Foundational principles of classical Ayurveda research

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Abstract

Double-blind randomized controlled trials (RCTs) are viewed as the golden standard of drug research in Western medicine. However, RCTs are far from "golden" in many respects. They are impractical for many therapies, such as for surgeries and complex lifestyle changes. They encourage a one-size-fits-all approach to medical treatment that fails to address the huge diversity among individual patients in terms of their physical and emotional symptoms, social and cultural upbringing, and other factors. Perhaps, more importantly, they do not help doctors make the best medical decisions required to produce optimal patient outcomes. To guide a search for an alternate model of medical research, three principles based on Ayurveda, an ancient and powerful system of health care that has stood the test of time, are presented. These principles, arrived at after mining Ayurvedic epistemology, are: Inductive learning, whole systems thinking, and individually optimized therapy. In honor of the ancient sages or "Rishis," whose voice is used to deliver Ayurvedic knowledge in the ancient texts of Ayurveda, these are referred to as the "Rishi principles." Common research methodologies are examined for embodiment of these principles.

Keywords: Rishi principles, Yukti, inductive learning, whole systems, individually optimized therapy, decision analysis
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INTRODUCTION

Double-blind randomized controlled trials (RCTs) have long been viewed as the golden standard for clinical research, and yet they are hardly golden. Leaf notes that in a large double-blind trial that involved Avastin in the treatment of over 600 brain cancer patients, there was no difference in survival between those who were given the drug and those who were given the placebo. He questions the value of RCTs by pointing out that the Avastin study may have fulfilled its purpose, but doctors were no wiser after such an extensive study on treating brain cancer patients. This may be due to massive individual differences in patients who received the drug. He notes:[1]

"Researchers are coming to understand just how individualized human physiology and human pathology really are. On a genetic level, the tumors in one person with pancreatic cancer almost surely won't be identical to those of any other. Even in a more widespread condition like high cholesterol, the variability between individuals can be great, meaning that any two patients may have starkly different reactions to a drug.

That's one reason that, despite the rigorous monitoring of clinical trials, 16 novel medicines were withdrawn from the market from 2000 through 2010, a figure equal to 6 percent of the total approved during the period."

RCTs become quickly impractical when two people with the same condition need entirely different therapies. Illustrating with a non-medical example, consider two students with falling grades. One is unable to sleep at night due to stress, while the other is not much interested in the subject. The same approach for one student would not necessarily work for the other. If we only focused on the first student's sleep difficulty and did an experiment to give sleep-enhancing supplements on a population of randomly chosen students without filtering on interest levels in the subject, we would set ourselves up for different conclusions than if we did filter. To make matters worse, we may not know to filter students for interest levels and end up with RCTs that should never have been conducted.

In light of these problems, it is easier to understand why there have been no major drug discoveries through Ayurveda using controlled trials.[2] The goal of drug discovery itself is problematic as Ayurveda produces customized recommendations for each individual, and not a generalized treatment for a disease.

In Ayurveda, treatments are formulated in a holistic manner after examining the current state of imbalance in the patient. This involves a detailed examination of the patient's medical and psychological history. A combinatorial explosion of causative factors makes it very hard to predetermine filters for clinical testing, thus making controlled trials hard to formulate. Moreover, therapy is formulated with the active participation of the patient and the therapist, based on what is logistically possible for the patient. The gold standard double-blind trials are not applicable to therapies that involve critical lifestyle changes along with herbal formulations. For example, how do we fool an Ayurvedic therapist into prescribing fake meditation at some times and real meditation at other times? This logistically impossible attempt sounds strange and makes the misfit with double-blind trials obvious. It is possible to separate out just the herbal formulations and run double-blind trials with them, and there are good examples of studies that have taken care to custom fit therapy for appropriate *dosha* combinations.[3] However, this does not do justice to Ayurveda's holistic approach, and opens the door to the charge that the tests are not representative of actual Ayurveda therapy.

