

The Use of Health Behavioral Theories in HIV/AIDS Research: A Bibliometric Analysis (Gap Research)

Bach Xuan Tran^{1,2}, Huyen P. Do³, Brian Hall^{2,4}, Carl A. Latkin², Trong Q. Nguyen⁵, Cuong T. Nguyen⁶, Cyrus S.H. Ho⁷ and Roger C.M. Ho^{8,9,10}

¹Institute for Preventive Medicine and Public Health, Hanoi Medical University, Hanoi, Vietnam; ²Bloomberg School of Public Health, Johns Hopkins University, Baltimore, Maryland; ³Center of Excellence in Evidence-based Medicine, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam; ⁴Global and Community Mental Health Research Group, University of Macau, Macao (SAR), PR China; ⁵Department of Commercial Law, Hanoi Law University, Vietnam; ⁶Institute for Global Health Innovations, Duy Tan University, Da Nang, Vietnam; ⁷Department of Psychological Medicine, National University Hospital, Singapore; ⁸Center of Excellence in Behavioral Medicine, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam; ⁹Department of Psychological Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore; ¹⁰Institute for Health Innovation and Technology (iHealthtech), National University of Singapore, Singapore

Abstract

With emerging contextual factors and epidemiological transition of HIV/AIDS, the role and contributions of health behavior theories (HBT) are a compelling question after three decades of efforts to eradicate HIV. This study aims at exploring the global and historical evolution of literature and suggesting the most frequent research topics and research gaps in relation to the use of HBT in HIV/AIDS. A cross-sectional analysis of global HIV/AIDS bibliography was conducted through Web of Science (WoS) up to December 31, 2017. We utilized exploratory factor analysis to test the likelihood of research domains and landscape from the abstracts. A total of 29,997 papers in 153 HIV-related research areas were retrieved from the WoS database. This study suggests that HIV/AIDS research based on HBTs is increasing, and mainly focuses on elucidating traditional HIV driven factors and consonant with western perspectives most HBTs tend to be individually focused. Despite its important advancement, more research based on HBTs is essential to provide cultural background, social value, and contextualized factors where the HIV pandemic is dynamic; where new cases are transmitted from high-risk subgroups to the general population; and where epidemiological, social, and behavioral transitions change new infection routes, new perspectives for health service delivery especially non-medical services, and resource allocation. (AIDS Rev. 2019;21:93-107)

Corresponding author: Bach Xuan Tran, bach.ipmph@gmail.com

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Correspondence to:

Bach Xuan Tran
Institute for Preventive Medicine and Public Health
Hanoi Medical University
No 1 Ton That Tung Street, Hanoi, Vietnam
E-mail: bach.ipmph@gmail.com

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Introduction

After many decades of prevention and treatment efforts, HIV/AIDS remains a critical global health issue¹. It is estimated that there are approximately 40 million people living with HIV in 2017, with a total of 77 million HIV cases since 1981². With the goal of ending the AIDS pandemic by 2030, the United Nations targeted a reduction in 90% of new HIV positive cases and deaths related to HIV by 2030. During the past two decades, a large amount of financial support, human resources, and initiatives for networking have been built to achieve this goal, especially the stable coverage of antiretroviral therapy (ART). The global estimates of annual deaths due to AIDS-related diseases have significantly reduced by approximately 50%, from 1.9 million (2004) to 940,000 (2017), due in part to major treatment progress in sub-Saharan Africa, which contributes to 53% of the global HIV prevalence³. However, deaths related to HIV in Europe and Central Asia remain unchanged since 2010⁴, and worsened in the Middle East and North Africa, with an increased prevalence of 11% of people living with HIV/AIDS³.

The high prevalence of HIV/AIDS is mainly driven by high-risk behaviors (e.g., risky sexual behaviors, injection, and drug use) and the use of health behavior theories (HBT) in addressing HIV/AIDS can play an essential role in addressing the complex and multifaceted characteristics of HIV prevention and care interventions and clinical trials. There are many widely used theories to explain HIV-related behavior change that can be used to identify strategies to promote and predict a change in knowledge; perception; attitudes; and behaviors⁵. Using HBT plays a central role not only in behavior change approaches; methodology, study design, and outcome measurement from social and health sciences but also in understanding mediating pathways, barriers to change, and feasibility for scale-up.

Some theories focus on individual-level factors. The health belief model (HBM) focuses on psychological and behavioral processes with the belief that behavior changes to avoid disease will be motivated by improving awareness of the risk or severity of illness and identifying benefits or barriers to behavioral change⁶. A second theory, the Theory of Planned Behavior, is characterized by behavioral intention and a behavior change can be achieved by motivation and ability (an individual's actual control over the behavior)⁷. This theory has been widely applied to elucidate many

behavioral intentions (e.g., tobacco/alcohol/drug use, breastfeeding, and health services utilization). Another well-known theory to explain smoking behavior, developed by Prochaska, DiClemente, Velicer, and colleagues, is the transtheoretical model (TTM) or stages of change^{8,9}. This model is largely applied to addictions, and describes five stages (Precontemplation – no intention to change behavior, Contemplation – Intent to change in < 6 months, Preparation – Intent to stop in < 1 month, Action – Actively stopped and maintaining early behavior change, Maintenance, and termination). A person might experience multi-attempts in one stage before achieving a health behavior change outcome. However, the main weakness of the individual focused theories is the failure to address how the social determinants (e.g., income or socioeconomic status) and interpersonal factors can affect the progress towards achieving this outcome.

