Published in final edited form as:

AIDS. 2012 July 31; 26(0 1): S1–S5. doi:10.1097/QAD.0b013e3283560f54.

Aging with HIV in Africa: the challenges of living longer

Joel Negin, MIA¹, Edward J Mills, PhD², and Till Bärnighausen, MD, PhD³

¹Sydney School of Public Health, University of Sydney, Sydney, Australia

²Faculty of Health Sciences, University of Ottawa

³Harvard School of Public Health, Harvard University, Boston, USA

The global response to the HIV epidemic represents one of the greatest public health achievements of this century. The successful scale-up of antiretroviral therapy (ART) coverage in developing countries from negligible levels in 2003 to more than 7.9 million in 2012 demonstrates that with political commitment, substantial economic support, and concerted community and medical efforts, global epidemics can be slowed and, perhaps one day, halted. Between national governments, bilateral donors (such as the US Presidential Emergency Fund for AIDS Relief) and multilateral donors (such as the Global Fund to Fight AIDS, Tuberculosis and Malaria), and international organizations (such as UNAIDS) the total available funds for HIV-related activities in developing countries increased from US \$1.6 billion in 2001 – spent primarily on prevention efforts – to US\$15.9 billion in 2009 – invested mostly in the delivery of ART [1].

The HIV response was initially defined by a focus on mothers and children [2], motivated in part by the view that these two groups were particularly vulnerable, innocent, and deserving of protection [3], and in part by the fact that single-dose nevirapine for the prevention of mother-to-child transmission (PMTCT) was the first preventative treatment that was considered appropriate for use in developing countries based on delivery capacity and costs. As treatment expanded and resources increased globally, other groups received particular attention, such as sex workers, drug users, and migrants.

One group that has so far received very little attention in the HIV response in developing countries has been older adults. The indicators used by the United Nations General Assembly Special Session on HIV/AIDS are focused on children and adults younger than 50 years of age [4], and the HIV-related indicators for the Millennium Development Goals require reporting only on those aged 15–24 [5]. The Demographic and Health Surveys, which serve as the basis for much health-related evidence in developing countries, generally only interview women up to age 49 and men up to ages 54 or 59 [6].

In 2006, UNAIDS began reporting on total global and national numbers of HIV-infected adults 15 years and older (as opposed to adults aged between 15 and 49) in the *Global Reports on the Global AIDS Epidemic* [7]. UNAIDS explained this change with the recognition that “it is now evident that a substantial proportion of people living with HIV are

50 years and older,” estimating that there were around 2.8 million HIV-infected adults in this age group [7]. However, beyond this number hardly any mention has been made in UNAIDS and WHO reports on the ageing of the HIV epidemic. For instance, in the 2011 UNAIDS *World AIDS Day Report* [8], in the 364-page 2010 *Report on the Global AIDS Epidemic* [9], and in the 2008 WHO report *Towards Universal Coverage* [10], the ageing of the epidemic is not mentioned once and there is no discussion of the future demographic trends that might impact the HIV response.

Other opportunities to highlight the emerging trend of the aging of the HIV epidemic and the potential impact of this trend on the HIV response have been missed as well. In June 2011, the UN held a High Level Meeting on AIDS in New York, ten years after the historic 2001 United Nations Special Session on HIV/AIDS. The purpose of the meeting was to “take stock of the progress and challenges of the last 30 years and shape the future AIDS response” [11]. Despite the explicit forward-looking goal of the meeting the resolutions failed to acknowledge the ageing of the epidemic and its implications, mentioning the relationship between the HIV and NCDs epidemics only in the context of a long list of conditions with programmatic overlaps with HIV [12]. Aids2031, the group established by UNAIDS to chart the actions needed to address the trajectory of the HIV epidemic over the coming decades, has emphasized the need for a shift in the response from “crisis management to sustained strategic response [13]” Despite its mandate, in their recent publication [13] the group does not discuss the substantial changes to the HIV response that will likely become necessary as the large-scale delivery of ART will change the age composition of HIV-infected populations over the coming decades.

