Human Immunodeficiency Virus (HIV)
Infection in the Netherlands

HIV Monitoring

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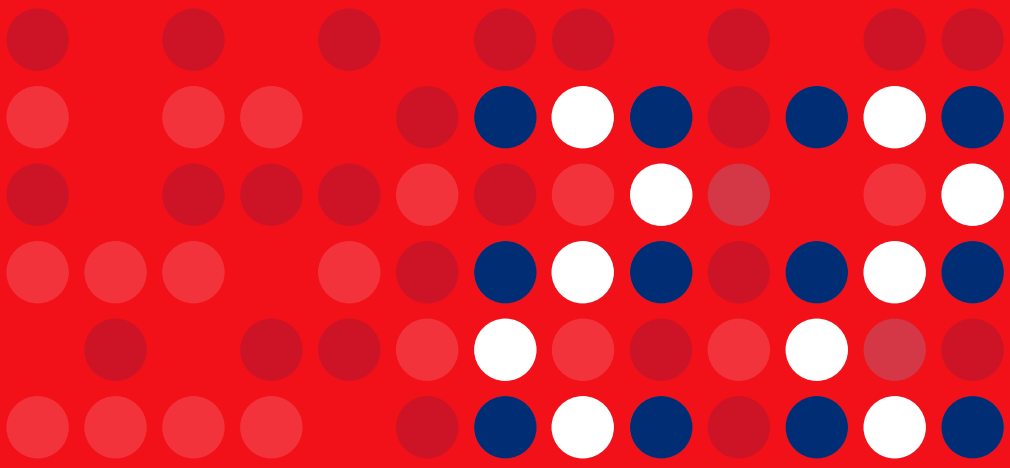
Special report 1.1: COVID-19 in people living with HIV in the Netherlands



Special reports

1.1 COVID-19 in people living with HIV in the Netherlands

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Introduction

The first case of SARS-CoV-2 infection in the Netherlands was documented on 27 February 2020[1]. By December 2021 an estimated cumulative 3.1 million individuals had become infected and 20,897 had died of COVID-19[2]. The majority of SARS-CoV-2 infections result in a self-limiting disease with minor or mild symptoms, but certain people are at increased risk of developing severe COVID-19, hospitalisation and death[3–5]. These include individuals who:

- are older;
- are male;
- belong to certain ethnic groups;
- have a lower socio-economic status;
- have underlying health conditions such as obesity, hypertension, renal dysfunction, diabetes mellitus, and cardiovascular disease;
- have certain congenital immunodeficiency syndromes;
- have haematological malignancies;
- have had solid organ transplants;
- are receiving immune-suppressive/-modulatory therapy[6].

Populations at risk of severe COVID-19-related outcomes

Geographical region of origin

Many studies from general population COVID-19 cohorts in Western countries have reported migrants and individuals belonging to non-Western ethnic groups to be at increased risk of COVID-19-related hospitalisation and death[7–14], with possible explanations including lower socio-economic status and a higher prevalence (and severity) of comorbid conditions.

In the general Dutch population, migrant and ethnic groups (people with a non-Western migrant background; the largest groups being of Dutch Antillean, Moroccan, Surinamese, Turkish and Ghanaian descent) had a higher risk of COVID-19 hospitalisation compared to those of Dutch origin[15]. There were also significant ethnic disparities in the associations between the presence of comorbidities and risk of COVID-19 hospitalisation; the presence of certain comorbidities heightened the risk of a severe COVID-19-related outcome for some ethnic groups, more than for others[16].

Individuals living with HIV

At present, data to determine *if* people with HIV (PWH) – and if so, which particular groups – are at increased risk of severe COVID-19 are inconclusive[17]. Studies have suggested either a similar[18–23] or an increased risk of severe outcomes[24–29] in PWH. A meta-analysis looking at the risk of COVID-19-related mortality in PWH, mainly including studies from North-America and Europe, reported a pooled relative risk of 1.23[30], which is very similar to the adjusted odds ratio of 1.29 reported by a large cohort study from the USA[31].