The socio-ecological model, developed by Bronfenbrenner,¹⁰ is a well-known model for understanding why some individuals or sub-population are at higher risk of ill health. The foundation of this model considers that health outcome is an interaction among multiple factors at multiple levels with the social ecology, from the individual, interpersonal, organizational level, community, and policy. The model is widely accepted because it captures the multi-faceted characteristics of health behaviors¹¹. This framework is suitable for making sense of health behaviors, correlates, and consequences but does not provide guidance on the optimal level for interventions. Social cognitive theory (SCT)¹², developed by Albert Bandura, emphasizes the social influence and external and internal social reinforcement. Behaviors are strongly influenced by the social environment. This theory also considers a person's past experiences that influence reinforcements, expectations, and expectancies of a specific behavior. SCT can be used to consider several levels of the socio-ecological model in addressing behavior change of individuals but does not address structural or cultural factors or social identities.

Although HBT is considered important for a better understanding of behavior change and how key factors interact across different populations and settings, each HBT has its strengths and drawbacks¹³. Within the HIV/AIDS research area, previous systematic reviews have investigated the application of HBT to advance knowledge of certain typical behaviors such as sexual behaviors related to hepatitis B or C virus¹⁴⁻³⁶, tuberculosis^{37,38}, ART, and vaccination^{25,39-43}. However, due to practical constraints, this type of study cannot

provide a comprehensive review of HBT applications at the global level but unable to capture the constructs or landscapes were used to develop health modeling in the HIV/AIDS research area. Further, because the previous systematic reviews are only able to reveal the use of HBT in a certain domain of HIV/AIDS, intervention in a specific setting and target population, they fail to reflect global contextual factors that significantly impact the spread of HIV/AIDS worldwide. In addition, there is a knowledge gap the utilization of HBT to gain insights the nature of the emerging high-risk behaviors and their associations with the burden of HIV/AIDS (e.g., amphetamine-type stimulants (ATS) abuse, online interaction in social media, and health service utilization), especially among large HIV populations. Studies that utilize HBT for HIV stigma and discrimination also remain modest.

This global bibliometric analysis examines the emerging role of HBT in researching HIV/AIDS worldwide in the context of a rapid change of HIV-drivers globally and locally. This review aims to (i) provide a description of the global trend of publications of HBT in efforts to eliminate HIV/AIDS and (ii) advance knowledge of HBT's contributions and its main constructs in studying HIV/AIDS globally. This study aims to contribute to this growing area of research by exploring the current knowledge gap of HBT as well as suggest the global trend in conducting future research and intervention related to the HIV/AIDS field.

Methods

Search strategy

The Web of Science (WoS) was purposefully selected to perform a cross-sectional search for a global HIV/AIDS bibliography analysis up to the December 31, 2017. The search terms were incorporated into keywords related to HIV (human-immunodeficiency-virus) and AIDS. Criteria for selecting the study subjects were as follows:

- Any publication that met the search terms
- Only research articles and reviews from peer-reviewed journals to obtain high quality of evidence. This approach excluded other types of publications (e.g., abstract conference, book chapters, or report).
- Research papers published in English, The WoS database only reports papers from English journals. Thus, non-English journals (e.g., local journals) were not analyzed in this study.

- Date of publication up to December 31, 2017, since the search was conducted in the middle of 2018.

Data extraction

All data of papers that met the key search were selected to download from the WoS. Informative data were general information (e.g., authors' names, publication's title, publication year, the journal title, and authors' affiliations), citation and usages (e.g., frequency of citation, the frequency of download, and citation reports), keywords, and abstract. The dataset package was downloaded and converted to the xlsx format (Microsoft Excel) for independent cross-checking by two independent researchers. The purpose of this cleaning approach is that it avoids data errors and improves the reliability of the dataset, especially the standardization of author's names with different journal format. The data extraction process was initially by screening step. All the downloaded records that did not meet the criteria regarding language or research type were removed from the list. Then, due to a large amount of data, abstract scanning was undertaken by four researchers to filter which publications did not actually relate to HIV/AIDS. The term "HIV/AIDS" that appeared in the background rather than research questions were also removed. The dataset was scanned by two independent research teams to ensure the data outcome matched. Two researchers worked separately to compare the frequency of the type of publication from a dataset with analytical reports from WoS and filter publications by the different groups of behavioral health theories (HBT). Any disagreement was addressed by discussion and the third senior research (Fig. 1).

Summary measures

This study measured the global evolution of publications related to HBTs and HIV/AIDS using these indicators: (i) publication speed (i.e., number of publication by years); (ii) level of readers' attention (i.e., frequency of citation, Mean cite rate per year); and (iii) level of readers' usage short-term and long-term (i.e. total usage past 6 months, total usage past 5 years, mean use rate past 6 months, and mean use rate past 5 years). In addition, global networking and collaboration were generated based on the coauthorship in HIV/AIDS research area from 58 countries. We also synthesized the main research clusters of HIV/AIDS using HBT by

