Global Mapping of Interventions to Improve the Quality of Life of People Living with HIV/AIDS: Implications for Priority Settings

Bach X. Tran[1,2]*, Giang T. Vu[3], Giang H. Ha[4,5], Hai T. Phan[4,6], Carl A. Latkin[2], Cyrus S.H.-Ho[7], and Roger C.M.-Ho[8,9,10]

[1]*Institute for Preventive Medicine and Public Health, Hanoi Medical University, Hanoi, Vietnam;* [2]*Bloomberg School of Public Health, Johns Hopkins University, Baltimore, USA;* [3]*Center of Excellence in Evidence-based Medicine, Nguyen Tat Thanh University, Ho Chi Minh City;* [4]*Institute for Global Health Innovations;* [5]*Faculty of Pharmacy, Duy Tan University, and* [6]*Faculty of Medicine, Duy Tan University. Da Nang, Vietnam;* [7]*Department of Psychological Medicine;* [8]*Department of Psychological Medicine, Yong Loo Lin School of Medicine, and* [9]*Institute for Health Innovation and Technology (iHealthtech), National University of Singapore. Singapore, Singapore;* [10]*Center of Excellence in Behavioral Medicine, Nguyen Tat Thanh University, Ho Chi Minh City, Vietnam*

Abstract

Enhancing the quality of life (QOL) of people living with HIV and AIDS (PLWHA) has become a significant global health goal, as combination antiretroviral therapy has helped to transform HIV/AIDS from a fatal illness to chronic disease. In this study, we aim to comprehensively describe the growth of research publications and the development of research landscapes regarding interventions to improve QOL among PLWH, as well as to characterize interdisciplinary topics and emerging interests of the research community. English articles and reviews published from 1991 to 2018 concerning interventions to improve QOL among PLWHA were retrieved from the Web of Science. Collaboration among organizations sharing coauthorships and co-occurrence network of authors' keywords was illustrated through network graphs. Latent Dirichlet Allocation was used for classifying papers into corresponding topics. A total of 2304 publications were included in the study. The USA continues to lead in research productivity, followed by South Africa, China, and India. Emerging research themes were found to be the application of multilevel interventions and long-term care, rehabilitation, along with topics relating to mental health issues, behavioral therapy and social supports for patients receiving treatments, and application of e-health approaches in designing and implementing interventions. There has been, however, a modest appearance of topics covering local, cultural, and environmental contexts of interventions. The findings of the study suggest expanding the coverage of psychosocial, behavioral, and contextualized interventions, increasing the involvement of family and community, improving the effectiveness of technology-based and e-health interventions, and developing strategies for lifelong treatment of HIV/AIDS. (AIDS Rev. 2020;22:91-102)
Corresponding author: Bach Xuan Tran, bach.ipmph@gmail.com

Key words

Scientometrics. Content analysis. Text mining. Interventions. HIV/AIDS. Quality of life.

Correspondence to:
*Bach X. Tran
Institute for Preventive Medicine and Public Health
Hanoi Medical University
Hanoi, Vietnam
E-mail: bach.ipmph@gmail.com

Introduction

The introduction and scale-up of combination antiretroviral therapy (ART) have fundamentally changed the nature of HIV/AIDS, from a fatal illness to chronic disease[1]. HIV-positive patients having access to ART have significantly increased life expectancy[2,3], to the level comparable to other chronic diseases[4] and approaching that of uninfected population, especially in cases where timely treatment initiation and optimal care are achieved[5,6]. In addition, previously common causes of death among people living with HIV (PLWH) such as AIDS-related opportunistic illnesses and tuberculosis have been found to be replaced, though on varying extent depending on specific cohort or population studied, by non-AIDS infections and other chronic conditions including cancers, cardiovascular, and liver diseases[7-10]. The burden of disease on PLWHA thus would be extended to chronic, age-related morbidities that suffered by the uninfected general population. Nonetheless, it should be noted that HIV-related health issues resulted from incomplete immune system restoration or abnormal immune function, for example, inflammation, have yet to be eliminated by ART, while side effects of prolonged, toxic HIV-associated medications would continue to cause adverse impacts on the health of PLWHA[1]. Besides, PLWHA have been known to also endure the psychological health problems, most notably depression[11], either caused by (1) the disease itself when the virus affects the brain of the infected and/or due to the effects of related opportunistic infections and (2) the stress resulted from social stigma or other social consequences of living with HIV such as loss of jobs, having difficulties in accessing health services[12].

As PLWHA having to suffer numerous health issues associated with a complex combination of physical, mental, and social factors for an extended period of time, the assessment of their quality of life (QOL), among other health outcomes, has become important[13]. QOL has been defined as it reflects the complex interaction of physical health, psychological state, personal beliefs, social relationships, and salient features of the environment[14]. Evaluation of QOL would not only add to the mapping of a comprehensive picture regarding the burden of disease endured by PLWH but also assist the assessment of treatment efficacy and cost-effectiveness[13]. Furthermore, the variability in QOL measured overtime on the same population, or among different sub-populations among PLWHA – for instance, women, adolescent, and people who inject drugs, would merit the development of targeted interventions and the enhancement of resources allocation, which would, in turn, potentially increase the effectiveness and success of HIV/AIDS management[15,16].

The current literature suggests that the determinants of QOL in PLWHA comprise a range of factors, including their physical well-being, the effects of ART of their health, their mental condition, the comorbidities they suffer, the level of social support they received, and the methods of coping they adopt[16]. As such, any intervention that aims to impact any of the physical, psychological, and mental aspects of the well-being of PLWHA would likely have some effect on their QOL. A number of studies have indicated an association between that ART enrolment and better QOL among PLWH, due to the enhancement of both physical and mental health of patients following ART initiation[17-20]. Meanwhile, interventions that target psychological issues of PLWH, for instance, those aimed at reducing stress, eliminating the presence of maladaptive coping styles, creating life meaningfulness, and treating depression among PLWH, have been found also to improve QOL of those treated[21-23]. In addition, a range of interventions targeting social aspects of HIV/AIDS management, from an increasing level of social support to limit the impacts of social stigma, has been proved to be positively associated with enhancing QOL[23-25].

