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Invited Review

COVID-19 infection in people living with HIV

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Abstract

Background: Coronavirus disease 2019 (COVID-19) and human immunodeficiency virus (HIV) are intersecting pandemics, with implications for care at an individual and global scale.

Sources of data: PubMed search with relevant articles and their references reviewed.

Areas of agreement: COVID-19 has changed the delivery of care to people living with HIV (PLWH). Vaccines are efficacious and safe for PLWH; patient care for symptomatic COVID-19 is similar to that of people without HIV.

Areas of controversy: It remains unclear whether PLWH experience increased COVID-19-specific mortality. Treatments to reduce severity in early COVID-19 infection lack evidence in PLWH.

Growing points: The effects of the COVID-19 pandemic on HIV-related morbidity and mortality are yet to be seen. COVID-19 epidemiology among PLWH is complicated by changes to the severe acute respiratory syndrome coronavirus 2, population behaviours and vaccine availability.

Areas timely for developing research: Global trends in HIV-related morbidity and mortality should be monitored to appreciate the effects of the COVID-19 pandemic. The benefits of early antiviral and/or neutralizing

monoclonal antibody (nMAb) treatment for PLWH and nMAb prophylaxis require investigation.

Key words: COVID-19, SARS-CoV-2, HIV, epidemiology, severity, treatment, COVID-19 vaccines

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a novel respiratory pathogen causing the disease coronavirus disease 2019 (COVID-19), was first reported as a localized outbreak in the Wuhan province of China in December 2019. Within months, COVID-19 had developed into a global pandemic. In the 2 years since its emergence, approximately 6.4 million people worldwide have died from COVID-19. The losses and effects from national suppressive measures and societal changes are more difficult to quantify. Large-scale economic changes, fundamental changes to the delivery of health and social care, and the effects of social isolation will have had profound effects on population health during the time of COVID-19.[1]

Parallels to human immunodeficiency virus (HIV) are easy to draw. HIV developed quickly into a global pandemic and is estimated to have caused 36.3 million deaths since its emergence as a novel infectious disease in the early 1980s.[2] Currently, 37.5 million people are estimated to be living with HIV worldwide, with an average of 1.5 million new infections yearly.[2]

During the timeline of HIV, the COVID-19 pandemic is the only epidemic infection to come close to the scale of the HIV pandemic. Its emergence and the widespread changes to access to treatment, regular medical care and consultations have dramatically changed the management of HIV in most settings. Co-infection has potential implications for transmission dynamics, variant emergence and prognosis, while people living with HIV (PLWH) are a unique group in which COVID-19 vaccination guidelines and treatment approaches may differ. In this review, we aim to cover some of the key clinical aspects of COVID-19 and HIV co-infection, from epidemiology and risk of COVID-19 disease, through treatment options, vaccination approaches and the effects of the COVID-19 pandemic on HIV service provision.

No new data were generated or analysed in support of this review.

HIV and COVID-19 incidence

Studies published from the first year of the COVID-19 pandemic provided a variable picture of the risk of COVID-19 infection among PLWH. In 2020, a sample of 193 PLWH from San Francisco demonstrated higher incidence of SARS-COV-2 infection,[3] yet in contrast a Spanish study conducted during a similar period demonstrated a lower incidence of COVID-19 among PLWH. These contrasting results were a sign of the difficulty measuring incidence across a spectrum of socioeconomic determinants of health, and societal strategies towards COVID-19. 55% of those studied in San Francisco were homeless, and only 44% virologically suppressed, while the majority in Spain were adhering to strict lockdown measures, under regular follow-up, and were almost all virologically suppressed on ART.[3]