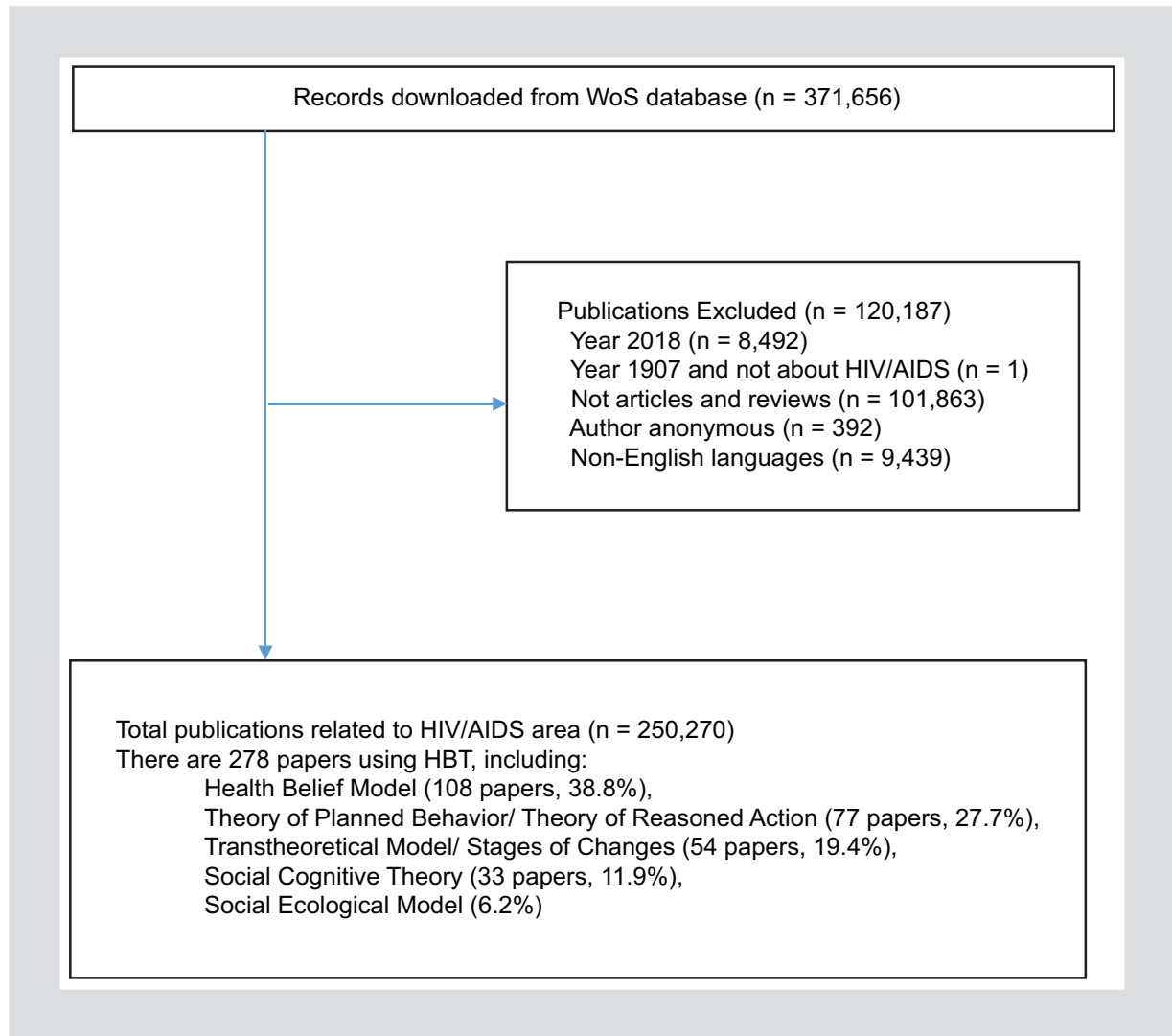


Figure 1. Selection of publications on HIV/AIDS and health behavior.

analyzing co-occurrence of most frequent authors' keywords. The likelihood of research domains and landscapes which were synthesized from abstract's content has shown the research trend of HIV/AIDS using HBTs in the future.

Data analysis

The general characteristics of search results and included publication were assisted by Macro, a coding program based on the Excel platform to calculate the indicators related to the global evolution of research papers. To generate the visual graphs of research networking and global collaboration based on shared coauthorship, VOSviewer software (Ver 1.6.8, Center for Science and Technology of Leiden University, <http://www.vosviewer.com/>) was applied to create a

co-occurrence network and international collaboration and clusters of topics concurrence. We generated a network figure to visualize the association among the 480 most frequent keywords co-occurrence with the cutoff of appearances from 30 times for each keyword. Then, the main topics of HBTs were analyzed from the frequency of keywords.

We used Jaccard's similarity index to identify research topics or most frequently co-occurring keywords. This index was calculated as the magnitude of the intersection divided by the magnitude of the union of two sets of co-occurring terms. The proximity values were created by computing on all analyzed keywords using multidimensional scaling. The map indicated a point for a topic category, and the distances between pairs of items show how probable those items link together. Colors illustrated the partnership of certain

items to different partitions created using hierarchical clustering.

To measure the likelihood of research trend (e.g., emerging research domains and landscapes), we utilized exploratory factor analysis (EFA) which allows us to test the variance of domains and landscape appearing from the abstracts' contents with loadings of 0.4. The statistical analyses (i.e., EFA) and Jaccard's similarity index were performed using STATA software version 15.0. An alpha level of 0.05 (two-tailed) was applied for all statistical tests in this study.

Results

Number of published items and publication trend

Figure 1 describes the paper selection process that identified 29,997 papers in 32 social sciences and related fields of 153 HIV related research areas. Among 250,270 journals publishing papers on HIV/AIDS, only 278 papers were based on HBT, accounting for 0.1% of total papers. The HBM was the most common HBT used for HIV/AIDS research, accounting for one-third of total number of publications, followed by Theory of planned behavior (27.7%), TTM (19.4%), SCT (11.9%), and social ecological model (6.2%).

Table 1 presents the growth in a number of studies applied HBT among HIV/AIDS populations by country. The top five countries produced 67 publications, accounting for approximately 80% of papers from 37 remaining countries (85 records). Most of the countries in top five categories are upper-middle-income countries (e.g., United States of America [USA], China, Mexico) while the HIV/AIDS pandemics are rapidly spreading in less developed countries, especially in sub-Saharan Africa and within South and South East Asia.

Table 2 displays in detail the growth of research and publications related to HIV/AIDS, which applied HBT. Over the last decade, the amount of this type of publications has increased 1.6 times compared to the number 10 years ago, responsible for 62% of total publications (n = 278). The growth of citations and usage rates has doubled since 2018. The figure indicates that total usage of publications related to HBT in the HIV/AIDS area in period 2008-2017 increased 3.4 times compared to the prior period (1991-2007). However, mean use rate in the past 5 years has decreased gradually since 2014.

