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A new era of HIV care for age-associated multimorbidity

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Abstract

Purpose of review: The management of people with HIV has shifted focus from acute AIDS-defining illness towards improving detection of chronic disease and reducing impact of multimorbidity. In this review we explore this shifting paradigm of HIV care and the evidence for alternative models proposed to provide integrated holistic services for people living with HIV (PLWH) with multimorbidity.

Recent findings: Despite 25 years of the ART era an increased incidence of NCD and multimorbidity in PLWH persists. As the world moves closer to universal ART coverage this phenomenon is now reported in low- and middle-income settings. Multimorbidity affects PLWH disproportionately compared to the general population and results in reduced health related quality of life (HRQoL), greater hospitalisation and higher mortality. There is evidence that NCD care provision and outcomes may be inferior for PLWH than their HIV negative counterparts. Various models of integrated multimorbidity care have developed and are grouped into four categories; HIV specialist clinics incorporating NCD care, primary care services incorporating HIV care, community NCD clinics offering integrated HIV care, and multidisciplinary care integrated with HIV in secondary care. Evidence is limited as to the best way to provide multimorbidity care for PLWH.

Summary: A new era of HIV care for an ageing population with multimorbidity brings challenges for health providers who need to develop holistic patient focused services which span a range of coexisting conditions.

Key words; HIV, multimorbidity, primary care, primary prevention, chronic non-communicable disease, general practice.

Introduction

People living with HIV (PLWH) are living longer due to the success of antiretroviral treatment (ART)(1). This has shifted the management of human immunodeficiency virus (HIV) from responding to AIDS-associated illness to maintaining long-term health through the primary prevention and treatment of chronic non-communicable diseases. Routine monitoring of patients for such comorbidities has become commonplace in many HIV clinics, but it remains unclear how this interfaces with the preventative primary care model. An international consensus statement published in 2021 designated multimorbidity as one of three key health-related challenges for PLWH along with, health-related quality of life (HRQoL) and stigma/discrimination (2). In this review we focus on the challenges of primary prevention and management of multimorbidity in PLWH and present evidence for existing models of care.

Multimorbidity

One of the challenges of exploring this subject area within HIV care is the variety of language used to describe secondary, non-AIDS-related diseases. The literature is replete with terms such as multimorbidity, comorbidities, age-associated comorbidities, ageing related non-AIDS comorbidities, accelerated ageing process, ageing-associated noncommunicable disease, and chronic non-communicable disease, among other others. Here, we use the term non-communicable disease (NCD) to define the non-AIDS associated diseases which can occur in PLWH as they age. Thus, this definition includes chronic liver disease, but not the viral hepatitides *per se*. We use the WHO definition of multimorbidity as the coexistence of two or more chronic diseases in one individual (3), thus a PLWH with a single NCD has multimorbidity. There is a comprehensive body of evidence explaining the mechanisms and aetiology of specific NCDs in PLWH in isolation, e.g., cardiovascular disease (CVD) and HIV. Here, our focus is on the complexity of multiple conditions and the implications for service delivery.

Burden of multimorbidity

The higher rates of NCDs and, consequentially, multimorbidity in ART treated PLWH became apparent in longitudinal cohorts as the ART era became established (4–6). Recently published studies that extend over the second decade of the 21st century demonstrate that this increased incidence of NCD and multimorbidity in PLWH persists when compared to matched general population controls (7–9), and the gap may be widening(10). Importantly, this is not a phenomenon restricted to high income countries as studies from

low- and middle-income settings as diverse as Kenya (11), South Africa (12)(13) and Latin America (14) all attest.

While NCD and multimorbidity accumulate with older age among PLWH (12,15), this doesn't appear to be a legacy effect from pre-ART era AIDS related disease as risk is not associated with the calendar period of HIV diagnosis (12). Indeed, NCDs may be accruing early in life as the differences compared to HIV negative individuals are more pronounced in younger PLWH; in the WHIS cohort, women <25 years old had the greatest NCD incidence rate ratio (7) and in the UK hazard ratios for hypertension (HTN), chronic kidney disease (CKD) and ischaemic heart disease (IHD) are higher in PLWH under, rather than over, 40 years old (9). Thus, with projections estimating the majority of ART-users will be over 50, and one fifth over 65 years old by 2030 (16,17), PLWH will continue to live with greater multimorbidity for the foreseeable future.

