Shedding a Light on Innovation: Traditional Medicine in Sri Lanka

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Keywords: *Innovation; Medicine; Biotechnology; Sri Lanka*

Introduction

Western medicine, with recent advances in biotechnology and advanced standards for proving efficacy of cure and safety of drugs, has become the mainstream pharmaceutical intervention in healthcare relegating traditional cures to a subaltern space. This sharp change in preferred method for medical care is evident in most South Asian countries. Most of these countries have had thriving practices of traditional medicines in the past. For instance, Ayurveda has long been practiced in India and Sri Lanka, Unani in the ancient Arab world, and Siddha medicines in the state Tamil Nadu of India[4].

A standard problem with traditional medicine is the yardstick of quality and efficacy of cure. Western medicine has employed institutions like clinical trials, standardization, patenting of therapeutic molecules, research establishing biochemical equivalents between patented and generic drugs to address this issue. The design of these institution help bypass or solve the problem of asymmetric information that exists between drug manufacturers on the one hand and medical practitioners and patients on the other. Though many of these institutions create additional problems (patent thickets and enhanced drug prices for patented cures), it is an undeniable fact that the absence of some of these institutions prevent appropriate dissemination of information about quality of herbal drugs and their curative properties. All pharmaceutical research, be it traditional or western, share or have some commonality in their discovery process. Traditional medicine, till recently, has shied away from standards established by western medicines regarding novelty (patents) or efficacy of cure (clinical trials) (Saha & Vasuprada,

[4]https://www.ayurtimes.com/siddha-system-medicine/

2018). The abundance of practitioners who have little scientific knowledge might have been the reason for the decline of the systems of traditional medicine. It is also becoming increasingly hard to distinguish between the quack and the real doctor in the latter discipline of medical cure at present. The decline could also possibly be due to the patient's preferences for the kind of treatment they want to go for. Glynn & Heymann (1985) find that western medicine is dominant due to the reasons that it exhibits efficacy of cure, places no dietary restrictions, and also that the government provides free treatment as opposed to Ayurvedic treatment. So, problems like fractures, mental illnesses among various others, lie in the realm of indigenous medical systems, whereas others which demand immediate action attract western medicine. In all, the demand and practice of traditional medicine is under the shadow of great doubt and hence looking at the status of research and innovation in traditional medicine becomes important to shed light on the process by which a dominant system of medicine becomes marginalized.

Objectives

The purpose of this paper is to investigate the status of research and innovation in traditional medicine (Ayurveda) in Sri Lanka. Understanding the nature of innovation in traditional medicine in Sri Lanka, where standard measures like patents or patent citations (commonly used for western medicine) are minimally present is not an easy task. Our objective is to empirically characterize the research network (through co-author connections) as this is the genesis of scientific innovation (Fleming (2001)). The statistical properties of the network help us infer the quality of research, innovation as well as support institutions supporting such activities.

Methodology

We adopt the combinatorial perspective on novelty in research (Saha & Vasuprada (2018) and Fleming (2001). The genesis of innovation for slow-moving traditional systems can effectively be tracked by our modeling of publications, authors and co-authors as elements of a strategic research network (refer to the citations network in Newman (2010)). The revealed preference of a researcher to co-author or publish with another researcher determines his or her relative ranking in the network which we capture using

statistical measures such as degree, betweenness, and closeness centrality. The ***empirical modelling of research network*** is calculated by in-built algorithms which come with *Gephi software*.

We use data on research papers on PubMed maintained by the US National library of Medicine and National Institutes of Health. It contains more than 28 million citations for biomedical literature from MEDLINE, life science journals, and online books. Using the keyword searches of 'Ayurveda in Sri Lanka' and as well as 'Ayurveda, Diabetes and Sri Lanka', we create the co-author network of research not only for all of Ayurveda but also for a particular disease (diabetes) to illustrate the properties of the network generally as well as in the particular (by disease). We list information on articles, authors, journals (national - Sri Lanka) versus international (rest of the world)), and the country of institution to which the author is affiliated. This data is then used in appropriate and coded format to plot the networks as well as to calculate the other network statistics. We filtered the results for the last five years thus covering the time period from 29th July 2013 to 30st July, 2018.