Global coauthorship of included publications

Figure 2 shows the global interaction of 58 countries having coauthorships of selected publications related to HBT in HIV prevention. The size of nodes indicates the proportional contribution to the number of papers and the thickness of lines indicates the percentage of the number of collaborations. These countries have been classified into nine clusters depending on their level of international partnerships. The same color indicates the equivalent level of international coauthorship. The most obvious finding to emerge from the figure is that the USA and European nations remain the leading countries for HIV/AIDS prevention research. This figure shows the strong growth and moves toward North-South collaboration in doing HIV/AIDS research rather than South-South cooperation, where there is the highest concentration of HIV/AIDS.

Most frequent research topics among HBT in the HIV/AIDS area

Figure 3 displays the core components of keywords structure with most frequent groups of terms among HBT in HIV/AIDS area. There were four major clusters emerging from 480 most frequent keywords co-occurrence of 30 times and higher. Most of the keywords can be categorized into four major clusters, which indicates the topics of greatest concern in relation to using HBT in ending HIV/AIDS, as below:

- Cluster 1 (red) – “Prevention of HIV infection” which refers to a randomized control trial, diagnoses, testing, treatment, and prevention of the spread of HIV and sexually transmitted infections
 - Cluster 2 (yellow) – “Sexual risk behaviors” which reveal studies that focus on HIV transmission due to less safe sex (e.g., risky sex, condomless sex, and anal intercourse)
 - Cluster 3 (green) – “Targeted high-risk populations” which perform keywords in relation to vulnerable sub-populations of HIV/AIDS (e.g., Black men, LGBT, youth, and people with mental disorders)
 - Cluster 4 (blue) – “HIV treatment” that related to method or therapy for treating HIV (e.g., ART, medication adherence, medical care, and survival)
- The thickness of the lines shows the strong association between cluster 1 and three remaining clusters. In contrast, cluster two (risky sexual behavior) and four (HIV treatment) have fewer interactions.

Table 1. Selection of publications on HIV/AIDS and health behavior by country

No	Country settings	Frequency	Percentage	No	Country settings	Frequency	Percentage
1	United States	23	15.0	25	Zambia	2	1.3
2	South Africa	19	12.4	26	Australia	1	0.7
3	China	11	7.2	27	Belize	1	0.7
4	Kenya	8	5.2	28	Brazil	1	0.7
5	Mexico	6	3.9	29	Cambodia	1	0.7
6	Ghana	5	3.3	30	Cameroon	1	0.7
7	Hong Kong	5	3.3	31	Guinea	1	0.7
8	India	5	3.3	32	Guyana	1	0.7
9	Taiwan	5	3.3	33	Indonesia	1	0.7
10	Ethiopia	4	2.6	34	Jamaica	1	0.7
11	Tanzania	4	2.6	35	Lao	1	0.7
12	Thailand	4	2.6	36	Malaysia	1	0.7
13	Benin	3	2.0	37	Morocco	1	0.7
14	Iran	3	2.0	38	Myanmar	1	0.7
15	Malawi	3	2.0	39	Nepal	1	0.7
16	Niger	3	2.0	40	Portugal	1	0.7
17	Nigeria	3	2.0	41	Puerto Rico	1	0.7
18	Zimbabwe	3	2.0	42	Rwanda	1	0.7
19	Ireland	2	1.3	43	Saudi Arabia	1	0.7
20	Israel	2	1.3	44	Senegal	1	0.7
21	Netherlands	2	1.3	45	Spain	1	0.7
22	Uganda	2	1.3	46	Suriname	1	0.7
23	United Kingdom	2	1.3	47	Togo	1	0.7
24	Viet Nam	2	1.3				

Most established research domains and landscapes

Table 3 describes 50 research domains that are the most frequently present in HBT research involving HIV/AIDS. Results from exploratory factor analysis of all abstracts' contents reveal that what is striking in this table is the dominance of the utilization of HBT

on prevention and treatment for communicable diseases (e.g., cervical cancer, HPV, STIs, TB, HCV, and hepatitis) or medical services (e.g., screening, contraception, care, mental health, and breastfeeding). To date, very little attention has been paid to the role of HBTs in conducting programs or studies for non medical services (e.g., smoking and drug use).

Table 2. General characteristics of publications using HBT in HIV/AIDS research area

Year published	Total number of papers	Total citations	Mean cite rate per year	Total usage past 6 months	Total usage past 5 years	Mean use rate past 6 months	Mean use rate past 5 years
2017	20	39	1.95	53	120	2.65	1.20
2016	17	44	1.29	44	228	2.59	2.68
2015	17	83	1.63	12	194	0.71	2.28
2014	19	215	2.83	16	358	0.84	3.77
2013	16	99	1.24	4	270	0.25	3.38
2012	16	139	1.45	8	146	0.50	1.83
2011	10	99	1.41	3	86	0.30	1.72
2010	15	123	1.03	6	66	0.40	0.88
2009	26	640	2.74	6	240	0.23	1.85
2008	14	160	1.14	7	88	0.50	1.26
2007	8	157	1.78	4	63	0.50	1.58
2006	9	149	1.38	0	28	0.00	0.62
2005	9	159	1.36	2	46	0.22	1.02
2004	8	249	2.22	1	41	0.13	1.03
2003	6	283	3.14	1	45	0.17	1.50
2001	6	136	1.33	1	32	0.17	1.07
2000	9	217	1.34	1	61	0.11	1.36
1999	4	150	1.97	1	17	0.25	0.85
1998	6	127	1.06	6	39	1.00	1.30
1997	5	154	1.47	1	16	0.20	0.64
1996	9	229	1.16	1	30	0.11	0.67
1995	11	373	1.47	2	52	0.18	0.95
1994	3	102	1.42	1	8	0.33	0.53
1993	5	205	1.64	0	20	0.00	0.80
1992	5	278	2.14	1	26	0.20	1.04
1991	1	8	0.30	0	2	0.00	0.40

Figure 4 visualizes the topic of greatest concern when HBTs are applied in reducing HIV/AIDS worldwide. It refers to three landscape: behavior testing (green), care (blue), and undefined construct (other color bubbles). What can be clearly seen in this figure

is the continual growth of psychological, social, and family influences on testing behavior.