The widespread provision of ART has reduced worldwide mortality from AIDS-related causes down from a peak of 2.2 million in the mid-2000s to 1.8 million in 2010 [9] and has transformed HIV into a chronic disease that affects the lives of millions but no longer necessarily cuts short their life expectancies. Studies in several African countries have shown steep declines in HIV-related death following the scale-up of ART coverage [14, 15]. Using Ugandan data, Mills and colleagues recently estimated that individuals who start ART at age 20 are likely to live an additional 26.7 years; at age 35, life expectancy was an additional 27.9 years and at age 50, an additional 24.0 years [16], and a mathematical model using South African data has recently predicted substantial increases HIV prevalence in older age groups [17]. These findings suggest that as ART coverage expands and as individuals initiate the treatment in increasingly early stages of the disease, HIV-infected populations in sub-Saharan Africa, where the vast majority of all HIV-infected people live, are likely to live well past the age of 50, leading to an aging of the HIV epidemic in the region.

The aging of the HIV epidemic due to ART has several important implications for the health of HIV-infected populations [18–21]. Age, independent of HIV infection, is linked to a decline in the production of naïve T cells and diminished T cell functionality; both are exacerbated by HIV infection [22]. As a result, older adults have steeper declines in CD4 progression [23] and slower immune system reconstitution than younger adults following treatment [24] suggesting that ART provision needs to be specifically tailored to the needs of older patients. Moreover, ART implies three important risks for non-communicable

diseases (NCDs) [25], including ischaemic heart disease [26], diabetes [27, 28] to diabetes, certain cancers [29], intracranial haemorrhage [30], and osteoporosis [31]. First, many drugs included in the standard ART regimens increase the risk for NCDs [28]; second, individuals on ART increasingly live into ages when NCDs burdens increase due to aging and life style, an “inevitable price of success” [32]; and, third, people on ART live longer *with HIV*, and the virus is an independent risk factor for NCDs. This evidence led Jules Levin, the founder and executive director of the New York-based National AIDS Treatment Advocacy Project, to state in 2009 that “aging is the No. 1 problem in HIV today” [33].

One explanation for the neglect of older adults in the HIV response to date has been that it has been commonly assumed that older adults are not at risk of acquiring HIV because they are no longer sexually active. As far back as the early 1990s, clinicians in the US were commenting on HIV infections among older adults and observing that healthcare providers failed to pay attention to HIV disease in older adults, because they did not expect the disease to occur in this age group [34–36]. For example, el-Sadr and Gettler stated that providers were less likely to attribute HIV-related symptoms to the disease in older than in younger people [37] and Whipple and Scura outlined specific tips to support nurses in identifying HIV among the elderly [38]. Another consequence of the mistaken belief that older adults are not at risk of acquiring HIV is that HIV incidence in this age group has rarely been measured, in particular in developing countries. Where it has, however, it was found to be high, such as in study by Wallrauch and colleagues in rural South Africa [39]. Data from developed countries confirms that it is likely that substantial numbers of people acquire HIV in old age. Older adults accounted for 15% of new cases of HIV in the US in 2005 [40]. Another study estimates that 48% of older adults diagnosed in the UK between 2000 and 2007 acquired their infection at age 50 and over [41].

These findings are not surprising, as the “ageist assumptions” that older adults no longer engage in risky sex [42] is unlikely to hold true: behavior surveys have consistently found substantial sexual activity in old age [43, 44]. There is substantial evidence that people remain sexually active past the age of 50 and well into their 70s. Data from the US [45, 46], Europe [47, 48] and Asia [49, 50] all highlight that a considerable proportion of the elderly are sexually active – especially men. In a Swiss study, the 46–65 age group showed the highest number of occasional sexual contacts per person compared to younger age groups [47]. Rates of condom use in particular are less frequent among older adults [51], and studies in developed countries have reported that older people are less knowledgeable about HIV than younger people [47]. In a recent analysis from Uganda, among 750 patients aged 50 and above, 40% remained sexually active after their HIV diagnosis. Older patients also had a significantly higher rate of STIs than younger patients (Odds Ratio [OR]: 2.38 [95% Confidence Interval: 1.85–3.09] [52]. These findings show that the current neglect of the elderly in HIV prevention efforts is unwarranted and that HIV prevention interventions targeted at the specific needs of older adults are needed.