Underlying comorbidities and other general risk factors for severe COVID-19-related outcomes appear to play a larger role than HIV-related factors in PWH on antiretroviral therapy with well-controlled HIV-replication and preserved CD4 cell counts[32,33]. However it is important to point out that while most of these studies adjusted their analyses for age, sex, ethnicity and comorbidities, many of them were conducted as part of general COVID-19 population-based studies. Consequently they often did not have detailed data available on potentially relevant HIV-related parameters, such as use and type of antiretroviral therapy, plasma HIV-RNA levels, prior AIDS diagnoses, and current and nadir CD4 cell counts. As a result it remains unclear which people with HIV in particular are at increased risk of severe COVID-19-related outcomes. Finally, many of the risk factors for severe COVID-19 in the general population are more prevalent in PWH, and more research is needed to clarify whether a potential increased risk in PWH is driven by (i) differences in demographic characteristics, (ii) a high prevalence of non-HIV-related comorbidities, and/or (iii) HIV-related factors.

We report on the incidence of COVID-19 and risk factors for severe outcomes in the nationally representative adult population of PWH in the Netherlands using all available data collected up to 1 December 2021.

Methods

Data collection

Stichting hiv monitoring (SHM) has prospectively been collecting relevant HIV and antiretroviral therapy (ART) related data on all consenting PWH in the Netherlands[34] since 2001. As of November 2020 this was supplemented with automated electronic queries of HIV treatment centre electronic medical records (EMR) to quickly identify new diagnoses of SARS-CoV-2 infection. SHM prioritises additional data collection regarding diagnosis, disease severity, hospitalisations and outcomes of COVID-19 events, but it should be noted that data collection does not happen in real time. Consequently, there are delays between the COVID-19 event itself, the recording of information in the EHR at the treatment centre, and the moment SHM captures the data for analysis.

SHM data collection of COVID-19 events is based on the Case Report Forms of the International Severe Acute Respiratory and emerging Infection Consortium and World Health Organisation, or ISARIC-WHO CRF[35]. The main focus of our data collection is on hospitalised patients, as individuals diagnosed with mild COVID-19 who are not admitted to hospital rarely have reliable, detailed information documented in their HIV treatment centre EHRs. SHM has not (yet) established links to other COVID-19 providers and cohorts/datasets, so direct comparisons with other patient populations cannot be made at present. Data on SARS-CoV-2 vaccination levels are also not yet available.

Measures of COVID-19 disease severity

It was often impossible to record objective measures of COVID-19 disease severity as these data were not systematically recorded in the HIV treatment centre EHRs. This was particularly the case for individuals who were not hospitalised or those who were hospitalised in a different facility to the one where they receive HIV care. Risk factors for COVID-19-related hospitalisation and death were investigated using multivariable logistic regression including:

- Relevant demographics (age, sex at birth, region of origin)
- Established other risk factors (comorbidities)
- HIV-related parameters

The presence of the following comorbidities and conditions known to increase the risk for severe COVID-19 were taken into account:

- **Cardiovascular disease** (myocardial infarction; coronary artery bypass grafting; coronary angioplasty or stenting; and carotid endarterectomy);
- Stroke;
- **Non-AIDS-defining malignancies** (excluding non-melanoma skin cancers and premalignant lesions found at cervical/anal screening;
- **Chronic kidney disease** (eGFR below 30 ml/min/1.73 m^2);
- **Diabetes mellitus** (defined as having glycated haemoglobin levels above 52 mmol/mol and/or the use of antidiabetic medication);
- **Hypertension** (defined as the use of antihypertensive drugs and/or measured grade 2 [or higher] hypertension with systolic pressure at or above 160 mmHg and/or diastolic pressure at or above 100 mmHg;
- **Obesity** (body mass index over 30 kg/mm^2).

The association between these comorbidities and the risk of developing severe COVID-19 were investigated by (i) entering them into the regression models separately, and (ii) as a multimorbidity covariate, i.e. the sum of all seven conditions listed above. All reported p-values are two-sided, with p-values below 0.05 considered statistically significant.

Results

Incidence of COVID-19

Between 27 February 2020 and 31 December 2021, 2,301 primary SARS-CoV-2 infections were registered among 21,289 adult PWH. Of these, 2,281 (99.1%) were found to be SARS-CoV-2 PCR-positive and an additional 20 (0.9%) were SARS-CoV-2 PCR-negative but clinical assessment indicated that infection was highly likely nonetheless (*Table 1*).

An additional 264 possible SARS-CoV-2 infections were self-reported by individuals who had experienced mild symptoms that could have been caused by SARS-CoV-2 infection, but without PCR confirmation. These had mostly occurred in the early months of the epidemic in 2020, when SARS-CoV-2 testing was not yet widely available for mild cases. None of these possible infections resulted in hospitalisation and therefore they are not included in this report.