Figure 5 describes the most frequent terms co-occurring with the application of HBT in the content analysis of all abstracts. It shows the scope and main

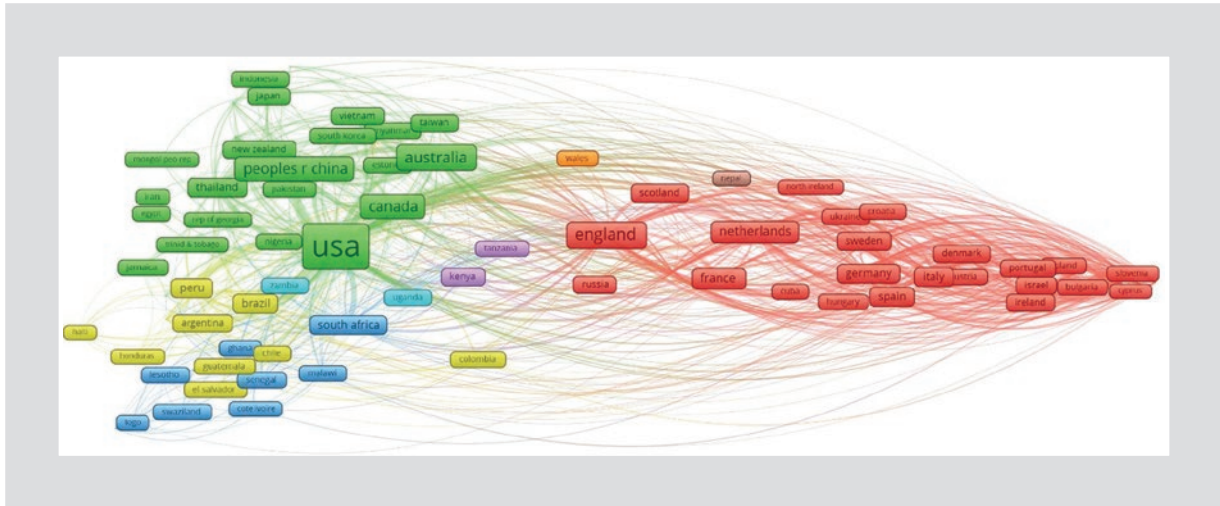


Figure 2. The global networking of 58 countries having coauthorships in health behavioral theories research in HIV/AIDS.

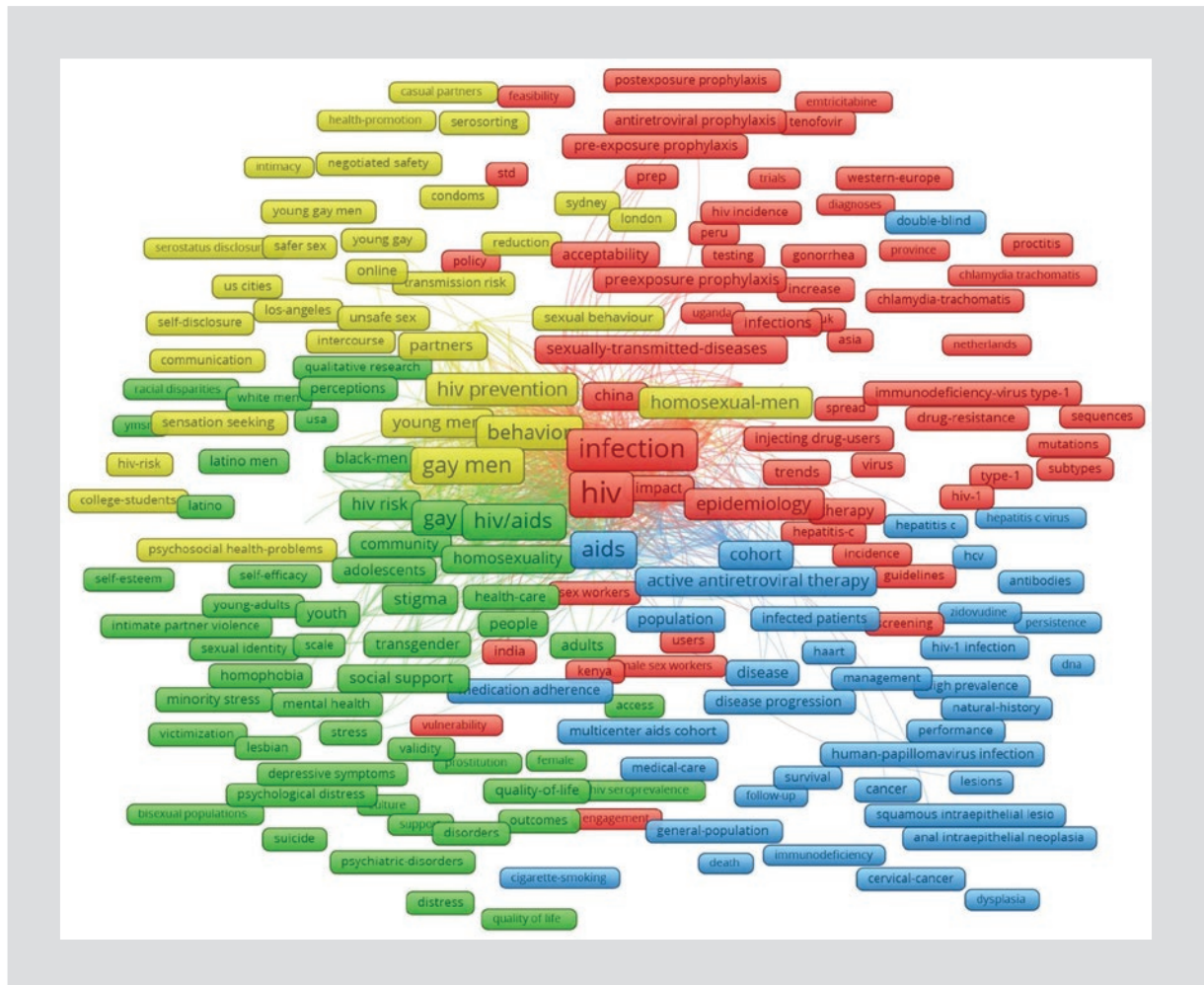


Figure 3. Co-occurrence of most frequent author's keywords. The colors of the nodes refer to principal components of the data structure; the size of the node was scaled to the keywords' occurrences; the thickness of the lines was drawn based on the strength of the association between two keywords.

