite contributions, however, the Armenian philosopher Davit Anhaght elegantly discussed questions that he attributed specifically to anatomy, biology, pharmacology, pathology, and medical ethics. And by the end of the first millennium, the scholar Hovhannes Sarkavag (1045–1129) vigorously lectured in favor of a separation of science and medicine from religion, and for the necessity for the experimental study of nature, and a systematic process of gathering and analyzing evidence. In that sense, Sarkavag’s Armenian school of the biomedical sciences clearly anticipated the developments of scientific thought to occur in the West in the Renaissance and beyond. It is also remarkable, in light of our current understanding of developmental neurology and of biological psychiatry, to note that this scholar also demonstrated the value of learning and teaching that is obtained in an environment created and sustained by the teacher to stress and emphasize not fear and anxiety but care and concern toward the learner.

### ***11.2.2 Western Oral Medicine from 1728 Onward***

The Western medicine progressive compartmentalization of systems and organs led to the separation of oral diseases from the larger systemic pathology. As we discussed elsewhere [5, 6], the inception of dentistry and dental treatment modalities can be traced to the French anatomist, medical doctor, and dentist Pierre Fauchard (1678–1761), and his treatise entitled *Le Chirurgien Dentiste* (The Surgeon Dentist, 1728). This work was the first ever compendium of basic oral anatomy and function, oral pathology signs and symptoms, operative methods for removing decay and tooth restoration, periodontal disease, and manifestations associated with pyorrhea,

orthodontics, as well as prosthodontic techniques including replacement of missing teeth and tooth transplantation. It signaled the inception of oral biology and medicine as we recognize today in the West and was soon followed in the USA by Harris' work entitled *The Dental Art, a Practical Treatise on Dental Surgery* (1839).

It is notable that Fauchard was among the first to reject the theory that worms cause tooth decay. Rather, he observed that sugar, which was arriving from the New World as a first rate commodity, was detrimental to the teeth structure and the surrounding gingiva. By the turn of the twentieth century, Miller, following on Pacini's groundbreaking work in microscopic anatomy and Koch's discoveries in bacteriology, reported the observations that bacteria inhabited the oral cavity and that they were responsible for the production of acids capable of substantive damage of tooth structures when in the presence of fermentable carbohydrates—what biochemists were by now describing as the glycolytic process by which glucose, fructose, and most commonly sucrose are metabolized into acids, such as lactic acid. These developments in Western scientific thinking established a fundamental change in our conception of the etiology of dental caries shifted from the diet to a “chemoparasitic” model, which was soon confirmed by the studies on plaque and tartar by Black and Williams. By 1921, clinical experimentation by Major Rodriguez Vargas, of Army Dental Corps, established and demonstrated that dental caries was actually a bacterial disease of the oral cavity [6].

In terms of models of treatment interventions for oral diseases, three time periods can describe this process of evolution in the West:

- Initially, and following Fauchard's conceptualization, dental care was envisioned as a form of manipulations aimed at countering the ills consequential to poor oral health and little or no oral hygiene. Stemming from a “drill and fix” reparative mode, the primary goal of dental care was to repair damaged or decayed dental structures or, when all else failed, to perform extractions—often by today's standards, wanton extractions—some would call it a “drill, fix, or amputate” model [6].
- Research in physiology and medicine in the late nineteenth century, particularly with Paul Ehrlich's concept of the “magic bullet”—recognized today as antibodies—which earned him the Nobel Prize in medicine and physiology in 1908, the conceptualization of health and disease was fundamentally changed in the West. The “trend” of research permeated health care in general and the dental field in particular. Understanding and describing the fundamental mechanisms of tooth decay, caries, and other oral disease became the object of pursuit and the core of treatment interventions. Research yielded successful observations with respect to certain modes of cure or prevention—case in point, the protective nature of sealants, of water fluoridation, and of simple behaviors and habits of oral hygiene. A second great period of Western care for oral diseases had emerged, which came to be known as the “*prevention*” model [6].
- Based on the insights of Archibald Cochrane, MD in the early 1970s, the field of evidence-based medicine emerged. Within a few decades, the realization that treatment interventions for oral diseases ought to be based on the best available

evidence had been disseminated, and the American Dental Association formally defined evidence-based dentistry (1999) and launched the present-day “*translational effectiveness*” model of dental care [6–8].