The principal NCDs that are more common in PLWH remain consistent, although prevalence and incidence may vary according to each studied cohort's characteristics, and principally include cardiovascular disease (including IHD, stroke, heart failure), HTN, dyslipidaemia, diabetes mellitus (DM), CKD, osteoporotic bone disease, chronic lung disease and psychiatric illness (7,9,10,18–20). Malignancies are also more common in PLWH but will not be explored in this review as their management necessarily involves referral to specialist care rather than in the HIV service or primary care. The consequences of NCD for PLWH are already clear; NCDs adversely impact on health-related quality of life (21) and have all been seen to be increasing (and at a faster rate) in hospitalised PLWH compared to people without HIV (22). Compared to PLWH without NCD, those with 1, 2 and ≥3 NCD have 3, 7 and 13 fold risk of death respectively (8). With multimorbidity comes polypharmacy (defined as five or more daily medications) which can lead to increased issues with side effects, coherence and interactions (23) and is especially common in PLWH over the age 50, even when antiretroviral medication is discounted(24).

The evidence base for how best to deliver services for PLWH with multimorbidity is less conclusive. This should not be a surprise as while chronic disease prevalence in the general population doubled from 1985 to 2005, with a consequent 3-fold jump in the number of individuals with four or more co-existing NCD (25), clinical guidelines and models of care still remain focused on a single disease approach (3). Traditionally, sexual health or infectious diseases specialists have provided HIV care in clinics concentrating on HIV, while NCDs, where they occurred, have been the remit of other specialists or primary care practitioners. The latter group especially being well placed to promote risk factor modification, primary prevention and the timely identification and management of early-stage comorbidities that

remain the mainstays of addressing multimorbidity (3). But HIV specialists have found themselves widening their scope of care provision, yet the HIV focused model has rarely changed. For example, a recent cross-sectional analysis from France found a significant increase in use of NCD preventative medication (statins, clopidogrel, aspirin) in PLWH (15). The potential deficiency of the single disease model of HIV care was strikingly illustrated by a 20-year analysis of the Multicenter AIDS Cohort Study cohort that found risk for incident DM in men with pre-diabetes was 40% (95% CI: 0 -80%) higher among PLWH after adjusting for competing risk factors (20). Similarly, in a Spanish study which made comparisons to those in the general population with the same comorbidities, PLWH were 1.5 to 3 fold less likely to be receiving treatment for their HTN, DM and dyslipidaemia (19).

Moving from a single disease approach to multimorbidity management

The transition from a single disease approach to multimorbidity management requires the health system to reorientate the models of care currently in practice. Patients with multiple chronic health conditions are high utilisers of health services, and combining clinic appointments and reviews can positively impact the cost of care(26).

As stated, primary care or general practice is usually the provider of holistic and preventative care for NCDs, especially in high-income settings(3). However, a French analysis demonstrated that PLWH with NCDs were less likely to consult a general practitioner compared to controls (76.7% vs. 79.9%; $p = 0.030$)(18). Yet, those PLWH that did manage to get access then had a higher number of consultations (6.2% vs. 5.0%; $p<0.001$)(18), which suggests that PWH had greater need for general practice even if their access was poorer.

Fundamental to providing holistic patient-centred care is understanding that social determinants of health impact health and access to care(27); an unsecured job, poor access to childcare, probation, substance addiction, debt and immigration status influence how people prioritise secondary prevention. Furthermore, multimorbidity and socioeconomic status are strongly linked; people from deprived communities not only die earlier but live with poor health from an earlier age(28). These factors are relevant to many PLWH who often report poor HRQoL and challenges accessing services(29,30). A population-based cohort study that analysed 32 long term conditions including HIV and described patterns of accumulation of comorbidities, found that the speed of transition from no comorbidities to multiple conditions was increased by deprivation and linked to gender and ethnicity(31). The study found consistent links between alcohol and substance misuse as a co-morbidity and HIV, viral hepatitis, and liver disease (31).

