

VOL. 3, NO. 2, 2021, 10-43

# THE NETWORK LIFE OF NON-BIOMEDICAL KNOWLEDGE: MAPPING VIETNAMESE TRADITIONAL MEDICINE DISCOURSES ON FACEBOOK

Dang Nguyen <sup>a</sup>

## ABSTRACT

Traditional medicine is hugely popular throughout Southeast Asia and other parts of the world. The development of the internet and online social networks in these contexts has enabled a significant proliferation of non-biomedical knowledge and practices via platforms such as Facebook. People use Facebook to advocate for non-biomedical alternatives to unaffordable biomedicine, share family medical recipes, discuss medicinal properties of indigenous plants, buy and sell these plants, and even crowdsource disease diagnoses. This paper examines the network characteristics of, and discourses present within, three popular Vietnamese non-biomedical knowledge Facebook sites over a period of five years. These large-scale datasets are studied using social network analysis and generative statistical models for topic analysis (Latent Dirichlet allocation). Forty-nine unique topics were quantitatively identified and qualitatively interpreted. Among these topics, themes of religion and philanthropy, critical discussions of traditional medicine, and negotiations involving overseas Vietnamese were particularly notable. Although non-biomedical networks on Facebook are growing both in terms of scale and popularity, sub-network comment activities within these networks exhibit ‘small world’ characteristics. This suggests that social media seem to be replicating existing social dynamics that historically enable the maintenance of traditional forms of medical knowledge, rather than transforming them here.

Keywords: non-biomedical knowledge; traditional medicine; social network analysis; topic modeling; Vietnam.

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<sup>a</sup> School of Historical and Philosophical Studies, University of Melbourne, Australia.

## 1 INTRODUCTION

This paper examines the structure and discourse of Vietnamese non-biomedical knowledge propagation on public Facebook sites and considers how the characteristics of non-biomedical networks on Facebook may differ from or resemble traditional community-based social processes. Non-biomedical knowledge is defined as “therapeutic modalities that exist in separation, but not isolation from, biomedicine” (Nguyen 2019, p. 1). Non-biomedical knowledge as a term is better equipped to capture the diversity as well as the historical continuities and discontinuities of therapeutic traditions and practices at the margin of mainstream scientific medicine (Nguyen 2019). While partially displaced by mainstream biomedicine as a unifying yet plural system propelled by the scientific enterprise, non-biomedical practices persist in forms of integration, amalgamation, hybridization, and borrowing in various contexts around the world (Singer et al 2019). In this paper, the terms non-biomedical modalities and traditional medicine (TM) are used interchangeably with the dual purpose of recognising the historical trajectories of medical practices that continue to exist outside of the scientific enterprise, while paying attention to local expressions of these non-biomedical modalities. In the Vietnamese context, the phrase *y dược cổ truyền* (traditional medicine) is often used to refer to the codified non-biomedical modalities examined in this paper.

Traditional medicine in Vietnam is regulated by the Ministry of Health. According to Ministry of Health statistics, about 30% of patients receive treatment with traditional medicine throughout Vietnam in a formal capacity. According to Ministry of Health statistics, about 92.7 per cent of public hospitals in Vietnam has a traditional medicine division (Hai Chau 2017). Despite comparatively high level of integration to mainstream biomedical practices, the rate of treatment with traditional medicine in Vietnamese public hospitals varies along a rural-urban divide. Treatment with traditional medicine in public hospitals, either exclusively or in combination with biomedicine, rises progressively from 4.1 per cent at the central level to 11.7 per cent at the provincial level. This rate rises to 13.4 per cent at the district level, and 28.5 per cent at the commune level (Hai Chau 2017). These statistics, however, do not include visits to private practice and treatment through informal practices. Even though it is not clear whether opting for traditional medicine would always result in lower cost of treatment compared to exclusive use of biomedicine, traditional medicine remains a popular alternative and/or complementary option in the way Vietnamese manage their experience of health and illness (Nguyen 2021a).

Traditional medical knowledge and skills have often been transferred from generation to generation orally, which in the past made it difficult to identify qualified practitioners and to systematically monitor popular discourses and protocols surrounding quality, safety, and efficacy. The large-scale propagation of traditional medical knowledge and practices via social media offers opportunities to

expand the global knowledge base about indigenous therapeutic traditions and practices while understanding how these practices are transformed by digital technologies. In resource-poor contexts, economic constraints on data collection, monitoring, processing, dissemination, and publication are often worsened by poor institutional conditions and capacities that perpetuate non-standardization, non-structured information operations, and non-transparency (Mol 2009, Feather 2013). This is especially prominent in Vietnam, and Southeast Asia more generally, where there is a continuing lack of robust knowledge databases, frequent national surveys, and national research centers (Mol 2009, Ortmann 2017). In the meantime, heavily subsidized internet access in these contexts has allowed people to perform increasingly significant parts of their everyday lives online, which as a by-product generates a large amount of standardized and structured data as well as data in the form of unstructured natural language. The analysis of these data is capable of providing unique insights into the dynamics, discourse characteristics, and networked dimensions of the emerging health ecologies that reflect the historical continuities of local and regional socio-cultural realities as they condition health experiences of the local population.

## 2 NETWORK SOCIALITY AND THE PROPAGATION OF VIETNAMESE MEDICAL KNOWLEDGE

### 2.1 Background

In 2020, 70 per cent of the population in Vietnam are using the internet – higher than the Asia-Pacific average at 53.1 per cent (Kemp, 2020; Internet World Stats, 2021). The majority of internet users in Vietnam access the internet via mobile broadband, with 74 million mobile broadband subscriptions recorded in 2020 (MIC 2020). Vietnamese are increasingly performing significant parts of their everyday lives online; the average daily time spent on the internet is six and a half hours, 2.22 of which are spent on Facebook (Kemp, 2020). Facebook is the third most popular website in Vietnam after Google and YouTube, and is the most popular social media platform in the country (Kemp, 2020). There are around 61 million Facebook users in Vietnam (out of the population of over 96 million people) in 2020, making Vietnam the seventh-largest market for Facebook worldwide (Kemp, 2020; We Are Social, 2020). This intense participation in digital modes of sociality is having significant impacts on the way Vietnamese seek, construct, produce, and consume information about their social world.

### 2.2 Network sociality and Actor-Network Theory

The changing nature of sociality against the background of modern economic and technological development is a rigorously theorized issue in academic literature. Wittel (2001), for example, speaks of a ‘network sociality’ in late capitalism wherein

social relations are informational rather than narrational. Characterized not by a sense of common history or community but rather a logic of data exchange and ‘catching up’, network sociality is fleeting and transient, ephemeral but intense encounters of iterative social relations (Wittel 2001, p.51). Arguing that network sociality is emerging alongside and sometimes displacing community-based sociality, Wittel (2001) draws on Castells’ preceding body of works on the network society (Castells 1996, 1997, 1998) to elaborate how network sociality is becoming increasingly formalized and institutionalized, while at the same time promoting the commodification of social relationships (Zuboff 2019). In his influential Actor-Network Theory (ANT), Latour (2005) on the other hand, asks us to rethink the ‘social’ as bundles of ties that can be mobilized to account for some other phenomenon; it is only through following the ‘actors’ who interact with each other while leaving behind traces of network among themselves that the ‘social’ can properly be assembled. In other words, from a Latourian view, the social and network are one and the same: the social is never fixed, and there does not exist a social world outside of networks of relations among actors. Latour calls this the actor-network – whose existence ceases as soon as the actors involved stop performing the interactions that characterize their relations. Sociality, as theorized from the ANT point of view, is therefore always dynamic, contingent, and momentary. This sociality is also all-inclusive: the actors involved in the assembling of actor-network also include objects, whose agency equals that of human actors. From this perspective, Vietnamese internet users, their mobile phones, their personal computers, social media platforms, and the information they create and share on these platforms are all actors and actants in a dynamic network of sociality. This network can constantly be assembled and disassembled as the actors traverse through their connections and disconnections.

In drawing extensively from the vocabulary of ANT, which qualifies humans and non-humans as actants, this paper attends to the hybrid sociality that is inclusive, but not made of, network traces in the form of standardized platform data (e.g. Facebook metrics such as posts, comments, reacts, shares, and so on). As such, platform data are understood as visible traces that are not the whole, but only part of the hybrid sociality that network actors are forging through their participation on platforms such as Facebook. This is particularly useful if we want to understand how network sociality can materialize over and beyond these highly structured traces of platform data as measures internally constructed for platform administrative purposes, which prescribe sociality through design (Wu & Taneja 2020). Assembling the networks that can be constructed from platform data is the first step towards reassembling their hybrid sociality through systematically examining what is being exchanged on these networks. Here, the role of ANT is not to offer interpretation, but to assemble traces into descriptions or accounts (Latour 2005). ANT views sociality not only on the level of association between humans and non-humans, but from a dynamic of interaction between entities and categories, which produces social effects (Latour 2005). In this sense, ANT is not

a ‘social theory’ but an adaptable, open repository (Mol 2010); it is a way to “attune to different events and situations” (Mol 2010, p. 259), where different “networks”, simultaneously interdependent and in tension, coexist.