Results and Discussion

The network between coauthors researching Ayurveda overall and diabetes in particular in Sri Lanka has been plotted using *Gephi* which is an open source software for analyzing networks and is represented by Figures 1 and 2. The nodes have been color coded according to the nationality of the institutions to which authors are affiliated. The purple colored nodes represent authors with Sri Lankan nationality, the orange colored nodes represent authors with Indian nationality, the green colored nodes represent other foreign nationalities, and the blue ones are those that were not mentioned in the article. Figure 1 has 37 nodes and 78 edges while Figure 2 has 123 nodes and 260 edges. Node that edges are weighted to reflect multiple connections (thicker edges imply more connections between nodes).

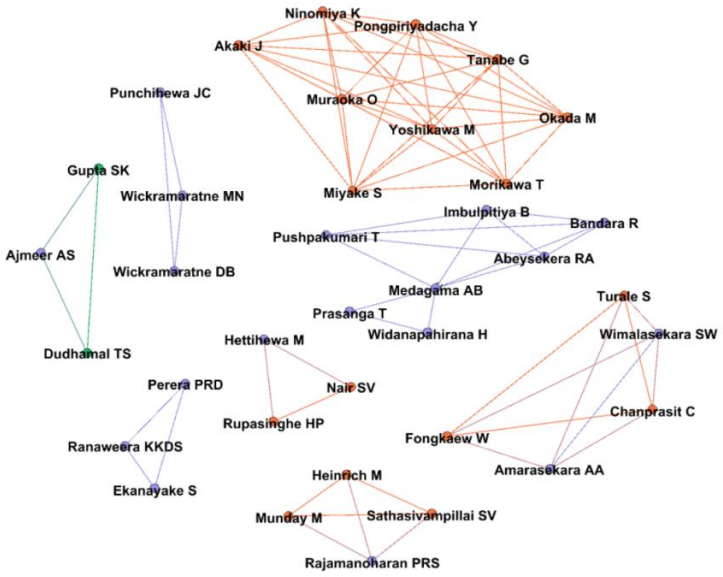

Figure 1: Co-author network of Ayurveda diabetes research in Sri Lanka

One can observe from the networks, there are separate clusters representing co-author collaboration. One can clearly identify that the connections are limited in the sense that most of the connections occur among Sri Lankans, and foreign authors mostly working among themselves. We rarely find Sri-Lankan and foreign authors collaborating across groups as opposed to working within the individual group clusters.

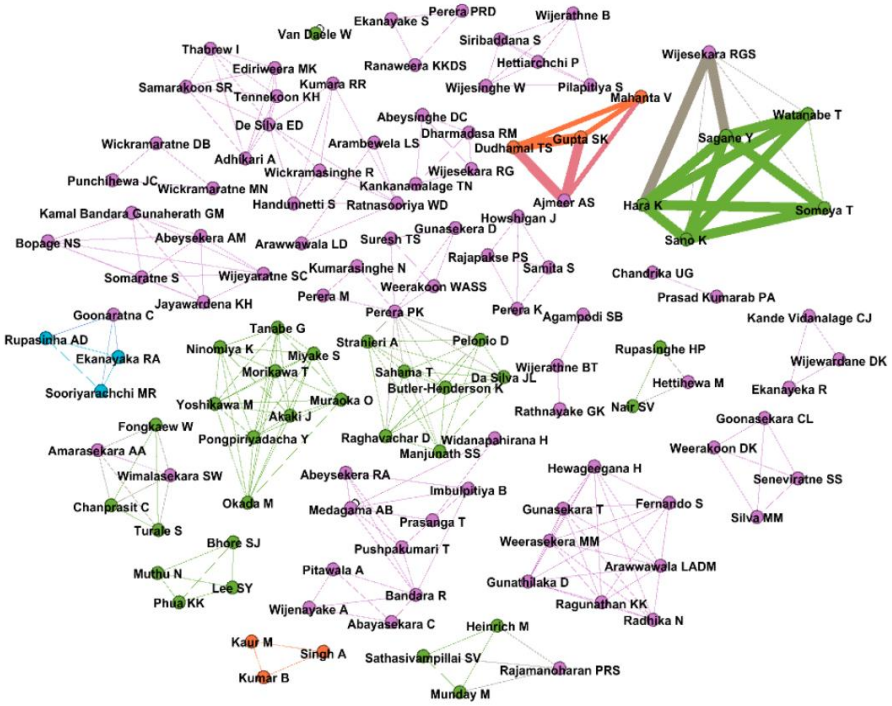

Figure 2: Co-author network of Ayurveda research in Sri Lanka

The following are the observed graph statistics such as degree and graph density, and subsequently, a description of the results.