Models of integrated care for PLWH with multimorbidity

The term integrated care is difficult to define and varies between stakeholder and health system(32). The most commonly used health services definition emphasises services that are "*managed and delivered so that people receive a continuum of health promotion, disease prevention, diagnosis, treatment, disease-management… coordinated across the different levels and sites of care …according to their needs throughout the life course.*"(33). In response to the evolving burden of multimorbidity among PLWH, there has been a shift away from single disease services towards integrated care. Duffy and Njuguna describe a framework of four models of HIV/NCD integration, which Gausi et al. have sought to evaluate in a recent scoping review(34–36). We present these models below with further discussion and evidence from additional recent publications (Figure 1).

1. HIV specialist clinics incorporating NCD care

This model centres on enhancing HIV specialists' ability to provide NCD or multimorbidity care within their existing service. One example is the use of simplified geriatric principles for non-geriatrics-trained providers(37). There has been limited evaluation of NCD control from this approach to date. Gausi et al found 3 studies focusing on HTN in PLWH, these reported higher rates of control of HIV and comorbid NCDs(36). However, NCD management was often evaluated as a single comorbidity associated with HIV rather than as part of holistic multimorbidity care; the studies simply reported patient outcomes upon integrating NCD screening and treatment services in established HIV programs rather than directly comparing them to outcomes with non-integrated care. While further studies are needed to provide an evidence base for this model, an important discussion is about the capacity of HIV care providers to offer screening and management of multiple NCDs, especially in settings where it is a challenge to adequately provide ART and monitor HIV. Furthermore, the management of NCD needs longitudinal and multidisciplinary services which are more challenging to provide and access in a secondary care setting compared to general practice(3).

2.Primary care services incorporating HIV care

In this model the management of NCDs is in primary care by primary care providers, general practice or family practice depending on the health system. Also known as shared care or collaborative care, this approach seeks to facilitate primary care to focus on NCD management with support from HIV specialists. Primary care services are better established in high-income settings where this model has most often been described. For example, the British HIV Association outlines how to realise shared care for PLWH(38), the

difficulties of PLWH access to primary care services from HIV-related stigma and health discrimination notwithstanding(18,30). A 2015 systematic review of current practice and the clinical, economic and patient satisfaction outcomes of shared care models identified a limited number of studies from Australia, Switzerland, Germany, Canada and UK(39). The overall quality of evidence for these outcomes was poor and the authors postulated that context specific factors might be involved(39). They did note that robust clinical protocols, training and timely communication were key facilitators, and the latter has been demonstrated in the context of prescribing by a 2022 UK intervention called 'Think ARV'(40). This aimed to reduce risk of potential drug-drug interactions (DDI) for people taking ART; a high proportion of general practitioners reported they would like support with prescribing non-ART medications in patients on ART so the initiative provided a dedicated telephone and email service for them staffed by HIV-specialist pharmacists and it led to increased awareness and detection of DDIs among community prescribers(40).

3.Community NCD clinics offering integrated HIV care

This model involves management of HIV and NCDs concurrently in NCD focused primary care settings. It is most applicable to, and so most often described in, LMIC settings where the driver is to address weak primary healthcare by establishing services for stand-alone NCDs (usually HTN and DM) by integrating them with already successful, better funded vertical HIV programmes(41). In their scoping review Gausi et al. identified 5 studies describing this model(36). Only 1 of the 5 studies, in urban Kenya, compared outcomes against non-integrated care finding some evidence for better control for both HIV and NCDs. Evidence from Ugandan and Tanzanian centres that do cater for PLWH with multimorbidity shows that retention in care is improved(42). Gausi subsequently reported outcomes for integrated ART and NCD clubs in Cape Town(43). This study compared HIV (viral suppressions), HTN (controlled BP) and DM (HBA1C) control in PLWH 12 months before, at entry, and 12 months after joining the integrated care service. High levels of retention in care and good viral suppression were maintained, but not NCD control.