This shift to a ‘network sociality’ might have important implications for the propagation of traditional medical knowledge in contexts such as Vietnam. Historically, Vietnamese non-biomedical knowledge has been passed down from generation to generation through oral traditions and written recipes that are kept within the family, or sold to those in need – both by healers and specialists as well as petty traders (Monnais et al 2011, Wahlberg 2006). Thompson (2017a) investigated the *gia truyền* (most literally ‘family transmission’) genre of medical texts in Vietnam and found that these texts were often written anonymously, which is reflective of not only the practice of communal authorship but also a community that can produce such texts as ‘familial’. A ‘medical family’ (*thuốc gia truyền*) is a family in which for more than one generation some of the members of the family, both men and women, were known as healers. An important social distinction is made, however, between physicians who were literati and who happened to be interested in medicine, healers who come from ‘medical families’, and those who earn a majority of their livelihood from medicine or pharmacy (Thompson 2017a). As such, there exists a hierarchy of traditional medical knowledges in Vietnam that maps onto different socioeconomic classes. These classes in turn form quite distinct, although sometimes overlapping communities, consisting of medical practitioners of different kinds, those who seek them out for therapeutic relief, and those who pass on these knowledges within their immediate networks.

### 2.3 Non-biomedical knowledge in the Vietnamese context

Throughout history, knowledges produced by these different social classes received different levels of marginalization under French colonialism and through competition from the more ‘learned’ and established Chinese medical traditions. *Thuốc Bắc* (Northern medicine), for example, is commonly associated with the literati class and is heavily influenced by Chinese medicine, whereas *thuốc Nam* (Southern medicine) is commonly associated with medical families (Monnais et al 2011). Those who make a living by scouting, growing, collecting, prescribing, and selling raw medicinal plants also contribute to this knowledge ecosystem with their own interpretations and revisions of family recipes through direct interaction with patients as well as experience with local flora and fauna. The propagation of these knowledges throughout history has followed flexible patterns and structures that enabled composition, retention, reperformance, as well as constant revision. These knowledges fulfil clear and immediate functions for communities that maintain them – namely managing illnesses and preserving health – through their ability to vary and respond to different circumstances. Weak ties among traditional medicine groups on Facebook, for example, provide various types of social support, including informational, emotional, tangible, esteem, and network support (Nguyen 2021a).

The adoption and domestication of livestreaming technologies on Facebook among emergent non-biomedical therapeutic practices also create alternative temporal spaces for them to thrive at the margin of scientific biomedical practices and at the centre of everyday life (Nguyen 2021b).

What is not known, however, is whether the democratization of these knowledges through decentralized propagation on social media has changed the very fabric of their sociality: whether new crossovers and contacts are being forged as a result of intensified and increasingly visible flows of these historically marginalized knowledges. What also remains unknown is the content of knowledges being exchanged on these sites, as well as its associated discourses. Given that social media have their own agency, to follow Latour's line of thinking, it is worth asking whether new forms and expressions of knowledge are being created on these sites. These unknowns may be addressed in this way:

**RQ1:** What are the network characteristics of Vietnamese non-biomedical sites on Facebook?

**RQ2:** What types of non-biomedical knowledge discourses are present within these sites?

### 3 METHODS

#### 3.1 Methodological choices and motivation

This paper uses social network analysis (SNA) and machine learning techniques (particularly natural language processing and topic modeling) to answer the two research questions. SNA is both a set of theoretical perspectives and analytic techniques used to examine how exchanges between individual units both shape, and are shaped by, the larger context in which those two individual units are embedded (Carolan 2016). SNA assumes an emphasis on relations among individuals and not their individual attributes, with a particular focus on individuals not as members of discreet groups but rather as members of overlapping networks (Marin & Wellman 2011, Carolan 2016). Formal network measures provide a rigorous language with which to discern network properties and make sense of the way non-biomedical knowledge propagates on internet environments (Hanneman & Riddle 2016).

Machine learning techniques, particularly that of an unsupervised nature such as Latent-Dirichlet Allocation (LDA), allow for the statistically-driven uncovering of topics 'hidden' in the dataset under the assumption that underlying topics match with the probabilistic distribution of words over a set vocabulary (Blei et al 2003, Blei and Mcauliffe 2007). These techniques allow for robust and automated discovery of a large corpus, which is useful for the current context. Subsequent interpretation and labeling of the topics discovered by this automated process are

conducted by the researcher, which ensures that these topics are meaningful according to human evaluation standard.

### 3.2 Site selection strategy

This study was reviewed and approved by the Human Ethics Sub-Committees (HESC) at The University of Melbourne (Ethics ID: 1852471). The selected sites were purposively sampled from an automated list of 1900 Vietnamese non-biomedical health groups and pages on Facebook, based on three criteria: (i) popularity, measured in number of active participants, (ii) activity, measured in number of posts per week, and (iii) privacy settings, in that only public sites with fully public content are selected. Criteria i and ii ensure the sites sampled are active rather than abandoned sites (Hether et al 2016, Smith & Graham 2019). Criterion iii ensures that automatic collection of textual data does not violate participants’ privacy; informed consent was not sought because participants were engaged in a public discussion and no personally identifiable information was collected. These criteria are also consistent with what van Dijck and Poell (2013) theorize as the four grounding principles of social media logic: programmability (the mutual layering of technological features and human agency in shaping platform usage), popularity (the algorithmic and socioeconomic conditioning of influence and importance), connectivity (socio-technical affordances of the platform apparatus that mediate user activity), and datafication (the ability of network platforms to render into data aspects of life that were not quantified before). Only sites with over 30,000 members and a posting frequency of over 10 posts per day were selected for the sample. The automated list was generated by automating searches using the search function on Facebook with 21 different keywords. Table 1 provides descriptive statistics of the sampled sites.

**Table 1. Descriptive statistics of sampled sites (as of August 2019)**

Site	Number of members	Number of posts	Number of comments	Number of ‘reacts’	Number of ‘shares’
Site 1 Good traditional medical recipes ( <i>Các bài thuốc dân gian hay</i> )	38,744	3,940	16,459	55,511	13,921
Site 2 Southern medicinal plants and family recipes ( <i>Cây thuốc nam và những bài thuốc gia truyền</i> )	82,008	2,983	6,874	36,159	69,120
Site 3 Your wise medical cabinet ( <i>Tủ thuốc thông thái</i> )	45,829	1,034	17,699	94	29
Total	166,581	7,957	41,032	91,764	83,070

Facebook has been chosen as the platform in focus, despite changes to the Graph API in 2016 following the Cambridge Analytica scandal (Albright 2018), as it remains the most popular social network site in the world and remains the fastest growing platform in Vietnam and Southeast Asia (Kemp 2019a). Facebook is the most popular social network site in Vietnam, and Vietnam is Facebook’s seventh-largest market worldwide (Kemp 2019b).

The sites sampled here are public sites where membership is not moderated, as opposed to moderated membership where applicants are required to answer a set of questions to gain access approval from site administrators. As such, gatekeeping within these sites is minimal. Sites 1 and 2 are more similar to each other than they are to Site 3 in that they are both sites built exclusively around promoting and sharing Vietnamese traditional medical recipes. Site 1 centers on the sharing of traditional Vietnamese medicine in general, while Site 2 is focused on Southern medicine and family recipes. Site 3 has an explicit anti-biomedicine philosophy; the site description outlines its advocacy against over-reliance on biomedicine as an expensive therapeutic option. Each of these sites corresponds to a different existing knowledge paradigm that characterizes the diversity of non-biomedical practices in Vietnam. Together, these sites are the top active sites for the exchange of non-biomedical knowledge on Facebook in Vietnam.

### 3.3 Data collection and network generation

Data were collected with a purpose-built web scraper. The scraper utilizes the Puppeteer library developed by Google to collect publicly available data via the Chrome web browser. The scraper collected all text content on original posts and their associated comments over five years, from 19 August 2014 to 19 August 2019. As shown in Table 1, the dataset contains 7,957 unique posts and 41,032 comments, representing the activities of 166,581 unique members. Table 1 also includes the total number of ‘shares’ across all posts for each of the three public sites. A ‘share’ means that a viewer of a post has shared the post and any associated links within their personal network. All together for this dataset, posts were shared over 80,000 times. A ‘react’ on Facebook is an emotional response that takes on one out of six available emotional reactions, signified by six distinct emojis. Due to the limits of non-API scraping, finer data for the ‘react’ construct are not available. There were altogether 91,764 reacts in this dataset.