Table 3. Top 50 research domains emerged from the exploratory factor analysis of all abstracts' contents

No	Name	Keywords (main item)	Eigen value	Frequency	Percentage of cases
1	Sexual risk	Sexual; risk; reduction; behaviors; designed; sex	1.76	454	74.5
2	Behavior; theory of planned	Behavior; planned; behavioral; intentions; TPB ; theory; recruited; norms	4.48	502	70.9
3	Perceived susceptibility; severity	Susceptibility; severity; barriers; perceived; benefits; belief; HBM	3.48	439	66.9
4	Social	Social; cognitive; reducing; theory	2.87	299	63.3
5	Reasoned action	Reasoned; action; TRA; theory	2.21	260	59.4
6	Intention; attitude	Intention; attitude; norm; subjective; planned; TPB; positively; intended; theory	2.03	361	57.6
7	Unprotected; anal	Unprotected; anal; MSM; sex; intercourse; men; China; partners; prevalence; partner	3.71	319	48.6
8	Trials; contraception	Trials; contraception; pregnancy; contraceptive; focused; outcomes; theories; primary; improving; randomized; provided; STIS; main; infections	4.62	228	43.2
9	Services; education	Services; education; perceptions; risks; access; perception; infected	1.85	168	38.5
10	Females; male	Females; males; male; female; condoms	2.84	168	34.2
11	Transtheoretical	Transtheoretical; stage; stages; change; readiness; maintenance; TTM; decisional; balance	3.95	247	31.7
12	Treatment; care	Treatment; care; nurses; adherence; infected	1.84	140	31.3
13	Cervical cancer; Screening	Cervical; cancer; screening; HPV; lack; women	3.24	117	30.2
14	Role; norms	Role; norms; examined; determinants	1.86	114	29.1
15	South Africa; key	Africa; South; key; context; psychosocial; youth	2.52	132	28.8
16	Heterosexual; men	Heterosexual; men; transmission	1.66	104	28.4
17	Qualitative interviews	Interviews; qualitative; structured; seeking; access; providers	2.45	127	27.7
18	Communities; attendance	Communities; attendance; community; disease; clinical	1.71	106	27.0
19	Sexually transmitted	Transmitted; sexually; diseases; STD; infections	2.88	162	27.0
20	Awareness	Awareness; analyses; lack	1.76	73	23.0
21	Development	Development; work; risky	1.73	66	21.9
22	Alcohol; drug	Alcohol; drug; AOD; substance; abuse; post; adults	2.26	97	21.9
23	SOC; acquiring	SOC; acquiring; training; provide; primary	2.05	74	20.9
24	Adolescent; adolescents	Adolescent; adolescents; school; instrument	1.92	82	20.9

(Continue)

Table 3. Top 50 research domains emerged from the exploratory factor analysis of all abstracts' contents (Continued)

No	Name	Keywords (main item)	Eigen value	Frequency	Percentage of cases
25	STIs	STIs infections; effective; seeking	2.28	87	20.9
26	Release; taking	Release; taking; relationships; experience; characteristics	2.16	76	19.4
27	VCT; participate	VCT; participate; counseling; testing	2.58	70	18.4
28	TB; mental	Tb; mental; selected; regular; intended	2.25	58	17.6
29	FSWS; female sex workers	FSWS; workers; clients; female; paying; acquiring	2.69	80	17.6
30	Text messages; trial	Text; messages; trial; SMS; attendance; randomized; informed	2.73	80	16.9
31	Potential; mental	Potential; mental; substance	1.62	57	16.9
32	Normative beliefs	Beliefs; normative	1.79	57	16.6
33	Exclusive breastfeeding; mothers	Breastfeeding; mothers; pregnant; children; exclusive; transmission	17.71	64	16.6
34	Implications	Implications; discussed	1.94	64	15.8
35	Behavior	Behaviors; behavior; abstinence	2.09	58	14.8
36	Circumcision; VMMC	Circumcision; VMMC; medical; uptake; acceptability; service	3.12	67	14.0
37	Consumers; materials	Consumers; materials; placement; public; tests	2.12	49	13.7
38	Vaccination; vaccine	Vaccination; vaccine; uptake; acceptance; acceptability	2.36	51	13.0
39	Stress	Stress; processes; greater	1.74	40	12.6
40	Exclusive; promoting	Exclusive; promoting; appropriate; breastfeeding; communities	2.08	46	12.6
41	Medication	Medication; adherence; SMS; compliance	1.65	42	11.9
42	Linkage to hypertension; countries	Hypertension; linkage; countries; factor	3.06	39	11.5
43	Evaluate; RCT	Evaluate; RCT; acceptance	1.68	34	10.4
44	Learners; rural	Learners; rural; contracting	1.99	30	9.4
45	Hepatitis; HCV	Hepatitis; HCV; compliance; states	2.4	35	9.4
46	Decisional balance	Balance; decisional; college	2.17	37	9.0
47	Heroin; Chinese	Heroin; Chinese; participated	2.24	24	7.6
48	Preventive	Preventive	1.77	19	6.8
49	Populations	Populations	1.69	17	6.1
50	Quality	Quality	1.67	9	3.2