It is important to note that from the translational effectiveness viewpoint mandates a systematic perusal of the entire body of available research reports (i.e., the bibliome) on the treatment of a given oral pathology in order to yield a consensus of the best available evidence principally with respect to effectiveness. The model calls for the efficacious translation of these effectiveness findings in specific clinical settings to ensure not only maximizing benefits, while minimizing risks and costs, but also adherence to the patient’s clinical case and history, value system and preferences, and overall health literacy ([6–9]; cf., Chap. 1).

### 11.2.3 Oral Diseases Manifest Systemic Diseases: The Ayurvedic Tradition

As noted in greater details throughout the noteworthy chapters of this book, Ayurveda, believed to be a comprehensive, traditional system of holistic medicine originated from the Vedic civilization of India about 5,000 years ago, is universally accepted as the oldest form of health care on earth. It is often referred to as the *mother of all healing*.

Ayurveda is a Sanskrit term made up of the words *ayu* and *veda*. *Ayu* means life and *veda* means knowledge or science. The term “Ayurveda” thus means “the knowledge of life” or “the science of life” [10]. Ayurveda lays a foundation within a trend of deeply relaxing wellness therapies. The fundamental philosophy of this tradition can be traced to two original schools also about the 1st millennium BC:

- The *Charaka*, initiated by the “father of Indian medicine,” Charaka, defended that *ayu* comprises the mind, body, senses, and the soul and, therefore, that health and disease are not predetermined, and life may be prolonged by human effort and attention to lifestyle. In this view, it is more important to prevent the occurrence of disease than to seek a cure (cf., the ancient Ayurvedic treatise Charaka Samhita).
- The *Sushruta*, led by surgeon and physician Sushruta himself along the banks of the Ganges in northern India and based on the Sushruta Samhita, a descriptive text of over 300 surgical procedures, 120 surgical instruments, and demonstration and classification for human surgery.

Together, the *Charaka* and the *Sushruta* signify the basis, foundations, and traditions for ensuring the wisdom (*veda*) or longevity (*ayu*). In fact, from these emerged over the centuries the eight primary domains of Ayurvedic medicine:

- *kāyācikitsā*—internal medicine
- *śalyacikitsā*—surgery and anatomy



- *śālākyaikitsā*—medicine specifically for eye, ear, nose, and throat diseases
- *kaumārabhr̥tya*—pediatrics
- *bhūtavidyā*—spirit medicine
- *agada tantra*—toxicology
- *rasāyana*—rejuvenation and antiaging
- *vājīkaraṇa*—aphrodisiacs

The Ayurvedic tradition conceives oral diseases, specifically, as diseases of the organisms that happen to manifest in the oral cavity. In Ayurveda, dental health (*danta swasthya* in Sanskrit) is held to be very individualistic, varying with each person's constitution (*prakriti*) and climatic changes resulting from solar, lunar, and planetary influences (i.e., *kala-parinama*) [10].

Following the fundamental philosophy of Ayurvedic medicine, treatment intervention in general, and modes of treatment specifically directed to oral diseases, must be grounded on the balance of the three elemental humors (*doṣas*, i.e., doshas), which, by their own nature, can and do deteriorate easily. The relative proportion and combination of these humors in any one patient at any given time determines the likelihood, the site, and the severity of disease. That is to say, Ayurveda is a common sense science with a profound knowledge of all the systems and functions of the body; hence, it is important to understand that any imbalance in the doshas is what really triggers the disease process including oral diseases.

To eliminate disease is to reestablish the appropriate balance among these forces, and that is achieved through a systematic process of *Panchakarma* (five detoxification processes). These elemental energies are:

- *Vāta*: air, space—"wind" (i.e., nervous system equivalent)
- *Pitta*: fire, water—"bile" (i.e., venous system equivalent)
- *Kapha*: water, earth—"phlegm" (i.e., arterial system equivalent)

The objective of curative treatment in Ayurveda is to restore the balance of the doshas (i.e., *dhatu-samyā*), but in malignant tumors, all three systems get out of control (i.e., *tridoshas*) and lose mutual coordination that causes tissue damage, resulting in critical condition. Tridoshas cause excessive metabolic crisis resulting in proliferation [11, 12]. *Dhatu-samyā* is essentially obtained by:

- Strengthening the weakened doshas
- Decreasing the increased doshas
- Maintaining the normal levels of doshas [11]

Treatment through *Panchakarma* is used for deep detoxification. However, Ayurveda encourages the prevention of imbalance and restoration of balance through the management of the doshas with a natural, down-to-earth Ayurvedic regime that includes proper diet and lifestyle, Ayurvedic herbs and herbal preparation, daily healthy routines, yoga, and meditation practices suited to your unique, individual constitution, as well as Ayurvedic therapies for relaxation and rejuvenation. These are the tools to optimal health and long life with Ayurveda [10, 13].