Table 1 Degree and Graph Density of the networks

Research Network	Min Degree	Max Degree	Average Degree	Graph Density
Ayurveda diabetes research (Figure1)	1	8	4.22	0.117
Ayurveda research (Figure 2)	1	12	4.23	0.035
Source: Authors' own calculations				

Degree of the Network: As evident from Table 1, the average degree of the networks in figure 1 and 2 are almost the same. That is, on an average each node in the former coauthor network has approximately 4.22 connections which is almost equal to 4.23 connections for the latter network. Even though the maximum degree varies for the two networks, average degree for the two networks is almost the same. Drawing a parallel with Vasuprada & Saha (2018), we find that the overall research network in Sri Lanka has a higher average degree as compared to the average degree of the Ayurveda research network in India which is 1.5.

Graph Density: The graph density of the coauthor network of diabetes Ayurveda research is 0.117 and for the coauthor network of Ayurveda research is 0.035. These figures are low when compared to the graph density of a complete graph (in which every pair of nodes is connected by a unique edge) which equals 1.

Table 2: Top five nodes with the highest degree in the co-author network of Ayurveda diabetes research in Sri Lanka

Id	Label	Nationality	Degree	Closeness Centrality	Betweenness Centrality
	Medagama				
13	AB	Sri Lankan	8	1	8
2	Akaki J	Foreign	8	1	0
15	Morikawa T	Foreign	8	1	0
14	Miyake S	Foreign	8	1	0
19	Ninomiya K	Foreign	8	1	0

Source: Authors' own calculations

Betweenness and Closeness Centrality: For the networks in Figure 1 and 2, we represent the betweenness and closeness centrality of the top five nodes with the highest degree. We find many '0' values in the betweenness centrality column and many '1' values in the closeness centrality column because this centrality is calculated according to the disconnected components of the graph. This shows that the edge connectivity from one node to another does not always exist because of the myriad number of co-

author clusters (which are usually disconnected) that exist. This is a feature that is similar in the Indian context as discussed in Vasuprada & Saha (2018). The values other than 0 and 1 for both betweenness and closeness centrality measures are within cluster values of a particular node.

Table 3: Top five nodes with the highest degree in the coauthor network of Ayurveda research in Sri Lanka

Id	Label	Nationality	Degree	Closeness Centrality	Betweenness Centrality
65	Perera PK	Sri Lankan	12	1	41
19	De Silva ED	Sri Lankan	9	0.85	30
53	Medagama AB	Sri Lankan	8	0.75	14
7	Akaki J	Foreign	8	1	0
54	Miyake S	Foreign	8	1	0

Source: Authors' own calculations

General observation about this research network is its sparseness and inward-looking homophilistic (similar nationality authors researching together) character. Our measure of homophily is the nationality of the institute to which the author is affiliated, and we find that collaborations happen between authors belonging to the same nationality. The cross collaborations of authors across nationalities is a rare occurrence in the networks specific to Sri Lanka. We also noticed that University of Peradinya, Sri Lanka is the institution of affiliation of about 10 out of 37 authors in first network (Figure 1), and roughly 15 out of 123 authors in the second network (Figure 2). We notice from the search made on PUBMED that the journals in which the research specific to Sri Lanka is being published are mostly based outside Sri Lanka. The absence of domestic journals might have served as a deterrent to scholars in motivating or encouraging themselves to come up with novel research in Ayurveda as such.

Conclusion

Enhancing the strength of the research network requires policy measures that improve incentives for innovation. Though some recent measures have been undertaken by the government of Sri Lanka, most of them ensure standards for commodification of traditional herbs. The Sri Lankan UGC formed the Standing Committee on Indigenous Medicine at its 37th Meeting held on 04th

March 2013 for the enhancement of the Indigenous Medicine sector. This ranges from assisting policy dissemination to promoting research and formulating curriculum of traditional medicine courses[5]. National Drug Policy for Sri Lanka (2005) subsequently the National Medicines Regulatory Authority Act (Act No. 05 of 2015) was introduced, the objectives of which include ensuring the availability and affordability of safe and good quality, and efficient medicines relevant to the health care needs of the people in a sustainable and equitable manner, and so on[6]. However, we feel the establishment of quality research institutions with peer reviewed local journals encouraging collaborations with Sri Lankan peers with other researchers worldwide will aid the process alongside standardization measures taken up by the government.

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[5]http://www.ugc.ac.lk/en/policy/16-indigenous-medicine.html

[6] Discussed in www.health.gov.lk/moh_final/english/public/elfinder/files/publications/publishpolicy/Policy Repository.pdf