TPB: theory of planned behavior; HBM: health belief model; TRA: theory of reasoned action; TPB: theory of planned behavior; STIs: sexually transmitted infections; VCT: voluntary counseling and testing; FSWS: female sex workers; TB: tuberculosis; BMMC: voluntary medical male circumcision; RCT: randomized controlled trials

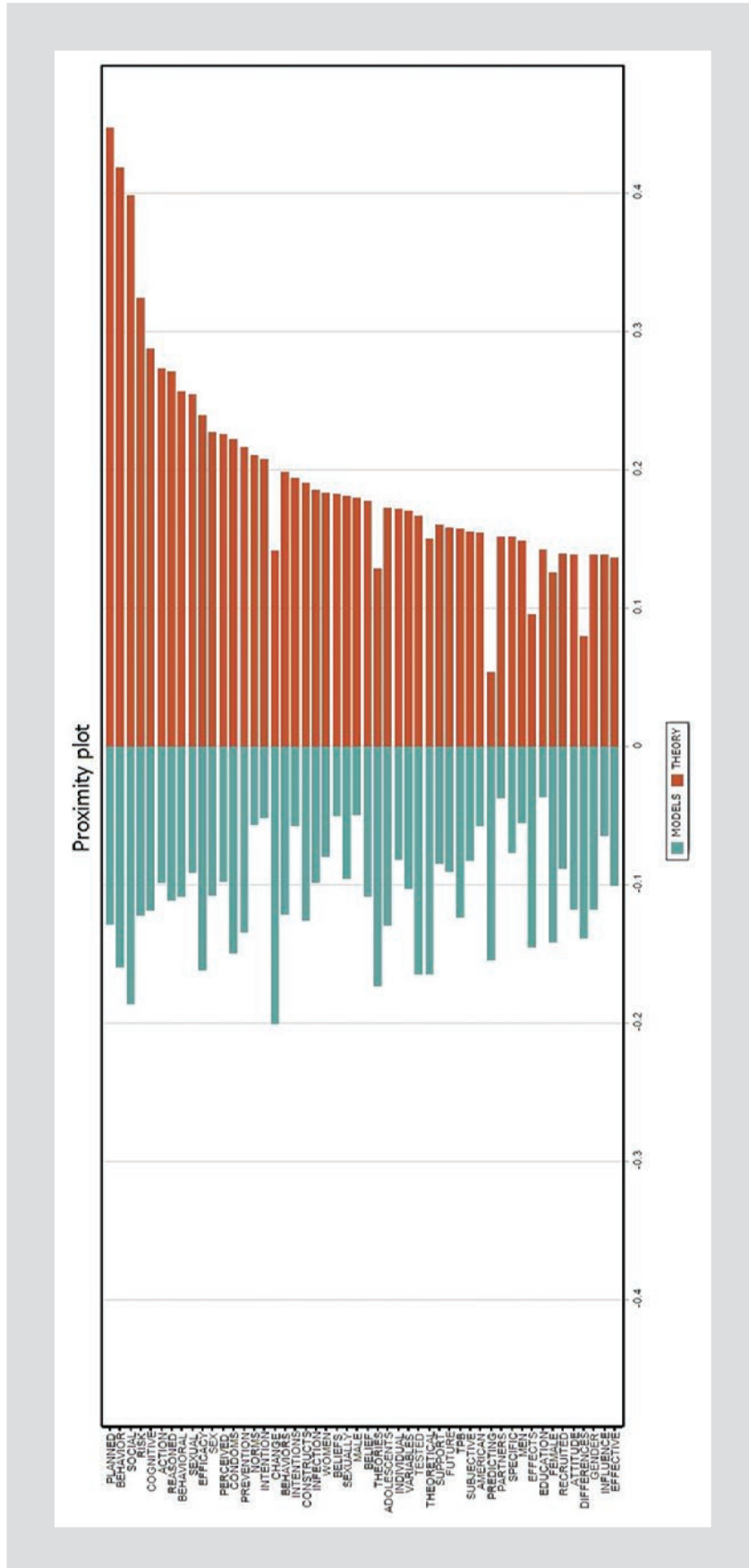


Figure 5. Proximity plots of “theory” and “model” term with the top 50 most frequent co-occurring terms in all abstracts. The X-axis refers to the Jaccard coefficient that measures the similarity between finite sample sets and defined as the size of the intersection divided by the size of the union of the sample sets.

based on research priorities, study settings, especially unmet needs of the growing HIV affected population to maintain global interest and attention.

The current study found the unequal distribution of a number of publications related to HIV/AIDS and HBTs by geography. This is important because ending HIV/AIDS pandemic must rely on interventions or programs based on behavioral characteristics of target populations. Most of the published studies have produced by North-South collaboration (e.g., USA, UK, China, Europe, and Mexico) while the outbreak and mortality rate of HIV/AIDS mainly occurs in low- and middle-income countries, especially countries in sub-Saharan Africa. Limit publications and modest research networks and collaborations from South-South collaboration also suggested the current gap in evidence-based practice, especially applying HBT in research, among nations where is struggling with reducing HIV/AIDS transmission driven by unsafe behaviors. For example, while the HIV/AIDS burden in Africa countries is driven by unsafe sex, the mortality rate of HIV/AIDS in Asian countries is determined by drug use⁴⁹. Thus, to develop a full picture of the HIV/AIDS pandemic additional health behavior studies based on theories are needed to in the specific regions with a high prevalence of HIV/AIDS through research capacity building and partnership of health behavior studies for local researchers.