Moreover, RCTs and controlled studies, in general, rest on the shaky foundation of Statistical Hypothesis Testing (SHT). First, SHT is unable to formally incorporate learning from observations to yield clarity of action, and second, it is unable to deal with a paucity of experimental data to draw inference.[4] Schneider points out the practical difficulty that a research approach exclusively reliant on data poses in the real world:

"*Some scientists, including many medical doctors, still seem to be living in the nineteenth century in this respect, thinking that for any question, infinite sets of replicable experiments should be performed, providing them with data from which they can calculate probabilities, assign accurate risk estimates, and 'scientifically' tackle the problem at hand. Unfortunately, in the real world, as topics of inquiry become increasingly complex and involve questions about the future, scientists do not always*

enjoy the luxury of extensive, comprehensive, and reliable frequency data when they need them."[5]

While these problems have been well known, a much bigger problem is that we do not quite know what we are looking for in an alternative to RCTs. Before we can find a better research method, we must be able to first find the criteria that a "better" research method must fulfill. We will examine the core values of Ayurvedic epistemology and use these to propose principles that can serve as the criteria for finding better Ayurvedic research methods.

Ayurvedic epistemology

Ayurvedic epistemology is known through the words of ancient Rishis, or sages, as documented in Ayurvedic texts. The historicity of the sages is irrelevant to a critical examination of their ideas, which is the focus of this paper. Ayurvedic epistemology, influenced by broader Indian philosophy, concerns itself with four forms of validity, known as *pramānas* ("means of knowledge") in Sanskrit. The first three are noted by the legendary forebear of Ayurveda, Charaka, in the following Sanskrit verse:[6]

त्रिविधं खलु रोगविशेषविज्ञानं भवति; तद्यथा-आप्तोपदेश:, प्रत्यक्षम्, अनुमानं चेति ॥

The special science to understand disease is indeed threefold. These are: Advice of the wise {aptopadesha}, direct perception {pratyaksha} and inference {anumāna}.

Vimānasthāna, IV.3

Aptopadesha is practically understood by the Ayurvedic community as extant literature, where the advice of the wise resides. Combining extant literature with direct perception and inference is not dissimilar to the western intellectual tradition. What makes the sages' methodology any different?

First, aptopadesha comes from the conjunction of *Apta* and *Upadesha* (advice), or the advice of the *Aptas*. *Apta* is a difficult word to translate – it broadly refers to those who have achieved clarity through dedicated inquiry with a still mind. *Aptas* were considered to be beyond the grip of both indifference and passion, so their goodwill and objectivity could be trusted. Their goal was to understand their own nature, and having done so, they would share their subjective insights with other sages to find recurring patterns that would lead them toward more universal truths. This approach of inducing theory from reality allowed inductive learning, which was an important source of knowledge. In contrast, deductive learning is about deducing reality from theory and using experiments to validate a theory. Inductive learning has been a hallmark of the eastern intellectual tradition, where subjective experience is both accepted and rigorously examined.

"Subjective" is a word that often has a negative connotation in science, for it gets conflated with lack of general applicability. The Rishis used their subjective reality only as a starting point, examined it rigorously, and compared it with the experiences of others to generalize universal theories. These theories have stood the test of time and practitioners find them just as applicable today as when they were codified. The Charaka Samhita gives us a remarkable example of inductive theory formation in action

through a dialog amongst a group of sages with diverse subjective perspectives on the topic of rasa, which may be loosely translated as taste [Table 1].[7]

[Table 1](#)
Nine sages put forth their frameworks for explaining *rasa*

It is left to the authoritative Purnarvasu Atreya, in whose voice we find most of the knowledge in the Charaka Samhita, to reconcile the diverse perspectives. Atreya says,