Despite having a wealth of evidence on the potential and proved QOL enhancement effect of the interventions targeting PLWH, the current picture on interventions improving QOL of PLWHA has so far been fragmented and not comprehensive. Existing studies, though offered insights into specific issues, have only been able to cover one or some topics within the field of QOL in PLWH, without the ability to provide a comparison between topics and overtime. This would result in a lack of understanding of the coverage and development of the research landscape of interventions to improve the QOL among PLWH, overtime, across the research domain, and on a global scale. In this study, we combine the bibliometrics approach and context analysis techniques to comprehensively describe the growth of research publications and development of research landscapes regarding interventions to improve the QOL among PLWH, as well as characterize interdisciplinary topics and emerging interests of research community, in hope to assist priority setting and more targeted, effective policy development.
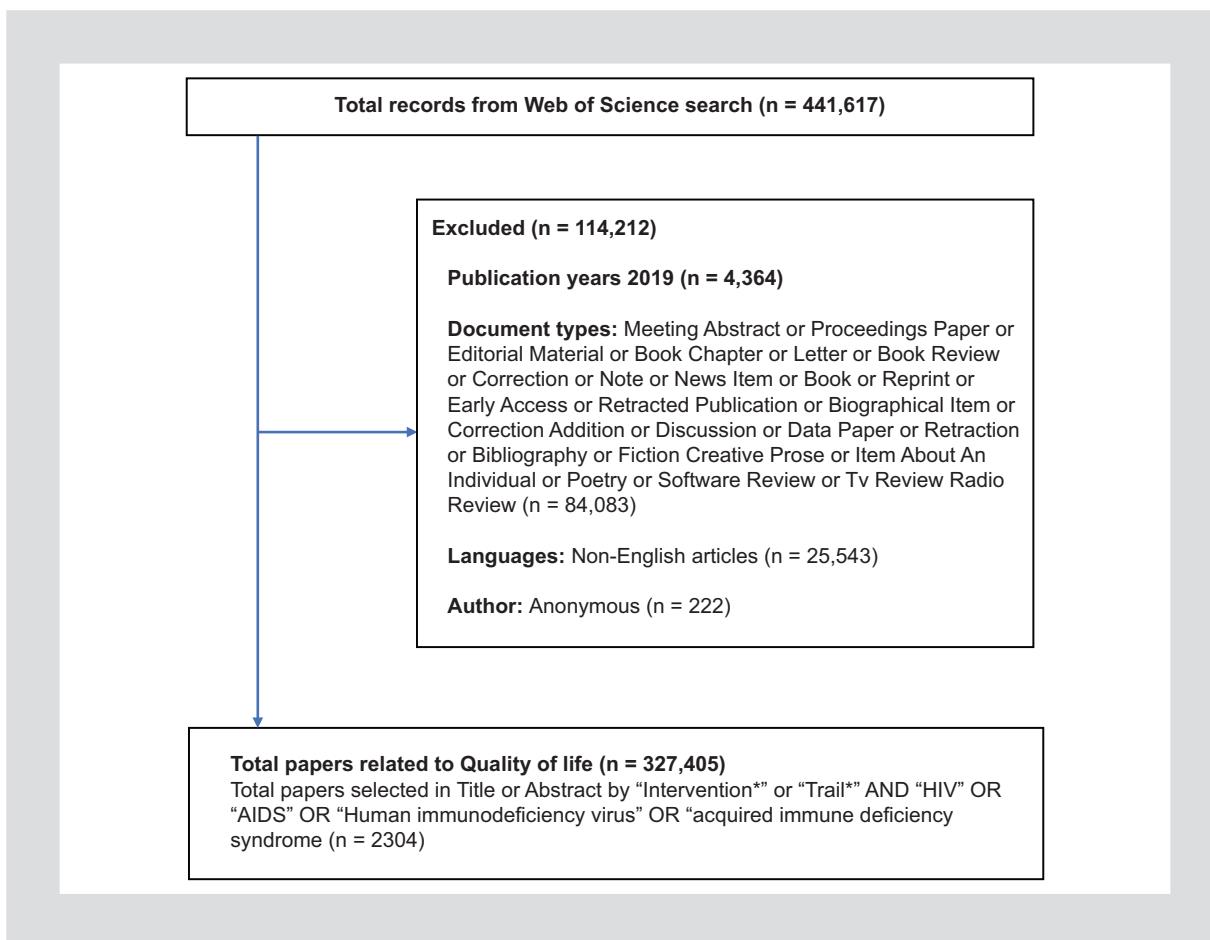
Figure 1. *Selection of papers.*

Materials and methods

Study design

The previous researchers have conducted several systematic reviews and meta-analyses in the field of intervention to improve the QOL for people living with HIV/AIDS (PLWHA)[26-28]. These studies provided insights into a defined research question by synthesizing evidence from the previous studies. The limitation of this approach is that it is highly focused on a single topic and unable to draw up an overview or comparison of multiple research domains overtime. Other authors applied the scientometric approach, in which the profile of publications, namely, the number of publications, citations, downloads, type of journals, and co-authorship, were analyzed to understand the growth in research productivity and trends in research topics[29,30]. However, these bibliometric analyses lacked important implications for clinical research, health service improvement, and community interventions. Thus,

we applied our proposed approach, which is the combination of scientometrics and content analysis, to fully explore the capacity of data and information from the literature.

Database and search strategy

The published scientific papers related to the intervention to improve QOL among PLWHA were retrieved from the Web of Science (WOS). We use the WOS for this kind of analysis because of its advantages: (1) downloading necessary information of a large number of papers, (2) provide deep coverage in science, social science (from 1900 to present), and (3) accept high-impact scientific journals[31,32].

The set of keywords related to "HIV/AIDS," "Quality of life," and "Intervention" was prepared by two experts in research fields. Moreover, we based on Medical Subject Headings (MeSH) (https://www.ncbi.nlm.nih.gov/mesh) and reviewed some systematic and meta-analysis research to build up our keywords[33,34].

Table 1. Summary of techniques employed for data analysis

Type of data	Unit of analysis	Analytical methods	Presentations of results
Keywords, countries	Words	Frequency of co-occurrence	1. Map of keywords clusters
Abstracts	Papers	Latent Dirichlet Allocation	2. Ten classifications of research topics
WoS classification of research areas	WoS research areas	Frequency of co-occurrence	3. Dendrogram of research disciplines (WoS classification)

The search strategy was described as follows (Fig. 1):

– Step 1: We combined the following terms to download scientific research mentioning QOL in title, abstract, keywords, and topic: "quality of life" and "well-being."

– Step 2: Among papers in the first step, we used the term with HIV/ADIS or similar in titles and abstracts to filter the paper related to QOL among HIV-positive patients.

– Step 3: The publication in Step 2 was narrowed down by applied the term "Intervention" in titles and abstracts.

Data extraction and analysis

The data were downloaded separately by two researchers. Any disagreements were solved by discussing them with a senior researcher. Only papers published from the end of 2018 backward were included since we conducted our search in June 2019 and would only have data of half of 2019, which may not reflect the research trend of the whole year. Papers which were (1) not article and review, (2) not in English, and (3) with anonymous author information were excluded from the downloaded data. The final dataset was transferred to a data file to be further analyzed using STATA version 14.0 (STATACorp, Texas, USA) (Fig. 1).

Based on the profile of a paper, including the title, publication year, author keywords, the number of citations, subject areas, and abstracts, we described some fundamental characteristics of publications, which consisted of years of publication, the number of papers per country/per year, total citations up to 2018, mean citation rate per year, total usage in the past 6 months/5 years, and mean use rate the past 6 months/5 years. A number of papers by country were also calculated. A network graph showing the collaboration among organizations sharing coauthorships and a co-occurrence network of authors' keywords was established by VOSviewer (version 1.6.8, Center for Science and Technology, Leiden University, the Netherlands). Latent Dirichlet Allocation was used for classifying papers into corresponding topics[35-39]. The summary of analytical techniques for each data type is presented in table 1.

