

Characterizing the Development of Research Landscapes in Substance Use and HIV/AIDS During 1990 to 2021

Tham Thi Nguyen^{1,2}, Hien Thu Nguyen^{1,2}, Huyen Phuc Do³, Cyrus SH Ho⁴ and Roger CM Ho^{4,5}

¹Institute for Global Health Innovations, Duy Tan University, Da Nang, Vietnam. ²Faculty of Medicine, Duy Tan University, Da Nang, Vietnam. ³Institute of Health Economics and Technology, Hanoi, Vietnam. ⁴Department of Psychological Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore. ⁵Institute for Health Innovation and Technology (iHealthtech), National University of Singapore, Singapore.

Substance Abuse: Research and Treatment
Volume 17: 1–11
© The Author(s) 2023
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/11782218231177515



ABSTRACT: Mitigating the impacts of Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) and substance use requires comprehensive and systematic thinking in designing interventions and developing policies. This study describes the growth of research publications from 1991 to 2021 in the Web of Science database and points out current research landscapes in the fields of HIV/AIDS and substance use. Latent Dirichlet Allocation was used for classifying 21 359 papers into corresponding topics. The most common topics were HIV transmission, HIV infection, quality of life and mental health of substance users, and the biomedical effect of substance use. Emerging research landscapes include vulnerabilities of people who inject drugs to HIV transmission and related health problems. This study found a lack of research on health services, interdisciplinary and inter-sectoral in combination with clinical evaluation and treatment services. Future investment and implementation of HIV/AIDS and substance use programs should focus on research of health services and clinical evaluation, especially context-specific interventions.

KEYWORDS: Scientometrics, content analysis, text mining, HIV/AIDS, substance use

RECEIVED: December 20, 2022. **ACCEPTED:** May 7, 2023.

TYPE: Review

FUNDING: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by NUS Department of Psychological Medicine (R-177-000-100-001/R-177-000-003-001); and NUS iHealthtech Other Operating Expenses (R-722-000-004-731).

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CORRESPONDING AUTHOR: Tham Thi Nguyen, Institute for Global Health Innovations, Duy Tan University, 254 Nguyen Van Linh, Da Nang 550000, Vietnam. Email: nguyenthitham11@duytan.edu.vn

Introduction

Globally, HIV/AIDS has been recognized as one of the biggest health challenges, fueled by ineffective responses of health systems, social inequalities, and psycho-behavioral drivers such as substance use disorders.¹⁻⁵ Substance use, including drugs, alcohol, and tobacco, is not only a risk behavior for HIV infection but also diminishes patients' adherence and treatment outcomes.⁶⁻¹⁰ In large samples of people with substance use disorder, multiple substance uses increases the risk of developing chronic conditions and neurocognitive disorders.¹¹⁻¹⁸ Mitigating the impacts of HIV and substance use, therefore, requires comprehensive and systematic thinking in designing interventions and developing policies.

In recent years, there has been a significant shift in international aid and resource allocation for HIV programs globally.¹⁹⁻²³ International funding for HIV/AIDS has plateaued over the past decade,²⁴ which puts immense pressure on domestic governments, especially in low-middle income countries (LMICs), to finance their HIV response by domestic funding.²⁵ With limited resources, LMICs need to enhance the efficiency of programs and identify cost-effective interventions. Reviewing existing literature can clarify the effects of different interventions, summarize the evidence, and guide policy development to amplify the impacts of health systems.

Several systematic reviews and meta-analyses on HIV/AIDS, including various aspects of substance use among HIV patients, have been conducted.^{7,26-29} Given the benefits of systematic review, these research offered more reliable and accurate connections between alcohol use disorders and poor HIV treatment results⁷ or between HIV and the risk of acquiring diabetes and cardiovascular disease.²⁸ Nevertheless, one limitation of this method is that it focuses on a single topic, making comparisons with other research domains over time difficult. Some authors used the scientometric approach, in which the publication profile, such as the number of publications, citations, downloads, journal type, and co-authorship, was analyzed to understand the growth in research productivity and trends in HIV research in general.³⁰⁻³⁹ However, to the best of our knowledge, this approach has not been specifically applied to research on the relationship between HIV and substance use, so there are no specific implications for clinical research, health service improvement, or community interventions for HIV-positive individuals who use substances. It is critical to understand the larger research landscape surrounding drug use among HIV patients to research substance use treatments in HIV populations. This information is critical for creating treatments, enhancing healthcare delivery, and preventing HIV transmission in high-risk groups. Researchers may identify



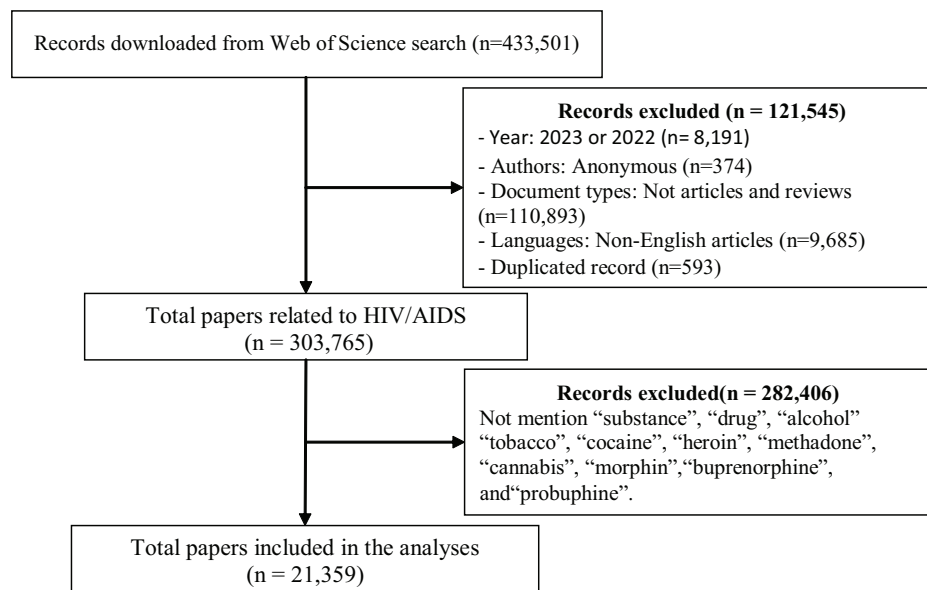


Figure 1. Selection of papers.

knowledge gaps, avoid repeating prior research, identify risk factors for drug use, and develop focused treatments to reduce substance use and prevent HIV transmission by being familiar with existing research. Moreover, substance use can complicate HIV therapy by decreasing medication adherence and leading to drug interactions and adverse effects, all of which contribute to poor health outcomes. Therefore, healthcare providers must have a comprehensive understanding of the research landscape to develop effective strategies for managing substance use and improving health outcomes in this population. Only one study by Baghaei Lakeh and Ghaffarzadegan⁴⁰ has attempted to define research domains by analyzing the content of studies. There is still a lack of evidence on the development and trends of the research landscape of substance use in HIV/AIDS use globally.