A later meta-analysis involving 22 studies comprising a pooled sample of 20 000 000 patients across Europe, America, Africa and Asia reported a relative risk of COVID-19 infection among PLWH of 1.24 (confidence interval (CI) 1.05–1.46) compared to a SARS-COV-2-tested population without HIV. The point prevalence of HIV-1 among COVID-19 infected was reported at 1.22% compared to a point prevalence of HIV-1 among pooled COVID-19 negative populations at 0.65%.[4] There was, however, high heterogeneity among included studies, and the prevalence of HIV amongst COVID-19 patients varied by country. A further systematic

review and meta-analysis reported a 2% prevalence of HIV among a pooled global population testing positive for SARS-COV-2. Yet there was again wide variability across continents, with a 0.5%, 1.2%, 1% and 11% prevalence for Europe, North America, Asia and Africa, respectively.[5] Despite these results, the prevalence of HIV among people testing positive for COVID-19 is likely overestimated by meta-analysis techniques due to publication bias toward HIV treatment cohorts with higher rates of testing and SARS-COV-2 positivity.

The relationship between COVID-19 testing rates and positivity was investigated by the Corona Infectious Virus epidemiology Team (CIVET) in a 2022 study.[6] CIVET comprised six cohorts of patients across regional health systems in the USA, comparing large national cohorts of PLWH and people without HIV (PLWoH). CIVET reported rates of SARS-COV-2 testing to be significantly higher amongst PLWH compared to those without. However, rates of SARS-COV-2 positivity did not significantly differ between cohorts of PLWH and PLWoH.[6]

The specific antiretroviral regime of a patient appears to have no effect on the risk of SARS-COV-2 acquisition. Initial theories suggested that tenofovir could inhibit the SARS-COV-2 RNA polymerase and hence offer protection against infection and serious disease.[7] Theories were supported by observational data early in the pandemic.[8] However, contrary to these early findings, the odds of detectable SARS-COV-2 IgG have been shown to be not significantly different among pre-exposure prophylaxis users in Paris.[9] Subsequent investigations have failed to demonstrate protective effects from tenofovir or HIV protease inhibitor therapy.[4]

The variability in data on COVID-19 incidence among PLWH likely reflects differences in social determinants of health, prevalence of comorbid conditions and the local and national COVID-19 suppression measures in place during studies. These socioeconomic determinants appear to be more predictive of COVID-19 infection rates among PLWH than the physiological effects of HIV infection or antiretroviral therapy (ART).[10] However, most data on testing rates and incidence have come from high income countries, with low HIV prevalence and a high percentage of PLWH on effective ART, where the effects of HIV on the immune system are likely lessened. Furthermore, rates of testing among PLWH appear to be higher in some cohorts confounding observations of increased infection risk.

The increasing coverage of COVID-19 vaccination, emergence of new viral variants and changes in behaviour as populations emerge from suppressive measures mean the epidemiology of COVID-19 will continue to shift. Despite these factors, current available evidence suggests that patterns of infection among PLWH are unlikely to differ significantly from that of the general population.

HIV and COVID-19 outcomes

In the early months of the pandemic, COVID-19 was predicted to be more severe and cause excess mortality among PLWH. There was particular concern for those with advanced immunosuppression (low CD4 counts), uncontrolled disease (high HIV viral load) and recent opportunistic infection. As a result, national organizations initially published advice for all PLWH with low CD4 counts to follow shielding advice and minimize contact with others.[11]

The World Health Organization (WHO) in July 2021 reported that HIV infection is a risk factor for severe or critical COVID19 infection and for in-hospital mortality.[12] However, with a multitude of conflicting observational results, the influence of HIV infection on the severity of COVID-19 disease remains unclear.