Specifically directed to enhance and maintain oral health and prevent or treat oral diseases, Ayurvedic doctors recommend using warming, astringent, connective-tissue-healing herbs. These herbs can be used as a rinse or applied as packs (a pinch of powder wetted to a mush with a liquid such as water or vitamin E and tucked next to the teeth). Rinses are made by preparing an herb as tea, or by simply stirring herb powder into water, and by holding the rinse in the mouth for a few seconds or up to several minutes before rinsing [10, 13].

For example, Amla (i.e., *Phyllanthus emblica*, *Emblica officinalis*), an herb that works well as a mouth rinse, or 1–2 g per day can be taken orally in capsules for long-term benefit to the teeth and gingiva. Amla supports the healing and development of connective tissue when taken internally and that always benefits the gingiva. Western experimental science has established that Amla extracts induce programmed cell death in vitro (i.e., apoptosis) and modify gene expression in the bone-resorbing cell population known as the osteoclasts, thus preventing or slowing the progression of rheumatoid arthritis and osteoporosis [14].

Moreover, the Ayurvedic text Charaka Samhita refers to the protocol Kavala (i.e., Gandusha: medicinal gargles that can be oleaginous—*snehi*, soothing—*prasadi*, purifying—*shodhi*, or healing—*ropana* in nature and purpose) that involves swishing oil in the mouth for oral and systemic health benefits and that is claimed to cure about 30 systemic diseases ranging from headache, migraine to diabetes and asthma. In the context of oral diseases, this mode of intervention is reputed to prevent decay, oral malodor, bleeding gums, dryness of throat, and cracked lips and for strengthening teeth, gums, and the jaw [10].

### 11.3 The Purpose and the Process of Evidence-Based Research

Translational effectiveness refers to the translation of the best available evidence gathered in systematic reviews in specific clinical settings [6–9]. These stringent research synthesis protocols [15, 16] proffer recommendations about clinical practice guideline revisions, decisions about standard of care and health information technology policy, new research and funding directions, and to fully empower patients by ensuring patient empowerment and participation through increased health literacy (cf., Chap. 1).

Optimal efficiency and reliability of this process depends critically on the quality of the systematic reviews by means of adherence to fundamental standards of research excellence and the regular update of the consensus of the highest quality evidence. This is the concerted purpose of the work that will enrich an evidence-based conceptualization of Ayurvedic medicine.

The standard protocol of systematic reviews is based largely on the recommendations of the Center for Reviews and Dissemination (crd.york.ac.uk/CMS2Web, cf., 26), the evidence-based dentistry study group (ebd-pbrn.org), the international forum on evidence-based dentistry and comparative effectiveness research (ifebdc.org),

the Agency for Health Care Research and Quality (AHRQ) ([ahrq.gov](http://ahrq.gov)), and similar entities and can be outlined as the following steps [7, 8, 15, 16].

1. The PICO question generally arises from the patient-clinician encounter, and emerges as the patient's characteristics (P), and the possible interventions (I) to be considered and compared (C) are noted in the pursuit of a given clinical outcome (O). The PICO question also generates the keywords necessary to enable an in-depth perusal of the entire body of available evidence [7, 8].
2. The entire bibliome of peer-reviewed literature and gray literature that is available needs to be accessed through multiple electronic databases and by hand in the library stacks, as necessary. The pertinence of the identified bibliome to the PICO question is ensured by the stringency of the inclusion and exclusion criteria [7, 8]. To minimize publication bias, literature must be collected in all languages. Translators and readers in foreign languages must be recruited, trained, and standardized as needed.
3. The resulting literature is analyzed for the level of the evidence and the quality of the evidence reported in each study by means of well-established and standardized checklists (e.g., CONSORT, PRISMA, SORT, STREGA, STROBE), as well as validated instruments to quantify the measurable outcome of evidence quality (i.e., R-Wong and Jadad for primary research, R-AMSTAR for existing systematic reviews) and strength of clinical relevance (i.e., Ex-GRADE) [7–9, 15–18]. The STRICTA instrument was recently developed for the specific purpose of performing evidence-based research of acupuncture [19, 20]. Concerted effort has also been deployed to establish protocols and tools for the pursuit of the best available evidence in Ayurvedic medicine [21–23]. The construct and content validity of these instruments are established based on standard criteria of research methodology, design and statistical analysis, and interrater reliability, and Cohen's  $\kappa$  coefficient agreement reliability must be clearly defined in a manner similar to that we have employed for the validation of the R-AMSTAR [24], which is commonly utilized in clinically relevant complex systematic reviews [25, 26].
4. The data thusly generated are typically summarized and abstracted in appropriate evidence tables and systematically analyzed for the level and quality of the evidence outcomes by means of acceptable sampling statistical analysis ([7, 24]; cf. Chap. 1). Overarching statistical significance among nonheterogeneous outcomes (as determined by the Cochran Q and  $I^2$  statistical test) are tested by fixed, or when appropriate, random effects model meta-analysis [7, 24], using the Cochrane-RevMan or any equivalent appropriate software. L'Abbé, funnel, and forest plots serve to illustrate data patterns. The level of significance is usually set at  $\alpha=0.5\%$ , although the variability inherent to complementary and alternative medicine protocols in general and Ayurvedic medicine in particular may dictate a higher level of significance (e.g., 10%). Bonferroni correction is used as needed to control for increased risk of type I error upon multiple comparisons [7, 15, 26, 27].