This study aimed to describe the growth of research publications and establish research landscapes of substance use in the field of HIV/AIDS. By combining scientometric and content analysis, we characterized interdisciplinary topics and interests of the research community to inform priority setting and policy development toward sustainable national and global efforts of controlling the dual epidemics of HIV and substance use.

Materials and Methods

Searching strategy

In order to analyze the empirical HIV/AIDS bibliography, we designed a literature analysis using the Web of Science (WoS) database. The search process included 3 steps:

Step 1: Terms consisting of “HIV,” “human-immunodeficiency-virus,” “AIDS,” and “Acquired-Immune-Deficiency-Syndrome” were used as the search query for keywords.

Step 2: Papers chosen were research articles and research reviews in English. Other documents (books, book chapters, or data papers) and in any other language were excluded. As the study was performed in the middle of 2022, the data produced in the first half of the year might not be able to adequately reflect the research patterns of the whole year. Therefore, publications produced after the year 2021 were not included in this study.

Step 3: After refining search results in terms of language, paper types, and year of publication, we downloaded the refined papers from WOS in txt. format. We imported the dataset into Stata 16.0 and used STATA syntax to extract the papers mentioning “substance,” “drug,” “alcohol” “tobacco,” “cocaine,” “heroin,” “methadone,” “cannabis,” “morphin,” “buprenorphine,” and “probuphine” in titles and abstracts.

Data extraction

General information, including authors’ names, the papers’ titles, the journals’ names, authors’ keywords, institutional affiliations, the frequency of citations, subject categories, and abstracts, was downloaded from the WoS database. In addition, we downloaded citation reports automatically generated by the database.

The number of papers in each stage of selection is presented in Figure 1. The downloaded papers in Step 3 were screened by 2 independent researchers to further exclude the studies not focusing on HIV and substance use. Two researchers were also responsible for the standardization process, in which different names of one author were brought together.

Table 1. Type of data, methods, and the results.

TYPE OF DATA	UNIT OF ANALYSIS	ANALYTICAL METHODS	PRESENTATIONS OF RESULTS
Keywords, Countries	Words	Frequency of co-occurrence	Map of keywords clusters
Abstracts	Papers	Latent Dirichlet Allocation	10 Classifications of research topics
WoS classification of research areas	WoS research areas	Frequency of co-occurrence	Dendrogram of research disciplines (WoS classification)

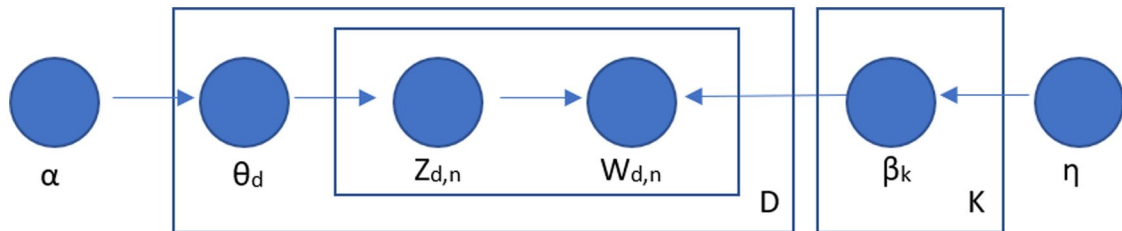


Figure 2. LDA's algorithm in topic modeling.

Where: K = number of topics; α = prior weight of topic k by document based on Dirichlet distributions, identifying θ ; η = Prior weight of word w by document based on Dirichlet distributions, identifying β ; θ_d = ratios of topics as per document; β_k = probability that word w is created by topic; $Z_{d,n}$ = topic of the n th word in document d , created from θ_d ; $W_{d,n}$ = n th word in document d , determined by $Z_{d,n}$.

Data analysis

Data were analyzed using basic publishing indicators (number of authors, year of publication, primary categories), keywords (most prevalent keywords and co-occurrence of keywords), citations, usages, and abstracts. The downloading and extraction operations were followed by descriptive statistical analysis, in which we utilized Stata to determine national citations and inter-country collaboration.

VOSviewer (version 1.6.11, Center for Science and Technology, Leiden University, the Netherlands) created a network graph depicting collaboration across companies sharing co-authorships as well as a co-occurrence network of authors' keywords. The dendrogram was used to depict the hierarchical grouping of the selected publications' key research disciplines.

Latent Dirichlet Allocation (LDA) is a topic modeling approach that identifies the representation of a subject of publications, with each topic defined by a distribution across words. We utilized LDA to categorize the papers into relevant areas.⁴¹⁻⁴⁵ The summary of analytical techniques for each data type is presented in Table 1.

Topic modeling was used in this work to find 10 latent themes from document titles and abstracts using the LDA approach. Latent Dirichlet allocation is a popular topic modeling approach for categorizing articles into comparable subjects. It considers publications to be "discrete distributions over latent topics," with each subject represented as a "discrete distribution over all terms."⁴¹⁻⁴⁵ In summary, topic modeling is performed using the text mining approach, which aids in the identification of subjects within an unstructured body of texts. It is an algorithm that allows a series of words with similar meanings to be grouped together to represent a single topic. LDA is a Bayesian probabilistic topic model and one of the

most widely used topic modeling algorithms. Previously, LDA has been defined as the most advanced or widely used method for topic modeling.⁴⁶ The LDA considers all pooled representations of K latent subjects, each of which is likewise represented by a collection of words.⁴⁶ It is expected that these words with a high likelihood in a comparable topic will often appear together, forming a cluster of words that may be used to deduce the underlying topic/theme.^{46,47} The LDA generative process is illustrated in Figure 2.⁴⁸

In our study, STATA's LDA command was employed.⁴⁹ STATA was used to break the abstracts and titles into individual words in the first stage. The words are then given to one of the n themes at random with equal probability. A new subject is assigned for words with a similar theme after the burn-in time (every 50 iterations). After LDA is completed, we export the file containing the assigned topics to Excel format.⁵⁰ We identified the themes by carefully reviewing the most referenced publications on each issue. As a result, the LDA technique aids in identifying current research trends and defining the growth of research landscapes in Substance Use and HIV/AIDS.