**Table 2. Descriptive statistics for constructed co-commenting networks**

Site	Nodes	Edges	Density
1	3560	10208	0.000805
2	2783	5136	0.000663
3	5475	12137	0.000405

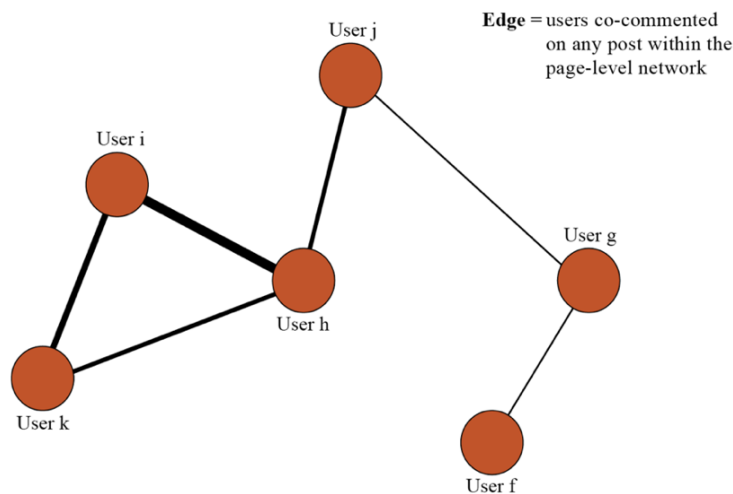


Although site 3 has a significant number of members and a high count of commenting activity, their ‘React’ and ‘Share’ metrics are significantly lower than sites 1 and 2. This peculiar dynamic could be due to the nature of site 3 as a consumer movement site; while the positive framing of knowledge propagation found in sites 1 and 2 might entice more affective engagement and sharing behavior, the negative framing of site 3 (anti-biomedicine) might limit these forms of engagement. Table 2 provides descriptive statistics for the co-commenting networks constructed from the data collected, with density measuring the prevalence of dyadic linkage or direct tie within a social network (Frey 2018). The index of network density is expressed as the ratio of observed ties (edges) to all possible pairwise ties in a network, whose value ranges between 0 and 1. It can be interpreted as the proportion of potential ties that are actually present (Frey 2018).

## 4 RESULTS

### 4.1 Network analysis

From the data collected, undirected co-commenting activity networks were constructed for each site, wherein nodes represent unique users and edges represent comments. An undirected edge is created if users co-commented on any posts; a low bar is therefore set for creating a relationship between users (Smith & Graham 2019). Two users are connected if they have both commented on the same post within the five-year time period. This construction adapted the methods proposed by Graham and Ackland (2016), as data on ‘Reacts’ and ‘Shares’ could not be collected with the current non-API scraper. Figure 1 illustrates the structure of the networks constructed, wherein the thickness of the edges represents the weight value associated with the frequency of co-commenting between users.



*Figure 1: Structure of the constructed Facebook co-commenting activity network (adapted from Smith & Graham 2019)*

User comment networks provide a more fine-grained understanding of the structure and nature of user interactivity on Vietnamese non-biomedical knowledge sites, even though Facebook does not directly provide this type of data. Comments are individually composed as open-text and as such represent a novel contribution and extension to discussion, as compared to a reproduction of a previous contribution through reacting or sharing. Comments also contribute differently to the propagation of non-biomedical knowledge on Facebook, as users often read each other's comments, interpret and learn from them, as well as engage in discourse by posting their own comments (Smith & Graham 2019). Within online health contexts, users actively seek and provide various types of social support through interacting with each other via the interface of social media platforms (Hether et al 2016, Nguyen 2021a). As such, these networks provide interesting insights into user (co)participation and discourse dynamics not only within each site, but also across these sites as an aggregate network. Figure 2 presents a sample discussion thread from the dataset.


<p>24 December at 18:45</p> <p>mình bị xoang và đã tự chữa khỏi bằng cây thuốc nam . nay mình muốn chia sẻ lại cho những bạn cần. với mong muốn duy nhất là mọi người khỏi bệnh sống hạnh phúc :</p> <p>cac bạn mua chai nước muối sinh lý loại to ấy thực hiện rửa mũi bằng cách nghiêng đầu sang 1 bên bơm vào lỗ mũi bên này cho nước muối và dịch mũi chảy sang bên kia( tham khảo youtube nhé) tương tự làm với bên kia.🍀🍀🍀</p> <p>Sạch rồi lấy lá cây phân xanh đã lấy nước cốt nhỏ đảm bảo khoảng 1 tuần là khỏi . và có thể duy trì 2 hoặc 3 tuần để rất diêm khỏi hẳn</p> <p>🍀🍀🍀 cảm ơn các bạn đã đọc🍀🍀🍀 chúc thành công ạ</p>  <p>159 92 comments 106 shares</p> <p>Like Share</p> <p>View 39 more comments</p> <p>Cay bợp bợp . Like · 17h</p> <p>Người này quý trọng hết tâm ... Giúp đời chữa bệnh nào cần gì đâu ...mô phật Like · 4h</p>	<p>Text translation:</p> <p><u>Post content</u>: "I used to have sinusitis and I had it cured by southern medicine plants. Now I want to share to anyone that needs it. My only hope is that everyone will no longer be sick and be happy: Buy a big bottle of saline solution then perform nose washing by tilting your head to one side. Pumping the solution into one nostril until the solution and nasal fluid flow to the other one (please also consult Youtube) then do the same with the other nostril 🍀🍀🍀. Once it's clean, pound the green manure leaves to get its extract and pump it into your nose. I guarantee it will be gone after around one week. And you can maintain for two to three weeks for it to be completely gone. 🌸🌸🌸 Thanks for reading 🌸🌸🌸 Good luck.";</p> <p><u>Comment 1</u>: "But this is Siam weed";</p> <p><u>Comment 2</u>: "This person is a treasure... They are giving medical help without asking for anything return... Namo amitabud.")</p>
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Figure 2: Sample Facebook thread from the dataset (usernames are hidden)

Although a large number of users are members of these sites, only a small portion of users participated in the form of commenting regularly. As Table 3 shows, a majority of users only commented on a post once or twice over a five-year period, which constitutes a highly skewed out-degree distribution. Only a small subset of

users within each site contributes in terms of posting content and commenting frequently, and there is a ‘long tail’ of users who are very infrequent in their commenting activity. This finding is similar to what Smith and Graham (2019) found in their study of anti-vaccination Facebook groups in Australia – where ‘transient users’, whose participation in anti-vaccination Facebook sites is few and far between – also dominated their sample. This could be indicative of larger trends in user participation on Facebook within health-related groups across different contexts, although further research is needed to examine these dynamics.

**Table 3. Out-degree distribution of user activity by site-level network**

Network	Number of users who commented twice or less	Percentage of total activity within network
Site 1	2082	55.24%
Site 2	1606	54.66%
Site 3	3904	70.64%

On an aggregate network level, it is of interest to examine whether users who participate in one site-level network also participate in other sites within the sample. Perhaps quite surprisingly, the percentage of cross-participation within the selected sites is very low (see Table 4). In each pair of the site-level network, cross-participation is below one per cent, with a particularly low cross-participation rate between sites 2 and 3. As such, not only does site 3 have a very low affective engagement rate (‘Reacts’) and sharing behavior within the site itself, its members also do not seem to engage in the other most popular non-biomedical knowledge sites. Contrasting this against the high intensity of discussion that happens within the site (high counts of comments and posts), it seems that non-biomedical knowledge groups that rely on an anti-biomedicine philosophy could be exhibiting cult-like behavior, in the sense that content is frequently discussed within, but not does not propagate outside of, the group. This implies a sense of insularity that does not benefit knowledge exchange among the examined groups. However, overall low cross-participation rates across the sampled sites are again consistent with what Smith and Graham (2019) have found in their anti-vaccination study. This further supports the observation of the ‘transient user’ on Facebook, wherein users ‘pass by’ discursive groups without investing in maintaining discursive relationships or coordinating different discourses across groups.

**Table 4. Percentage of user participation across pairs of site-level networks**

	Site 1	Site 2	Site 3
Site 1	100%	0.83%	0.46%
Site 2	0.83%	100%	0.06%
Site 3	0.46%	0.06%	100%

Considering that each network from the sampled sites remains largely separate from each other, it is worthwhile to further examine whether these networks exhibit the properties of ‘small world’ networks (Watts & Strogatz 1998). Small world networks are network structures that are both highly locally clustered and have a short path length – two network characteristics that are usually divergent (Watts 1999). Small world networks are interesting for many reasons. For example, small world networks enable infectious diseases to spread much more quickly and easily than other types of networks, as the dynamics of the network is an ‘explicit function of structure’ (Watts & Strogatz, 1998, p. 441). Empirical research has also shown that the more a network exhibits characteristics of a small world, the more connected actors are to each other and connected by persons who know each other well through past interactions, or through having had past interactions with common third parties (Uzzi & Spiro 2005). These conditions allow information circulated in separate clusters to also circulate to other clusters, and to gain the credibility that unfamiliar materials require to be regarded as valuable in new contexts and subsequently used by other members of other clusters (Uzzi & Spiro 2005). Small world networks are also interesting because they are robust and resistant to damage, in the sense that randomly removing nodes from the network will not significantly impact the effectiveness and dynamics of the network (Smith & Graham 2019). The small-world phenomenon is not only common in sparse networks with many vertices, as even a tiny fraction of short cuts would suffice. Research has demonstrated that it is common in biological, social and artificial systems (Watts & Strogatz 1998, Uzzi et al 2007, Telesford et al 2011, Bassett et al 2017, Opsahl et al 2017, Smith & Graham 2019).