Results

Table 2 reveals some basic characteristics of selected publications. A total of 2304 papers were included in the research. There has been a gradual increase in the number of studies on the intervention to improve the QOL of PLWHA during 1991-2018. Notably, the total citations and the number of downloads in the past 5 years in 2013 were highest compared with that of other years. Meanwhile, the mean use rate in the past 6 months was significantly higher for papers published in 2018, which may indicate a recent spike of interest in readers on the topic.

Table 3 shows the number of papers by the locations of study settings as mentioned in the abstracts. In total, there were 977 times the bibliography included country settings; of those, the number of studies that were set up in the United States of America accounted for 16.7%. Nearly one-third of the study (28%) was conducted in developed countries (the U.S, Canada, the UK, Australia, and Ireland). Among the top 10, there were also some developing nations with a high prevalence of HIV/AIDS, such as South Africa (8.8%), China (7.4%), India (5.0%), and Uganda (4.3%)[40-43].

Fig. 2 provides an illustration of clusters of authors' keywords by frequency of co-occurrence (denoted by color). The input into VOSviewer (the software used for this illustration) was keywords that cooccur at least 20 times. The 175 such keywords formed six major clusters. The three major clusters are as follows: cluster 1 (red) refers to the QOL of PLWHA, mainly focus on the QOL with regard to psychosocial, behavioral,

Table 2. General characteristics of publications

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
2018	186	119	1	791	1049	4.3	1.1
2017	207	745	1.8	281	1373	1.4	1.3
2016	191	1296	2.3	225	1976	1.2	2.1
2015	181	2096	2.9	170	2318	0.9	2.6
2014	184	3450	3.8	134	2260	0.7	2.5
2013	181	3670	3.4	119	3102	0.7	3.4
2012	139	2900	3.0	95	1966	0.7	2.8
2011	128	3486	3.4	87	1443	0.7	2.3
2010	109	4158	4.2	68	1177	0.6	2.2
2009	90	2887	3.2	44	834	0.5	1.9
2008	81	2624	2.9	46	821	0.6	2.0
2007	83	3461	3.5	37	823	0.4	2.0
2006	72	3071	3.3	31	581	0.4	1.6
2005	81	4126	3.6	33	555	0.4	1.4
2004	45	2067	3.1	17	287	0.4	1.3
2003	49	2358	3.0	21	363	0.4	1.5
2002	48	2898	3.6	9	251	0.2	1.0
2001	34	1746	2.9	9	225	0.3	1.3
2000	34	1596	2.5	9	150	0.3	0.9
1999	42	2350	2.8	9	211	0.2	1.0
1998	26	1186	2.2	7	123	0.3	0.9
1997	18	372	0.9	1	45	0.1	0.5
1996	33	1230	1.6	4	84	0.1	0.5
1995	21	453	0.9	2	70	0.1	0.7
1994	18	1103	2.5	0	54	0.0	0.6
1993	14	432	1.2	2	19	0.1	0.3
1992	6	320	2.0	0	3	0.0	0.1
1991	3	513	6.1	0	11	0.0	0.7

and familial factors; cluster 2 (yellow) focuses on the treatment of HIV/AIDS, its progress, and its side effects; and cluster 3 (green) points out clinical trials for the management of HIV/AIDS and related chronic diseases. Cluster 4 (blue) shows the monitoring of HIV/AIDS treatment outcomes. Cluster 5 (purple) illustrates interventions on the rehabilitation and functioning of the patients. Cluster 6 (jade) includes studies on various important sub-populations, for example, gay, drug users, and psychiatric patients.

Supplementary Table 1 shows the most cited papers among the total papers in the analysis. Based on the list, we were able to define the major topics within interventions to improve the QOL of PLWHA that have recently attracted the interests of researchers, being (1) immunological status and palliative care, (2) psy-

Table 3. Number of papers by countries as study settings (total 977)

	Country settings	Frequency	%		Country settings	Frequency	%
1	United States	163	16.7	31	Cambodia	6	0.6
2	South Africa	86	8.8	32	Germany	6	0.6
3	China	72	7.4	33	Taiwan	6	0.6
4	India	49	5.0	34	Haiti	5	0.5
5	Uganda	42	4.3	35	Hong Kong	5	0.5
6	Canada	41	4.2	36	Iran	5	0.5
7	United Kingdom	37	3.8	37	Peru	5	0.5
8	Australia	30	3.1	38	Puerto Rico	5	0.5
9	Ireland	28	2.9	39	Swaziland	5	0.5
10	Oman	25	2.6	40	Argentina	4	0.4
11	Kenya	24	2.5	41	Cameroon	4	0.4
12	Brazil	19	1.9	42	Colombia	4	0.4
13	Thailand	19	1.9	43	Georgia	4	0.4
14	Malawi	18	1.8	44	Israel	4	0.4
15	Tanzania	16	1.6	45	Japan	4	0.4
16	Zimbabwe	16	1.6	46	Lesotho	4	0.4
17	Sweden	14	1.4	47	Malaysia	4	0.4
18	Viet Nam	13	1.3	48	Norway	4	0.4
19	Ethiopia	12	1.2	49	Ukraine	4	0.4
20	Netherlands	12	1.2	50	Zambia	4	0.4
21	Niger	11	1.1	51	Denmark	3	0.3
22	Nigeria	11	1.1	52	Finland	3	0.3
23	Mexico	9	0.9	53	Gambia	3	0.3
24	France	8	0.8	54	Lao	3	0.3
25	Italy	8	0.8	55	Romania	3	0.3
26	Nepal	8	0.8	56	Singapore	3	0.3
27	Switzerland	8	0.8	57	Belgium	2	0.2
28	Ghana	7	0.7	58	Botswana	2	0.2
29	Rwanda	7	0.7	59	Chile	2	0.2
30	Spain	7	0.7	60	Cuba	2	0.2

chological and mental health issues, and (3) clinical, familial, and social supports for patient receiving treatments.