Incidence of COVID-19 hospitalisation

Of the 2,301 individuals with a registered SARS-CoV-2 infection, 158 (6.9%) were hospitalised, with 27 (1.2%) requiring intensive care unit (ICU) admission. Of the remaining 2,143 (93.2%) individuals, 50 (2.2%) did present with COVID-19 at an emergency room, but did not require hospitalisation.

Those diagnosed with a SARS-CoV-2 infection who were not hospitalised were very similar to the total population of PWH in care in the Netherlands at the end of 2020 in terms of demographics, comorbidities and HIV-related characteristics. The only exception was that they were substantially more likely to be born in a non-Western country (*Table 1*).

Those who were hospitalised for COVID-19 however, were older, more likely to have acquired HIV through heterosexual contact (in men, and to a lesser extent women), and more likely to be born in sub-Saharan Africa or Latin America and the Caribbean, than the total population of PWH in care in the Netherlands at the end of 2020.

Overall, men were not more likely to be hospitalised for COVID-19 than women, as the percentage of men among hospitalised patients (77.2%) was slightly lower than in the total population of PWH (81.9%). Each investigated comorbidity was much more prevalent among those hospitalised compared to those not hospitalised for COVID-19, also resulting in a higher multimorbidity count in the hospitalised group (*Table 1*). The median duration of hospitalisation was 6 days (IQR 3-14). Individuals who were admitted to the ICU remained hospitalised for a median of 19 days (12-34).