The need for more evidence

The broader context of the lack of attention to HIV among older adults in Africa is that the global research and policy community has in general neglected the disease burdens and

healthcare needs of this age group on the continent. The little work that has been done has found poor health and high rates of undernutrition [53, 54]. The neglect has occurred despite the fact that the number of older adults in Africa is increasing rapidly. The United Nations has estimated that the percentage rise of the population aged 50 and above in Africa will be the greatest of any region in the world [55].

To date, little data has been published about older adults in Africa. A few older studies from African settings examined HIV among older adults specifically in medical wards [56, 57] or small communities [58] and other research has extracted small amounts of data on older adults from among larger HIV cohorts [59].

Using 2007 UNAIDS data, Negin and Cumming estimated that there are 3 million people aged 50 years and older living with HIV in sub-Saharan Africa – 14% of the all HIV infected adults [60]. A South African national HIV survey in 2008 found high rates of HIV infection among older people. Males older than 50 had an HIV prevalence of 6.0% leading to their inclusion in the national list of most-at-risk populations [61]. Studies from South Africa [62], Malawi [63] and Uganda [64] have detailed treatment outcomes among older adults showing excess mortality among older adults in ART cohorts. However, other studies have shown higher levels of adherence among older adults [61] and lower levels of loss to follow-up [65].

A recent study by Hontelez and colleagues takes a longer-term view of this ageing of the epidemic. They use a mathematical model to estimate the impact of HIV over the next 30 years, finding that HIV prevalence in people aged 50 and older will nearly double from 2010 to 2040 from 9% to 17% [66]. These projections reinforce the importance of understanding HIV among older adults over the coming years.

This Special Issue

To address the shortage of information on the interplay between aging and the HIV epidemic in Africa, this special issue brings together manuscripts from academics and practitioners, covering epidemiology and future trends, ART outcomes and adherence, the emerging issue of co-morbidity between HIV and NCDs, and the most appropriate response to this emerging challenge.

Justice and Braithwaite set the scene by extracting lessons learned from developed countries' experiences with HIV and aging and assessing their applicability to the African context [67].

Hontelez and colleagues use data from 43 countries in sub-Saharan Africa to estimate the national effects of the ART scale-up on the age composition of the HIV epidemic [68]. They predict that if treatment coverage continues to increase at present rates, the total number of HIV-infected patients aged 50 or above will nearly triple over the coming three decades – from 3.1 million in 2011 to 9.1 million in 2040 – while the total number of HIV-infected younger adults will dramatically decrease. These findings herald a new era in the HIV response, where the needs and demands of older populations can no longer be ignored.

In the largest study of patients receiving ART to date, Greig and colleagues from Médecins Sans Frontiers present convincing evidence from 17 programs in 9 countries in Africa that aging is associated with heightened mortality, even in the short term.

Nachega and colleagues discuss the importance of ensuring high levels of adherence to ART in older adults and the need for vigilance in monitoring potential drug-drug interactions in this age group [69].

Negin and colleagues use a national survey on the health of older adults in South Africa to provide a national picture of HIV infection among various groups along with the prevalence of various chronic NCDs among both HIV-positive and HIV-negative individuals [70].

Hirschhorn and colleagues review the evidence from resource-poor settings on relationships between HIV and a range of NCDs, including malignancies, osteoporosis, and mental, renal and chronic respiratory diseases.

Rabkin and colleagues focus on the delivery of health services in Africa through a “continuity of care” model that integrates HIV and NCD treatment and care. They argue that such integration will lead to significant synergies [71].