Latent Dirichlet Allocation was applied to texts in the titles and abstracts to generated groups of research topics (Table 4 and Fig. 3). We extracted a list of papers most likely to be associated with each topic identified, then reviewed the most cited papers within each group to determine the label for each topic. We then ranked the topics by the total number of publications in the past 5 years. We have found a recent trend in developing interventions that included the psychoso-
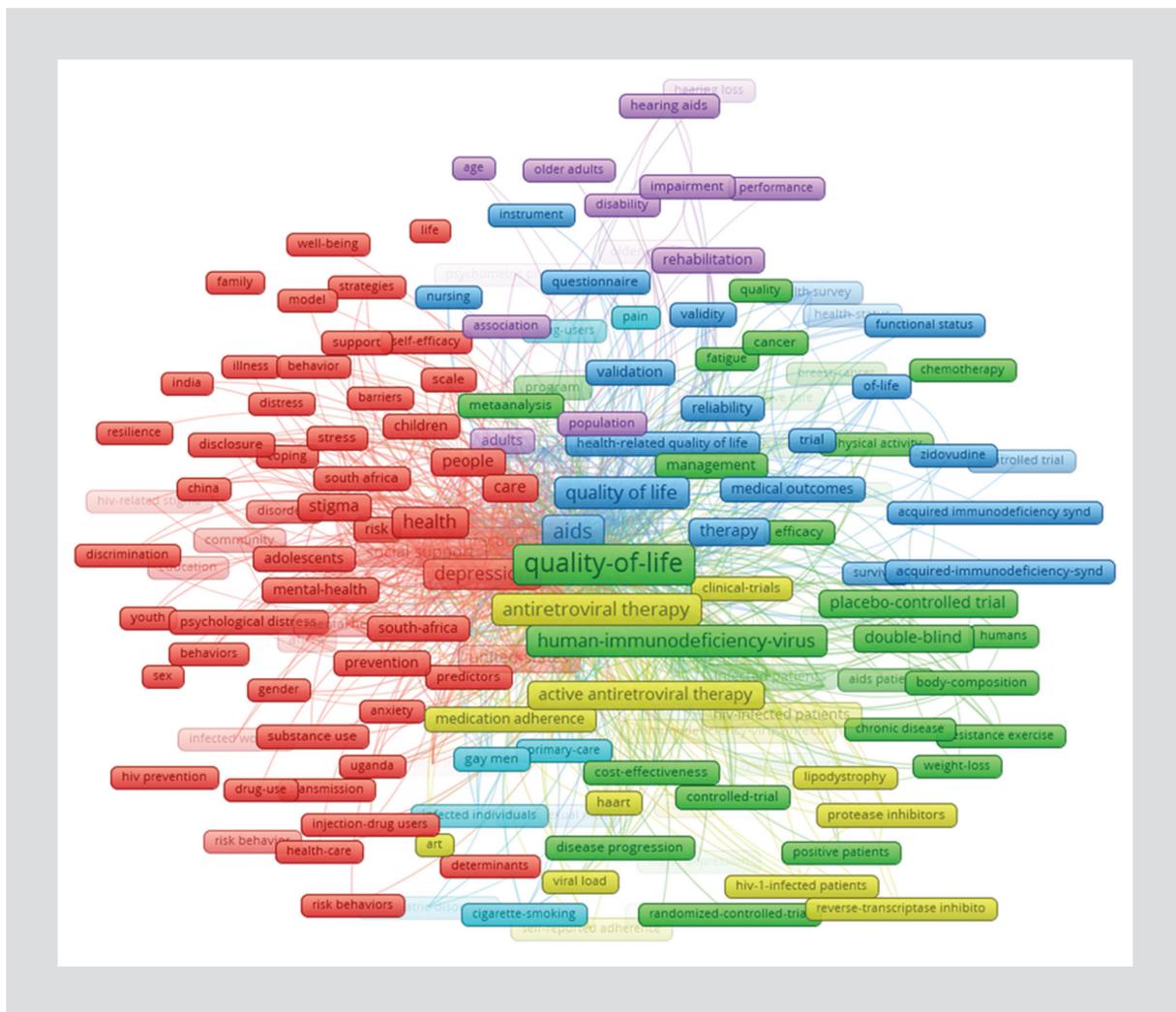
Figure 2. *Co-occurrence of most frequent author's keywords. The colors of the nodes refer to principal components of the data structure; the nodes size was scaled to the keywords' occurrences; the thickness of the lines was drawn based on the strength of the association between two keywords.*

cial and behavioral determinants of QOL and the applications of multilevel interventions as well as supporting patients in lifelong treatment with functional aids and rehabilitation. Noticeably, we found that e-health interventions have emerged among the top three most frequent approaches of interventions to improve the QOL for PLWHA. Meanwhile, studies involving culture, religion, and contextual considerations accounted for just 1.3% of the total articles.

Fig. 4 shows the dendrogram of research disciplines applied to HIV interventions and trials related to the QOL of patients. We found the traditional approaches rooted in infectious diseases, immunology, and virology, which were then expanded to rehabilitation, gerontology, and multidisciplinary approaches with regard to chronic conditions, health behaviors, and health

services utilization of patients with HIV/AIDS. At the top of the dendrogram, there has been a relatively separated group of disciplines, including social, policy, and environmental aspects.

Discussion

This study provided a comprehensive overview of development in global research regarding interventions to improve the QOL of PLWHA, both in terms of quantity and content. The majority of papers have been published in the past 10 years, from 2008 to 2018. While the number of articles published per year from 2013 to 2018 remained at a similar level, the average cite rate (per year) and usage rate (per past 5 years) have shown a slight decline for publications from 2016

Table 4. Ten research topics classified by LDA

Rank by the highest volume past 5 years	Research topics	n	%
Topic 1	Psychosocial and behavioral determinants of QOL among patients with HIV/AIDS	430	21.2%
Topic 2	Multilevel interventions on mothers and children affected by HIV/AIDS	340	16.7%
Topic 3	Functional aids and rehabilitation for patients with HIV/AIDS	185	9.1%
Topic 4	e-health interventions on behaviors, treatment adherence, and chronic condition management	218	10.7%
Topic 5	Economic evaluation of therapies and interventions	141	6.9%
Topic 6	Impact of different antiretroviral regimens on HRQOL of patients with HIV/AIDS	194	9.5%
Topic 7	Physical and functional deteriorations among patients with HIV/AIDS	129	6.3%
Topic 8	Clinical management of HIV-associated non-communicable diseases	204	10.0%
Topic 9	Methodological considerations of QOL measures in HIV populations	166	8.2%
Topic 10	Culture, religion, and contextual factors associated with QOL of patients with HIV/AIDS	26	1.3%

to 2018. In terms of research productivity by country, the USA continues to be in the leading position, followed by the high disease burden country of South Africa and populous China and India. We found several emerging research themes that reflect the transformation of HIV/AIDS from fatal illness to chronic condition, most notably the application of multilevel interventions and long-term care as well as rehabilitation, while topics relating to mental health issues, behavioral therapy, and social supports for patients receiving treatments, and application of e-health approaches in designing and implementing interventions have received increasing attention. There has been, however, a modest appearance of topics covering local, cultural, and environmental contexts of interventions. These results suggest areas that should be considered priority when making policies and implementing interventions aiming to improve the QOL of PLWHA, as well as research gaps that need to be further explored.

Findings of the study on the quantity and growth of publications, citations, and usage of paper relating to interventions to improve the QOL of PLWHA confirmed what reported by other studies that HIV/AIDS gradually becoming a chronic illness, more attention and research efforts have been given to study the QOL of PLWHA and interventions that would enhance such

health outcome[13,25]. On the other hand, one may argue that the maintained growth in publications found by this study can be seen as, to a certain extent, a result of the continued commitment by various donors in providing funding for HIV/AIDS research in general and HIV/AIDS intervention in particular. A recent report on HIV prevention research funding showed that after having minor but gradual declines in the 2013-2017 period, global investment on HIV prevention research and development has started to rise again in 2018 by 1.2% compared to 2017, reaching US$1.14 billion[44]. Nonetheless, major organizations involved in HIV/AIDS research and management have warned of potential cuts in HIV/AIDS intervention research funding[45]. Such potentially reduced funding would not only undermine the progress of achieving the target HIV/AIDS elimination by 2030 but also have adverse effects on the quest to design and implement interventions to enhance the QOL of PLWHA – interventions which required to have long-term effect and heavily depended on care as HIV/AIDS becoming a chronic condition.