The most obvious finding to emerge from the analysis is that HBTs have been applied mainly to prevent HIV from spreading through sexual transmission and HIV infection among high-risk populations and to improve survival rates with ART. The most common HBT in the HIV/AIDS field was the HBM, Theory of Planned Behavior, TTM, and SCT. These HBTs tend to focus on individual-level attributes with an emphasize on cognitions and motivations. This bias may be due to western researchers from counties that value individualism. This present study also suggests that the most frequent theoretical constructs of HBT in HIV/AIDS areas include the motivation of belief, attitudes, perception, intention, and then, an action for behavioral change. Results from analysis of keywords suggest that HBT primarily focused on advance knowledge and insights of unsafe behaviors, HIV infection, and treatment among high-risk populations. This result is consistent with the fact that most of the previous review regarding behavior models on HIV/AIDS focus on single domains of HIV spread, for instance, STI and sexual behaviors^{14-36,50}, drug use^{51,52}, medication adherence⁴⁰⁻⁴⁴, and vaccination^{43,53}. In contrast, the application of HBT on multiple-behaviors (e.g., substance abuse) has been mostly restricted to

limited understanding of nature and hidden cause of disease and exposure. It is noted that the spreading of HIV/AIDS is driven by multidisciplinary factors that are shared by society and community. The absence of contextualized factors (e.g., social norms, culture, belief, value, and religion) in the analysis of the keyword suggests that the future studies need to refine and adapt behavioral model by adding more contextualized factors. Structural factors were also infrequently mentioned and needed to be included in behavioral models. This is a crucial step to enhance validity and apply transferability, and scalability of models within certain contexts.

The evidence from analysis of abstracts content also suggests that the application of HBT has been limited in disease and mental services (e.g., family and contraception, STIs, and treatment). On the other hand, previously published studies are limited to applying HBT in non-medical services such as improving social supports and reducing stigma. This finding might be explained by the weakness and specific scope of HBTs. Literature shows that a critical problem in choosing HBT is the number of theories but the little consensus in operationalization and interpretation³⁸. Thus, to move forward in applying HBT in HIV/AIDS research area there is a need for theoretical integration (i.e., incorporate existing HBTs at multi-level approach rather than the creation of new theory) or comparison of HBTs to best understand non-medical service accessibility and health behavior change and respond to the complexity of contextualized factors. This perspective is supported by the previous reviews on the new directions of HBT in general^{13,28}. It is also useful to construct HBT in the direct and indirect landscapes or main determinants for the behaviors of interest. For instance, it is essential to understand the nature of sharing needles (medical service domain) among drug users by applying HBT to explain peer networks and social interactions (non-medical domain) as well as opportunities for HIV reduction interventions addressing sexual education⁵⁴. The other explanation might be due to the fact that the focus on pre-exposure prophylaxis and pharmaceutical prevention is a disincentive to theory development⁵⁵. Thus, future HIV/AIDS intervention efforts should be considered the importance of complex social dynamics and context and that multi-level theories are a better approach to unmask the interactions between individuals and networks and how they may promote better health outcomes in a specific setting and context.

Overall, this analysis attempts to advance knowledge on how the literature might provide a direction on how to best proceed to assist in global HIV control, at least

for the two major risk transmission behaviors of HIV/AIDS: (i) injection drug use and (ii) riskier sexual behavior (including condomless anal intercourse). The most recent recommendations from the Centers for Disease Control and Prevention with the talk-test-treat campaign in USA or Abstinence-Be faithful-Condom approach from Europe^{56,57} to reduce partner numeracy⁵⁸ and reduce new infections of STIs and HIV. To the best of our knowledge, through the literature related to HIV/AIDS research area, recent advances have examined how to best use HIV reduction interventions to enhance sexual education⁵⁴ and stepwise interventions for use among injection drug users⁵⁰. With the important role of HBT, future studies can apply and reconceptualize how integrated HBT can sufficiently contribute to design and/or implement affordable, cost-effective and sustainable health interventions and clinical trials that are targeting the two major risk transmission behaviors of HIV/AIDS to achieve the Millennium Development Goal 6, and the United Nations goal of ending the AIDS pandemic by 2030.

The strength of this paper includes an extensive bibliometric search of the global empirical literature and an analysis of both keywords and abstract content of all searchable papers. However, some limitations should be acknowledged. First, the search strategy was performed through electronic databases only (i.e., WoS that has only indexing publications from the year 1900 up to now). Thus, it might not cover all peer-reviewed publications, especially those published in the period 1981-1989, when HIV/AIDS was first discovered. Second, because gray literature (e.g., project reports and conference papers) are not indexed by the Institute for Scientific Information, this was excluded in the bibliometric analysis, so these findings cannot be extrapolated to all types of publication. Third, the restriction of English language key-searches might be a critical barrier in accessing non-English peer-reviewed papers, especially in non-English local journals in Africa and Asia⁵⁹. This discrepancy could be attributed to the small size of publications from non-western countries, which are also less likely to be visible and cited globally^{60,61}. However, higher quality studies are much more likely to be published in English⁶². Thus, language restriction might be more likely to provide robust findings, extracted from good quality studies. Finally, due to a large amount of publication at the global level, we were not able to retrieve the full texts and conduct a content analysis of all full-texts. However, the current analysis approach is considered a good proxy that reflects full-text contents. In future investigations, it might be possible to conduct a systematic review and meta-analysis

of how HBTs can contribute to the effect size of interventions or programs related to HIV/AIDS.

Conclusions

In this investigation, the aim was to assess the global evolution trend of publications and elucidate the HBT's contributions and their main research constructs through Global Bibliometric Analysis in HIV/AIDS research. The study findings suggest an important role for HBTs in promoting HIV/AIDS research and intervention especially in trending topics related to high-risk behaviors (i.e., unprotected sex and heroin use), medical services and prevention of communicable diseases accompanied with HIV rather than focusing on non-medical services and multiple high-risk behaviors. With the emerging contextualized factors and emerging epidemiological transition of HIV/AIDS pandemic, the insights gained from this study suggest the urgent need for the use of HBTs to reduce the morbidity and mortality rate of HIV/AIDS by multi-disciplinary programs and interventions in the future and how to build up research capacity and network among South-South collaboration to promote HIV/AIDS elimination.

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