Results

Number of published items and publication trend

There has been a gradual increase in the number of studies on HIV and substance use during 1990 to 2021, contributing to a total of 20 645 papers. The number of published papers in the year 2015 has more than doubled since 2005. However, the mean citation rate per year was slightly lower in the past 5 years compared to the previous period. The mean use rate of the most recent 6 months was significantly higher within the past 5 years (Table 2).

Table 2. General characteristics of publications.

YEAR PUBLISHED	TOTAL NUMBER OF PAPERS	TOTAL CITATIONS	MEAN CITE RATE PER YEAR ¹	TOTAL USAGE ² LAST 6 MO	TOTAL USAGE LAST 5 Y	MEAN USE RATE LAST 6 MO ³	MEAN USE RATE LAST 5 Y ⁴
2021	1360	3655	2.69	1753	5205	1.29	0.77
2020	1342	9227	6.88	1013	5977	0.75	0.89
2019	1269	12932	5.10	886	7569	0.70	1.19
2018	1252	19538	5.20	1032	11261	0.82	1.80
2017	1256	22015	4.38	644	11299	0.51	1.80
2016	1000	24478	4.90	506	11933	0.51	2.39
2015	1089	27920	4.27	447	14312	0.41	2.63
2014	1017	29314	4.12	380	13032	0.37	2.56
2013	983	33593	4.27	313	14986	0.32	3.05
2012	874	27983	3.56	254	11010	0.29	2.52
2011	852	30145	3.54	207	8082	0.24	1.90
2010	794	34557	3.96	233	7741	0.29	1.95
2009	668	27387	3.42	145	5283	0.22	1.58
2008	676	30374	3.46	114	4959	0.17	1.47
2007	591	37963	4.59	134	5179	0.23	1.75
2006	611	42806	4.67	200	6355	0.33	2.08
2005	506	31107	3.84	158	4224	0.31	1.67
2004	423	23258	3.23	119	2823	0.28	1.33
2003	432	26350	3.39	77	2613	0.18	1.21
2002	366	20699	2.98	59	1850	0.16	1.01
2001	369	25336	3.43	58	2184	0.16	1.18
2000	346	23388	3.22	65	1969	0.19	1.14
1999	339	19318	2.59	45	1939	0.13	1.14
1998	375	18969	2.20	55	1461	0.15	0.78
1997	354	26230	3.09	98	2693	0.28	1.52
1996	342	15130	1.77	26	965	0.08	0.56
1995	311	17654	2.18	50	1229	0.16	0.79
1994	276	14944	2.01	24	688	0.09	0.50
1993	207	11626	2.01	24	652	0.12	0.63
1992	200	7051	1.22	8	404	0.04	0.43
1991	134	8958	2.23	10	243	0.07	0.36
1990	16	1051	2.12	1	30	0.06	0.38
1989	7	891	3.98	1	14	0.14	0.40
1988	6	282	1.42	0	5	0.00	0.17
1987	1	75	2.21	0	0	0.00	0.00
1986	1	35	1.00	0	0	0.00	0.00

¹Mean cite rate per year = total citations / (total citations × (2021 - that year)).²Total usages: total downloads.³Mean use rate last 6 months = total usage last 6 months / total number of papers.⁴Mean use rate last 5 years = total usage last 5 years / (total number of papers × 5).

Table 3. Number of papers by countries as study settings.

NO	COUNTRY SETTING	NUMBER OF PAPERS	PERCENTAGE (%)	NO	COUNTRY SETTING	NUMBER OF PAPERS	PERCENTAGE (%)
1	United States	9160	45.12	26	Switzerland	144	0.71
2	South Africa	898	4.42	27	Niger	131	0.65
3	China	821	4.04	28	Taiwan	108	0.53
4	India	696	3.43	29	Sweden	98	0.48
5	England	688	3.39	30	Peru	94	0.46
6	Canada	675	3.33	31	Scotland	93	0.46
7	Brazil	486	2.39	32	Malaysia	89	0.44
8	France	445	2.19	33	Zambia	83	0.41
9	Spain	357	1.76	34	Ukraine	79	0.39
10	Uganda	357	1.76	35	Turkey	69	0.34
11	Italy	342	1.68	36	Zimbabwe	67	0.33
12	Germany	263	1.30	37	Denmark	61	0.30
13	Japan	258	1.27	38	Portugal	61	0.30
14	Australia	230	1.13	39	Malawi	59	0.29
15	Thailand	220	1.08	40	South Korea	55	0.27
16	Mexico	202	1.00	41	Indonesia	55	0.27
17	Russia	189	0.93	42	Belgium	54	0.27
18	Ethiopia	185	0.91	43	Botswana	53	0.26
19	Wales	184	0.91	44	Egypt	52	0.26
20	Kenya	176	0.87	45	Pakistan	47	0.23
21	Georgia	173	0.85	46	Cambodia	45	0.22
22	Tanzania	172	0.85	47	Ireland	43	0.21
23	Iran	171	0.84	48	Israel	43	0.21
24	Netherlands	147	0.72	49	Poland	43	0.21
25	Vietnam	146	0.72	50	Lebanon	42	0.21

In Table 3, the locations of study settings mentioned in the abstracts of selected papers were examined. In total, there were 20300 times the bibliography included country settings, in which the number of studies set up in the United States of America accounted for 45.12%. Over 60% of the total was attributed to the top 10 countries. In Asia, the 2 countries with the highest proportions of involvement in study settings, China and India, contributed 4.04% and 3.43% respectively.