The USA leads in research on interventions to improve the QOL of PLWHA, surpassing the country in the second position by a significant margin. This finding is not surprising given the long-standing leading position of the USA in HIV/AIDS research as well as in research funding[46]. The appearance of developing countries with

high prevalence of HIV/AIDS and rising number of new HIV infections such as China, India, South Africa, and Uganda[40-43] in the top 10 countries with most papers on interventions to improve the QOL of PLWHA (by country settings) can be regarded as an encouraging sign, signaling, perhaps, that more efforts have been given to research in key countries, either through the support of foreign donors or investments by local governments or the combination of both. There has been a slight rise in spending for HIV/AIDS reported for low- and middle-income countries in 2010-2015 although the reliance on foreign assistance remained high in these countries, especially those low-income countries hardest hit by the epidemic[47].

One of the emerging research themes found in our analysis is the influences of psychological, social, and behavioral factors on QOL of PLWHA (Topic 1). Along with physical pain and other health deteriorations caused by the illness, psychological conditions such as depression or anxiety can significantly affect QOL of those infected[48], possibly being amplified by the presence of stigma and discrimination resulted from having HIV/AIDS[25]. Moreover, a number of existing studies have indicated a positive relationship between social supports and decreased HIV-related risk behaviors among some key at-risk populations like female sex workers[49]. A key point is that, as HIV/AIDS transforms from a fatal illness to chronic condition, disease response should also shift from taking an emergency perspective to a more long-term view[50], which require going beyond interventions aiming only at treating the infected individual to have a combination of interventions targeting also all the parties involved with the health management of that individual – health professionals, family, and the society. The focus on health management is partly reflected in the rise of researches on the application of multilevel interventions in HIV/AIDS management to improve the QOL of those infected (Topic 2). Multilevel interventions have been well-researched and adopted in chronic care management and have been shown to be more effective than those stand-alone interventions[51-57]. As PLWHA going through their ART-prolonged life with various physical, psychological, and social issues, addressing influencing factors at multiple levels of individual (for instance, substance use disorders, risky sexual behaviors, and self-stigma), clinical (including lack to timely, regular HIV testing and counseling, as well as discrimination in health-care services accessibility), and community (for example, stigma and discrimination, culture norm toward PLWHA) has been argued to be the key to reduce the risk of deteriorating health condition and promoting QOL of PLWHA[58-61]. Studies concerning multilevel inter-

ventions targeting key at-risk populations in certain epidemic-concentrated areas, for instance, people who inject drugs in Vietnam or more vulnerable populations like MSM in the Arabian region are recommended to determine treatments and campaign that are specific, appropriate, and effective. Moreover, our study also found a recent rise in researches on the application of e-health interventions in improving QOL of those suffering HIV/AIDS (Topic 4). The use of e-health applications in chronic disease[62] and HIV management[63] has long been discussed and adopted, however, in this context of QOL enhancement, e-health applications are being used to deliver multilevel interventions, leveraging on their portability, ease of usage, and capacity in population reaching[64]. Again, these emerging themes highlight the transformation in the nature of HIV/AIDS, with new requirements for multifaceted interventions and disease management regime while also reflect the multidimensional characteristics of QOL. It is thus important to maintain a comprehensive view of the disease when initiating research, designing interventions, or drafting policy.

In addition, our results showed a relatively limited presence of researches concerning contextual factors such as culture, religion, and beliefs among studies on interventions to improve the QOL of PWLHA, although these issues have appeared in the top 10 emerging research topics (Topic 10) according to our analysis (Table 5). With the confirmed influence of religion and personal beliefs on QOL of people[65,66], as well as of spirituality and beliefs on how PLWHA cope with difficulties that occurred due to have HIV/AIDS and find purpose in living[67-70], it is recommended to increase efforts dedicating to explore these issues. Studying the impact and affecting the mechanism of these contextualized factors on PLWHA would potentially facilitate the initiation and development of interventions appropriate to and effective for specific populations such as PLWHA of different ethics, sexual, or religious orientation; a recent study on HIV/AIDS publications has argued for the crucial role of culture on adherence to and effectiveness of pre-exposure prophylaxis treatment among those at-risk, in particular, MSM[71]. Given the importance of religious organizations in the life of people from certain communities, for example of the church among African-American population, interventions that tie with religious organizations such as establishment of HIV testing and counseling services within the church can potentially effective ways to improve the QOL of PLWHA.

Notwithstanding its comprehensive coverage of global publications on interventions to improve the QOL of PLWHA, this study should be viewed in light of
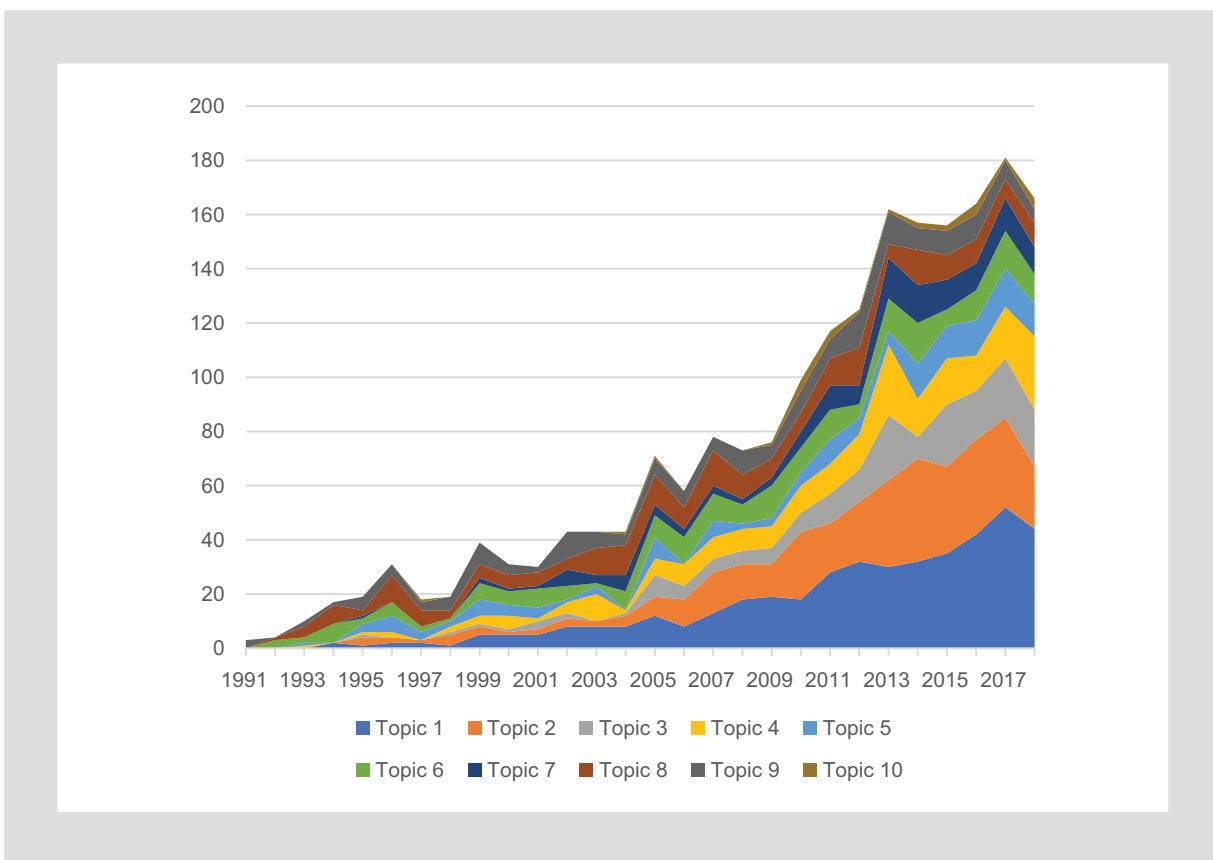
Figure 3. *Changes in research topics* development.*
*Topic 1: Psychosocial and behavioral determinants of QOL among patients with HIV/AIDS.
Topic 2: Multilevel interventions on mothers and children affected by HIV/AIDS.
Topic 3: Functional aids and rehabilitation for patients with HIV/AIDS.
Topic 4: e-health interventions on behaviors, treatment adherence, and chronic condition management.
Topic 5: Economic evaluation of therapies and interventions.
Topic 6: Impact of different antiretroviral regimens on HRQOL of patients with HIV/AIDS.
Topic 7: Physical and functional deteriorations among patients with HIV/AIDS.
Topic 8: Clinical management of HIV-associated non-communicable diseases.
Topic 9: Methodological considerations of QOL measures in HIV populations.
Topic 10: Culture, religion, and contextual factors associated with QOL of patients with HIV/AIDS.