4.Multidisciplinary care integrated with HIV in secondary care

This fourth model concerns the management of HIV and NCDs by bespoke secondary care teams. This integrated model within a secondary care setting supports multidisciplinary teams that can manage HIV and multimorbidity holistically. Gausi et al. found 3 reports from services using this model all demonstrating high rates of NCD control similar to HIVuninfected populations(36). A recently published example of this multidisciplinary clinic is the Golden Compass Clinical Care Program for Older People with HIV(44). This clinic led by

HIV-geriatricians also includes other specialists such as cardiologists, pharmacists and care navigators and offers programmes to patients to improve cognitive and functional ability. Patients reported the value of patient focused, whole-person care. In London a similar over50s clinic has been established to support PLWH and described in a service evaluation, but outcomes have not been compared against existing services(45). The clinic has developed dedicated space for senior doctors, trainee doctors, nurses and pharmacists who can do clinical case review. Patients can also be referred into 'live well' pathways to help with lifestyle modification and well-being services delivered by dedicated dieticians and physiotherapists. Common to all the specialised clinics that offer this model of multimorbidity care for PLWH are entry criteria such as frailty or advanced age, high staff to patient ratios and extended interaction times. Although economic outcome analyses are yet to be reported, it is likely these clinics will be too resource hungry to roll out to a more general population of PLWH with multimorbidity. Furthermore, such comprehensive services are often not available for those living without HIV but who may benefit from integrated care of multimorbidity. A less resource intensive approach, at least for those with geriatric needs, might be to integrate PLWH within existing geriatric services. However, there are barriers to developing HIV care by geriatricians which will need to be overcome, in particular the lack of experience and knowledge about HIV in older adults as it is an evolving area of expertise(46). Thus, although this model provides a fully integrated service for PLWH with multimorbidity, it's unlikely to provide a major part of an integrated health system outside secondary care.

Conclusion.

There continues to be a disproportionately higher burden of NCD and multimorbidity in PLWH that carries important negative impacts. The traditional specialist HIV service model may not be adequately addressing prevention and management of NCDs which are otherwise in the remit of primary care. New models of more integrated care are evolving which seek to improve care of multimorbidity in PLWH, either by integrating HIV into primary care or by strengthening NCD services within secondary care. Models differ according to the PLWH population and existing healthcare infrastructure; LMIC with high HIV prevalence place more emphasis on community-based approaches whereas higher income setting centres with more elderly PLWH have developed comprehensive services run by multidisciplinary teams in secondary care. As yet there is little evidence evaluating the benefits for NCD or HIV outcomes of integrated models compared with existing approaches. Whatever the model, integrating multimorbidity and HIV care will require generalist care and must be acceptable for the individual and the healthcare providers.

Key points:

- HIV care has shifted focus from acute AIDS-defining illness management towards management of chronic multimorbidity.
- The burden of multimorbidity for PLWH continues to be greater than that in the general population with impacts on quality of life and life expectancy.
- Evidence suggests that multimorbidity care needs of PLWH are not adequately met by currently configured HIV specialist services.
- A range of models of integrated care have developed, but there is only weak or no evidence evaluating their outcomes.
- Resource availability and local differences in the multimorbidity burden and existing health service infrastructure dictate which models are being developed but will require collaboration between secondary care HIV expertise and primary care proficiency in chronic disease management.

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**Lazarus J V., Safreed-Harmon K, Kamarulzaman A, Anderson J, Leite RB, Behrens G, et al. Consensus statement on the role of health systems in advancing the long-term well-being

of people living with HIV. Nat Commun. 2021 Dec 1;12(1). This is a consensus statement from a global group of experts who identify key issues in moving to deliver integrated, person-centred healthcare for PLWH.

**Jespersen NA, Axelsen F, Dollerup J, Nørgaard M, Larsen CS. The burden of noncommunicable diseases and mortality in people living with HIV (PLHIV) in the pre-, early- and late-HAART era. HIV Med. 2021 Jul 1;22(6):478–90. This is a cohort study using a population-based Danish medical registry looking at PLWH between 1985 and 2017. This article highlights the excess mortality associated with NCDs, which are more prevalent in PLWH.

*Gausi B, Otiku P, Jacob N, Oni T. Patient outcomes in integrated HIV and noncommunicable disease models of care: a scoping review. J Glob Heal Reports. 2021;5. This is a scoping review looking at outcomes of integrated care models for HIV. The review describes four models of care across high, middle and low-income settings.

*Knox C, Leak Date H, Lim SS, Shaw M, Flynn B, Kendall L, et al. Facilitating primary care non-antiretroviral drug prescribing in people living with HIV: The “THINK ARV” initiative. Jan;(1):88–93. This study looked at UK GPs’ knowledge and confidence in drug-drug interactions in ART. They then developed a co-production intervention to link specialists and primary care.