5. Decision-making of the best available evidence can be both qualitative and quantitative [6–9, 28–30]. Qualitatively, the clinical relevance of the resulting consensus of the best available diagnostic or prognostic evidence is discussed in the framework of the Logic Model and is described along (a) patient-centered criteria of satisfaction and quality of life, (b) practitioner satisfaction of clinical efficacy, (c) patient and clinician satisfaction about cost-effectiveness and risk-benefit ratio effectiveness, and (d) public health values and concerns, such as translation of the findings and the data into the specific clinical setting presently attending to the patient (i.e., translational effectiveness). Quantitatively, the outcomes of the research synthesis process can be utilized in a probabilistic mode of clinical decision-making that is directed to computing the probabilities of cost and risk, compared to benefits in a utilitarian model of decision-making (cf., Markovian tree). Consensus of the best available evidence will be analyzed in light of limitations of each independent systematic review and of threats to internal and external validity of the research synthesis protocol itself (cf., Chap. 1).
6. Based on PRISMA, AMSTAR, R-AMSTAR, and Ex-GRADE criteria (cf., Chap. 1) and the acceptable sampling analysis protocol, metrics are generated that are quantitative in format (rather than being single-word statements such as “good,” “limited”) and are grounded on statistical percentile (e.g., medians, interquartile intervals) and confidence intervals. The conclusions produced by the graded and ranked systematic reviews are thus be better used as communication materials for helping researchers and research-funding agencies to identify important gaps in our knowledge and for informing the actions of public health officials and other decision-makers [8, 9, 24, 30].
7. For the purpose of dissemination of knowledge, critical summaries (i.e., “evidence reviews”) of each generated systematic review are developed in a user-friendly format for the researcher, the clinician, the policymaker, and as much as the patients themselves. These summaries serve as the foundation for recommendations about each intervention reviewed to ensure that practice, policy, research, and funding decisions can be informed by the highest quality evidence. These summaries also become key instruments to empower the patients by raising health literacy [7–9]. Current work in our research group (cf., EBD-PBRN.org) aims at standardizing and validating the quality and value added of evidence reviews recommendations.

## **11.4 Conclusion: Translational Effectiveness in the Ayurvedic Paradigm**

Gargantuan steps have been taken as of late in the process of incorporating the research synthesis protocol for obtaining the best available evidence of efficacy and effectiveness for Ayurvedic medicine interventions and in the generation of systematic reviews in this domain [21–23, 31, 32]. Nevertheless, the complexity of the field

of the Ayurvedic perspective on health care, which is presented in this book, and was briefly outlined in the above section, renders the process of research synthesis toward the best available evidence particularly arduous—and that, particularly if one seeks to focus on disease manifestations specific to one or another organ, such as the oral cavity—simply because the fundamental principles of Ayurvedic medicine defends the intimate intertwining among all organs. The Ayurvedic principles defend that a specific anatomic region (e.g., the oral cavity) cannot and must not be considered in and of itself, and precluding its appartenance and interdependence with all other anatomic sites, organs, and physiologic processes.