"*There are only six tastes – sweet, sour, salty, pungent, bitter and astringent. Their primary basis is water (as the water element supports the perception of taste); cutting and calming – two actions, both are combined to give balance; delicious or otherwise are individual perceptions, beneficial and harmful are the effects; the five elements are the basis of everything and so are the fundamental principles for tastes as well. As tastes emerge from them, the five elements can't be tastes themselves. According to their fundamental composition of the five elements, rasas tend to change. This can be seen in different products, preparations and changes according to place and time; heavy, light, cold, hot, oily, dry, etc., are the properties of matter. 'Ksara' (alkaline) is so called because of 'ksarana' (scraping out due to sharpness). It is not a taste but a substance having been derived from many substances, having many tastes predominantly pungent and salty, with many sense objects and produced by a particular method of preparation. Primary taste is perceptible, but the secondary taste is sometimes difficult to assess and this imperceptibility is due to various factors associated with the food/herb. As these factors are innumerable and can change, there can be innumerable shades of tastes that are imperceptible. However, as the primary taste always retains its identity, imperceptibility cannot be considered as a separate taste. Even in case of the combination of rasas, there is no innumerableness of its primordial source, natural properties and actions; that is why, the intelligent ones do not describe the action of the combined rasas. Based on this fact, I will describe the characteristics of the uncombined six rasas separately.*"

Atreya demonstrates that induction is not blind acceptance of subjective perspectives, but a rigorous examination and reconciliation of the subjective experience. He puts forth his own overarching framework and shows the validity of the sages' perspectives by relating their subjective truths to his. His framework has the greatest validity for it includes the essence of all the other perspectives. It is to be noted that he does not bend over backward to incorporate everyone's perspective. Instead, he shares a language of powerful distinctions to help interrelate diverse observations.

Inductive learning is not new to the western intellectual tradition. The social sciences have taken the lead in following an inductive approach through the ethnographic method that generalizes from patterns in subjective data to produce theory about culture. Such theories have stood the test of time, and the ethnographic method is taught as a

scientific discipline. While the social sciences have brought qualitative rigor to subjectivity, the decision sciences have brought quantitative rigor to it by examining and documenting biases. The engineering discipline of decision analysis (DA) has incorporated the work of the decision sciences to systematically address biases in subjective judgment.

Second, the Rishis' inquiry for universal truths in medicine occurred within a "whole systems" perspective. Diseases were not seen as isolated to organs, but as a connected whole with causes that may lie elsewhere in the body, the environment, habit patterns, etc. The emphasis was on arriving at the causative factors, which, if addressed, would restore health. Moreover, the body and mind were seen as integrally connected. For example, in the causative factors of mental illness, Ayurveda lists not only psychological factors but also physical ones such as incompatible, putrid, or impure food.[8] Therefore, before starting counseling, mental illnesses are first diagnosed in terms of the specific physical imbalances that are associated with them, and then treated with Panchakarma. Vata-dominated mental illness is treated by ingesting oil or ghee, followed by mild purgation. Kapha- or pitta-dominated mental illness is treated by medicated emesis and purgation.[9]

The mind could also be used as an indicator of health, which is accepted even in the western paradigm. The study of this connection is more than just a general understanding in Ayurveda. The diagnosis of some diseases even included the content of the patient's dreams. For instance, a whole host of dreams are mentioned for *Rajyakshma* (or emaciation) patients, which involve a sense of deep loss, such as being left alone in a village, or dried-out water bodies, or a destroyed forest.[10] The connection was based on the notion that the mind is generally aware of what is happening to the body, and when faced with a condition that involved major tissue loss, the mind exhibited awareness of this condition at a subconscious level.

Whole systems perspectives have been slow to emerge in Western medicine, partly because the RCT methodology emphasizes the study of only one independent variable at a time. Specialization in a particular part of the body may have contributed to the lack of a holistic understanding. The mind–body connection is only now getting to the frontier of medical research. In non-medical fields, however, whole systems perspectives have been encouraged. The ethnographers in the social sciences strive hard to get a holistic view of what they are studying. The decision analysts spend a lot of time challenging the frame of their decision so that they can get a broader perspective. More broadly, systems engineering has advanced the idea of engaging with parts without losing sight of the whole system.

Third, the Rishis of Ayurveda went farther than general philosophers of their time who were only interested with inquiry on the meaning of existence, and were therefore content with their three branches of epistemology: Extant literature, direct perception and inference. The Ayurvedic Rishis had to actually deduce individualized treatment decisions for their patients. This forced them to develop a fourth branch of epistemology, called Yukti, which has the same root as "Yoga," which is to "yoke" or "unite."