its limitations. Our choice of WOS – despite holding the largest collection of published papers to our knowledge, as our only data source would potentially omit relevant documents. A similar issue may also be present due to our decision to include only English articles and reviews. In addition, our analysis was only conducted on the title and abstract rather than the full text of the papers. However, as the title and abstract can be considered as representative of the paper's content, the authors are confident that such an analysis is sufficient to provide meaningful results.

Conclusion

This study has reviewed the global development of interventions to improve the QOL of PLWHA. Many trials

and interventions, using biomedical and clinical approaches, were implemented in the USA, in countries with the highest burdened epidemics like South Africa or large populations such as China and India. The study also found an overall trend of applying multidisciplinary, multilevel interventions to improve the QOL of patients in the lifelong treatment of HIV/AIDS and a major focus on improving the functioning of the patients by addressing chronic conditions and rehabilitation. However, evidence on local contexts, culture, policy, and environment was still modest. The findings of the study suggest expanding the coverage of psychosocial, behavioral, and contextualized interventions, increasing the involvement of family and community, improving the effectiveness of technology-based and e-health intervention, and developing strategies for lifelong treatment of HIV/AIDS.
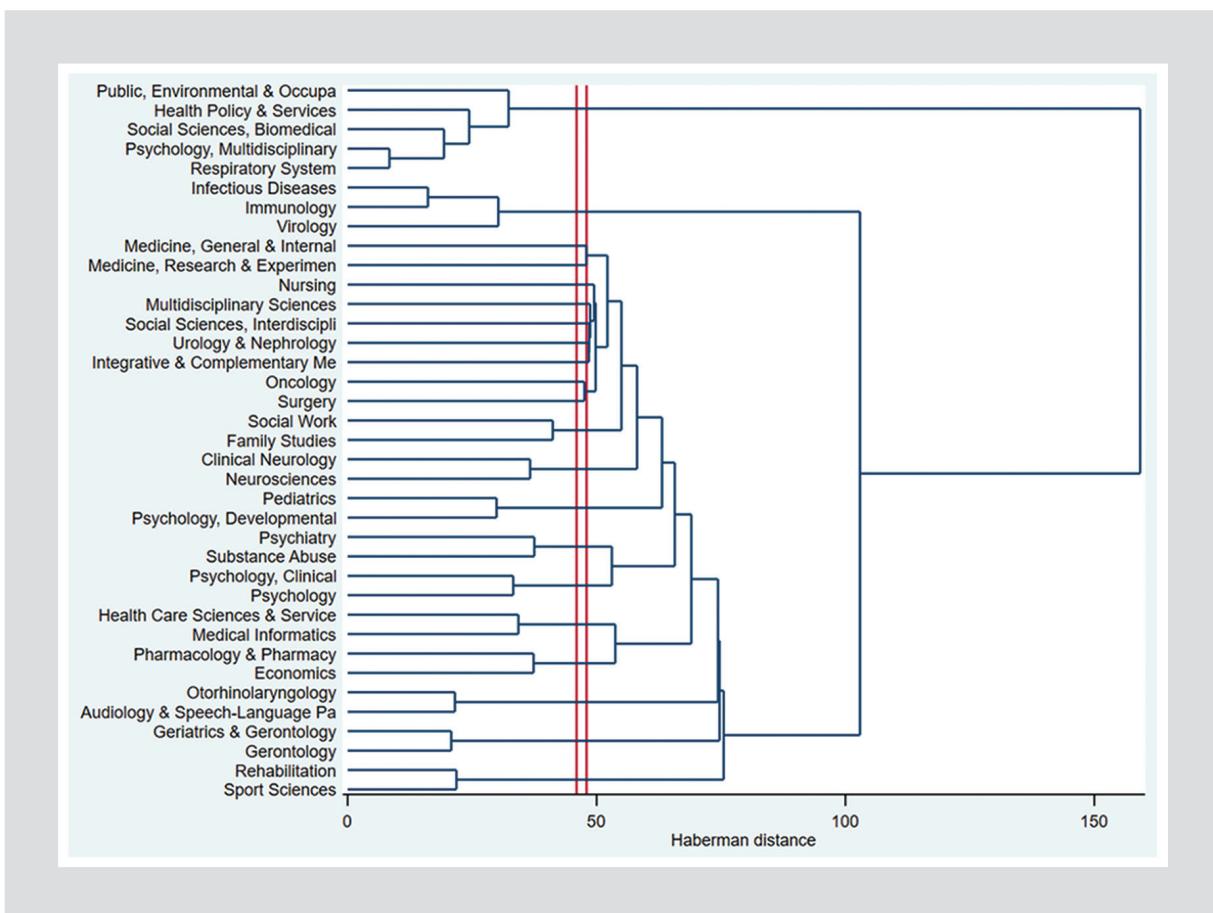
Figure 4. *Dendrogram of coincidence of research areas using the Web of Science classifications.*

Supplementary data

Supplementary data are available at AIDS Reviews online (http://www.aidsreviews.com/). These data are provided by the corresponding author and published online for the benefit of the reader. The contents of supplementary data are the sole responsibility of the authors.