International collaborations

Figure 3 depicts the worldwide network of 302 organizations with at least 30 co-authorships with others out of 14380. The size of the nodes symbolizes each organization’s contribution to the overall number of publications, while the thickness of

the lines depicts the fraction of cooperation volume. These institutions were divided into 8 groups based on their level of collaboration. The top 5 institutions having the highest numbers of publications and citations include the University of California at San Francisco, Johns Hopkins University, the University of California at Los Angeles, Yale University, and Columbia University.

Keywords co-occurrence

We examined the keywords in the content of abstracts and titles to characterize the breadth of investigations and the co-occurrence of keywords. The co-occurrence of keywords with the most common categories of phrases is depicted in Figure 4. There were 16 clusters formed from the 286 most common

Table 4. Ten research topics classified by LDA.

TOPIC	RESEARCH TOPICS	N	%
Topic 1	Vulnerabilities of people who inject drugs to HIV transmission and related health problems	3207	17.88
Topic 2	Factors affecting HIV infection risks in substance users	1923	10.72
Topic 3	Quality of life and mental health among HIV-positive substance users	1892	10.55
Topic 4	Biomedical effect of substance uses on HIV/AIDS populations	1765	9.84
Topic 5	Interventions and policies for preventing non-communication diseases in HIV/AIDS populations	1710	9.53
Topic 6	Associations of risk factors and respiratory problems among HIV/AIDS patients	1637	9.12
Topic 7	Biomedical factors and clinical impact of substance use on HIV/AIDS and comorbidities	1619	9.02
Topic 8	Associated factors of liver disease coinfection among HIV/AIDS patients	1556	8.67
Topic 9	Burden and infection risks in immunocompromised patients	1523	8.49
Topic 10	Pharmacokinetic interactions of substance use and medications for the treatment of HIV/AIDS and comorbidities	1109	6.18

opioid-dependent therapies. Cluster 5 (cyan) presents the psychosocial factors that might be associated with HIV and substance use disorders.

Research domains

Using the LDA of abstract texts, we classified research themes into 10 primary groupings (Table 4). We then manually allocated labels to each topic after carefully reviewing the titles and abstracts of the most referenced publications in each category. We examined changes in research interests by grading these topics based on the total number of publications in the previous 5 years, as well as the total number and proportion of publications by each topic.

Topics with the highest volumes of publications include (1) Topic 1: Vulnerabilities of people who inject drugs to HIV transmission and related health problems, (2) Topic 2: Factors affecting HIV infection risks in substance users, and (3) Topic 3: Quality of life and mental health among HIV-positive substance users. In the last 5 years, the number of papers in Topic 1 and Topic 3 was higher than in other topics. This phenomenon showed that researchers have paid greater attention to 2 emerging research topics that focused on the vulnerabilities of people who inject drugs to HIV transmission and related health problems (Topic 1) and the quality of life and mental health among HIV-positive substance users (Topic 3). Meanwhile, the interest in Topics 8 and 10 decreased during the period from 2013 to 2017 (Figure 5).

Figure 6 depicts the hierarchical grouping of HIV/AIDS and drug use research fields. The dendrogram’s horizontal axis reflects the distance or dissimilarity between clusters, while the vertical axis represents the research fields. The research landscapes in HIV/AIDS and drug use may be viewed to be founded in the following disciplines: (a) Biotechnology and applied microbiology and (b) Genetics and heredity, then involved (c) Medicine, Research, and experiments as the first

cluster in the bottom of the dendrogram. At the top, we found the integration of (a) Public, Environment, and Occupation, (b) Biomedical Social Sciences, (c) Health policy and services, (d) Multidisciplinary psychology, and (e) Respiratory System. Although health services for substance users with HIV/AIDS are increasingly important, this integration is far from other groups in the dendrogram. Substance use and Psychiatry are close and connected with various clinical and biomedical research disciplines. Interestingly, substance use is still rather distant from Social Work and Family Studies, indicating the lack of community- and family-based interventions on substance use among HIV populations.

Discussion

In this study, we systematically synthesized a large volume of literature and analyzed the development of research landscapes in HIV/AIDS and substance use during 1990 to 2021. By quantifying the profile of the publications, we found a gradual increase in the research outputs of these topics over the period, albeit the number of citations and downloads has been stable in recent years. The advancement in the content analysis of papers’ abstracts and titles provided us with insights into interdisciplinary research topics and landscapes. The most critical and prolific topic appeared to be the investigation of increased risk of HIV transmission attributed to and/or induced by substance use. While the understanding of vulnerabilities of substance users with HIV/AIDS has been expanded in the past decades, the interest of researchers has been largely focused on the assessment of biomedical, clinical, pathological, and pharmacokinetic interactions of substance use concerning HIV/AIDS and comorbidities treatment outcomes in recent years.

We confirmed the recognition of substance use as one of the major drivers of the spread of HIV epidemics and barriers to HIV/AIDS care and treatment in various settings as previously found by other researchers in both empirical and review studies.⁵¹⁻⁵⁴ By applying a scientometric approach, the findings