Certainly, there are certain pathophysiological manifestations of the organism's increasing and overall loss of inner strength (i.e., energy, weakness: *agni*), which is represented as a loss in digestive capacity (i.e., decreased ability to eliminate toxic substances and influences: *mandagni*), that result in increased levels of unwanted “unripe” byproducts of such impaired processing (*ama*), that in turn unleash a response by the organism toward these toxic materials (*amavastha*). A Western view of this process may be akin to an immune or an autoimmune response raised against *amavastha* [11, 33, 34].

Immune activation results in the production of proinflammatory cytokines, which act on the hypothalamus to induce lethargy, nausea, and other alterations in behavior [2, 3, 5]. Similarly, the Ayurvedic principles teach us that the *amavastha* response increasingly leads to increasing impermeability and sluggishness of the *srotas* (i.e., *srotas*, internal bodily channels [31] that act as conduits for nutrients crucial to physical functioning throughout the human body—not dissimilar to the concepts of meridians in traditional Chinese medicine), resulting in stagnation or accumulation of the humors (i.e., *sanchaya* of *doshas*) and consequently a state of psychophysiological imbalance and morbidity, which can become so acute as to lead to mortality [11, 33, 34].

The following generalization follows, which could be pertinent to most conditions, which, in Western medicine, might be considered “oral pathologies”: that is to say, that many, if not most pathologies viewed through the prism of Ayurvedic medicine commence as a state of weakness of *agni* (*mandagni*) that obturates *srotas*, and leads to *doshas* stagnation. Consequently, Ayurvedic intervention is designed to detoxify the *srotas* network (i.e., *samshodhana*) to allow free flow of *doshas* and to strengthen *agni*. *Panchakarma*, as noted above, is the classic example of a set of five therapeutic procedures described for *samshodhana* systemically, as well as specifically for oral diseases [11, 33, 34].

Ayurvedic principles recommend two types of *samshodhana*:

- External purification through diverse means (e.g., oleation, fomentation, massage) to soften and mobilize impurities (i.e., *malas*) and direct them through gross excretory channels (i.e., *kosthas*)
- Internal purification, the principal and most effective Ayurvedic intervention

An excellent brief compendium of Ayurvedic treatment modalities of diseases specific to the teeth, the tongue, the palate, and other structures in the oral cavity is to be found in [11, 35]. For example, in the case of the pathology of the soft mucosa,

which in the West is termed oral lichen planus, an Ayurvedic intervention would prescribe the following:

- Oil gargle with either of *Jatyadi taila* (i.e., an herbal oil preparation from jasmine), or *Irimedadi taila* (a mixture of extracts from acacia and 19 other herbs, designed for oral ulcers, bleeding gums, halitosis)
- Possibly, a *Panchakarma* protocol (aimed at pacifying the aggravated *doshas* [the three bodily humors that make up one's constitution according to Ayurveda: wind, *vata*; bile, *pitta*; and phlegm, *kapha*, as noted above] by using appropriate diet, natural herbs and minerals, and at eliminating the increased *doshas* from the body) with *virechana* (i.e., administration of purgative substances for cleansing—therapeutic purgation)
- *Rasayana* herbs (i.e., tissue rejuvenating, reinvigorating herbs), such as *Tinospora cordifolia* (common name: Guduchi; a “hepatoprotectant” and immunomodulatory herb)

Moreover, from an Ayurvedic perspective, dental problems are linked to poor bone nourishment and related poor diet, with particular reference to taking excess refined foods which remove minerals from the body while passing through the digestive process. For those wishing to strengthen teeth, white sugar and white flour must be removed from the diet as well as any other processed, denatured, and refined foods. Nature gives us wholesome, nutritive foods, and our modern processing methods remove all the nutrition which has its price. There are various formulas in Ayurveda for strengthening bones and subsequently teeth such as coral and pearl powders. *Ayushakti* have a special formula called *Keshiya* and another called *Praval Moti* for this purpose alone which we found in clinical observation to be very effective. If bones are not being adequately nourished, there is often a deeper imbalance in the body which could be addressed by *Panchakarma*, which aims to restore the digestive fire to its full and optimal power so that what is eaten can be transformed into tissues correctly and completely.