*Wiginton JM, Murray S, Kall M, Maksut JL, Augustinavicius J, Delpech V, et al. HIV-related stigma and discrimination in health care and health-related quality of life among people living with HIV in England and Wales: A latent class analysis. Stigma Heal. 2021; This study presents data from Positive Voices, a national cross-sectional probability survey of adults ≥18 years living with HIV. The paper describes HIV-related stigma and discrimination in the UK Health System.

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References

1. Trickey A, May MT, Vehreschild JJ, Obel N, Gill MJ, Crane HM, et al. Survival of HIVpositive patients starting antiretroviral therapy between 1996 and 2013: a collaborative analysis of cohort studies. Lancet HIV. 2017 Aug 1;4(8):e349–56.
2. Lazarus J V., Safreed-Harmon K, Kamarulzaman A, Anderson J, Leite RB, Behrens G, et al. Consensus statement on the role of health systems in advancing the longterm well-being of people living with HIV. Nat Commun. 2021 Dec 1;12(1).
3. WHO. Multimorbidity. Technical Series on Safer Primary Care. Vol. Geneva: Wo, World Health Organisation. 2016.
4. Althoff KN, McGinnis KA, Wyatt CM, Freiberg MS, Gilbert C, Oursler KK, et al. Comparison of risk and age at diagnosis of myocardial infarction, end-stage renal disease, and non-AIDS-defining cancer in HIV-infected versus uninfected adults. Clin Infect Dis. 2015 Feb 15;60(4):627–38.
5. Althoff KN, Smit M, Reiss P, Justice AC. HIV and ageing: improving quantity and quality of life. Curr Opin HIV AIDS. 2016 Sep 1;11(5):527–36.
6. Schouten J, Wit FW, Stolte IG, Kootstra NA, Van Der Valk M, Geerlings SE, et al. Cross-sectional comparison of the prevalence of age-associated comorbidities and their risk factors between HIV-infected and uninfected individuals: the AGEhIV cohort study. Clin Infect Dis. 2014 Dec 15;59(12):1787–97.
7. Collins LF, Sheth AN, Mehta CC, Naggie S, Golub ET, Anastos K, et al. Incident NonAIDS Comorbidity Burden Among Women With or at Risk for Human Immunodeficiency Virus in the United States. Clin Infect Dis. 2021 Oct 5;73(7):e2059–69.
8. Nanditha NGA, Zheng G, Tafessu HM, McLinden T, Bratu A, Kopec J, et al. Disparities in multimorbidity and mortality among people living with and without HIV across British Columbia's health regions: a population-based cohort study. Can J Public Heal. 2021 Dec 1;112(6):1030–41.
9. Gooden TE, Gardner M, Wang J, Jolly K, Lane DA, Benjamin LA, et al. Incidence of Cardiometabolic Diseases in People With and Without Human Immunodeficiency Virus in the United Kingdom: A Population-Based Matched Cohort Study. J Infect Dis. 2022 Apr 15;225(8):1348–56.
10. Jespersen NA, Axelsen F, Dollerup J, Nørgaard M, Larsen CS. The burden of noncommunicable diseases and mortality in people living with HIV (PLHIV) in the pre-, early- and late-HAART era. HIV Med. 2021 Jul 1;22(6):478–90.