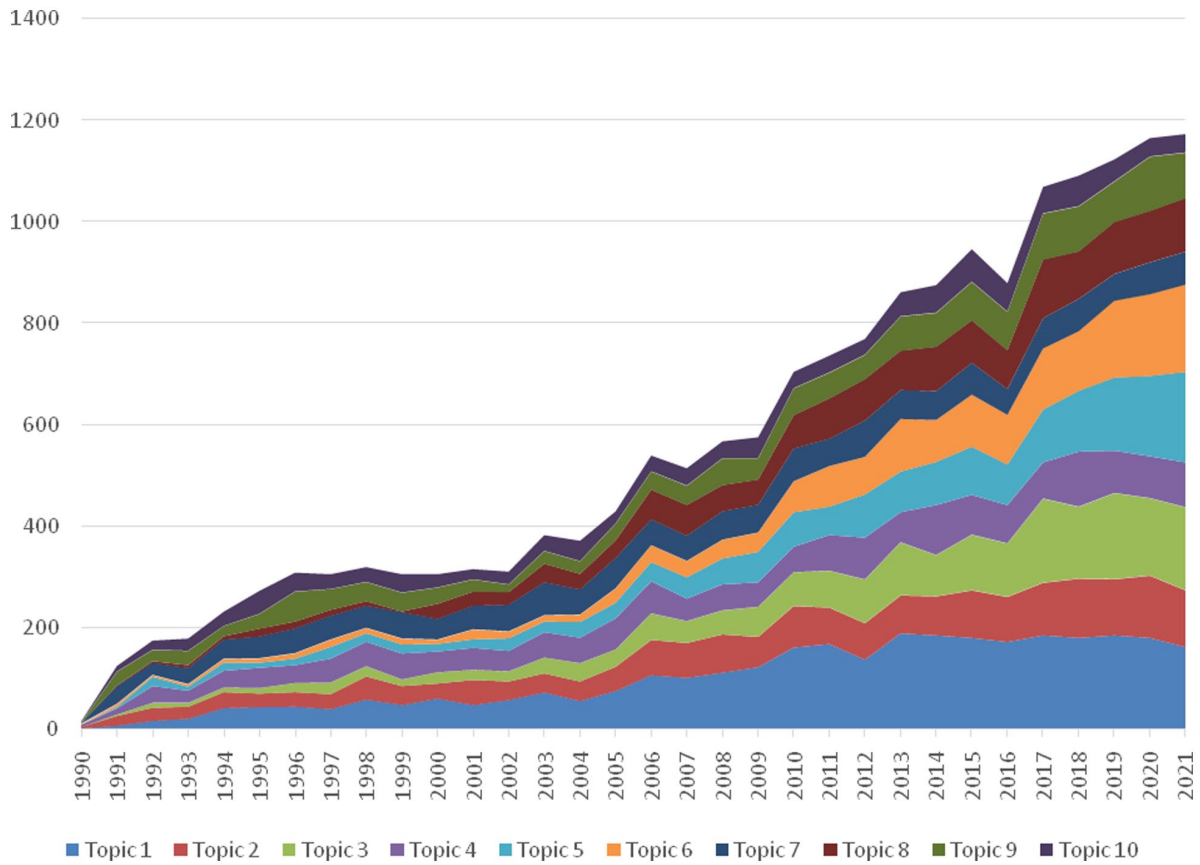


Figure 5. Changes in research topics development in HIV/AIDS and substance use.

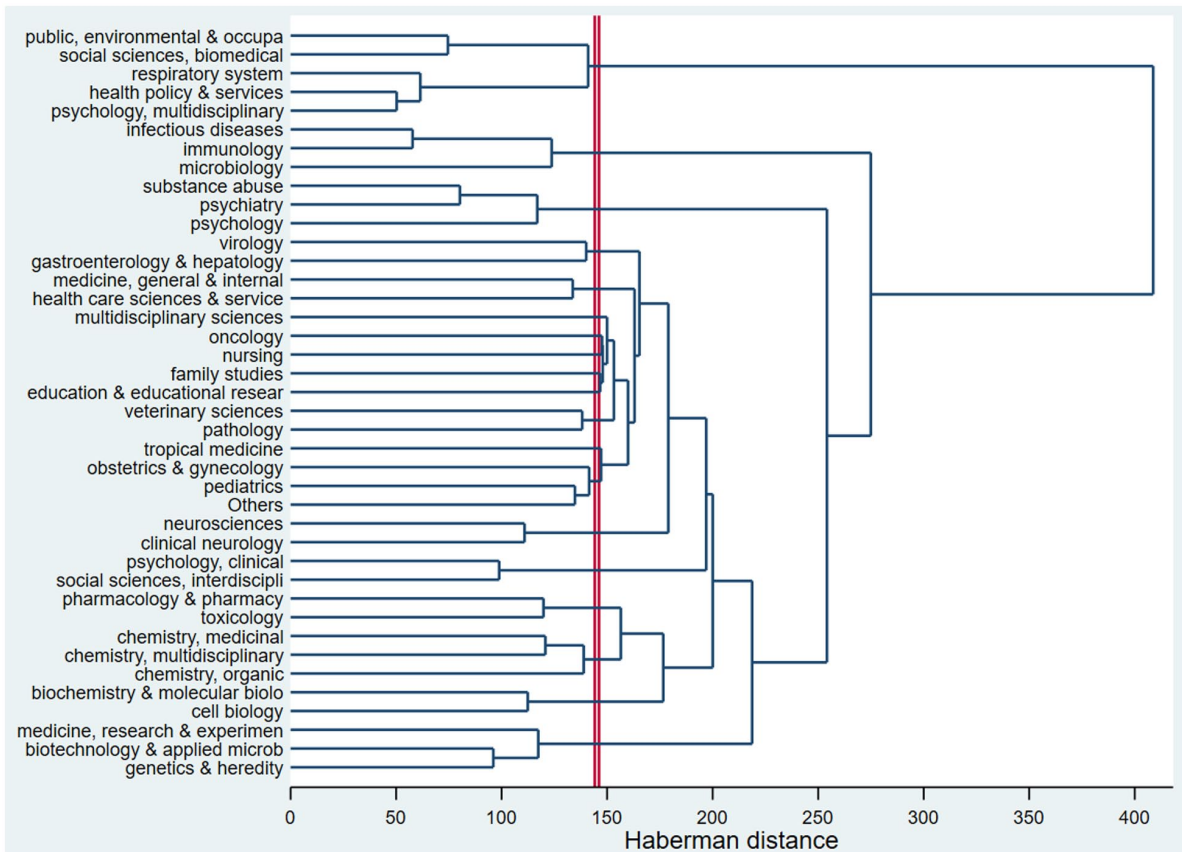


Figure 6. Dendrogram of coincidence of research areas using the WoS classifications.

of this study showed that this research interest has remained significant in recent years. In addition, the analysis of the papers' contents has shown emerging research landscapes, including the clinical and biomedical impact of substance use on patients with HIV/AIDS and its interactions with treatment regimens. Over the past 4 decades, while understanding of the vulnerabilities of patients suffering from both HIV/AIDS and substance use has been well-established, there is still strong interest in finding effective interventions for substance use among HIV populations. This might be attributable to the fact that contextual and social factors of the settings have yet received adequate consideration, especially in low- and middle-income countries with limited resources.⁵⁰⁻⁵² Moreover, given the sociocultural and contextual nature of problematic substance use, its related causes and consequences rapidly change over time and thus require constant surveillance and control measures. Importantly, we have characterized research disciplines applied to HIV/AIDS and substance use and realized that important fields like health services have not been strongly linked with clinical and biomedical research (Figure 5). Likewise, social work and family studies seemed to focus only on the late stages of the HIV/AIDS disease progression and comorbidities treatment. In fact, family members play a critical role in providing the vast majority of caregiving to people living with HIV. Moreover, the family is often negatively impacted by members' substance use. This study has also highlighted the accelerated development of chronic conditions among substance users with HIV/AIDS.^{16,28,55,56} In the lifelong treatment of HIV/AIDS, universal access to antiretroviral therapy has substantially improved the life expectancy of HIV populations. Nonetheless, it is essential for affected countries to respond effectively to a rapidly increasing demand for long-term care. For many years, in developing countries that were receiving enormous international financial support, HIV programs have not yet been consolidated with existing service delivery systems. Thus, integration of HIV/AIDS with chronic care has remained challenging and required not only leadership and management but also capacity building and effective mechanisms and approaches.⁵⁷