A higher risk of mortality for PLWH compared to PLWoH HIV is supported by a number of sources. An increased mortality risk for PLWH compared to PLWoH was observed among a large cohort in Western Cape, South Africa, with risk maintained across strata of CD4 count, viraemia and ART.[13] However, more than a quarter of PLWH had a history of previous or current tuberculosis infection and TB was independently associated with higher COVID-19 mortality. The high prevalence of TB and medical comorbidity amongst both groups[13] are not representative of PLWH in high-income countries

where comorbid medical conditions are less prevalent.[14] Also, the persistence of mortality risk across all levels of HIV severity could represent either a general class effect of HIV infection or, more likely, HIV as a marker of poorer health, comorbidity and socioeconomic deprivation. Increased mortality in a high-income setting was demonstrated in a UK study utilizing primary care records of more than 17 million adults, with a cohort of 27 480 PLWH.[15] The risk of COVID-19-related death was similar between PLWH and those without; however, when adjusted for age and sex, risk was nearly three times higher among PLWH. This increase remained significant when further adjusted for deprivation, ethnicity, obesity and smoking. However, these data were collected during the early pandemic between February 2020 and June 2020. Further meta-analyses have supported an increased COVID-19-related mortality risk for PLWH. In an analysis of 17 studies published up to July 2021, death from COVID-19 was 2.29 times more likely among PLWH. However, when studies were pooled by continent, there was no statistically significant increase in mortality risk for Africa or Europe, but North America maintained a 2-fold mortality risk increase.[5] A recent meta-analysis pooling mortality data from 32 studies published up until December 2021 observed a significantly higher mortality risk for PLWH compared to those without but did not report any significant differences in severity of disease presentation.[16]

Evidence also exists to suggest that PLWH may have no increased mortality risk compared to PLWoH. The ISARIC study was one of the first to report on COVID-19 severity among hospital inpatients from the UK: a sub-group analysis published in 2021 compared 122 PLWH admitted to hospital with COVID-19 to a cohort of 47 470 PWoH. Among PLWH, there was no statistically significant difference in the odds of COVID-19-associated death. However, the co-infected inpatient population was younger, less likely to have medical comorbidities, and more ethnically diverse.[14] A recent meta-analysis pooling 28 studies published up to February 2022 did not demonstrate any significant difference in COVID19-related mortality between PLWH and PLWoH, with a pooled sample of 168 531 PLWH. However, the authors conceded significant heterogeneity between included studies.[12]

Direct comparison between studies looking at COVID-19 severity in PLWH is complicated by the rapidly evolving nature of the pandemic. Within the first 2 years of SARS-COV-2 being described, effective vaccinations were available, antiviral therapies were licensed and targeted monoclonal antibodies were being offered to patients.[17] With most severity studies observing outcomes in the early pandemic, the current picture is less clear and more data are needed. Similarly, data are lacking on how risk from COVID-19 may differ across different levels of immunosuppression in HIV.

Antiviral and neutralizing monoclonal antibody treatments

At present, the antivirals remdesivir, nirmatrelvir/ritonavir (Paxlovid), molnupiravir and a selection of neutralizing monoclonal antibody (nMAb) treatments are licensed for the prevention of worsening COVID-19 disease among vulnerable groups, including PLWH, within the first 5–7 days of infection.[17] As the relationship between HIV and COVID-19 severity remains unclear, defining groups of PLWH who would benefit from these treatments has been based on expert opinion alone. In most countries, these drugs are recommended to highly vulnerable groups of individuals, particularly those with significant immunosuppression considered to be at increased risk of severe COVID19.[17–19] In the UK, this includes those living with HIV with a CD4 count of <350 cells/mm^3, although global guidelines vary by country.

Low numbers of PLWH were involved in the trials that demonstrated the efficacy of these medications. Hence guidance to offer treatment to these HIV subgroups is an extrapolation of the expected immunosuppression they will suffer. Currently, these drugs are not recommended for hospitalized patients, except in very specific situations where early COVID-19 is likely, although several trials in hospitalized patients are ongoing. Some nMAbs (bamlanivimab/etesevimab and casirivimab/imdevimab)

have also been licensed in the USA for post-exposure prophylaxis in vulnerable populations[20]; however, their effectiveness against Omicron variants has been questioned.