11. Smit M, Perez-Guzman PN, Mutai KK, Cassidy R, Kibachio J, Kilonzo N, et al. Mapping the Current and Future Noncommunicable Disease Burden in Kenya by Human Immunodeficiency Virus Status: A Modeling Study. Clin Infect Dis. 2020 Nov 5;71(8):1864–73.
12. Demontès M, Duvernay SE, Allavena C, Jovelin T, Reynes J, Hentzien M, et al. Multimorbidity in Elderly Persons According to the Year of Diagnosis of Human Immunodeficiency Virus Infection: A Cross-sectional Dat'AIDS Cohort Study. Clin Infect Dis. 2020 Dec 31;71(11):2880–8.
13. Rosario M, Martins O, Pimentel V, Nuño-Solinís R, Roomaney RA, Van Wyk B, et al. Multimorbidity Patterns in a National HIV Survey of South African Youth and Adults. Front Public Heal. 2022 Apr 4;10:862993–862993.
14. Belaunzarán-Zamudio PF, Caro-Vega YN, Shepherd BE, Rebeiro PF, CrabtreeRamírez BE, Cortes CP, et al. The Population Impact of Late Presentation With Advanced HIV Disease and Delayed Antiretroviral Therapy in Adults Receiving HIV Care in Latin America. Am J Epidemiol. 2020 Jun 1;189(6):564–72.
15. Bonnet F, Le Marec F, Leleux O, Gerard Y, Neau D, Lazaro E, et al. Evolution of comorbidities in people living with HIV between 2004 and 2014: cross-sectional analyses from ANRS CO3 Aquitaine cohort. BMC Infect Dis. 2020 Dec 1;20(1):1–8.
16. Smit M, Brinkman K, Geerlings S, Smit C, Thyagarajan K, van Sighem A V., et al. Future challenges for clinical care of an ageing population infected with HIV: a modelling study. Lancet Infect Dis. 2015 Jul 1;15(7):810–8.
17. Althoff KN, Stewart CN, Humes E, Zhang J, Gerace L, Boyd CM, et al. The shifting age distribution of people with HIV using antiretroviral therapy in the United States. AIDS. 2022 Mar 1;36(3):459–71.
18. Pourcher V, Gourmelen J, Bureau I, Bouee S. Comorbidities in people living with HIV: An epidemiologic and economic analysis using a claims database in France. PLoS One. 2020 Dec 1;15(12):e0243529.
19. Camps-Vilaró A, Pérez-Fernández S, Subirana I, Teira R, Estrada V, Domingo P, et al. Standardized Comparison of Cardiovascular Risk Factors Prevalence in Spanish Women and Men Living with HIV and in the General Population. J Pers Med 2021, Vol 11, Page 1085. 2021 Oct 25;11(11):1085.
20. Slama L, Barrett BW, Abraham AG, Palella FJ, Kingsley L, Viard JP, et al. Risk for incident diabetes is greater in prediabetic men with HIV than without HIV. AIDS. 2021 Aug 1;35(10):1605–14.