Charaka introduces us to Yukti twice in the Sutrasthana (or "Connecting Thread") section of his classic Charaka Samhita. The first is a detailed treatment of Yukti in the

context of the other three sources of validity, where the connection between inference and Yukti is of interest:[11]

द्विविधमेव खलु सर्व सञ्चासञ्च; तस्य चतुर्विधा परीक्षा-आप्तोपदेश:,

प्रत्यक्षम्, अनुमानं, युक्तिश्चेति॥१७॥

Existence {satya} and non-existence {asatya} truly forms a duality. That duality is examined in four ways – extant literature, direct perception, inference and Yukti.||17||

प्रत्यक्षपूर्वं त्रिविधं त्रिकालं चानुमीयते।

वह्निर्निगूढो धूमेन मैथुनं गर्भदर्शनात्॥ २१ ॥

एवं व्यवस्यन्त्यतीतं बीजात् फलमनागतम्।

दृष्ट्वा बीजात् फलं जातमिहैव सदृशं बुधा:॥ २२॥

Past direct perception applied threefold (effect to cause, cause to effect, comparing repeated observations) to the three times (past, present and future) is inference. (For effect to cause), fire is inferred from smoke as is sexual intercourse from a foetus. And (for cause to effect), understanding that the seed marks the beginning of the fruit. Observing similarity in the seed and the fruit, the wise infer the same species. ||21-22||

जलकर्षणबीजर्तुसंयोगात् सस्यंभव:।

युक्ति: षड्धातुसंयोगाद्गर्भाणां संभवस्तथा ॥ २३ ॥

मथ्य मन्थन (क) मन्थानसंयोगादग्निसंभव:।

युक्तियुक्ता चतुष्पादसंपद्धाधिनिबर्हणी॥ २४॥

(Through Yukti, the knowledge of) Water, plowing, and seed unite to make crops possible. Similarly, Yukti (helps us understand how) six tissues {*dhātus*} unite to produce a foetus.

(Similarly) wooden log, (the action of) churning, and the churning stick unite to make fire possible. Proper application of Yukti on the four limbs of therapeutics (patient, physician, caregiver and medicines) is necessary to alleviate illness. ||23-24||

बुद्धि:पश्यति या भावान् बहुकारणयोगजान्

युक्तिस्त्रिकाला सा ज्ञेया त्रिवर्ग: साध्यते यया ॥ २५ ॥

(Yukti is the result of the) intellect that perceives reality as produced by multiple factors uniting. Yukti can be successfully applied to the three times (past, present and future) as also to the three types of knowledge (cause from effect; effect from cause; repeated observation). ||25||

Sutrasthana, XI.[15,16,17,18,19,20,21,22,23]

These verses seem to portray Yukti as inference and some commentators who came after Charaka, like Chakrapani and Yogindranath, did not think that Yukti should have been a separate source of validity. Yogindranath interpreted Yukti as vyāpti – joining cause and effect together. Gangadhara supported Charaka's view and felt that Yukti was a separate source of validity, but it meant "argument." This is problematic, as it does not quite distinguish Yukti from inference.[12] In our present understanding, all of these are confusing explanations, until we take a decision analytic perspective, where logic is used to arrive at a clear action, and this logic utilizes inference but is not limited to it. Utilizing the example in verses 23-24, the growth of crops requires water, seeds, and an essential action – plowing. Similarly, a wooden log and a churning stick are not enough to start a fire. One needs the action of churning. Pure inference of the "where there is smoke, there may be fire"[13] kind may tell us what is behind the smoke, but we need the actional logic of Yukti to know how to start a fire. In short, Yukti seems to be the logic of action. What was the motivation to go beyond pure inference and include action. The answer comes a little later in the Sutrasthana:[14]

परापरत्वे युक्तिश्च संख्या संयोग एव च |… ||२९||

…इत्येते गुणा ज्ञेया: परादय: | सिद्ध्युपायाश्चिकित्साया.. ||३०||

Primary and secondary causes, Yukti, counting, combination, etc.… These approaches {gunas} are considered important {"paradi"}. (These are the) successful means of treatment.