The EPIC-HR trial, which demonstrated a reduction in hospitalization and death with the antiviral nirmatrelvir/ritonavir, specifically excluded PLWH with a viral load of more than 400 copies/ml and excluded those taking medications metabolized by the CYP3A4 system, which includes any protease inhibitor (PI) and the booster cobicistat. This resulted in only 1 PLWH out of 2085 participants in the trial randomized to the placebo group.[21] Despite exclusion from initial study, a 5-day course of nirmatrelvir/ritonavir can be used in PLWH taking protease inhibitor or elvitegravir-based therapy with ritonavir or cobicistat, with no dose adjustments required. Given potential drug interactions of ritonavir with other co-medications, it is important to consider these interactions in PLWH prior to nirmatrelvir/ritonavir use.

Remdesevir, a small-molecule nucleotide inhibitor of SARS-COV2 RNA-dependent RNA polymerase, was initially developed for use against Ebola but repurposed for the treatment of COVID-19 in the early stages of the pandemic. The ACT-I trial demonstrated a reduction in COVID-19 mortality, while the ACT-I and GS-US-540-5773 both demonstrated an improvement in time to recovery with remdesivir.[22,23] Further evidence subsequently emerged of remdesevir's benefit in preventing hospitalization or death in early COVID-19 infection: 3 days of remdesivir treatment in those with mild-to-moderate COVID-19 and at least one other comorbidity reduced the risk of COVID-19 hospitalization or death by 87% compared to placebo when given within 7 days of symptom onset.[24] Most of the participants were white, under 60 and had a diagnosis of diabetes mellitus or hypertension as their additional comorbid condition. Only 23 of 584 participants were defined as having immunocompromising condition putting them at increased risk of severe covid-19. No data on the numbers of PLWH included in these three studies were published.[22–24]

Molnupiravir was reported to reduce the risk of COVID-19-related hospitalization or death in the Move-OUT study (6.8% risk in molnupiravir group, 9.7% in placebo). This trial specifically excluded patients with HIV and a CD4 count of <200 cells/mm^3 or a HIV viral load of >50 copies/ml.[25]

Sotrovimab, the only nMAb treatment in current use in the UK, demonstrated an 85% reduction in the risk of COVID-19-related death or hospitalization, compared to placebo, when patients, with an additional risk factor for severe COVID-19, were treated before 5 days of symptom onset in the COMET-ICE trial.[26] Another long-acting antibody combination, tixagevimab–cilgavimab (Evusheld), has demonstrated a relative risk reduction of 76.1% for symptomatic COVID-19 compared to placebo; however, absolute numbers of COVID-19 infection were small. This antibody combination was given as a single dose for pre-exposure prophylaxis in groups expected to have reduced vaccine responsiveness, and at increased risk for SARS-COV2 acquisition. PLWH were pre-specified in the inclusion criteria; however, only 0.5% of the cohort were enrolled due to immunosuppression as a risk factor.[20] Both trials excluded individuals with severe immunosuppression or unstable medical conditions and provided no data on numbers of PLWH enrolled or their disease stage.

Despite the lack of evidence for the use or efficacy of antiviral treatments and nMAbs against COVID-19 specifically in PLWH, and the absence of people living with advanced or uncontrolled HIV from early treatment trials, national guidelines in many countries recommend their use (Table 1).[19]

PLWH hospitalized with COVID-19 should be treated as per guidelines similar to PLWoH. Dexamethasone is indicated for treatment of those requiring supplemental oxygen, although metabolized via the CYP3A4 system as most PI drugs, no clinically significant interaction is expected at the doses or durations of dexamethasone treatment used in COVID-19. The IL-6 inhibitors, tocilizumab or sarilumab, can be considered for those requiring supplemental oxygen and CRP of more than 75 mg/l, or within 48 hours of starting respiratory support.[17] However,