What is clear is that the nature of the Ayurvedic process is grounded largely on philosophical principles of physiological models that are untestable by established Western criteria of the scientific method. That is to say, observations, deductions, diagnosis, decision-making for clinical intervention, and ultimately assessment and evaluation of clinical outcome efficacy and effectiveness are relatively more qualitative than in the Western health care paradigm. Therefore, as we push forward toward an evidence-based conceptualization of the Ayurvedic paradigm of health care, and reminiscent of the stringent adherence of evidence-based process upon the scientific method in research synthesis, certain caveats are noteworthy, which bring us beyond the excellent, albeit preliminary attempt to evaluate the best available evidence for translational effectiveness of Ayurvedic interventions [21, 32]:

- Firstly, it is important to recall the fundamental philosophical tenets of the great Ayurvedic school of thought. In brief, Ayurveda describes five ways to acquire knowledge and create an evidence base. Together, they reflect the epistemology of Ayurveda and its robust approach to ensure evidence-based rigor.

- *Apta* refers to the unbiased and intuitive acquisition of knowledge from the masters.
  - *Pratyaksha* pertains to observational data acquired through the senses or their extensions in the form of actual experimentation.
  - *Anumana* is evidence derived from logical analysis leading to a deduction.
  - *Upamana* concerns the evidence generated by analogy (or similar association between variables).
  - *Yukti* pertains to facts ascertained from a planned intervention to test an idea or evaluate an observation.
- In the performance of systematic reviews of Ayurvedic medicine, considering the complexity of the field, it will be critical to ascertain a comprehensive search of the pertinent bibliome, because, as in other complex domains of health care where systematic reviews are particularly difficult to bring forth, adequate search is key to ensuring high quality of the resultant review. In order to circumvent difficulties such as the fact that much of the clinical observations and even the clinical research is never published or is published in journals that are not indexed on the main databases, it is critical to enhance standard web searches through multiple search engines with hand searches, personal communications, as well as searches beyond medical or dental sources and databases. Specifically, and because much of the pursuit of the best available evidence is directed to improving evidence-based modes of interventions particularly in terms of cost-effectiveness and benefit-effectiveness, it is important to supplement traditional biomedical search modalities, such as the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Evidence-Based Medicine Reviews, EMBASE, International Pharmaceutical Abstracts, and MEDLINE, with business and economics databases, including ABI/Inform, the economics database EconLit, the general database Web of Science, ProQuest Digital Dissertations and Theses (PQDT) database, and the Public Affairs Information Service databases (PAIS International and PAIS Archive) [36, 37].
  - In Ayurvedic medicine, as in other areas of health care where the process of retrieval of information and data from the obtained bibliome may be relatively elusive compared to other more scientifically driven areas of clinical medicine, due to the interdisciplinary nature of the field and the lack of a significant body of evaluative literature, certain challenges of methodology arise in relevant literature retrieval for systematic reviews in the pursuit of effectiveness of strategies, which must be carefully addressed and considered [38].
  - In most cases, level and quality of evidence assessments and analysis will be limited, and perhaps even data will not be sufficient for stringent meta-analysis. These limitations ought not hinder the pursuit of evidence-based Ayurvedic medicine, since newer models of evaluation of the best available evidence now exists (e.g., thematic analysis) that pertain to synthesizing diverse and perhaps less quantitative and more qualitative evidence. In that view, a conceptual understanding of the causal pathways that influence health is sought, based on the rationale that causal pathways for health and disease spread wider than uniquely

individual determinants of health outcomes, and that they broaden up to population determinants and patterns of health. That is to say, causal pathways of health and disease viewed through the Ayurvedic paradigm embrace a range of phenomena at a variety of different analytic levels including economic, social, political, physical, and biological factors, along four primary theological (i.e., causal) dimensions: population, environment, organization, and society. It is the interaction among these forces within the individual human experience of the patient that determines a state of health or disease [39]. This view is akin to the model of inner world/outer world person-environment fit, which we presented elsewhere in the context of mind-body interactions in general and oral biology and medicine in particular [3, 5, 40].

- The question then becomes not so much whether or not systematic reviews in Ayurvedic medicine will utilize, derive, and depend more from qualitative assessment of the evidence—because clearly they will—but how best is the qualitative evaluation of the best available evidence to be obtained. Novel methodological approaches have been crafted and validated in response to the growing recognition of the need for qualitative modes of research synthesis to facilitate effective and appropriate evidence-based health care. These techniques involve computer-based (e.g., QSR’s NVivo software for qualitative data analysis, EPPI-Reviewer) thematic, rather qualitative synthesis and analysis, and consist of three levels: (a) “line-by-line” coding of the text, (b) development of “descriptive/conceptual themes,” and (c) generation of “analytical/interpretative themes.” Thematic analysis yields meta-synthesis inferences toward a qualitative “theory-driven” conceptualization of the best available evidence [41–43].

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