Sutrasthana, XXVI.29

युक्तिश्चयोजना या तु युज्यते||३१||

Yukti is the rational planning (of therapeutic measures).

Sutrasthana, XXVI.31

The sages were interested in coming up with thoughtful therapeutic measures to help people, and not just remain confined to understanding phenomena. This necessity forced them to invent Yukti, much like engineers had to invent DA to go beyond mere statistics and toward decisions.[15]

A Brief Introduction to DA

In 1966, Ronald Howard coined the term "Decision Analysis" in a seminal paper, where he wrote:[16]

Decision analysis is a logical procedure for the balancing of the factors that influence a decision. The procedure incorporates uncertainties, values, and preferences in a basic structure that models the decision.

Since then, DA has evolved into a philosophy for decision-making. Howard makes an important distinction in DA is that between normative and descriptive models:[17]

A descriptive model characterizes what happens in the world without judgment of it. A normative model states what ought to be the case. It is the judgment of desirability of a human being about proper action in the world. Thus, physical science is descriptive, the rules of law are normative. It is descriptively true that I make mistakes in arithmetic calculation, but I accept the norms of arithmetic. In fact, it is the acceptance of these norms that allows me to recognize a mistake….

Decision analysis is the normative practice of decision-making. The acceptance of its norms allows me to recognize my decision mistakes. Using decision analysis I can be sure that the decision I make follows the rules I would use to reason in very simple, and therefore transparent, situations, as well as the rules I would use to reduce complex situations to transparent ones.

The normative foundations of DA rest on a view of probability that is referred to as the "Bayesian approach" or "epistemic probabilities," where an objective probability is an oxymoron, for probabilities do not exist in nature waiting to be discovered. Rather, they are helpful and clear expressions of our ignorance, created solely in our mind, to communicate and work with uncertainty. This view is in stark contrast to the "frequentist approach" or "aleatory probabilities," where probability is a frequency to be discovered in nature and it does not make sense to have different probabilities for the same event. And yet, imagine two people, A and B, viewing a coin toss, where B is also secretly shown the outcome. The two might place very different probabilities on heads, with B justified in placing either 0% or a 100% probability on heads. Frequentism is the paradigm of SHTs, and results in many philosophical and practical problems.[18]

DA makes a key distinction between decisions and outcomes. Good decisions are logical decisions. Good outcomes are highly valued outcomes. A fundamental principle of DA is that a decision cannot be judged from the outcome, but only by the process used to arrive at that decision. A second fundamental principle is the *Sunk Cost principle*, where investments of the past are treated as sunk costs that will never be recovered. Future prospects cannot include any accounting of resources that have already been invested. To state it another way, the past matters only for learning, and not for accounting.

DA offers a key framework, the *Six Elements of Decision Quality*, which are: Framing, alternatives, information, values, logic, and commitment to action. Framing is about the question we want to answer. Is that the right question? Is our frame so big that it feels like boiling an ocean? Or is it too small for anyone to really care? Is the frame meaningful for us? Alternatives are about what we can do. Are our alternatives feasible and distinct? Or are we unable to generate multiple alternatives due to our attachment to a single alternative? How creative and compelling are our alternatives? Information is about what we know. Is the information we wish to possess material to our decision? Do we have reliable information? Values are about who we are and our preferences that describe what we want. Are we clear about what is good for us, and what we want? Logic is about how we integrate the frame, alternatives, information, and values to arrive at a clear course of action and a coherent narrative. Is the logic consistent with the norms of DA? The norms of DA are captured in the *Five Rules of Actional Thought*, which are beyond the scope of this paper. Finally, commitment to action is about both ethical leadership and followership. Are the commitments we make of high quality, or are we simply interested in analysis for the sake of it?[15]

DA has not only made contributions to medical decision making with its general framework[19] but also offered the convenient units of microprobabilities (one in a million chance) and micromorts (one microprobability of death). Howard writes:[20]

Medical risks can be placed in perspective by noting that we live in a society where people face about 270 micromorts per year from interactions with motor vehicles.