Table 1 Recommendations for early treatment of symptomatic COVID-19 disease within the first 5 days (molnupiravir, nirmatrelvir/ritonavir, sotrovimab) or 7 days (remdesevir) of symptoms

Organization	Treatment guidelines for PLWH
UK Department of Health and Social Care[19]	• *Uncontrolled or untreated HIV (high viral load) or acute presentation with an AIDS defining diagnosis* • *People on treatment for HIV with CD4 < 350 cells/mm^3 and stable on HIV treatment OR CD4 > 350 cells/mm^3 and additional risk factors (for example, age, diabetes, obesity, cardiovascular, liver or renal disease, homeless, alcoholic dependency)* **First-line:** Nirmatrelvir/ritonavir (antiviral) OR sotrovimab (nMAb), as clinically indicated **Second-line:** Remdesivir (antiviral) **Third-line:** Molnupiravir (antiviral)
USA National Institute of Health[18]	• *All PLWH* **Preferred therapies:** • Ritonavir-boosted nirmatrelvir (Paxlovid) • Remdesivir **Alternative therapies.** For use ONLY when neither of the preferred therapies are available, feasible to use or clinically appropriate: • Bebtelovimab • Molnupiravir
WHO[17]	• *Immunosuppression and/or chronic diseases (No specific definitions for PLWH)* **Strong Recommendations in favour:** • Nirmatrelvir/ritonavir **Weak or conditional recommendations in favour:** • Sotrovimab • Molnupiravir • Casirivimab and imdevimab—Limited evidence of efficacy against Omicron variant

Definitions of eligibility applying to PLWH are italicized.

caution with IL-6 inhibitor use should be taken in scenarios where uncontrolled secondary infection is possible or in advanced HIV where opportunistic infections may co-exist. Baricitinib should be considered in PLWH with COVID-19-associated pneumonitis, additional oxygen requirements and who are already taking dexamethasone.[17]

COVID-19 vaccination in PLWH

A remarkably rapid pace of research and development resulted in three vaccines with proven efficacy and safety available by January 2021, a little over a year since first observation of SARS-CoV-2. This number has now expanded to at least 55 vaccines having shown efficacy or immunogenicity in phase 3 or 4 clinical trials.[27] As vaccination rates continue to climb globally, there continues to be disparity between the global rich and poor. As of July 2022, more than 74.6% of the total UK population had received two or more doses of a COVID-19 vaccine; this is in stark contrast to the 34.73% of South Africa, the country with the largest population of

PLWH in the world.[1,2] Seven out of the 11 countries where less than 10% of the population are vaccinated for COVID-19 are in sub-Saharan Africa,[1] a region that contains two-thirds of the global population of PLWH and the largest population of PLWH in low- to middle-income countries.[28] Global initiatives, such as COVAX, and the COVID-19 global vaccine delivery partnership have made some progress into increasing vaccination rates in countries with the poorest coverage; however, more work is clearly needed.

In the UK, two mRNA vaccines, Comirnaty (Pfizer) and Spikevax (Moderna), and one adenovirus-vectored vaccine, Vaxzevria (AstraZeneca), are the main vaccines available for use.[29] Globally, the adenovirus-vectored vaccines, Johnson and Johnson and Sputnik V, and the inactivated viral vaccines, Sinovac and Sinopharm, are in widespread use.[27]

PLWH were included in many of the phase 3 clinical trials that demonstrated the efficacy of vaccines at reducing symptomatic COVID-19 disease. However, specific subgroup analyses for effectiveness in PLWH were not carried out, and those with advanced HIV and severe immunosuppression were often excluded.[30]

Post-marketing observational reports of COVID-19 infection rates and studies of immunogenicity in PLWH and its longevity following vaccination have resulted in an adjustment in national guidelines to support additional vaccine doses.