Finally, Bendavid and colleagues review the complexities of ageing with HIV in Africa and discuss the idea of a polypill that could reduce the risks of cardiovascular mortality and cancer mortality.

We hope that this special issue on HIV among older adults in Africa marks the beginning of an important shift in the global HIV response with regard to research, funding and policy. As the evidence on the HIV-related disease burdens and healthcare needs in Africa grows, we anticipate that older adults will become a focus of HIV health policy and interventions.

References

1. UNAIDS. AIDS at 30 : nations at the crossroads. Geneva: Joint United Nations Programme on HIV/AIDS; 2011.
2. Mills EJ, Beyrer C, Birungi J, Dybul MR. Engaging men in prevention and care for HIV/AIDS in Africa. *PLoS Med.* 2012; 9:e1001167. [PubMed: 22346735]
3. Davies, S. Global politics of health. Malden, MA: Polity Press; 2010.
4. UNAIDS. Monitoring the Declaration of Commitment on HIV/AIDS : guidelines on construction of core indicators: 2010 reporting. Geneva: Switzerland: UNAIDS; 2009.
5. United Nations Statistics Division. Official list of MDG indicators; 2012.
6. MeasureDHS. Demographic and Health Surveys. 2012
7. UNAIDS. 2006 Report on the Global AIDS epidemic. Geneva: Switzerland: UNAIDS; 2006.
8. UNAIDS. World AIDS Day Report 2011. How to get to zero: Faster. Smarter. Better. Geneva: Switzerland: UNAIDS; 2011.
9. UNAIDS. 2010 Report on the Global AIDS epidemic. Geneva: Switzerland: UNAIDS; 2010.
10. World Health Organization. Towards universal access: scaling up priority HIV/AIDS interventions in the health sector. Progress Report 2008. Geneva, Switzerland: World Health Organization; 2008.
11. United Nations. 2011 High-Level Meeting on AIDS. 2011.
12. United Nations. Political Declaration on HIV/AIDS: Intensifying our Efforts to Eliminate HIV/AIDS. Draft resolution submitted by the President of the General Assembly. A/65/L.77. 2011.