This microrisk framework can also be used for disability instead of death. Once microrisks can be expressed in this way, a new conversation becomes possible – that of understanding the patient's willingness-to-pay to avoid them.[21]

Redefining Yukti

With the language of DA, we may redefine Yukti in the context of Ayurveda as that logic which combines generalized knowledge (from the literature) with localized information (through direct perception and inference), localized alternatives (e.g., tests, interventions) and the patient's preferences, to develop therapeutic measures that can lead to an outcome that is highly valued by the patient. Yukti results in "designer/customized/individualized" therapy, just as the application of DA delivers a decision that is custom fit to the decision maker, taking into account uncertainty about the future. Although this is what doctors often do informally, whether in the east or west, the formal recognition given to Yukti in Ayurvedic medicine is unparalleled in any medical tradition, as it places a formal emphasis on individualized medical decision making.

As an example of the application of Yukti, let us examine how Ayurveda customizes diabetes treatment. First, the classification itself is sophisticated, with 20 different types identified across the three doshas of vata, pitta, and kapha. Urine is collected at night and examined in the morning for different qualities to aid in diagnosing the specific type of diabetes. Treatment is dependent on the specific dosha category and further customized for the specific type, with some types being incurable. Those with a lean constitution are encouraged to gain weight, while those who are obese are encouraged to lose weight. Treatments are further customized on the ability of the patient to take a particular therapeutic step. Those who need to take harsh laxatives and cannot handle them are offered a less harsh treatment. Even food preferences are taken into account. For example, in a particular category of diabetes (kaphaja prameha), barley grain is an important part of the treatment, and vegetarian patients are asked to mix it with other drug formulations and consume it with honey, while non-vegetarian patients are asked to take barley mixed with various meats.[22]

In summary, the three core values that the Rishis seem to have placed emphasis on, hereafter referred to as the "Rishi principles," are:

- Inductive learning: Universal truths are induced rigorously from subjective experiences
- Whole systems: Scientific inquiry is focused on holistic understanding
- Individually optimized therapy: Decisions are deduced using logic that integrates knowledge from the literature with local information, local alternatives, and the patient's preferences to produce customized therapy.

Scientific inquiry in Ayurveda needs to be situated within these principles for it to be consistent with Ayurvedic epistemology. We shall examine how common research methods embody the Rishi principles [Table 2].

Table 2

Mapping of some common research methods, where each cell in the table answers the question, "Does the research method embody this principle?" A "yes" indicates formal embodiment

Ethnography formally incorporates inductive learning. However, this method has largely remained in the social sciences and has been used at the periphery of medicine with ethnobiology or ethnomedicine studies. First-person research is a new area that is slowly receiving some attention.[23] In this approach, great importance is given to the subjective experience of an individual. When used in the context of an ethnographic medical study, first-person research may be used to induce theory from the actual experience of subjects. Ethnography facilitates a whole systems perspective by explicitly attempting to understand how factors interact in an ecosystem. As ethnography is a descriptive and not a normative method, it does not have any formal notions of producing individually-optimized therapy (IOT).

Observation Design is used when controlled studies are not possible, and attempts to find correlations between treatments given in the past and the outcomes they have produced. As factors under study tend to be reductive and isolated in nature, and no light is shed on their interactions, this method does not formally embody the whole systems principle. Unexpected effects around what was not in the hypothesis are also reported and this allows for informal inductive learning. As this method relies on SHT, it cannot be used to formally produce IOTs. There is no informal encouragement either for IOT formulation through the practice of this method. However, it can be used to study factors within an IOT produced by some other method (like Ayurvedic Yukti).

Reverse Pharmacology[24] hypothesizes that the modulation of a specific protein target may have beneficial therapeutic effects. The hypothesis is built using a large database of purified proteins and what is known about them from clinical observations. With the use of bioinformatics tools, such hypotheses can be made quickly and can reduce the time taken for drug discovery. This method embodies inductive learning as the hypotheses are formally grounded in clinical knowledge. However, as the attempt is to produce therapeutic benefits through single factors within a strictly mechanistic frame, this method remains reductive and does not formally embody the whole systems principle. Reliant as it is on SHT in its experimental phase, it does not formally or informally embody IOT.