The study's findings might help forecast future research trends by emphasizing areas that require more inquiry. These patterns can be used by researchers to inform their study or therapeutic practices. A researcher interested in exploring the association between drug use and mental health in persons living with HIV, for example, may find it beneficial to explore the literature in Topic 3 to discover knowledge gaps or unanswered research issues. Recognizing current trends in HIV and substance use research will assist researchers in identifying key topics for future study and improving the quality of care for persons living with HIV and substance use disorders. Based on the findings, researchers and funding agencies can prioritize research on high-volume topics such as people who inject drugs 'vulnerability to HIV transmission and related health problems, factors influencing HIV infection risks in substance

users, and quality of life and mental health among HIV-positive substance users. These themes have shown to be extremely important and relevant to the profession. Furthermore, the decline in interest in issues such as coinfection with liver disease and pharmacokinetic interactions of drug use and pharmaceuticals for the treatment of HIV/AIDS and comorbidities may indicate that these areas deserve additional attention and investigation. These findings can also be used to influence future research, particularly in terms of enhancing the quality of life and mental health of HIV-positive substance users.

Overall, scholars, policymakers, and agencies may use these patterns to inform their research and practice. For example, researchers might utilize these data to identify gaps in existing research and generate research topics to fill such gaps. Policymakers and organizations can utilize these data to influence their programs and strategies for controlling drug use among HIV-positive persons. Furthermore, policymakers may utilize these data to determine funding priorities and design policies to promote effective substance-use therapies in HIV-infected populations. Furthermore, the report emphasizes the importance of continuing financing for HIV initiatives and research, particularly in locations where interest has declined. By continuing to fund research in these areas, it may be feasible to discover novel approaches to prevent and cure HIV, improve health outcomes for HIV-positive people who use drugs and minimize HIV transmission in vulnerable groups.

This study provides an overview of interdisciplinary research landscapes of HIV/AIDS and substance use over the long history of international efforts to control these global health issues. While traditional profiling and synthesizing approaches, such as systematic review and meta-analysis, are valuable in summarizing and quantifying specially defined health topics, they are unable to provide a rapid illustration of an overarching theme with many inter- and trans-disciplines. On the other hand, scientometrics on its own only shows the productivity, collaborations, and interests in research domains, and is unable to provide insights on themes and research approaches. In this study, we applied a new approach, which is the combination of scientometrics and content analysis, to fully explore the capacity of data and information from the literature. This research is part of a broader initiative called Global Analysis for Policy in Research (GAP_{RESEARCH}), which seeks to establish priorities in global health research and give evidence for the development of successful treatments.⁵⁸⁻⁶¹ As a result, the findings of this study may be utilized to direct investments, allocate resources, formulate policies, and devise interventions. Moreover, the findings also suggest future collaborations to concentrate more on countries and settings with a high burden. Globally, the multiple transitions in dual epidemics of HIV and substance use require innovative and synergetic responses. This includes the re-structure and re-organization of services and interventions toward comprehensive and long-term care for HIV- and substance use-related health issues. Strengthening health systems and capacity building, particularly in developing

countries, will remain critical components of international and national policies. In addition, we advocate for multidisciplinary methods, notably the integration of health services in the delivery of medical treatment and psycho-socio-behavioral therapies at the individual, family, health institution, and community levels.

Analyzing the literature, however, was largely dependent on the availability and accessibility of databases. Similar to previous analyses, the shortcoming of this study was that the Web of Sciences was the only database used. Despite the substantial number of journals in the field of HIV and substance use indexed to the Web of Science database, we acknowledge that it might not be fully representative of all databases. Hence, there is a chance that our study did not cover all relevant publications as well as certain disciplines, countries, and areas of focus may not be included in this study. Secondly, the language of selected publications was restricted to only English. Thirdly, our study included review papers in a bibliometric analysis, hence this could lead to the skew in the frequency of the metrics in this study as well as prioritized interventions suggested from the findings. Finally, the content analysis included only abstracts instead of full texts. Nonetheless, we improved the validity of this analysis by quantifying different layers of information, for instance, abstract texts, keywords, classifications of research disciplines, and the profile of papers, and by applying an advanced analytic technique, the LDA.⁴⁰

Conclusion

In conclusion, we illustrate the development, and current global trends as well as highlight research gaps in landscapes of substance use in the field of HIV/AIDS. Overall, research on HIV/AIDS and substance use has remained of high interest at both national and global levels. The development of research landscapes in these fields emphasizes the importance of interdisciplinary and inter-sectoral approaches in both evaluation and intervention. Furthermore, despite a rather comprehensive coverage of topics relating to substance use in the field of HIV/AIDS, there has evidently been a lack of studies focusing on community-family-based interventions as well as the link between health services with clinical and biomedical research. Future investment and implementation of HIV/AIDS and substance use programs should focus on research of health services and clinical evaluation, especially context-specific interventions.

Author Contributions

Conceptualization: TTN, and RCMH; Data curation: TTN, HTN and CSHH; Formal analysis: TTN, HTN, RCMH; Methodology: TTN, HTN and CSHH; Interpretation of data: TTN, HTN, CSHH, and RCMH; Writing—original draft: TTN, HTN and RCMH; Writing—review and editing: TTN, HTN, RCMH and CSHH. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

The datasets used and analyzed during the current study are available from the corresponding author on a reasonable request.