13. Larson HJ, Bertozzi S, Piot P. Redesigning the AIDS response for long-term impact. *Bull World Health Organ.* 2011; 89:846–852. [PubMed: 22084531]
14. Reniers G, Araya T, Davey G, Nagelkerke N, Berhane Y, Coutinho R, et al. Steep declines in population-level AIDS mortality following the introduction of antiretroviral therapy in Addis Ababa, Ethiopia. *AIDS.* 2009; 23:511–518. [PubMed: 19169138]
15. Herbst AJ, Cooke GS, Bärnighausen T, KanyKany A, Tanser F, Newell ML. Adult mortality and antiretroviral treatment roll-out in rural KwaZulu-Natal, South Africa. *Bull World Health Organ.* 2009; 87:754–762. [PubMed: 19876542]
16. Mills EJ, Bakanda C, Birungi J, Chan K, Ford N, Cooper CL, et al. Life expectancy of persons receiving combination antiretroviral therapy in low-income countries: a cohort analysis from Uganda. *Ann Intern Med.* 2011; 155:209–216. [PubMed: 21768555]
17. Hontelez J, Lurie M, Newell M-L, Bakker R, Tanser F, Bärnighausen T, et al. Ageing with HIV in South Africa. *AIDS.* 2011; 25:1665–1673. [PubMed: 21681056]
18. Gebo KA. Epidemiology of HIV and response to antiretroviral therapy in the middle aged and elderly. *Aging health.* 2008; 4:615–627. [PubMed: 19915688]
19. Martin CP, Fain MJ, Klotz SA. The older HIV-positive adult: a critical review of the medical literature. *Am J Med.* 2008; 121:1032–1037. [PubMed: 19028193]
20. Silverberg MJ, Leyden W, Horberg MA, DeLorenze GN, Klein D, Quesenberry CP Jr. Older age and the response to and tolerability of antiretroviral therapy. *Arch Intern Med.* 2007; 167:684–691. [PubMed: 17420427]
21. Wellons MF, Sanders L, Edwards LJ, Bartlett JA, Heald AE, Schmader KE. HIV infection: treatment outcomes in older and younger adults. *J Am Geriatr Soc.* 2002; 50:603–607. [PubMed: 11982658]
22. Nguyen N, Holodniy M. HIV infection in the elderly. *Clin Interv Aging.* 2008; 3:453–472. [PubMed: 18982916]
23. Differences in CD4 cell counts at seroconversion and decline among 5739 HIV-1-infected individuals with well-estimated dates of seroconversion. *J Acquir Immune Defic Syndr.* 2003; 34:76–83. [PubMed: 14501798]
24. Goetz MB, Boscardin WJ, Wiley D, Alkasspooles S. Decreased recovery of CD4 lymphocytes in older HIV-infected patients beginning highly active antiretroviral therapy. *AIDS.* 2001; 15:1576–1579. [PubMed: 11504992]
25. Mills EJ, Bärnighausen T, Negin J. HIV and aging--preparing for the challenges ahead. *N Engl J Med.* 2012; 366:1270–1273. [PubMed: 22475591]
26. Carr A, Grund B, Neuhaus J, El-Sadr WM, Grandits G, Gibert C, et al. Asymptomatic myocardial ischaemia in HIV-infected adults. *AIDS.* 2008; 22:257–267. [PubMed: 18097228]
27. Ledergerber B, Furrer H, Rickenbach M, Lehmann R, Elzi L, Hirschel B, et al. Factors associated with the incidence of type 2 diabetes mellitus in HIV-infected participants in the Swiss HIV Cohort Study. *Clin Infect Dis.* 2007; 45:111–119. [PubMed: 17554711]
28. Valcour VG, Shikuma CM, Shiramizu BT, Williams AE, Watters MR, Poff PW, et al. Diabetes, insulin resistance, and dementia among HIV-1-infected patients. *J Acquir Immune Defic Syndr.* 2005; 38:31–36. [PubMed: 15608521]
29. Bedimo RJ, McGinnis KA, Dunlap M, Rodriguez-Barradas MC, Justice AC. Incidence of non-AIDS-defining malignancies in HIV-infected versus noninfected patients in the HAART era: impact of immunosuppression. *J Acquir Immune Defic Syndr.* 2009; 52:203–208. [PubMed: 19617846]
30. Justice AC, Zingmond DS, Gordon KS, Fultz SL, Goulet JL, King JT Jr, et al. Drug toxicity, HIV progression, or comorbidity of aging: does tipranavir use increase the risk of intracranial hemorrhage? *Clin Infect Dis.* 2008; 47:1226–1230. [PubMed: 18831696]
31. Brown TT, Qaqish RB. Antiretroviral therapy and the prevalence of osteopenia and osteoporosis: a meta-analytic review. *AIDS.* 2006; 20:2165–2174. [PubMed: 17086056]
32. Justice AC. HIV and aging: time for a new paradigm. *Curr HIV/AIDS Rep.* 2010; 7:69–76. [PubMed: 20425560]
33. France, D. Another Kind of AIDS Crisis. New York. New York: 2009.