Two methods were used to assess whether the three co-commenting networks are ‘small worlds’. The first approach follows the conditions set in Watts & Strogatz (1998), where a network is considered small world if (1) its average local clustering coefficient is much greater than a random network generated from the same set of vertices and (2) the mean shortest path length of the network is approximately the same as the associated random network. To do this, I calculated the average local clustering coefficient and mean shortest path length for the three networks studied here, and compared these metrics against those of three randomly generated networks with the same number of edge sets. I generated these three random networks using the Erdős-Rényi model implementation in the ‘igraph’ R package (Csardi & Nepusz, 2006). The second approach employs Humphries & Gurney (2008)’s small-worldness index, where the index is calculated as transitivity (normalized by the random transitivity) over the average shortest path length (normalized by the random average shortest path length). Transitivity, an alternative definition of network clustering, is understood as the propensity for two neighbors of a network node also to be neighbors of one another (Newman et al 2000, Newman 2009). Using the ‘qgraph’ R package (Epskamp et al 2019), the average of the same indices was calculated on 1000 random networks for each co-commenting network. A network can be said to be ‘small world’ if its small world

index is higher than one; a stricter rule requires the index to be higher than three (Humphries & Gurney, 2008). Results are presented in Table 5, where all three networks satisfy the conditions in both approaches to be small worlds.

**Table 5. ‘Small world’ metrics for user co-comment networks vs. random graphs (bolded in brackets) and small-worldness index (Humphries & Gurney 2008)**

Network	Average local clustering coefficient	Average shortest path length	Small-worldness index
Site 1	0.0214 ( <b>0.0018</b> )	4.414 ( <b>4.871</b> )	3.353
Site 2	0.0058 ( <b>0.0014</b> )	5.525 ( <b>6.152</b> )	9.689
Site 3	0.0099 ( <b>0.0007</b> )	4.316 ( <b>5.933</b> )	9.704

#### 4.2 Text analysis and topic modeling

In order to understand the nature of discourse on these networks, topic modeling was performed on the complete set of textual data collected, including original posts and their associated comments, across all three sites. Probabilistic topic modeling allows for efficient and reproducible analysis of large amounts of textual data without requiring prior annotations or labeling of the textual corpus; topics that emerge from this analysis are determined through the co-occurrence of words and the themes they carry within the texts (Blei 2012). The analysis was carried out using the LDA method (Blei et al 2003, Blei and Mcauliffe 2007), an established generative statistical topic modeling method within the social sciences (DiMaggio 2015). LDA defines a topic as a distribution over a fixed vocabulary; it assumes that topics are specified before textual data are generated (Blei 2012). This method formalizes the intuition that there exists hidden topics within set texts, and that these hidden topics can be inferred through examining words that appear with particular probabilities. The utility of topic models lies in the property that the hidden structures inferred resembles the thematic structure of the dataset (Blei 2012).

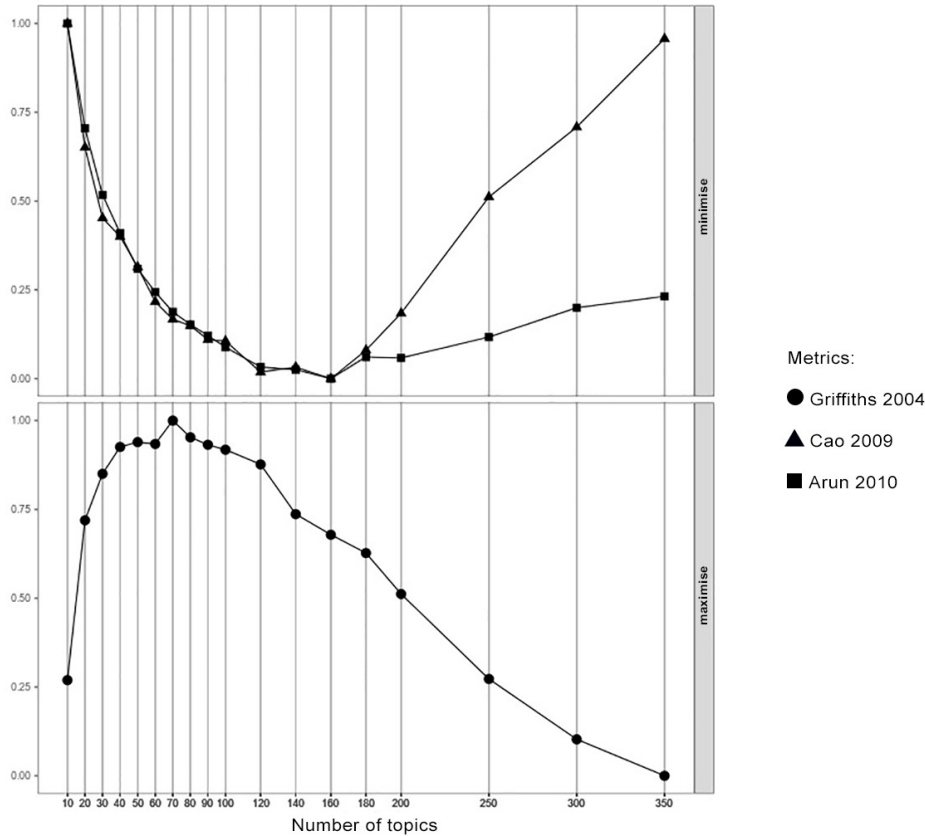


Figure 3. Computed metrics and estimated  $k$  number of topics using the 'ldatuning' R package

To prepare the corpus for LDA, a natural language processing annotation pipeline specific to the Vietnamese language was used to segment individual words and tag them with the appropriate part-of-speech (Vu et al 2018). The analysis was then conducted on 469,388 noun terms such as 'cancer', 'monk fruit', 'hibiscus', that occur in at least 80 per cent of 25,356 discussion threads in the dataset. The rationale behind this method is based on the observation that, within this dataset, discussions usually involve support seeking and provision (i.e. people naming a disease or condition to seek out names of medicinal plants or ingredients that supposedly help with said disease or condition). As such, disease names and names of medicinal plants or ingredients that appear alongside each other in the same discussion threads with high frequency could indicate popular non-biomedical therapeutic beliefs and practices. Specifying the LDA model consists of three steps: (1) draw  $k$  topics from a symmetric Dirichlet distribution, (2) for each document  $d$ , draw topic proportions from a symmetric Dirichlet distribution, and (3) for each word  $n$  in each document  $d$ , draw a topic assignment from the topic proportions and draw the word from a multinomial probability distribution conditioned on the topic (Grün & Hornik 2011). There are many approaches to choosing  $k$  number of topics, such as perplexity (Blei et al. 2003), marginal likelihood (Griffiths &

Steyvers 2004), density (Cao et al 2009), and symmetric Kullback–Leibler divergence (Arun et al 2010). No one approach is currently considered the standard; researchers working with LDA often choose the method most appropriate with the nature of their data (Smith & Graham 2019). To ensure rigorous k selection, I calculated all four metrics using the ‘ldatuning’ and ‘topicmodels’ R packages (Nikita 2016, Grün & Hornik 2011). Figures 3 and 4 plot the results of these metrics. Figure 3 indicates that the best number of topics lies somewhere in the range between 70 – 160, while Figure 4 indicates that the range is between 60 – 80. It is documented that Cao et al (2009) and Arun et al (2010) metrics tend to overfit the data (Hou-Liu 2018, Gerlach et al 2018). Marginal likelihood (Griffiths & Steyvers 2004) has been widely used as a measure to specify k on large-scale social media datasets across different languages and health topics, where the topic candidate with the highest likelihood value is considered the best fit (Paul & Dretze 2012, Ma et al 2016, Zhao 2018, Liebeskind & Liebeskind 2018, Rissola et al 2019). Perplexity is often used alongside marginal likelihood as a method of cross-validating k selection, where lower perplexity is considered better fit (Hoang 2015). Based on these analyses, k topic is selected at 70.

To validate the topic model fitted to the current data, Maier et al (2018) suggested employing ‘systematically structured combinations of existing metrics and in-depth investigation to boost the significance of the validation process’ (p.97). They devised a three-step process to operationalize this: summarizing the most important quantitative information from the model, outlining exclusion strategies for uninterpretable topics, and close reading of the data and labeling of topic.

Maier et al (2018) proposed the use of four particular metrics: rank-1 metric (Evans 2014), coherence (Mimno et al 2011), relevance (Sievert & Shirley 2014), and the Hirschman-Herfindahl Index (HHI). Rank-1 metric is useful for helping identify background topics. Coherence score, when applied to single topics, can help guide intuition in interpretation. Relevance score can help reorder the top words of a topic by considering their overall corpus frequency through manipulating the weighting parameter  $\lambda$ , with best interpretability of topics using a  $\lambda$ -value close to 0.6 (Sievert & Shirley 2014). Finally, HHI = 1 signifies maximum concentration (the topic is pronounced by only one source) and a very low HHI value, conversely, indicates that a topic can be found in many sources. HHI, while useful in Maier et al (2018)’s specific dataset which tracks the hyperlink network of over 300,000 websites, is not useful to the current Facebook dataset. HHI is therefore not calculated here. A sample summary statistic of these metrics is included in Appendix 2.