REFERENCES

- Murray CJ, Ortblad KF, Guinovart C, et al. Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2014; 384:1005–1070.
- Bazzi AR, Drainoni ML, Biancarelli DL, et al. Systematic review of HIV treatment adherence research among people who inject drugs in the United States and Canada: evidence to inform pre-exposure prophylaxis (PrEP) adherence interventions. *BMC Public Health*. 2019;19:31.
- Pham QD, Wilson DP, Law MG, Kelleher AD, Zhang L. Global burden of transmitted HIV drug resistance and HIV-exposure categories: a systematic review and meta-analysis. *AIDS*. 2014;28:2751–2762.
- Yu D, Sutherland D, Ghidinelli M, Jordan M. HIV drug resistance assessment in the Western Pacific region. A systematic review. *AIDS Rev*. 2011;13: 214–226.
- Mathers BM, Degenhardt L, Phillips B, et al. Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. *Lancet*. 2008;372:1733–1745.
- Tran BX, Nguyen LT, Do CD, Nguyen QL, Maher RM. Associations between alcohol use disorders and adherence to antiretroviral treatment and quality of life amongst people living with HIV/AIDS. *BMC Public Health*. 2014;14:27.
- Azar MM, Springer SA, Meyer JP, Altice FL. A systematic review of the impact of alcohol use disorders on HIV treatment outcomes, adherence to antiretroviral therapy and health care utilization. *Drug Alcohol Depend*. 2010; 112:178–193.
- Cioe PA, Gamarel KE, Pantalone DW, Monti PM, Mayer KH, Kahler CW. Cigarette smoking and antiretroviral therapy (ART) adherence in a sample of heavy drinking HIV-Infected men who have sex with men (MSM). *AIDS Behav*. 2017;21:1956–1963.
- Bonn-Miller MO, Oser ML, Bucossi MM, Trafton JA. Cannabis use and HIV antiretroviral therapy adherence and HIV-related symptoms. *J Behav Med*. 2014; 37:1–10.
- De Boni RB, Peratikos MB, Shepherd BE, et al. Is substance use associated with HIV cascade outcomes in Latin America? *PLoS One*. 2018;13:e0194228.
- Rao SG, Galaviz KI, Gay HC, et al. Factors associated with excess myocardial infarction risk in HIV-Infected adults: A systematic review and meta-analysis. *J Acquir Immune Defic Syndr*. 2019;81:224–230.
- Franzetti M, Ricci E, Bonfanti P. The pattern of non-AIDS-defining cancers in the HIV population: epidemiology, risk factors and prognosis. A review. *Curr HIV Res*. 2019;17:1–12.
- Scott W, Arkuter C, Kioskli K, et al. Psychosocial factors associated with persistent pain in people with HIV: a systematic review with meta-analysis. *Pain*. 2018;159:2461–2476.
- Rose A, Isenalmumbe L, Van den Bergh M, Sokol L. Clonal T-cell large granular lymphocytic disorders manifesting in patients with HIV-1 infection: case series and review of the literature. *Mediterr J Hematol Infect Dis*. 2018;10:e2018036.
- Park J, Zuñiga JA. Chronic kidney disease in persons living with HIV: a systematic review. *J Assoc Nurses AIDS Care*. 2018;29:655–666.
- Ekrikpo UE, Kengne AP, Bello AK, et al. Chronic kidney disease in the global adult HIV-infected population: a systematic review and meta-analysis. *PLoS One*. 2018;13:e0195443.
- Bari O, Vazirnia A, Cohen PR, Romero LS. Genitogluteal porokeratosis in an HIV-positive man: a case report and review of the literature on genital porokeratosis. *Dermatol Online J*. 2018;24:13030/qt0sg0z14s.
- Brandt C, Zvolensky MJ, Woods SP, Gonzalez A, Safren SA, O'Cleirigh CM. Anxiety symptoms and disorders among adults living with HIV and AIDS: a critical review and integrative synthesis of the empirical literature. *Clin Psychol Rev*. 2017;51:164–184.
- Kelly SL, Martin-Hughes R, Stuart RM, et al. The global Optima HIV allocative efficiency model: targeting resources in efforts to end AIDS. *Lancet HIV*. 2018; 5:e190–e198.
- Autenrieth CS, Beck EJ, Stelzel D, Mallouris C, Mahy M, Ghys P. Global and regional trends of people living with HIV aged 50 and over: estimates and projections for 2000–2020. *PLoS One*. 2018;13:e0207005.
- Clinton C, Sridhar D. Who pays for cooperation in global health? A comparative analysis of WHO, the World Bank, the Global Fund to fight HIV/AIDS,