Trials and observational studies report that for most PLWH, COVID-19 mRNA vaccines result in both effective immunogenicity and reduced incidence of severe infection. However, immunogenicity studies have demonstrated that the magnitude of immune response after priming vaccination is proportional to an individual's CD4 count.[31] In one study, cell-mediated and humoral immune responses to mRNA vaccines were shown to be significantly reduced in PLWH and CD4 count <200 cells/mm^3, while those with a CD4 > 500 cells/mm^3 showed comparable immune response to matched HIV-negative controls.[31] Further data from this same cohort, when tested at a median follow-up of 175 days from second vaccine, demonstrated significantly lower rates of detectable neutralizing antibodies in those with CD4 count <200 cells/mm^3 compared to those with higher counts.[32]

The adenovirus-vectored vaccine, ChAdOx1-nCoV-19, also demonstrated comparable immunogenicity among PLWH to HIV-negative controls in trials in South Africa and the UK; however, UK participants had CD4 count of >350 cells/mm^3, while participants in South Africa were required to have a viral load <1000 copies/ml and the median CD4 count among participants in this region was 695 cells/mm^3,[33,34] hence not representing those with more advanced HIV. Further follow-up analysis of 54 PLWH included in the original efficacy study for ChAdOx1-nCoV-19 demonstrated persistent humoral and cell-mediated immune responses, compared to pre-vaccination levels, in standardized assays 6 months following original vaccination, albeit with immunogenicity responses showing signs of decline by this point.[35]

Strong observational evidence of increased risk of breakthrough COVID-19 infection following completed vaccination is now reported. Colburn *et al.* examined the rate of COVID-19 infection following a completed vaccination course among the CIVET-II cohort of patients in the USA.[36] Among 33 029 PLWH, the cumulative incidence rate of COVID-19 at 9 months was significantly higher than matched controls, albeit with low absolute incidence rates for both groups (4.4% vs. 3.9%, $P < 0.001$). Incidence difference between PLWH and PWoH persisted regardless of HIV viral load or CD4 count. Although PLWH with CD4 count <200 cells/mm^3 had higher cumulative incidence compared to those with higher counts, this difference was not statistically significant.[36]

To date, there is no evidence of increased vaccine-related adverse events in PLWH, compared to the general population.[29]

Based on the evidence of waning immunity, poor vaccine responses, and increased breakthrough infection, guidelines in the UK and elsewhere have recommended third primary vaccination doses for those with advanced HIV, and multiple booster doses for all PLWH. The British Joint Committee on

Table 2 UK COVID-19 vaccination guidance for PLWH, as recommended by the UK Green Book[29]

	Primary vaccination	Booster doses
PLWH CD4 > 200 cells/mm^3	• Primary vaccination course ➔ Two doses of effective vaccine separated by 8 weeks **Vaccine choices:** >18 years: Comirnaty (Pfizer) Spikevax (Moderna) Vaxzevria (AstraZeneca) Janssen—*Not widely used in UK* Nuvaxovid®—*Not widely used in UK* <18 years: Comirnaty (Pfizer)	• Booster 6 months after completion of primary course • Second booster at 6 months after first **Vaccine choices (regardless of primary choice)** >18 years: Comirnaty (Pfizer) or Spikevax (Moderna) Nuvaxovid®—*Not widely used in UK* <18 years: Comirnaty (Pfizer)
PLWH CD4 < 200 cells/mm^3	• Primary vaccination course ➔ Three doses of effective vaccine each separated by 8 weeks **Vaccine choice:** >18 years: Comirnaty (Pfizer) or Spikevax (Moderna) Janssen—*Not widely used in UK* Nuvaxovid®—*Not widely used in UK* <18 years: Comirnaty (Pfizer)	• Booster 6 months after completion of primary course • Second Booster at 6 months after first **Vaccine choice (regardless of primary choice)** >18 years: Comirnaty (Pfizer) or Spikevax (Moderna) or Nuvaxovid® <18 years: Comirnaty (Pfizer)

Vaccinations and Immunisations (JCVI) recommends third and fourth booster vaccinations for all PLWH, in addition to the primary vaccination course.[29] This guidance is further summarized in Table 2.