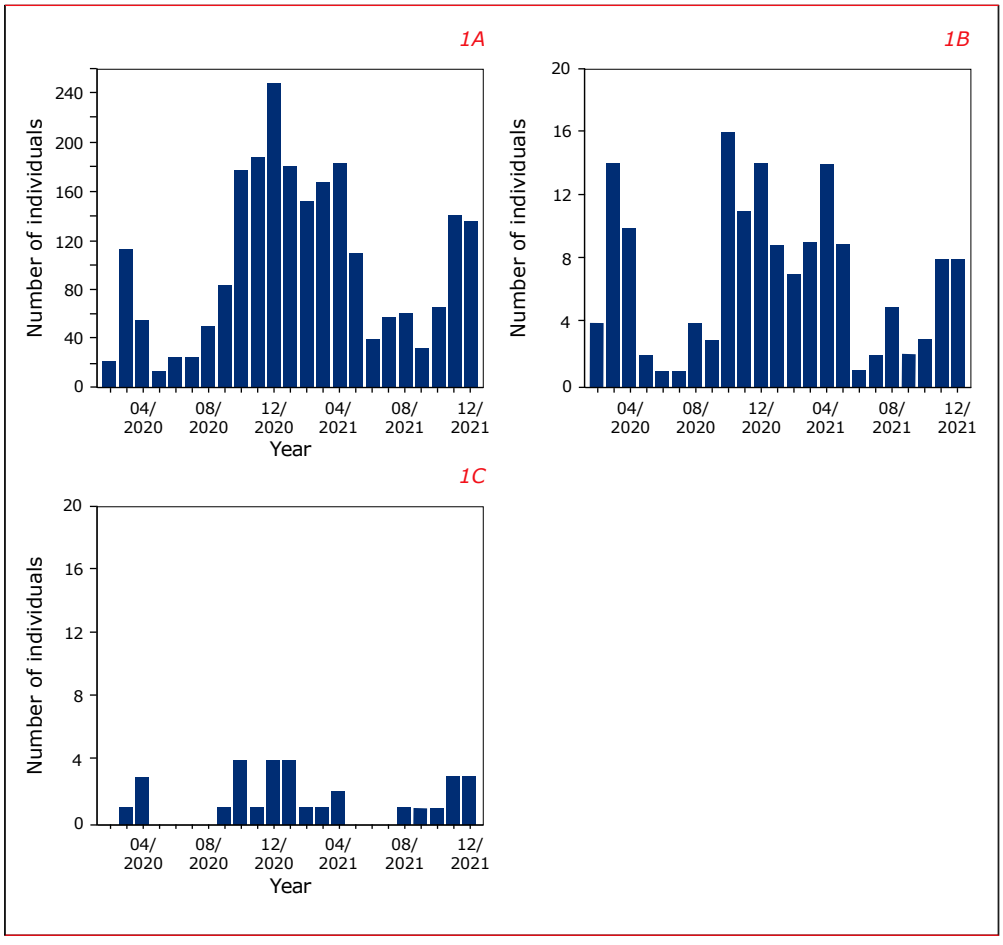
HIV-related characteristics

There were only minor differences between PWH who were diagnosed with COVID-19 but not hospitalised, and the total population of PWH, in terms of HIV-related characteristics. The vast majority of PWH receive ART, have a plasma HIV-1 viral load below 200 copies/ml and a high median CD4 cell count (above 500 cells/mm^3). There were, however, notable differences between PWH diagnosed with COVID-19 who *were* hospitalised and those who were not. Those who were hospitalised were on average 9.3 years older and, as a result, likely to have been living with HIV for longer. Furthermore, they had a lower median current and nadir CD4 cell count, and a higher prevalence of prior history of AIDS (*Table 1*).

Vaccinations

Figure 1 shows the number of registered SARS-CoV-2 infections, hospitalisations for COVID-19 and COVID-19-related deaths during the study period. The peaks and troughs of the epidemic waves in PWH largely resemble those observed for the general population of the Netherlands[1,2]. Vaccinations against SARS-CoV-2 in the Netherlands started in January 2021, with only the oldest PWH and those living in nursing homes initially eligible. From April 2021 all PWH became eligible for SARS-CoV-2 vaccination. Between June and December 2021 just 29 hospitalisations for COVID-19 were recorded, 16 of which occurred in individuals known to be vaccinated. Eight of these hospitalised patients died, four of which were known to be vaccinated.

Figure 1: *Incidence of COVID-19 diagnoses, hospitalisations and deaths over calendar time*



Risk factors for hospitalisation

Risk factors for COVID-19-related hospitalisation among PWH diagnosed with COVID-19, which were identified by multivariable logistic regression, included older age, migrant status (with higher risk for individuals originating from sub-Saharan Africa and to a lesser extent Latin America and the Caribbean), and a higher number of concomitant comorbidities. Additional factors identified as independently being associated with a higher risk of hospitalisation were (*Table 2*):

- a current CD4 count below 200 cells/mm^3
- a last measured HIV viral load of more than 200 copies/ml
- a history of prior AIDS

None of the other demographic, HIV and ART-related parameters were independently associated with a higher risk of being hospitalised following a diagnosis of SARS-CoV-2 infection. *Figure 2* shows the crude hospitalisation rates per age group, CD4 cell count category, and comorbidity count.

COVID-19-related mortality

In total, 31 (1.35%) out of the 2,301 PWH diagnosed with SARS-CoV-2 infection were reported to have died as a direct result of COVID-19. The observed mortality in the various age groups was (*Figure 2*):

- 0% (n=0) in 587 individuals aged 18-39 years;
- 0.2% (n=1) in 592 individuals aged 40-49 years;
- 0.7% (n=5) in 701 individuals aged 50-59 years;
- 3.1% (n=10) in 328 individuals aged 60-69 years;
- 13.0% (n=10) in 77 individuals aged 70-79 years; and
- 31.3% (n=5) in 16 individuals aged over 80 years.

COVID-19-related mortality was 13.9% (22) among the 158 who were hospitalised for COVID-19 and 37.0% (10) among the 27 who were admitted to the ICU.

Nine individuals (0.42%) died of COVID-19-related factors out of the 2,143 individuals who had *not* been hospitalised. Of those nine, eight were known to be living in a nursing home prior to being diagnosed with SARS-CoV-2 infection. The remaining individual was an unvaccinated 69-year-old Latin American man with a CD4 count below 500 cells/mm^3 and chronic renal failure due to HIV-related nephropathy.