- Tuberculosis and Malaria, and Gavi, the Vaccine Alliance. *Lancet*. 2017;390:324-332.
22. Schneider MT, Birger M, Haakenstad A, et al. Tracking development assistance for HIV/AIDS: the international response to a global epidemic. *AIDS*. 2016;30:1475-1479.
 23. Mookherji S, Ski S, Huntington D. Tracking Global Fund HIV/AIDS resources used for sexual and reproductive health service integration: case study from Ethiopia. *Global Health*. 2015;11:21.
 24. UNAIDS. Resources and financing; 2017. Accessed November 08, 2019. <https://www.unaids.org/en/topic/resources>
 25. Haakenstad A, Moses MW, Tao T, et al. Potential for additional government spending on HIV/AIDS in 137 low-income and middle-income countries: an economic modelling study. *Lancet HIV*. 2019;6:e382-e395.
 26. Lall P, Lim SH, Khairuddin N, Kamarulzaman A. Review: an urgent need for research on factors impacting adherence to and retention in care among HIV-positive youth and adolescents from key populations. *J Int AIDS Soc*. 2015;18:19393.
 27. Emamzadeh-Fard S, Fard SE, SeyedAlinaghi S, Paydari K. Adherence to anti-retroviral therapy and its determinants in HIV/AIDS patients: a review. *Infect Disord Drug Targets*. 2012;12:346-356.
 28. Young F, Critchley JA, Johnstone LK, Unwin NC. A review of co-morbidity between infectious and chronic disease in Sub Saharan Africa: TB and diabetes mellitus, HIV and metabolic syndrome, and the impact of globalization. *Global Health*. 2009;5:9.
 29. Uldall KK, Palmer NB, Whetten K, Mellins C; HIV/AIDS Treatment Adherence, Health Outcomes and Cost Study Group. Adherence in people living with HIV/AIDS, mental illness, and chemical dependency: a review of the literature. *AIDS Care*. 2004;16 Suppl 1:S71-S96.
 30. Sweileh WM. Global research output on HIV/AIDS-related medication adherence from 1980 to 2017. *BMC Health Serv Res*. 2018;18:765.
 31. Ronit A, Ahlström MG. Publication trends during the HIV pandemic: contributions by country. *AIDS*. 2017;31:1646-1647.
 32. Rios-González CM. Evaluation of the scientific production on HIV in indigenous people, from 1989 to 2016. *Travel Med Infect Dis*. 2017;18:83-84.
 33. Mugomeri E, Bekele BS, Mafaesa M, Maibwise C, Tarirai C, Aiyuk SE. A 30-year bibliometric analysis of research coverage on HIV and AIDS in Lesotho. *Health Res Policy Syst*. 2017;15:21.
 34. Moura LKB, Mobin M, Matos FTC, et al. Bibliometric analysis on the risks of oral cancer for people living with HIV/AIDS. *Iran J Public Health*. 2017;46:1583-1585.
 35. Gao J, Fu H, Lin L, Nehl EJ, Wong FY, Zheng P. Newspaper coverage of HIV/AIDS in China from 2000 to 2010. *AIDS Care*. 2013;25:1174-1178.
 36. Rosas SR, Kagan JM, Schouten JT, Slack PA, Trochim WM. Evaluating research and impact: a bibliometric analysis of research by the NIH/NIAID HIV/AIDS clinical trials networks. *PLoS One*. 2011;6:e17428.
 37. Chin LJ, Rifai-Bashjawish H, Kleinert K, Saltman A, Leu CS, Klitzman R. HIV/AIDS research conducted in the developing world and sponsored by the developed world: reporting of research ethics committee review in two countries. *J Empir Res Hum Res Ethics*. 2011;6:83-91.
 38. Uthman OA. HIV/AIDS in Nigeria: a bibliometric analysis. *BMC Infect Dis*. 2008;8:19.
 39. Huber JT, Schoonover WK, Kashka M. HIV/AIDS and nutrition: a bibliometric analysis. *Med Ref Serv Q*. 2000;19:29-37.
 40. Baghaei Lakeh A, Ghaffarzagdegan N. Global Trends and regional variations in studies of HIV/AIDS. *Sci Rep*. 2017;7:4170.
 41. Valle D, Albuquerque P, Zhao Q, Barberan A, Fletcher RJ. Extending the latent Dirichlet allocation model to presence/absence data: a case study on North American breeding birds and biogeographical shifts expected from climate change. *Glob Chang Biol*. 2018;24:5560-5572.
 42. Chen C, Zare A, Trinh HN, Omotara GO, Cobb JT, Lagaunne TA. Partial membership latent Dirichlet allocation for soft image segmentation. *IEEE Trans Image Process*. 2017;26:5590-5602.
 43. Lu HM, Wei CP, Hsiao FY. Modeling healthcare data using multiple-channel latent Dirichlet allocation. *J Biomed Inform*. 2016;60:210-223.
 44. Gross A, Murthy D. Modeling virtual organizations with Latent Dirichlet allocation: a case for natural language processing. *Neural Netw Off J Int Neural Netw Soc*. 2014;58:38-49.
 45. Li Y, Rapkin B, Atkinson TM, Schofield E, Bochner BH. Leveraging latent Dirichlet allocation in processing free-text personal goals among patients undergoing bladder cancer surgery. *Qual Life Res*. 2019;28:1441-1455.
 46. Amussen CB, Møller C. Smart literature review: a practical topic modelling approach to exploratory literature review. *J Big Data*. 2019;6:93.
 47. DiMaggio P, Nag M, Blei D. Exploiting affinities between topic modeling and the sociological perspective on culture: Application to newspaper coverage of U.S. Government arts funding. *Poetics*. 2013;41:570-606.
 48. Kang HJ, Kim C, Kang K. Analysis of the trends in biochemical research using latent Dirichlet allocation (LDA). *Processes*. 2019;7:379.
 49. Schwarz C. Ldagibbs: a command for topic modeling in stata using latent Dirichlet allocation. *The Stata Journal*. 2018;18:101-117.
 50. Blei D, Ng A, Jordan M. Latent dirichlet allocation. *Adv Neural Inf Process Syst*. 2001;14.
 51. Meyer JP, Springer SA, Altice FL. Substance abuse, violence, and HIV in women: a literature review of the syndemic. *J Womens Health*. 2011;20:991-1006.
 52. Berry MS, Johnson MW. Does being drunk or high cause HIV sexual risk behavior? A systematic review of drug administration studies. *Pharmacol Biochem Behav*. 2018;164:125-138.
 53. Ruger JP, Lazar CM. Economic evaluation of drug abuse treatment and HIV prevention programs in pregnant women: a systematic review. *Addict Behav*. 2012;37:1-10.
 54. Pearshouse R. Global: review of injecting drug use and HIV prevalence among users. *HIV AIDS Policy Law Rev*. 2008;13:24-25.
 55. Bigna JJ, Kenne AM, Asangbeh SL, Sibetcheu AT. Prevalence of chronic obstructive pulmonary disease in the global population with HIV: a systematic review and meta-analysis. *Lancet Glob Health*. 2018;6:e193-e202.
 56. Klein SK, Slim EJ, de Kruif MD, et al. Is chronic HIV infection associated with venous thrombotic disease? A systematic review. *Neth J Med*. 2005;63:129-136.
 57. Watt N, Sigfrid L, Legido-Quigley H, et al. Health systems facilitators and barriers to the integration of HIV and chronic disease services: a systematic review. *Health Policy Plan*. 2017;32:iv13-iv26.
 58. Tran B, Vu G, Ha G, et al. Global evolution of research in artificial intelligence in health and medicine: a bibliometric study. *J Clin Med*. 2019;8:360.
 59. Tran BX, Moir M, Latkin CA, et al. Global research mapping of substance use disorder and treatment 1971-2017: implications for priority setting. *Subst Abuse Treat Prev Policy*. 2019;14:21.
 60. Tran BX, Ho RCM, Ho CSH, et al. Depression among patients with HIV/AIDS: Research Development and effective interventions (GAPRESEARCH). *Int J Environ Res Public Health*. 2019;16:1772.
 61. Tran B, Dang K, Le H, et al. Global evolution of obesity research in children and youths: setting priorities for interventions and policies. *Obes Facts*. 2019;12:137-149.