As with other aspects of the COVID-19 pandemic, studies and observations of vaccines responses carry uncertain significance in the persistently changing landscape of infection. New variants with potential vaccine escape or altered clinical effects and the changing epidemiology of COVID-19 infection will need to be considered in future investigation of vaccine efficacy and planning of vaccine delivery.

COVID-19 and HIV: competing epidemiology and access to care

The COVID-19 pandemic has profoundly affected HIV care globally. In early 2020, health systems rapidly reorientated towards the delivery of emergency and urgent care, often at the expense of those with chronic conditions and community-based services. This is significant for HIV, which is typically treated as a chronic infection in the community. In the UK, and globally, reduced virological and immunological monitoring, reduced access to appointments and reduced rates of HIV testing have all been reported during 2020 and 2021.[37,38]

In the UK, face-to-face consultations decreased by 32% with a 7-fold increase in telephone consultations between 2019 and 2020. This change in engagement appears to have had an effect on engagement with care overall, with a doubling in the number of PLWH who did not attend for care in 2020 compared to 2019 (either face-to-face or virtual).[37] Testing in face-to-face settings was understandably reduced, with the number of tests at sexual health services down by 30% in 2020 compared to 2019,

but there were considerable differences between the numbers of tests among different at-risk groups: HIV tests in sexual health services were reduced by 33% among heterosexuals while the reduction among men who have sex with men was reduced by only 7% in 2020 compared to 2019.[37] A higher uptake of HIV self-testing services was noted however, with a 70% increased testing obtained via internet-based services compared to 2019.[37]

Globally HIV services were significantly disrupted. The WHO reported disruption to HIV services in nearly half of countries globally. Twenty-five percent of countries reported disruptions to services required to commence ART, while 17% of countries reported disruptions to the ability to continue ART.[38] Once again, the global poor experienced the most significant disruptions of service, with the African, Southeast Asia and Western Pacific regions reporting the most significant disruptions to HIV prevention, treatment and testing services.[38] There was, however, evidence of falling testing pre-pandemic, which may have skewed observation in this period as countries adopted a more targeted HIV testing approach. Furthermore, global HIV-related deaths, however, have not demonstrated a significant change in the time between 2019 and 2021.

At the start of the COVID-19 pandemic, mathematic modelling predicted a 10% increase in HIV-related deaths over the 5 years following.[39] The real-world long-term effects of disruption to care globally are yet to be seen in terms of HIV-related morbidity and mortality.

Conclusions

The COVID-19 pandemic has dramatically affected the care of PLWH. Initial fears of increased rates of COVID-19 infection and significantly increased risk of severe COVID-19 have not however been consistently demonstrated throughout the literature, and the pattern of COVID-19 epidemiology in PLWH is further complicated by the constantly changing nature of a pandemic caused by a novel, rapidly spreading and evolving respiratory virus.

The efficacy and safety of vaccines were demonstrated early and efficacy in PLWH was confirmed by their inclusion in clinical trials and subsequent observational studies, but concerns about the longevity of immune responses have led to enhanced booster strategies for PLWH. The efficacy of early antiviral and nMAb treatments in PLWH is less well established, but with recommendations from national guideline bodies advocating their use, real-world data will be key to monitoring efficacy across the strata of immunosuppression in the population of PLWH.

The delivery of care to PLWH has changed on a global scale, but we await more data on the long-term effects on morbidity and mortality caused by the COVID-19 pandemic.

Vaccinations and treatments for COVID-19 have developed at remarkable pace, serving as an example for the ongoing management of the HIV pandemic. The focused funding, research and coordinated global approach that have been directed towards COVID-19 over 2 years could significantly change the course of the HIV pandemic, which has continued for more than 40 years.

Authors' biography

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Conflict of interest statement

The authors have no potential conflicts of interest.

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