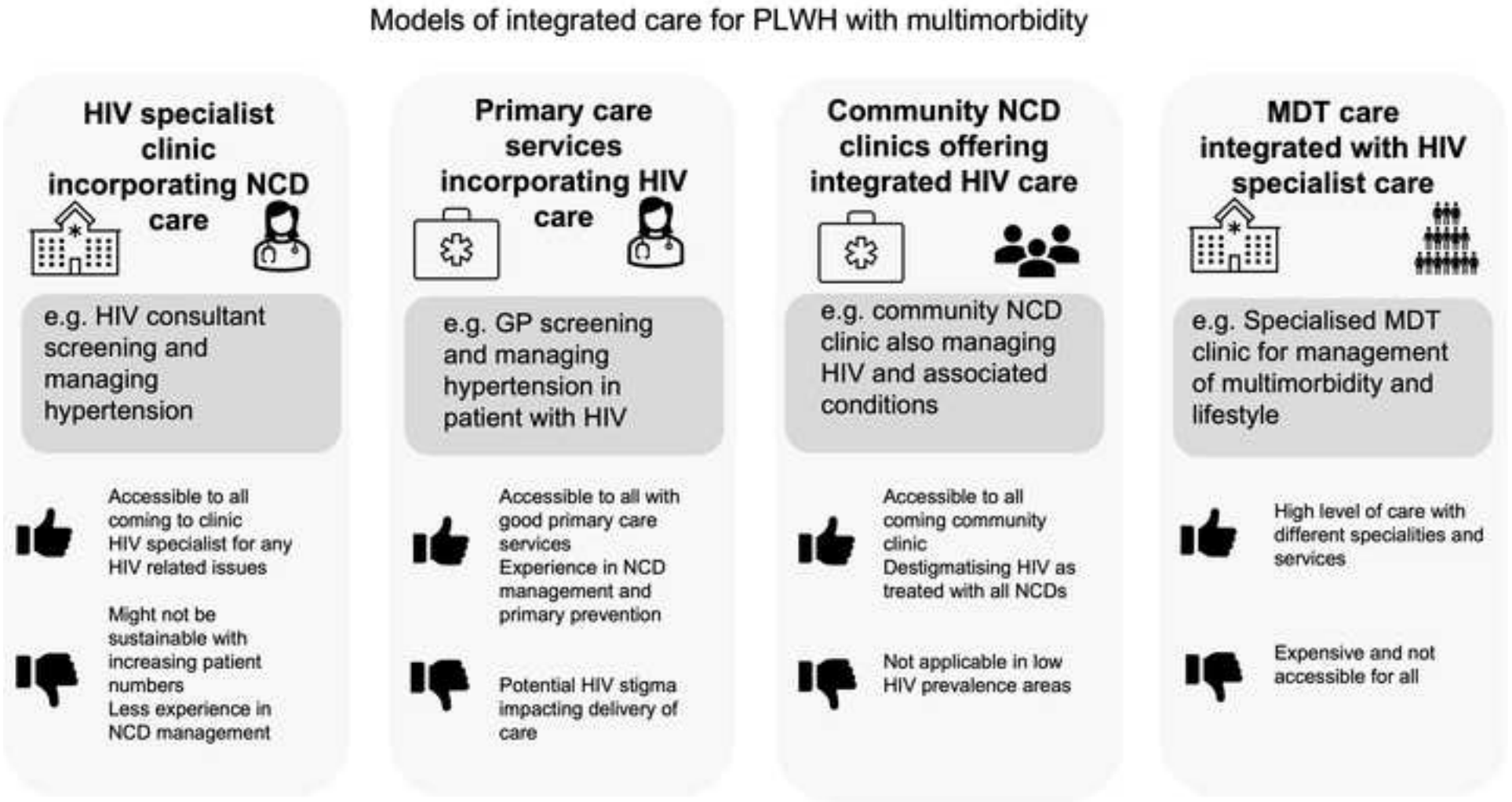
21. Engelhard EAN, Smit C, Van Dijk PR, Kuijper TM, Wermeling PR, Weel AE, et al. Health-related quality of life of people with HIV: an assessment of patient related factors and comparison with other chronic diseases. AIDS. 2018 Jan 2;32(1):103–12.
22. Rowell-Cunsolo TL, Hu G, Bellerose M, Liu J. Trends in Comorbidities Among Human Immunodeficiency Virus-Infected Hospital Admissions in New York City from 20062016. Clin Infect Dis. 2021 Oct 5;73(7):e1957–63.
23. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. BMC Geriatr. 2017 Oct 10;17(1).
24. Back D, Marzolini C. The challenge of HIV treatment in an era of polypharmacy. J Int AIDS Soc. 2020 Feb 1;23(2).
25. Uijen AA, Van De Lisdonk EH. The European Journal of General Practice. 2009;
26. Bähler C, Huber CA, Brüngger B, Reich O. Multimorbidity, health care utilization and costs in an elderly community-dwelling population: A claims data based observational study. BMC Health Serv Res. 2015 Jan 22;15(1):1–12.
27. Marmot M. HEALTH EQUITY IN ENGLAND: THE MARMOT REVIEW 10 YEARS ON. 2021.
28. Charlton J, Rudisill C, Bhattarai N, Gulliford M. Impact of deprivation on occurrence, outcomes and health care costs of people with multiple morbidity. J Health Serv Res Policy. 2013 Oct 1;18(4):215.
29. Rai T, Bruton J, Kall M, Ma R, Pufall E, Day S, et al. Experience of primary care for people with HIV: a mixed-method analysis. BJGP Open. 2019 Dec 1;3(4):1–14.
30. Wiginton JM, Murray S, Kall M, Maksut JL, Augustinavicius J, Delpech V, et al. HIVrelated stigma and discrimination in health care and health-related quality of life among people living with HIV in England and Wales: A latent class analysis. Stigma Heal. 2021;
31. Bisquera A, Turner EB, Ledwaba-Chapman L, Dunbar-Rees R, Hafezparast N, Gulliford M, et al. Inequalities in developing multimorbidity over time: A populationbased cohort study from an urban, multi-ethnic borough in the United Kingdom.
Lancet Reg Heal - Eur. 2022 Jan 1;12.
32. Goodwin N. Understanding Integrated Care. Int J Integr Care. 2016 Oct 28;16(4):1–4.
33. Contandriopoulos A-P, Denis J-L, Touati N, Rodríguez C. Secteur santé publique Faculté de médecine Étude comparée de la collaboration interorganisationnelle et de ses effets. 2003.