Ayurvedic Pharmacoepidemiology[25] aims to study the actual administration and efficacy of Ayurvedic drugs on large populations. By directly observing clinical evidence, inductive learning is informally embodied. As this is an evolving discipline, it

is not clear how such learning is to be structured formally just yet. This method embodies the whole systems principle due to its formal requirement of using multiple sources of evidence and understanding the ecosystem. As this method has not yet declared normative intentions, it does not formally produce IOT.

Pragmatic trials[26] encourage individual optimization of therapy in a qualitative way without having a formal theory around individual optimization. Therefore, this method informally embodies IOT. Inductive learning is not formally supported due to the reliance of this method on SHTs. Moreover, the reductive approach of studying factors in isolation continues, with the customization limited to the delivery of the therapy as opposed to the nature of the therapy itself.

RCTs are used in conjunction with SHT as the dominant method of clinical testing. This approach does not allow for inductive learning, as the lack of statistical significance does not allow us to make any meaningful conclusions. It also does not embody whole systems, as the focus is on finding a causative factor, as opposed to understanding interactions of factors within an ecosystem that goes beyond the mechanistic frame. Finally, there is no known formal method to utilize the results of an RCT to produce IOTs.

DA holds much promise in this area as a modern embodiment of Yukti that focuses on IOT and can plug an important methodological gap. Discussing specific applications of DA in Ayurveda is beyond the scope of this paper.

DISCUSSION

Inductive learning, whole systems thinking, and individualized therapy are powerful Rishi principles that can be used to judge the validity of modern research methods proposed for classical Ayurveda research. While one mapping of modern research methods against the Rishi principles has been shown, other mappings are welcome. The mapping presented in this paper highlights the need for innovation in Ayurvedic research methods that incorporate the three principles. These principles are general enough to be useful in broader medical research.

The Rishi principles are only a starting point for a discussion. While the general essence of these principles may be clear, the particulars remain to be worked out. On the inductive learning principle, what would rigorous first-person medical research look like? How should quantitative methods be used to formally incorporate new learning from evidence? What are the limits of formal methods as far as inductive ability is concerned?

On whole systems, how whole is whole? Would *in silico* studies that look at models of the whole body count? Noting that the power of the mind is already acknowledged by controlling for placebos, how might new health models include the mind and its interaction with the body? On individualized therapy, how much formalization can be done while still keeping the logic simple and accessible?

Ultimately, the real value of these principles will lie not in any absolutist truth claims, but in the usefulness of the methods that fulfill it.

(Care has been taken to not introduce words that are unsupported in the Sanskrit original. Contextual clarifications are in parentheses (). Reference to the Sanskrit in the translation is in curly braces {} and is applied to words that are difficult to translate.)

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REFERENCES

1. Leaf C. Do Clinical Trials Work? [Last cited on 2013 Jul 13]. Available from: http://www.nytimes.com/2013/07/14/opinion/sunday/do-clinical-trials-work.html .
2. Pulla P. Ayurveda: Hoax or science? Open Media Network. 2013. Feb 9, [Last cited in 2013 Mar 11]. Available from: http://www.openthemagazine.com/article/living/ayurveda-hoax-orscience .
3. Sharma RK, Patki PS. Double-blind, placebo-controlled clinical evaluation of an Ayurvedic formulation (GlucoCare capsules) in non-insulin dependent diabetes mellitus. J Ayurveda Integr Med. 2010;1:45–51. [PMC free article] [PubMed]
4. Raha S. A critique of statistical hypothesis testing in clinical research. J Ayurveda Integr Med. 2011;2:105–14. [PMC free article] [PubMed]
5. Schneider S. Da Capo Press; 2010. The Patient from Hell.
6. Sharma RK, Dash B, editors. 7th ed. Chapter IV, Verse 3. Vol. 2. Varanasi: Chowkhamba Sanskrit Series; 2002. Caraka Sam. hitā, Vimānasthāna.
7. Sharma PV, editor. 1st ed. Chapter 26, Verse 3-8. Vol. 1. Varanasi: Chaukhambha Orientalia; 2008. Caraka Sam. hitā, Sutrasthana; pp. 175–7.
8. Sharma PV, editor. 1st ed. Chapter 9, Verse 4. Vol. 2. Varanasi: Chaukhambha Orientalia; 2008. Caraka Sam. hitā, Chikitsāsthānam; p. 160.