References

1. Deeks SG, Lewin SR, Havlir DV. The end of AIDS: HIV infection as a chronic disease. Lancet. 2013;382:1525-33.
2. Nakagawa F, May M, Phillips A. Life expectancy living with HIV: recent estimates and future implications. Curr Opin Infect Dis. 2013;26:17-25.
3. Bhatta DN, Adhikari R, Karki S, Koirala AK, Wasti SP. Life expectancy and disparities in survival among HIV-infected people receiving antiretroviral therapy: an observational cohort study in Kathmandu, Nepal. BMJ Glob Health. 2019;4:e001319.
4. Antiretroviral Therapy Cohort Collaboration, Zwahlen M, Harris R, May M, Hogg R, Costagliola D, et al. Mortality of HIV-infected patients starting potent antiretroviral therapy: comparison with the general population in nine industrialized countries. Int J Epidemiol. 2009;38:1624-33.
5. May MT, Gompels M, Delpech V, Porter K, Orkin C, Kegg S, et al. Impact on life expectancy of HIV-1 positive individuals of CD4+ cell count and viral load response to antiretroviral therapy. AIDS. 2014;28:1193-202.
6. Sabin CA. Do people with HIV infection have a normal life expectancy in the era of combination antiretroviral therapy? BMC Med. 2013;11:251.
7. Ehren K, Hertenstein C, Kümmerle T, Vehreschild JJ, Fischer J, Gillor D, et al. Causes of death in HIV-infected patients from the Cologne-Bonn cohort. Infection. 2014;42:135-40.
8. Weber R, Ruppik M, Rickenbach M, Spoerri A, Furrer H, Battegay M, et al. Decreasing mortality and changing patterns of causes of death in the Swiss HIV Cohort study. HIV Med. 2013;14:195-207.
9. Buchacz K, Baker RK, Palella FJ Jr., Chmiel JS, Lichtenstein KA, Novak RM, et al. AIDS-defining opportunistic illnesses in US patients, 1994-2007: a cohort study. AIDS. 2010;24:1549-59.
10. Coelho L, Cardoso SW, Amancio RT, Moreira RI, Campos DP, Veloso VG, et al. Trends in AIDS-defining opportunistic illnesses incidence over 25 years in Rio de Janeiro, Brazil. PLoS One. 2014;9:e98666.
11. Bhatia MS, Munjal S. Prevalence of depression in people living with HIV/AIDS undergoing ART and factors associated with it. J Clin Diagn Res. 2014;8:WC01-4.
12. National Institute of Mental Health. HIV/AIDS and Mental Health; 2016. Available from: https://www.nimh.nih.gov/health/topics/hiv-aids/index.shtml. [Last accessed on 2016 Nov 15].
13. Basavaraj KH, Navya MA, Rashmi R. Quality of life in HIV/AIDS. Indian J Sex Transm Dis AIDS. 2010;31:75-80.
14. WHO. WHOQOL Measuring Quality of Life; 1997 Available from: https://www.who.int/mental_health/media/en/68.pdf.
15. Hays RD, Cunningham WE, Sherbourne CD, Wilson IB, Wu AW, Cleary PD, et al. Health-related quality of life in patients with human immunodeficiency virus infection in the United States: results from the HIV cost and services utilization study. Am J Med. 2000;108:714-22.
16. Douaihy A, Singh N. Factors affecting quality of life in patients with HIV infection. AIDS Read. 2001;11:450-4, 460-1, 475.
17. Burgoyne RW, Tan DH. Prolongation and quality of life for HIV-infected adults treated with highly active antiretroviral therapy (HAART): a balancing act. J Antimicrob Chemother. 2008;61:469-73.
18. Campos LN, César CC, Guimarães MD. Quality of life among HIV-infected patients in Brazil after initiation of treatment. Clinics (Sao Paulo). 2009;64:867-75.