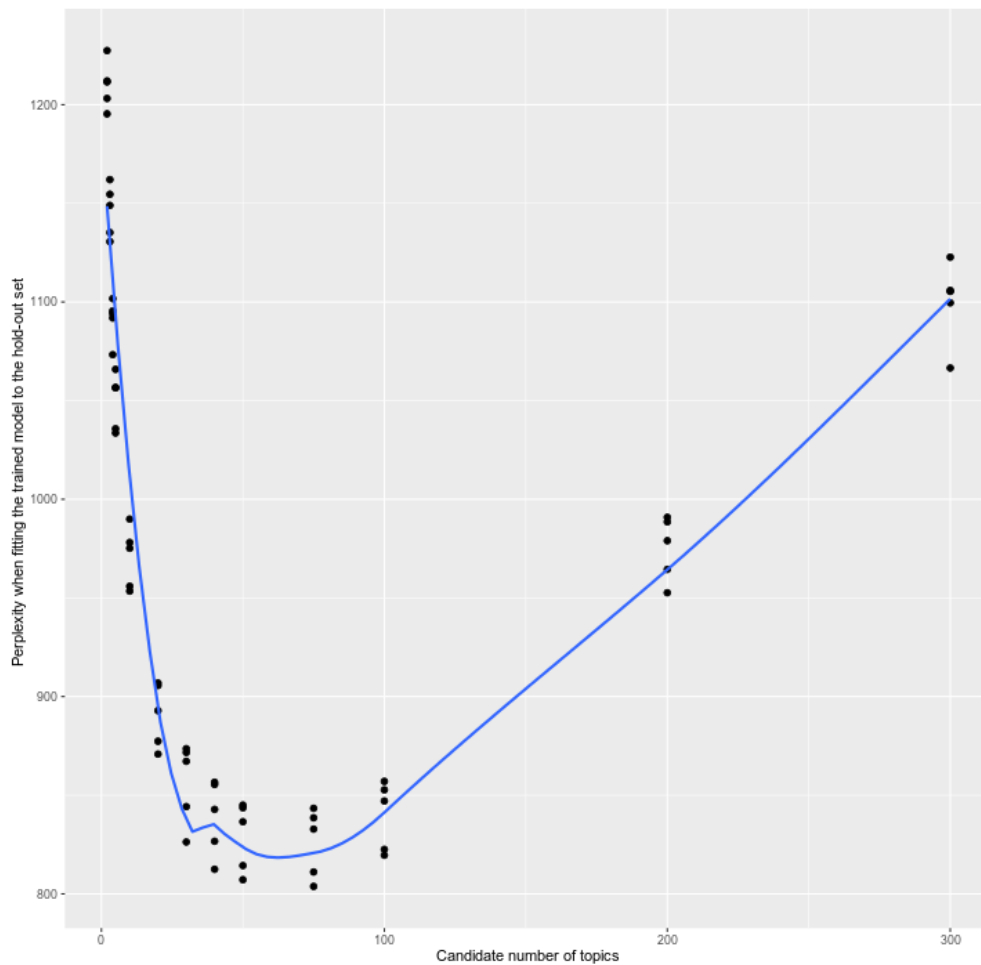


Figure 4. Computed perplexity and estimated  $k$  number of topics using the ‘topicmodel’ R package

Of the 70 topics generated, there were 17 overlapping topics (i.e. topic 2 appearing 17 times in the results). Only four topics include mostly ‘junk’ terms such as ‘shhh’, ‘kkkkk’, ‘hehehehe’ – which are words that were not interpretable in relation to others in the topic. These terms are generally considered to be an artifact of social media data and the phatic nature of online communication, which is commonly encountered (Smith & Graham 2019). These four topics, which contain mostly ‘junk terms’, are also excluded from analysis. From this filtering process, there are 49 topics that are eligible for analysis. The most representative threads containing each identified topic was retrieved; a close reading of each thread was then conducted manually to ensure that the topic labeling is reflective of the underlying topic by human evaluation standard. This is an indispensable step as the labeling of topics should be based on the basis of broader context knowledge (Maier et al 2018). The final analysis of the remaining 49 topics is presented in Appendix 1 Table 6, together with relevant statistics.



## 5 DISCUSSION

Following from the analysis, it appears that Vietnamese non-biomedical networks on Facebook are quite sparse: they do not seem to function as close-knit communities of knowledge exchange and support, where participants interact in a sustained fashion over time. The nature of this social exchange pattern diverges from how traditional medical knowledge has historically been passed down from generation to generation in Vietnam, which relied on upholding, and sometimes gatekeeping, closed therapy communities. This does not mean, however, that traditional medical knowledge is being ‘democratized’ as such. There is very little cross-pollination of knowledge sharing among the three sampled sites; people who participate in one site are not likely to also participate in others. Considering that each of these sites was organized around a different therapeutic regime (Southern medicine vs. ‘Traditional’ Northern medicine) with different philosophical outlooks (consumer advocacy vs. agenda-free knowledge sharing), the analysis seems to be suggesting that existing boundaries among different ‘traditions’ are being replicated online. This pattern is similar to the behavior of, for example, Australian anti-vaccination pages on Facebook, where cross-group participation is also not prevalent (Smith & Graham 2019). More research examining this emerging dynamic of Facebook groups and pages is warranted, especially against the context of Facebook redesigning its interface to prioritize interest-based group and community interactions to mitigate uses of the platform merely as an ‘address book’ (Statt 2019).

The lack of coordination across these sites might also have deeper roots in existing social mechanisms that maintain the propagation of traditional medical knowledge. Craig (2002) noted how the legacy of Vietnamese family health knowledge and practice, transmitted in its most durable forms through oral traditions and written recipes, is located within the household level where it is readily put to use. Since this locates the primary caregiving responsibility within the family unit rather than with professionals and institutions or online strangers, the logic that drives the propagation of non-biomedical knowledge is that of use-value: that people seek traditional medical knowledges in times of sickness and share them mostly in response to those in need in a transactional fashion. Unsolicited sharing of recipes and knowledges, when it happens, also seems to be grounded in collectively imagined boundaries between various undercurrents of TM. The lack of cross-pollination among different ‘traditions’ and consumer movements – Southern medicine vs. Northern medicine vs. Anti-biomedicine – seems to be replicating itself online, where people engage in rather insular and separate networks that map onto existing knowledge paradigms that are anchored in well-established everyday practices.

Despite the lack of interaction across different sites, network activities within the sites themselves are quite robust and resistant to change. All three networks exhibit ‘small world’ characteristics – which structurally enables quick and

easy propagation of information. It is in this regard that Vietnamese non-biomedical networks resemble the characteristics of other networks on Facebook (Catanese et al 2011, Caci et al 2012, Wohlgemuth and Matache 2012, Smith & Graham 2019). This analysis contributes to the growing body of evidence of the ubiquity of small-world networks on Facebook, which could indicate that the affordances of Facebook as a platform might be shaping networks towards ‘small-worldness’. If this is the case, then the growing popularity of self-contained community groups on Facebook might be fertile ground for resilient and durable discourse communities. Future research should look at the new temporalities that this mediated sociality is giving to the information and knowledge being propagated on social networking sites such as Facebook, especially with regards to rich and complex multimedia formats such as live-streaming videos and synchronous viewing of pre-recorded videos.

Following the Latourian approach to tracing the interactions and discourses left behind by actors in this knowledge network also means acknowledging the co-production of sociality and materiality (Law & Mol 1995, Latour 2005). Materials are relational effects; when we look at the social, we are also looking at the production of materiality. This materiality needs not stop at the collection of texts exchanged, photos shared, videos uploaded, or livestreams watched; the material heterogeneity of networks extends to people, medicines, money, institutions, food, traditional medicine clinics. Artifacts of this sort could embody social relations in materials more durable than those in online interactions. Durability is a relational effect; the strategies that reside within the materiality and affordances of things are contingent on durability as much as the manipulability and scale of these materials. A recipe shared as text on Facebook has a different malleability and tractability to a video instructing how to follow the same recipe, or suggestions on where to buy the necessary ingredients, or offers to send these ingredients through the mail to those who want them. Strategies or strategic loci of things are recursive and reflexive effects produced in a space where materials of different durability and manipulability join together (Law & Mol 1995). Following this, the discourse network traced here is not the end, but rather the beginning of reassembling the actor-network anew by the passage of another medium, another circulating entity (Michael 2017). The computational analyses conducted in this paper, while not addressing the materialistic conditions of the texts collected, serve as a reminder about the materiality that is already embedded in networks beyond the visible traces of data that can readily be collected as a result of platform enclosure of human behaviour (Wu & Taneja 2020).