34. Gropper EI. Can your nursing home resident possibly have AIDS? *Geriatr Nurs*. 1990; 11:240–242. [PubMed: 2172112]
35. Scura KW, Whipple B. Older adults as an HIV-positive risk group. *J Gerontol Nurs*. 1990; 16:6–10. [PubMed: 2303675]
36. Gaeta TJ, LaPolla C, Melendez E. AIDS in the elderly: New York City vital statistics. *J Emerg Med*. 1996; 14:19–23. [PubMed: 8655933]
37. el-Sadr W, Gettler J. Unrecognized human immunodeficiency virus infection in the elderly. *Arch Intern Med*. 1995; 155:184–186. [PubMed: 7811128]
38. Whipple B, Scura KW. The overlooked epidemic: HIV in older adults. *Am J Nurs*. 1996; 96:22–28. quiz 29. [PubMed: 8629694]
39. Wallrauch C, Barnighausen T, Newell ML. HIV prevalence and incidence in people 50 years and older in rural South Africa. *S Afr Med J*. 2010; 100:812–814. [PubMed: 21414272]
40. Simone MJ, Appelbaum J. HIV in older adults. *Geriatrics*. 2008; 63:6–12. [PubMed: 19061274]
41. Smith RD, Delpech VC, Brown AE, Rice BD. HIV transmission and high rates of late diagnoses among adults aged 50 years and over. *AIDS*. 2010; 24:2109–2115. [PubMed: 20616697]
42. Ory MG, Zablotsky DL, Crystal S. HIV/AIDS and aging: identifying a prevention research and care agenda. *Res Aging*. 1998; 20
43. Nicolosi A, Laumann EO, Glasser DB, Moreira ED Jr, Paik A, Gingell C. Sexual behavior and sexual dysfunctions after age 40: the global study of sexual attitudes and behaviors. *Urology*. 2004; 64:991–997. [PubMed: 15533492]
44. Shisana, O.; Rehle, T.; Simbayi, LC.; Zuma, K.; Jooste, S.; Pillay-van-Wyk, V., et al. South African national HIV prevalence, incidence, behaviour and communication survey 2008: a turning tide among teenagers. Cape Town: HSRC Press; 2009.
45. Lindau ST, Schumm LP, Laumann EO, Levinson W, O'Muircheartaigh CA, Waite LJ. A study of sexuality and health among older adults in the United States. *N Engl J Med*. 2007; 357:762–774. [PubMed: 17715410]
46. Matthias RE, Lubben JE, Atchison KA, Schweitzer SO. Sexual activity and satisfaction among very old adults: results from a community-dwelling Medicare population survey. *The Gerontologist*. 1997; 37:6–14. [PubMed: 9046699]
47. Abel T, Werner M. HIV risk behaviour of older persons. *Eur J Public Health*. 2003; 13:350–352. [PubMed: 14703323]
48. Moreira ED Jr, Hartmann U, Glasser DB, Gingell C. A population survey of sexual activity, sexual dysfunction and associated help-seeking behavior in middle-aged and older adults in Germany. *Eur J Med Res*. 2005; 10:434–443. [PubMed: 16287605]
49. Wang TF, Lu CH, Chen IJ, Yu S. Sexual knowledge, attitudes and activity of older people in Taipei, Taiwan. *J Clin Nurs*. 2008; 17:443–450. [PubMed: 18205677]
50. Wong SY, Leung JC, Woo J. Sexual activity, erectile dysfunction and their correlates among 1,566 older Chinese men in Southern China. *J Sex Med*. 2009; 6:74–80. [PubMed: 19170839]
51. Schick V, Herbenick D, Reece M, Sanders SA, Dodge B, Middlestadt SE, et al. Sexual behaviors, condom use, sexual health of Americans over 50: implications for sexual health promotion for older adults. *J Sex Med*. 2010; 7(Suppl 5):315–329. [PubMed: 21029388]
52. Funk, A.; Odit, M.; Nansubuga, M.; Batamwita, R.; Kawuma, E.; Macleod, C., et al. Elderly patients initiate therapy with more advanced disease and worse clinical outcomes than younger patients: A cohort analysis from Mildmay Uganda; Presented the II International HIV Treatment as Prevention Workshop; April 22–25, 2012; Vancouver. 2012.
53. Kimokoti RW, Hamer DH. Nutrition, health, and aging in sub-Saharan Africa. *Nutr Rev*. 2008; 66:611–623. [PubMed: 19019023]
54. Charlton KE, Rose D. Nutrition among older adults in Africa: the situation at the beginning of the millenium. *J Nutr*. 2001; 131:2424S–2428S. [PubMed: 11533288]
55. United Nations Department of Economic and Social Affairs Population Division. World Population Ageing 2009. New York: United Nations: 2009.