19. Mannheimer SB, Matts J, Telzak E, Chesney M, Child C, Wu AW, et al. Quality of life in HIV-infected individuals receiving antiretroviral therapy is related to adherence. AIDS Care. 2005;17:10-22.
20. Préau M, Leport C, Salmon-Ceron D, Carrieri P, Portier H, Chene G, et al. Health-related quality of life and patient-provider relationships in HIV-infected patients during the first three years after starting PI-containing antiretroviral treatment. AIDS Care. 2004;16:649-61.
21. Shriharsha C, Rentala S. Quality of life among people living with HIV/AIDS and its predictors: a cross-sectional study at ART center, Bagalkot, Karnataka. J Family Med Prim Care. 2019;8:1011-6.
22. Banks MH. Psychological effects of prolonged unemployment: relevance to models of work re-entry following injury. J Occup Rehabil. 1995;5:37-53.
23. Swindells S, Mohr J, Justis JC, Berman S, Squier C, Wagener MM, et al. Quality of life in patients with human immunodeficiency virus infection: impact of social support, coping style and hopelessness. Int J STD AIDS. 1999;10:383-91.
24. Rueda S, Mitra S, Chen S, Gogolishvili D, Globerman J, Chambers L, et al. Examining the associations between HIV-related stigma and health outcomes in people living with HIV/AIDS: a series of meta-analyses. BMJ Open. 2016;6:e011453.
25. Pozniak A. Quality of life in chronic HIV infection. Lancet HIV. 2014;1:e6-7.
26. Cooper V, Clatworthy J, Harding R, Whetham J, Emerge Consortium. Measuring quality of life among people living with HIV: a systematic review of reviews. Health Qual Life Outcomes. 2017;15:220.
27. Kimera E, Vindevogel S, De Maeyer J, Reynaert D, Engelen AM, Nuwaha F, et al. Challenges and support for quality of life of youths living with HIV/AIDS in schools and larger community in East Africa: a systematic review. Syst Rev. 2019;8:64.
28. Jin Y, Liu Z, Wang X, Liu H, Ding G, Su Y, et al. A systematic review of cohort studies of the quality of life in HIV/AIDS patients after antiretroviral therapy. Int J STD AIDS. 2014;25:771-7.
29. Mugomeri E, Bekele BS, Mafaesa M, Maibvise 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.
30. Uusküla A, Toompere K, Laisaar KT, Rosenthal M, Pürjer ML, Knellwolf A, et al. HIV research productivity and structural factors associated with HIV research output in European Union countries: a bibliometric analysis. BMJ Open. 2015;5:e006591.
31. Martín-Martín A, Orduna-Malea E, López-Cózar ED. Coverage of highly-cited documents in google scholar, web of science, and scopus: a multidisciplinary comparison. Scientometrics. 2018;116:2175-88.
32. Clarivate Analytics. Web of Science databases. Available from: https://www.clarivate.com/products/web-of-science/databases.
33. Robberstad B, Olsen JA. The health related quality of life of people living with HIV/AIDS in Sub-Saharan Africa-a literature review and focus group study. Cost Eff Resour Alloc. 2010;8:5.
34. Kennedy CE, Medley AM, Sweat MD, O'Reilly KR. Behavioural interventions for HIV positive prevention in developing countries: a systematic review and meta-analysis. Bull World Health Organ. 2010;88:615-23.
35. Dong C, Zhou Q, Fu T, Zhao R, Yang J, Kong X, et al. Circulating exosomes derived-miR-146a from systemic lupus erythematosus patients regulates senescence of mesenchymal stem cells. Biomed Res Int. 2019;2019:6071308.
36. Valle D, Albuquerque P, Zhao Q, Barberan A, Fletcher RJ Jr. Extending the latent dirichl 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;24:5560-72.
37. Chen C, Zare A, Trinh HN, Omotara GO, Cobb JT, Lagaunne TA. Partial membership latent dirichl allocation for soft image segmentation. IEEE Trans Image Process. 2017;26:5590-602.
38. Lu HM, Wei CP, Hsiao FY. Modeling healthcare data using multiple-channel latent dirichl allocation. J Biomed Inform. 2016;60:210-23.
39. Gross A, Murthy D. Modeling virtual organizations with latent dirichl allocation: a case for natural language processing. Neural Netw. 2014;58:38-49.
40. HIV and AIDS in Uganda; 2019. Available from: https://www.avert.org/professionals/hiv-around-world/sub-saharan-africa/uganda.
41. HIV and AIDS in South Africa; 2019. Available from: https://www.avert.org/professionals/hiv-around-world/sub-saharan-africa/south-africa.
42. HIV and AIDS in India; 2019. Available from: https://www.avert.org/professionals/hiv-around-world/asia-pacific/india.
43. HIV and AIDS in China; 2019. Available from: https://www.avert.org/professionals/hiv-around-world/asia-pacific/china.
44. Resource Tracking for HIV Prevention R and D Working Group. HIV Prevention Research and Development Investments 2018-investing to End the Epidemic. U.S: Resource Tracking for HIV Prevention R and D Working Group; 2019.
45. Trump Budget Proposes Largest Ever Cuts to Global HIV Programs; 2019. Available from: https://www.healthgap.org/press/trump-budget-proposes-highest-ever-cuts-to-global-hiv-programs.
46. Global Health Council. Briefs: HIV/AIDS; 2018. Available from: https://www.ghbb.globalhealth.org/briefs/hiv-aids.
47. Global Burden of Disease Health Financing Collaborator Network. Spending on health and HIV/AIDS: domestic health spending and development assistance in 188 countries, 1995-2015. Lancet. 2018;391:1799-829.
48. Sherbourne CD, Hays RD, Fleishman JA, Vitiello B, Magruder KM, Bing EG, et al. Impact of psychiatric conditions on health-related quality of life in persons with HIV infection. Am J Psychiatry. 2000;157:248-54.
49. Qiao S, Li X, Stanton B. Social support and HIV-related risk behaviors: a systematic review of the global literature. AIDS Behav. 2014;18:419-41.
50. Auerbach JD, Parkhurst JO, Cáceres CF. Addressing social drivers of HIV/AIDS for the long-term response: conceptual and methodological considerations. Glob Public Health. 2011;6 Suppl 3:S293-309.
51. Ham C. The ten characteristics of the high-performing chronic care system. Health Econ Policy Law. 2010;5:71-90.
52. Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A. Improving chronic illness care: translating evidence into action. Health Aff (Millwood). 2001;20:64-78.
53. Ballard-Barbash R. Multilevel intervention research applications in cancer care delivery. J Natl Cancer Inst Monogr. 2012;2012:121-2.
54. Flood AB, Fennell ML, Devers KJ. Health reforms as examples of multilevel interventions in cancer care. J Natl Cancer Inst Monogr. 2012;2012:80-5.
55. Strait A, Velasquez A, Handley MA, Leong K, Najmabadi A, Powe NR, et al. Acceptability of a multilevel intervention to improve blood pressure control among patients with chronic kidney disease in a public health care delivery system. Clin Kidney J. 2018;11:540-8.
56. Renders CM, Valk GD, Griffin S, Wagner EH, Eijk JT, Assendelft WJ. Interventions to improve the management of diabetes mellitus in primary care, outpatient and community settings. Cochrane Database Syst Rev. 2001;1:CD001481.
57. Cleary PD, Gross CP, Zaslavsky AM, Taplin SH. Multilevel interventions: study design and analysis issues. J Natl Cancer Inst Monogr. 2012;2012:49-55.
58. Chakrapani V, Subramanian T, Vijin PP, Nelson R, Shunmugam M, Kershaw T. Reducing sexual risk and promoting acceptance of men who have sex with men living with HIV in India: outcomes and process evaluation of a pilot randomised multi-level intervention. Glob Public Health. 2019;15(3):1-4.
59. Stewart JM. A multi-level approach for promoting HIV testing within African American church settings. AIDS Patient Care STDS. 2015;29:69-76.
60. Strathdee SA, Hallett TB, Bobrova N, Rhodes T, Booth R, Abdool R, et al. HIV and risk environment for injecting drug users: the past, present, and future. Lancet. 2010;376:268-84.
61. Strathdee SA, Shoptaw S, Dyer TP, Quan VM, Aramrattana A, Substance Use Scientific Committee of the HIV Prevention Trials Network. Towards combination HIV prevention for injection drug users: addressing addictophobia, apathy and inattention. Curr Opin HIV AIDS. 2012;7:320-5.
62. Whitehead L, Seaton P. The effectiveness of self-management mobile phone and tablet apps in long-term condition management: a systematic review. J Med Internet Res. 2016;18:e97.
63. Young SD, Swendeman D, Holloway IW, Reback CJ, Kao U. Use of technology to address substance use in the context of HIV: a systematic review. Curr HIV/AIDS Rep. 2015;12:462-71.
64. Cordova D, Mendoza Lua F, Muñoz-Velázquez J, Street K, Bauermeister JA, Fessler K, et al. A multilevel mHealth drug abuse and STI/HIV preventive intervention for clinic settings in the United States: a feasibility and acceptability study. PLoS One. 2019;14:e0221508.
65. Peterson M, Webb D. Religion and spirituality in quality of life studies. Appl Res Qual Life. 2006;1:107-16.
66. WHOQOL SRPB Group. A cross-cultural study of spirituality, religion, and personal beliefs as components of quality of life. Soc Sci Med. 2006;62:1486-97.
67. Hall BA. Patterns of spirituality in persons with advanced HIV disease. Res Nurs Health. 1998;21:143-53.
68. Tsevat J, Sherman SN, McElwee JA, Mandell KL, Simbartl LA, Sonnenberg FA, et al. The will to live among HIV-infected patients. Ann Intern Med. 1999;131:194-8.
69. Kaldjian LC, Jekel JF, Friedland G. End-of-life decisions in HIV-positive patients: the role of spiritual beliefs. AIDS. 1998;12:103-7.
70. Tuck I, McCain NL, Elswick RK Jr. Spirituality and psychosocial factors in persons living with HIV. J Adv Nurs. 2001;33:776-83.
71. Tran BX, Wong FY, Pham KTH, Latkin CA, Ha GH, Vu GT, et al. Evolution of interdisciplinary landscapes of HIV/acquired immune deficiency syndromes studies from 1983 to 2017: results from the global analysis for policy in research (GAPRESEARCH). AIDS Rev. 2019;21:[Epub ahead of print].