Some cues as to how to continue this tracing can be found by looking into the discourse content existing within the networks traced. With the LDA method, 49 unique topics were identified and qualitatively labeled. The significant number of overlapping topics found within the dataset is reflective of both the nature of social networking behavior and the way TM is communicated in Vietnamese. Reposting popular and interesting content found elsewhere is common behavior on

social media (Lu et al 2014, Wang et al 2019), making frequently recurring content characteristic to social media data. LDA modeling picked up this pattern in the dataset.

Overall, the topics identified through LDA can fit under eight broad themes: managing health and illnesses (topics 2-12, 14-17, 19-20, 24-25, 28-33, 35-40, 45-49), institutionalization of TM (topic 1), origins and legitimacy (topic 23), sales (topics 3, 7, 26, 27), lifestyle (topics 6, 21, 22, 34), religion and philanthropy (topic 4), negative aspects to TM (topics 13, 18, 42), and TM and overseas Vietnamese (topics 14, 16, 44). Among these broad themes, the last three themes are probably the most interesting. A close reading of posts containing the theme of religion and philanthropy reveals that Buddhist temples remain an important locus through which people of disadvantaged socioeconomic background in Vietnam seek and receive healthcare. TM, usually in the form of raw ingredients, is also frequently distributed for free by monks who practice medicine through Buddhist temples. This is an interesting finding, as it is pointing to the informal yet significant healthcare role that religious institutions continue to play, especially in a secular, post-socialist society such as Vietnam. One of the earliest extant Vietnamese medical texts, ‘Miraculous Drugs of the South’ (*Nam Dược Thần Hiệu*), for example, was written by the Vietnamese Buddhist monk-physician Tuệ Tĩnh (ca. 1330 – ca. 1389). For many centuries in Vietnam and East and Southeast Asia more generally, it was common for Buddhist monks and nuns to work as healers; Buddhist contexts have continued to be the most important loci for the cross-cultural exchange of diverse currents of medicine ideas and practices concerning illness and healing (Thompson 2017b). Local traditions of Buddhist medicine represent unique hybrid combinations of cross-culturally transmitted and indigenous knowledge (Salguero 2018). In addition to the transformations happening to Buddhist medicine by means of interactions with Western colonialism, scientific ideas, and new biomedical technologies, the internet and its social media platforms are the latest actors to contribute to the evolution and persistence of these non-biomedical modalities.

Critical discussions against TM are also present on these networks. There appear to be negotiations of what constitutes legitimate uses of medicinal plants, and indeed what counts as ‘medicine’ through these critical discussions. For example, in one discussion, speculations on the medicinal properties of shrimp paste – a Southeast Asian fermented condiment – was criticized as nonsensical and labeled as ‘country bumpkin’ thinking. “Food as medicine” has long been a prominent characteristic in the East and Southeast Asian systems of medical thought, where local food cultures are inseparable from traditional therapeutic systems (Ogle et al 2003, Pieroni & Price 2006). The perceived multiple functions of edible plants and local food, however, are not immutable; as the above example shows, the medicinal functions of local food are subject to ongoing negotiation and reinterpretations as understandings about nutrition and health evolve. Future research could look into the ways in which living discourses surrounding policing

and adjudicating the boundaries between food and medicine intersect with processes of urbanization and modernization, as well as how the changing distinction between functional foods and food medicines is being played out on social media.

Finally, it appears that the discourses conducted on and through these sites are transnational in nature. *Việt Kiều*, or overseas Vietnamese, are present in these online discussions; they are distinct actors insofar as they facilitate discussion topics that are distinct from those who reside inside Vietnam. These discussions involve, among others, requests for and provision of referrals to unlicensed traditional medical practices outside of Vietnam and transnational trading of herbal ingredients through informal means. It is estimated that there are around 4.5 million Vietnamese living overseas, contributing USD15.9 billion to the Vietnamese economy annually in remittances (Minh Huy 2018). The majority of the Vietnamese diaspora left Vietnam as political and economic refugees at the end of the Vietnam War in 1975; almost half of overseas Vietnamese reside in the United States, and the majority of *Việt Kiều* live in other industrialized countries such as Japan, France, Australia, and Canada. Given that non-biomedical therapies are much more marginalized and stigmatized in these societies, future research could look at the ways in which diasporic communities navigate, with or without success, the healthcare systems of host-states while forging and maintaining links with the 'homeland' through participating in networked propagation of traditional knowledges. Beyond issues concerning the navigation of biomedical health systems, issues with transnational belonging and emergent hybrid narratives about health and illness may also manifest themselves in novel ways through these networks. Furthermore, these network connections have the potential to materialize through the increasingly dense networks of transnational mobility.

Many of the discussions involving overseas Vietnamese also involved word-of-mouth referrals to private non-biomedical practices both within and outside of Vietnam, sales of medicinal plants and deliberations of international shipment details, and negotiations of international money transfers – through both formal and informal channels. The ways in which online networks manifest themselves materially beyond digitally-enabled interactions, particularly in health contexts, warrant closer attention in future studies. It is important to note that although material and social relations might be matters of local performance, they may not 'add up' to form an overall pattern or structure (Law & Mol 1995, Latour 2005). This 'patchwork' outlook, while promising to neither tell coherent stories nor provide a complete map of actors and their connections, is faithful to material multiplicity and committed to the generalized symmetry that treats material differences not as given, but rather generated in relations themselves.

## 6 CONCLUSION

This paper explored the network dynamics of, and discourses present within, Vietnamese non-biomedical discussion sites on Facebook. It is among the first of its kind to combine both natural language processing and generative topic modeling techniques to explore a large-scale online dataset in the Vietnamese language; it is also among the first of its kind to explore the proverbial network life of traditional medical knowledges on the internet. While limited by the sites sampled, the analysis presented here provides a foundational and empirically driven account of online propagation of traditional knowledges. The goal was not to exhaust all possible social media content, but rather to provide a rigorous analysis and suggest future directions in an under-researched topic that could have important implications in different disciplines. Vietnamese non-biomedical knowledges are propagating on social media with mechanisms that seem to be replicating existing socially and culturally constrained boundaries of knowledge regimes, with little evidence of cross-pollination between different ‘traditions’ of knowledge. The open and transnational nature of social media, however, has allowed for micro (national religion and philanthropy, negotiations of meaning and legitimacy) and macro (diasporic networks of resource and care) processes to unfold with increasing visibility and reach. More comprehensive studies in different developing contexts are certainly warranted, and comparative perspectives into how different traditional and non-mainstream knowledges perform on online networks could enrich current discussions on the changing sociality and the production of materiality in the network society.

## FUNDING STATEMENT AND ACKNOWLEDGMENTS

I would like to thank the Fox International Fellowship at The Whitney and Betty MacMillan Center for International and Area Studies at Yale University for hosting me during the writing of this paper. I owe a debt of gratitude to Emily Erikson, Erik Harms, Michele Thompson, and Michael Arnold for their insightful comments on early versions of the paper. Special thanks to Gia Dang for his assistance in data collection and processing, and Tam Nguyen for her assistance in the preparation of this paper.

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APPENDIX 1

Table 6. Topics generated and their top twenty terms.

Topic	Share % <i>M</i> (SD)	Top twenty terms (translated)
Topic 1: TM in context of formal national healthcare	3.33 (0.67)	Limited time, Curcumin, Seniority, Ranking, Two-week period, Bcl-2 protein family, Tráng phục linh (Colitis medication), Namo amitabud, Bảo an khương (Name of insurance scheme), Cutleaf groundcherry, Sickness, Tiger bone glue, Gathering, Half portion, Short course, Corn, Dental care, Russia, Kidney stone, Geoduck
Topic 2: General principles of TM	3.84 (1.02)	Local dialect, Quality, Ease, Human organs, Equilibrium, Blood veins, Medical effects, Fruits, Human anatomy, Egg, Cashew, Selection, Alternative, Kidney, Vinegar, Good quality, Pepper, Immersion, Softness, Food dish
Topic 3: Knowledge sharing as advertising for direct sales	2.67 (0.57)	Symptom, Dragon's tongue leaf, Phlegm, Service, Human back, Tuber fleecflower, Southern medicine, Tomorrow, Once a day, Circumstances, Plant processing, Plant scouting, Inbox, Knowledge, Medicine, Parasite, Recipe, Soda, Lymphatic system, Frequency
Topic 4: TM as religious philanthropy	3.31 (0.18)	Seafood, Frequency, Healing, Buddhist monk, Fruit, Phlegm, Basic, Consequences, Philippines, Yao people, Species, Hua Tuo, [Redacted username], Favour, Variety, Tree trunk, Plucking, [Redacted username], Sharpness
Topic 5: General childcare advice	2.21 (0.46)	Blanket, Hotness, False daisy, Homegrown, Fibraurea leaf, Table, Standard, Correction, Determination, Ground substance, Average, Seeing, Thread, Malignant hyperthermia, Chickenpox, Addiction, Childhood, Vân Hồ (a district in Sơn La, Vietnam), [Redacted username], Feces
Topic 6: TM as lifestyle	4.39 (1.04)	Blowing, Multitude, Avoidance, Shower, Tickling, Discovery, Leanness, Gypsum, Moisture, Sleep, Territory, Udumbarra flower, Backside, [Redacted username], [Redacted username], Atherosclerosis*, Vinegar*, Prevention, Fine meal, Miracle
Topic 7: Dietary benefits of traditional plants and call for direct sales	4.26 (1.42)	Sabah snake grass, Digestion problems, [Redacted username], Contrast, Ray, Year, Condensed, Tonsillitis, Pneumonia, Instructions, [Redacted username], Tomorrow, Soup, Red blood cell, Effectiveness, Zalo (a Vietnamese messaging application), This, Body, Gift, [Redacted username]
Topic 8: TM as dietary supplements	3.21 (0.44)	Vietnamese ginseng, Brand name, An Tồn (a former village in Vĩnh Phúc district, Thanh Hoá province), Alleviation, Negativity, Hiji, Vitamin B12, Body temperature, Sympathy, Small dots, Familiarity, Chinese mesona, Falling, Western, Fairy, Cashew, Cornea, Half portion, Intermediate, Men
Topic 9: TM as narratives	4.02 (1.32)	Medicality, Hour of the pig, Desire, 30 minutes, Publishing request, Once upon a time, Brothers and sisters, Death, Heat, Stop, Flanovoid*, Pencil cactus, Steaming, Cannabis, Seeds, Paper-thin, Medicine, Ingredients, Country, The Americas
Topic 10: TM in family health	3.75 (1.02)	Rice wine, Lightness, Eternity, Itchiness, [Redacted username], [Redacted username], Bastard children, Tropics, Warmth, Calmness, Sand, Cashew, Sweetness,