9. Sharma PV, editor. 1st ed. Chapter 9, Verse 25-26. Vol. 2. Varanasi: Chaukhambha Orientalia; 2008. Caraka Saṃ. hitā, Chikitsāsthānam; pp. 164–5.

10. Sharma PV, editor. 1st ed. Chapter 6, Verse 13. Vol. 1. Varanasi: Chaukhambha Orientalia; 2008. Caraka Saṃ. hitā, Nidānasthānam; pp. 285–6.

11. Sharma PV, editor. 1st ed. Chapter 11, Verse 17-25. Vol. 1. Varanasi: Chaukhambha Orientalia; 2008. Caraka Saṃ. hitā, Sutrasthana; p. 72.

12. Sharma PV. Varanasi: Chaukhambha Orientalia; 2007. Caraka Saṃ. hitā Critical Notes (Incorporating the commentaries of Jejjata, Cakrapāni, Gangadhara and Yogindranātha) pp. 118–19.

13. Parab KP, editor. 1st ed. Delhi: New Bharatiya Book Corporation; 1999. Kumar A, Hindi translator. The Tarkasangraha, Verse 40; pp. 26–7.

14. Sharma PV, editor. 1st ed. Chapter 26, Verse 29, 31. Vol. 1. Varanasi: Chaukhambha Orientalia; 2008. Caraka Saṃ. hitā, Sutrasthana; pp. 179–80.

15. Howard RA. Foundations of Decision Analysis Revisited. Advances in Decision Analysis: From Foundations to Applications. 2007:32–56.

16. Howard RA. Proceedings of the 4th International Conference on Operational Research. Stanford Research Institute; 1966. Decision Analysis: Applied Decision Theory; pp. 55–77.

17. Howard RA. Decision analysis: Practice and promise. Manag Sci. 1988;34:682–3.

18. Raha S. A critique of statistical hypothesis testing in clinical research. J Ayurveda Integr Med. 2011;2:105–14. [PMC free article] [PubMed]

19. Lee A, Joynt GM, Ho AM, Keitz S, McGinn T, Wyer PC. EBM Teaching Scripts Working Group. Tips for teachers of evidence-based medicine: Making sense of decision analysis using a decision tree. J Gen Intern Med. 2009;24:642–8. [PMC free article] [PubMed]

20. Howard RA. Microrisks for Medical Decision Analysis. Int J Technol Assess Health Care. 1989;5:357–70. [PubMed]

21. Howard RA. On making life and death decisions. Societal risk assessment: How safe is safe enough. 1980

22. Sharma PV, editor. 1st ed. Chapter 6, Verse 7-24. Vol. 2. Varanasi: Chaukhambha Orientalia; 2008. Caraka Saṃ. hitā, Chikitsāsthānam; pp. 117–9.

23. Varela FJ, Shear J. First-person methodologies: What, why, how. J Conscious Stud. 1999;6:1–14.

24. Takenaka T. Classical vs reverse pharmacology in drug discovery. BJU Int. 2001;88(Suppl 2):7–10. [PubMed]

25. Vaidya RA, Vaidya AD, Patwardhan B, Tillu G, Rao Y. Ayurvedic pharmacoepidemiology: A proposed new discipline. J Assoc Physicians India. 2003;51:528. [PubMed]

26. Patsopoulos NA. A pragmatic view on pragmatic trials. Dialogues Clin Neurosci. 2011;13:217–24. [PMC free article] [PubMed]