34. Duffy M, Ojikutu B, Andrian S, Sohng E, Minior T, Hirschhorn LR. Non-communicable diseases and HIV care and treatment: models of integrated service delivery. Vol. 22, Tropical Medicine and International Health. 2017.
35. Njuguna B, Vorkoper S, Patel P, Reid MJA, Vedanthan R, Pfaff C, et al. Models of integration of HIV and noncommunicable disease care in sub-Saharan Africa: Lessons learned and evidence gaps. AIDS. 2018;32.
36. Gausi B, Otiku P, Jacob N, Oni T. Patient outcomes in integrated HIV and noncommunicable disease models of care: a scoping review. J Glob Heal Reports. 2021;5.
37. Erlandson KM, Karris MY. HIV and Aging: Reconsidering the Approach to Management of Comorbidities. Infect Dis Clin North Am. 2019 Sep 1;33(3):769–86.
38. Maclellan J, Shahmanesh M, Singh S, Morton J, Estcourt C, Asboe D. Shared Care: how can we do it? Findings from the BHIVA Primary Care Project. 2017;
39. Mapp F, Hutchinson J, Estcourt C. A systematic review of contemporary models of shared HIV care and HIV in primary care in high-income settings. Int J STD AIDS. 2015 Dec 1;26(14):991–7.
40. Knox C, Leak Date H, Lim SS, Shaw M, Flynn B, Kendall L, et al. Facilitating primary care non-antiretroviral drug prescribing in people living with HIV: The “THINK ARV” initiative. Jan;(1):88–93.
41. Wong EB, Olivier S, Gunda R, Koole O, Surujdeen A, Gareta D, et al. Convergence of infectious and non-communicable disease epidemics in rural South Africa: a crosssectional, population-based multimorbidity study. Lancet Glob Heal. 2021 Jul 1;9(7):e967–76.
42. Birungi J, Kivuyo S, Garrib A, Mugenyi L, Mutungi G, Namakoola I, et al. Integrating health services for HIV infection, diabetes and hypertension in sub-Saharan Africa: a cohort study. BMJ Open. 2021 Nov 1;11(11):e053412.
43. Gausi B, Berkowitz N, Jacob N, Oni T. Treatment outcomes among adults with HIV/non-communicable disease multimorbidity attending integrated care clubs in Cape Town, South Africa. AIDS Res Ther. 2021 Dec 1;18(1):1–13.
44. Tan JY, Greene M, Blat C, Albers A, Grochowski J, Oskarsson J, et al. Examining the Impact of the Golden Compass Clinical Care Program for Older People with HIV: A Qualitative Study. AIDS Behav. 2022 May 1;26(5):1562.
45. Milinkovic A, Pereira B, Mazziteli M, Girometti N, Asboe D, Pozniak A, et al. Delivering specialised care to people ageing with HIV in the UK: experience and evolution of services from 2009 to 2019. Lancet HIV. 2022 Mar 1;9:S1.

46. Jones HT, Barber TJ. How do geriatricians feel about managing older people living with HIV? A scoping review. Eur Geriatr Med. 2022 Apr 9;1:1–11.

Figure 1 Legend

Summary of 4 models of integrated care for PLWH with multimorbidity with examples. NCD - non communicable disease; MDT – multidisciplinary team; GP – general practitioner.


Models of integrated care for PLWH with multimorbidity
HIV specialist clinic incorporating NCD care
e.g. HIV consultant screening and managing hypertension
Accessible to all coming to clinic HIV specialist for any HIV related issues
Might not be sustainable with increasing patient numbers
Less experience in NCD management
Primary care services incorporating HIV care
e.g. GP screening and managing hypertension in patient with HIV
Accessible to all with good primary care services
Experience in NCD management and primary prevention
Potential HIV stigma impacting delivery of care
Community NCD clinics offering integrated HIV care
e.g. community NCD clinic also managing HIV and associated conditions
Accessible to all coming community clinic
Destigmatising HIV as treated with all NCDs
Not applicable in low HIV prevalence areas
MDT care integrated with HIV specialist care
e.g. Specialised MDT clinic for management of multimorbidity and lifestyle
High level of care with different specialities and services
Expensive and not accessible for all