		Computer, Beauty, Menstrual cramps, Tumour, Household equipments, Substance
Topic 11: Ethnic variations in TM	1.09 (0.43)	Peeling, Gold apple, Career, Cardboard, Socks, Body part, Support, Satisfaction, Lâm Thao (a Northern province in Vietnam, also name of a fertiliser brand), [Redacted username], Solasodine*, Peony, Thuốc Nam Phong (rheumatism medication), Promotion, Noel*, Infection, Doctor Triệu Thị Thanh (a Yao doctor), Clots*, Magnesium, Zinc
Topic 12: Managing alcohol addiction	2.14 (0.98)	Wood, [Redacted username], Body, Sickness, Pearl, Retrograde ejaculation, Baldness, Darkness, Trick, Movement, Bad luck, Thủy Ngân (alcohol addiction medication), Bad temper, Vitamin K, Confession, Infection, Folliculitis, Crazyness, Below*, Hemorrhoids
Topic 13: Shaming uses of TM	1.30 (0.40)	Beta-Sitosterol*, Shrimp paste, Speed, Pomade, Technology, Space*, Sterculiaceae*, 6 years, Monoglucoside*, Rarity, Precipitation, Suppression, News, Mood, Bookstore, Country bumpkin, Reasoning, Morning sickness, Occasionality, Belief
Topic 14: Managing mental health among overseas Vietnamese	2.23 (0.34)	America, Wormwood, Rowatinex*, Hatred, Juice, Contact, Heaviness, Thankfulness, Isothiocyanate, Insomnia, Anxiety, Kohlrahi, Rhythm, Sunglasses, Translation*, Participation, Bruises, Borrowing, Vacuum, Sickness
Topic 15: Managing smoking addiction with TM	2.36 (0.26)	Antonin Seipin* (supposedly Russian doctor), Sleep, Vontaren*, [Redacted username], Gấc seeds, Bird, Walking, Dog blood, Hunger, 70 years old, Rheumatism, Water, Spine, Chicken, Picture, Gift, Food, Thankfulness, Heaviness, Intern
Topic 16: Cardiovascular health and overseas Vietnamese	2.26 (0.42)	Dick*, [Redacted username], Kkkkkkk, Untimely diagnosis, Shred, Penis, Garden, Combination, Announcement, Contradiction, Urging, Vitality, Hole, Hematology, Acceleration, Withdrawal, Visa*, Blood veins, Good reputation, Cikan (heart health supplement)
Topic 17: Anti-infective plants and pain management	2.00 (0.48)	La Gi (small town in Bình Thuận, Southern Central Vietnam), Common Purslane, Admin, Surplus, Usefulness, Salonpas, Indigenousness, Natural antibiotics, Summer, Autumn, Aches, Flower, Catching wind, Exercise, Trần Hưng Đạo (name of a street), Mink*, Bloodline, 100k, Boil
Topic 18: Cautionary tale against misuse of TM	1.57 (1.07)	Body, Women, Buying, Asking, Extra, Wine, Strength, Usage, Cancer, Diagnosis, Death, Sugar, Men, Friend, Steam bath, Weekly, Turmeric, Tea, Derris
Topic 19: Men's sexual & reproductive health	3.42 (1.44)	[Redacted username], Dry-zone mahogany bark, Expenses, Cure, Scabies, Effectiveness, [Redacted username], Researcher, Materials, Archipelago, Regret, Prevention, Amber, Gossypol*, Indian goosegrass, Testicles, Limonene*, Hygiene, Schefflera heptaphylla, Pedology
Topic 20: Food as medicine	3.84 (0.24)	Food with 'cold' properties, Fermented tofu, Money, Duck meat, Area, Cash flow, Contradiction, Sickness, Interaction, Diaper, Method, Water, Bear gallbladders, Springing, Medical practice, Pig, Mother, Reference, Honey, Hybridity
Topic 21:	2.28 (0.28)	Mushroom, PDR* (Physicians's Desk Reference), Happiness, Moment, [Redacted username], Tongue, 50

Agrarian lifestyle as healthy lifestyle		years, Buffalo, Quảng Ninh (a Northern province in Vietnam), Boil, Salt, Flies, Fullness, Applying ground leaves over wound, Shampoo, Class of plants, Fruit tree, Tea, Eating habits, Từ Sơn (a village in Bắc Ninh, a Northern province)
Topic 22: Buddhist lifestyle as healthy lifestyle	1.94 (0.12)	Suffocation, Digestion, Vegetarianism, Piper lolot leaf, Proof, Cần Thơ (a province in Southern Vietnam), Namo amitabud, Tree stump, Black bean, Studying overseas, Brain, Today, [Redacted username], The truth, Boat*, Taking medication, Storytelling, Adrenal gland, Happiness and Prosperity, Body organ
Topic 23: Discussions on the origins and originality of Vietnamese medicine	3.14 (1.73)	[Redacted username], [Redacted username], Patent, Clutching, Usage, Southern territories, [Redacted username], Better quality, Ethnic minorities, Lips, Determination, Admin approval, Destiny, Tuệ Tĩnh Đường Liên Hoa (a TM dojo in Huế, Central Vietnam), Trịnh Hoài Đức (18th century historical figure), [Redacted username], Coach bus, Malt, Pounding
Topic 24: Processes of preparing plants as medicine	1.62 (0.29)	House yard, Đống Đa (a district in Hà Nội), 6 months, Chromatophore, Purity, Daytime, Itchiness, Sleep, Nutrition, Rice wine, Oxygen, Chaff-flower, Gastric acid, Bowl, Citizen, Fermenting and Drying, Purpose, Afternoon, Ribs, [Redacted username]
Topic 25: Emergency childcare advice	1.37 (0.43)	Tools and equipments, Baby colic, Examination, Squeezing, Amount, Inner body, Selection, Sharp pain, Binystar (baby colic medication), Liking, Roseola, Couch, Lung, Dollar, [Redacted username], [Redacted username], Alkaloid*, Statistics, Ceylon hill gooseberry, Mothers
Topic 26: Negotiating sales of medicinal plants	2.35 (0.44)	Hedyotis*, Willow bark, [Redacted username], Parasite, Personal taste, Family recipe, Blue, Middle, White, Negativity, Experience, Lingao County, Savings, Colitis, Eel, Storm, Feet, Virginity, Post office, Quality
Topic 27: Negotiating shipping methods and sales of medicinal plants	2.13 (0.72)	[Redacted username], Shade trees, Bank, 350k, Carboxymethyl cellulose, Peanut, Miracle, Flagellate, Hà Nội, Incomprehensibility, Index finger, Stemona tuberosa, Concurrence, Long Biên (a district in Hà Nội), Dear friend, Billards, Hoàng Công (coach bus brand), Square, Birds, Wrapping cloth
Topic 28: Gastroenterology health	2.62 (0.51)	Recipe, Sugar beets, Investment, [Redacted username], Business, Gastralgia, Eating*, Falling off, Country, Family recipe, Discussion, Flatulence, Macau, [Redacted username], Urination, Guava, Stinkvine, Effect, [Redacted username], Money
Topic 29: Mental health and longevity	2.00 (0.62)	Reason, 100-year-old, [Redacted username], Greetings, Finickiness, Reasoning, Well-wishing, Anolyte, Acute pain, [Redacted username], Oneself, Sending, The truth, Quảng Ninh (a Northern province in Vietnam), Bait, Costliness, Heaviness, Jokes, Spa
Topic 30: Aging and Loneliness	1.42 (0.23)	Belonging, Myself, Sesame, Animal bones, Chi Thống Hoàn (osteoarthritis medication), Cadmium, Diaphoretic, Drawing, Blood, Dr. Lê Minh, Viettel (a telecommunication company), Envelope, Shampoo, Ramnoza, Kangaroo, Traditional medicine street, Lipstick, Prescription, Earth, Cat