56. Ibara JR, Itoua C, Gathse A, Obengui, Gassaye D, Nkoua JL, et al. Acquired immunodeficiency syndrome in elderly persons in a tropical zone. Apropos of 175 cases in the Congo. *Bull Soc Pathol Exot.* 2002; 95:100–102. [PubMed: 12145951]
57. Mtei LN, Pallangyo KP. HIV infection in elderly medical patients. *East Afr Med J.* 2001; 78:144–147. [PubMed: 12002055]
58. Kassu A, Mekonnen A, Bekele A, Abseno N, Melese E, Moges F, et al. HIV and syphilis infection among elderly people in northwest Ethiopia. *Jpn J Infect Dis.* 2004; 57:264–267. [PubMed: 15623952]
59. Nyambi P, Zekeng L, Kenfack H, Tongo M, Nanfack A, Nkombe I, et al. HIV infection in rural villages of Cameroon. *J Acquir Immune Defic Syndr.* 2002; 31:506–513. [PubMed: 12473839]
60. Negin J, Cumming RG. HIV infection in older adults in sub-Saharan Africa: extrapolating prevalence from existing data. *Bull World Health Organ.* 2010; 88:847–853. [PubMed: 21076566]
61. Newman J, Iriondo-Perez J, Hemingway-Foday J, Freeman A, Akam W, Balimba A, et al. Older Adults Accessing HIV Care and Treatment and Adherence in the IeDEA Central Africa Cohort. *AIDS Res Treat.* 2012; 2012:725713. [PubMed: 22400105]
62. Mutevedzi PC, Lessells RJ, Rodger AJ, Newell ML. Association of age with mortality and virological and immunological response to antiretroviral therapy in rural South African adults. *PLoS One.* 2011; 6:e21795. [PubMed: 21747959]
63. Negin J, van Lettow M, Semba M, Martiniuk A, Chan A, Cumming RG. Anti-retroviral treatment outcomes among older adults in Zomba district, Malawi. *PLoS One.* 2011; 6:e26546. [PubMed: 22031839]
64. Bakanda C, Birungi J, Mwesigwa R, Ford N, Cooper CL, Au-Yeung C, et al. Association of aging and survival in a large HIV-infected cohort on antiretroviral therapy. *AIDS.* 2011; 25:701–705. [PubMed: 21160412]
65. Maskew M, Brennan AT, Macphail AP, Sanne IM, Fox MP. Poorer ART Outcomes with Increasing Age at a Large Public Sector HIV Clinic in Johannesburg, South Africa. *J Int Assoc Physicians AIDS Care (Chic).* 2012; 11:57–65. [PubMed: 21951728]
66. Hontelez JA, Lurie MN, Newell ML, Bakker R, Tanser F, Barnighausen T, et al. Ageing with HIV in South Africa. *AIDS.* 2011; 25:1665–1667. [PubMed: 21681056]
67. Justice AC, Braithwaite RS. Lessons learned from the first wave of aging with HIV. *AIDS.* 2012; 26 000-000.
68. Hontelez JAC, de Vlas SJ, Baltussen R, Newell ML, Bakker R, Tanser F, et al. The impact of antiretroviral treatment on the age composition of the HIV epidemic in sub-Saharan Africa. *AIDS.* 2012; 26 000-000.
69. Nachega JB, Hsu AJ, Uthman OA, Spinewine A, Pham PA. Antiretroviral therapy adherence and drug-drug interactions in the aging HIV population. *AIDS.* 2012; 26 000-000.
70. Negin J, Martiniuk A, Cumming RG, Naidoo N, Phaswana-Mafuya N, Madurai L, et al. Prevalence of HIV and chronic comorbidities among older adults. *AIDS.* 2012; 26 000-000.
71. Rabkin M, Kruk ME, El-Sadr WM. HIV, aging and continuity care: strengthening health systems to support services for noncommunicable diseases in low-income countries. *AIDS.* 2012; 26 000-000.