Topic 31: Old age and health	1.29 (0.39)	Produce, Virus, Grind, Ringworm, Hypertension, Quality, Pleiku (a city in the Central highlands), Food dish, Unit, Coughing, Stew, Everybody, Water pipe, My aunt, Sickness, Manhood, Items*, Pharmacist, [Redacted username], Bad temper
Topic 32: Manging the common cold with TM	2.65 (0.28)	Sky, Capture, Labour, Weight, Panax pseudoginseng, Plant family, Samurai (energy drink brand), Conclusion, [Redacted username], Acyclovir, Buying, Cupping therapy, [Redacted username], The academy, Bravery, Treasure, Majority, Master
Topic 33: Nutrition and cardiovascular health	2.05 (0.19)	Battleground, Soil, Voice, Bran, Tip*, Nun, Quality, Ease, Human organs, Equilibrium, Blood veins, Medical effects, Fruits, Human anatomy, Egg, Cashew, Selection, Alternative, Kidney, Vinegar
Topic 34: Healthy lifestyle and religious narratives	2.02 (0.44)	Winter melon detox juice, Zona, Job's tears seeds, Strawflower tea, Freshness, Observation, Dharmapala, Afternoon, Namo amitabud, Inauguration, The moon*, Fruit, Instance, Beauty, Hibiscus, Medicinality, Multitude, Mint, Adults, Share*
Topic 35: Men's health and cardiovascular health	2.03 (0.60)	Actuality, Chia seeds, Spora Lygodii, Mass communication, Positivity, Magnolia bark, Bracelet, [Redacted username], Flatulence, Sudden, [Redacted username], High endogenous testosterone, Sharing, Total occlusion, Infection, Certainty, Guava, 10kg, Water, Basic
Topic 36: Women's beauty and sexual health	1.02 (0.16)	[Redacted username], Chlorophyll, Helping, Body, Know-how, Soul, Droppers*, Counsellor, Indochinese serrow, [Redacted username], Senior Colonel, Obstetric, Tetronic acid*, Euphorbia ambovombensis, Forrest, North winds, Flabby, Secret code, Ficus*
Topic 37: Narratives of medical families and family recipes	4.01 (1.57)	Efficacy, [Redacted username], False ginseng, Family recipe, Household registration book, Goods, Caterpillar fungus powder, Infertility, [Redacted username], Tour*, Retaining, The passing of spring, [Redacted username], Flower, Chickrassy, Water caltrops, Listed price, Wind, Filtered water, Aches, Rice
Topic 38: Insomnia and discussion of burnout	1.37 (0.22)	Disinfection, Wooden floor, Week, Sock*, Burning pain, 'Bread and butter', Year of the Dog, [Redacted username], Virus, Inadequate sleep, Gum, [Redacted username], Jaundice, Root cause, International*, [Redacted username], Caligan*, 330mg, Willow tree, Jelly
Topic 39: Diet and women's health	3.34 (1.33)	Snake, Forgotten recipes, Multitude, Winged bean pods, Women, Coconut shell, Once upon a time, Waistline, Weight loss, Ignoring, Rice paddy herb, Hypertension, Vestibular disorders, Shellfish, Toxaemia, Đà Nẵng (a city in Central Vietnam), Salt, [Redacted username], Virgin fish sauce
Topic 40: Pregnancy advice	2.94 (0.55)	Gypsum, Choking on a fishbone, Liver, Cornea, Helicteres hirsuta Lour, Long Ju, Flatulence, Aiming, Tù Dũ (an obstetric hospital in Ho Chi Minh City), Afterhour shirts, City, Night, Manufacturer, [Redacted username], [Redacted username], Pomade, [Redacted username], Kilogram, Common cold during pregnancy, Legitimacy

Topic 41: Health and beauty tips	2.10 (0.13)	Indian goosegrass, Flower stigma, Someday, Past recipes, Sarsi, Rice paddy herbs, Skills, Member*, Gifting, Blood cockle, Five fruits, Water caltrop, Brother and sisters, Caffeine, Salt, Professional, Delivery, [Redacted username], [Redacted username], Homegrown
Topic 42: Cautionary tales against abuse of indigenous tobacco	1.41 (0.20)	Coronary artery disease, Experience, Thuốc rê (traditional rustic tobacco), [Redacted username], Eggplant, U Minh (commune in Cà Mau, Southernmost province in Vietnam), [Redacted username], Almond, Wisdom teeth, Anticipation, Miracle, Monk fruit, Asthma, Phú Thọ (province in Northern Vietnam), Vestibular disorders, Step, Gấc seeds, Positivity, Origins, Sinusitis
Topic 43: Fantastic tales about the religious and historical origins of Vietnamese medicine	2.73 (0.76)	Miniscule, Today, Baton, Annoyance, Northern Central, Ākāśagarbha (a Buddhist Bodhisattva), Regret, Đà river (Northern Vietnam), The way, [Redacted username], [Redacted username], Himalayas, Needles, Joy, Trung sisters (ancient history women warriors), Snakehead, Time, Panadol, Accidentality, [Redacted username]
Topic 44: Traditional alternatives to biomedicine and overseas Vietnamese	1.22 (0.19)	Friend, Germany, [Redacted username], Miniscule, Dandruff, Military, Apple, Operation, Nature, Anti-inflammatory, Muscovy duck, Testicles, Timeliness, Heat, Pregnancy, Baby, mmol/L*, Oysters, [Redacted username], Multitude
Topic 45: Constipation and hot/cold binary	4.45 (0.78)	Sickness, Orchid, Loneliness, Orphan, Tightness, Extract, Sharing, Alcohol*, Goose, List, Sapodilla, Hygiene, Remainder, [Redacted username], [Redacted username], [Redacted username], Blue*, Eyedrops, Gulan*, Cooling agent, Purple heart plant
Topic 46: Northern medicine and haemostasis	4.02 (1.09)	Reduction, 50cm, Bleeding, Red beans, Pebbles, Phú Xuyên (a district in Hà Nội), Tip*, Pangolins, Pueraria thomsonii flower extract, Concurrency, Activity, Parasite, Thorns, Cover, Fish, Fungi, Health, Steaming, 1 month, Weighing scale
Topic 47: Nutritions and women's health	3.35 (1.72)	Withdrawal, Overreaction, Name, Mutuality, Aches, Mentality, Jar, Early, Long process, Infection, Sinusitis, Women, Pharmacy, Pouring, Sisters, Soaking, Time, Symptoms, Ming aralia, Crinum latifolium
Topic 48: Pain management with TM	1.78 (0.77)	Raising, Gratitude, Daisy, X-ray, Spinal disc herniation, Hospital, Phoenix eyes, Rambutan, Myself, Dry blood, Gauze, Advice, Cabbage, [Redacted name], Criticism, Quantifying, Superior grade, Poaching, Truthfulness, Sliding
Topic 49: Otolaryngology and TM	1.12 (0.07)	Photograph, Gum, Nose, Care, White, [Redacted username], Cabbage, Bone, Lemon, Buttocks, Conclusion, Minority, Life, Bottle cap, Sea, Vitamin B, Children, Papaya, Belching, Hot temper

Note: Terms are translated into English where appropriate. Proper nouns (brand names, location names) are kept in Vietnamese, accompanied by explanations in brackets. Common names of plants are preferred over their scientific names, although not all plants have common names in English. Usernames are redacted to ensure anonymity. Terms that were originally written in a language other than Vietnamese are marked with “\*”.



**APPENDIX 2**

Summary statistics for the interpretation of a topic

Note: This statistic presentation is modeled after Maier et al (2018). The figure depicts a divided table and an inter-topic distance map, where the specific topic in summary is colored red. The table maps out the top-words according to two different relevance values ( $\lambda = 1$  and  $\lambda = .6$ ). Below the table, the ranks of the Rank-1 and the coherence metrics are given.

Topic 30 – Aging and loneliness

Top words	
$\lambda = 1$	$\lambda = 0.6$
Sesame	Belonging
Animal bones	Myself
Prescription	Sesame
Earth	Animal bones
Belonging	Chỉ Thống Hoàn (osteoarthritis medication)
Dr. Lê Minh	Cadmium
Myself	Diaphoretic
Cat	Drawing
Envelope	Blood
Viettel	Dr. Lê Minh
Shampoo	Viettel (a telecommunication company)
Chỉ Thống Hoàn (osteoarthritis medication)	Envelope
Diaphoretic	Shampoo
Kangaroo	Ramnoza
Lipstick	Kangaroo
Cadmium	Traditional medicine street
Drawing	Lipstick
Blood	Prescription
Viettel (a telecommunication company)	Earth
Ramnoza	Cat

Rank-1 metric: rank 37 out of 70

Coherence metric: rank 23 out of 70

Inter-topic distance map (via multidimensional scaling using 'LDAvis' package)