Comorbidities and other risk factors for COVID-19-related mortality

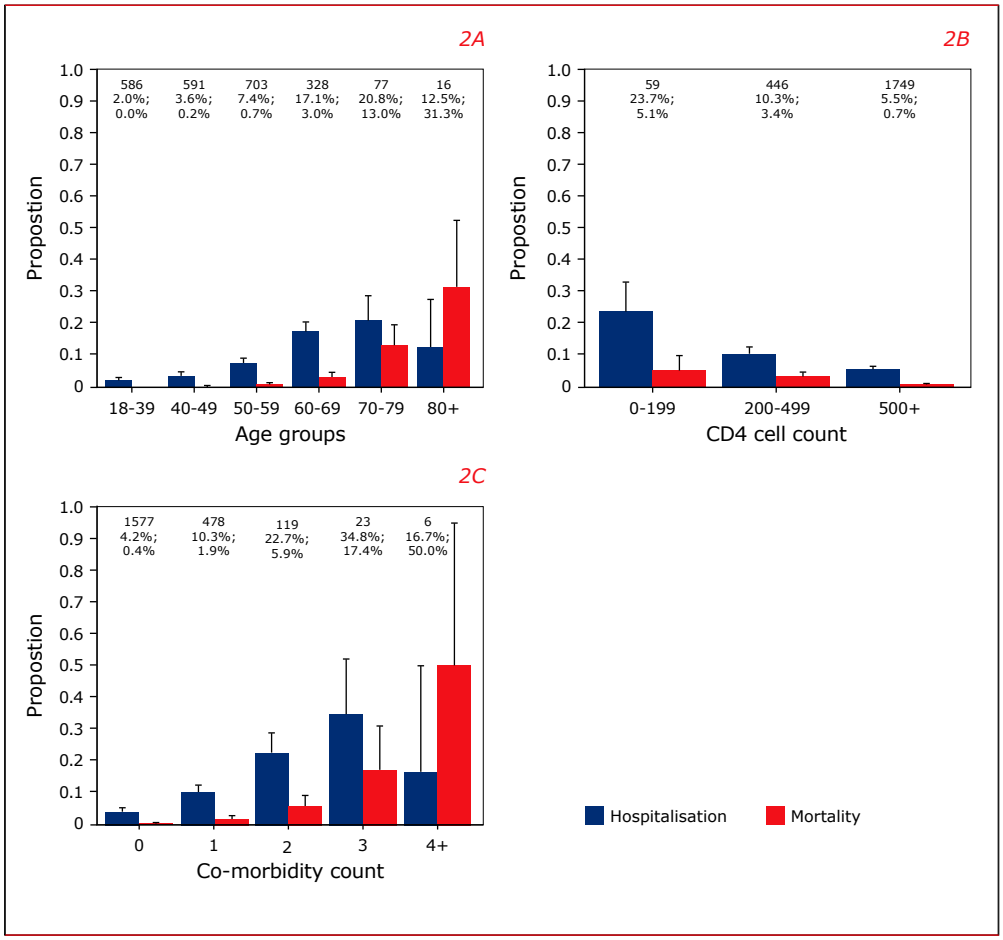
Table 3 shows the demographics, HIV-related characteristics and concomitant comorbidities of those who died of COVID-19 compared to those who recovered. As expected, there were very substantial differences between those who died of COVID-19 and those who survived, with the PWH who died of COVID-19 generally exhibiting poorer health at the onset of COVID-19, a higher number of concomitantly diagnosed comorbidities and less-favourable HIV-related parameters.

Because of the low number of COVID-19-related deaths, statistical power to formally explore risk factors using multivariable regression analysis was limited. Exploratory multivariable logistic regression models showed that independent risk factors for COVID-19-related mortality were (*Table 4*):

- Older age
- A Latin American origin
- A higher number of concomitantly diagnosed comorbidities
- A current CD4 cell count below 500/mm^3 (this risk increased further for CD4 cell counts below 200/mm^3)

Figure 2 shows the crude mortality rates per age group, CD4 cell count category, and comorbidity count.

Figure 2: Proportions of COVID-19-related hospitalisation and mortality by age group, CD4 cell count category, and comorbidity count



Legend: The numbers at the top of the panels denote the number of individuals (top row) and the percentage of hospitalised and deceased individuals (middle and bottom row) in each category.

Ethnicity and severe COVID-19-related outcomes

We attempted to investigate possible differential associations between ethnicity and severity of COVID-19 for various comorbidities, but were limited by the low number of individuals diagnosed with each comorbidity. Only obesity, diabetes mellitus and hypertension were prevalent enough to allow for an exploratory analysis into hospitalisations for COVID-19. This consistently showed that people

of African origin diagnosed with one of these conditions were substantially more likely to be hospitalised for COVID-19, when compared with individuals from the other ethnic groups and native Dutch people diagnosed with the same conditions (data not shown). The number of COVID-19-related deaths in our cohort were too low to allow for any analysis of a possible interaction between ethnicity and comorbidities, even on an exploratory basis.

Discussion

Risk factors

Our analyses confirm that risk factors of severe COVID-19 in the general population also apply to PWH: older age; the presence of (multiple) comorbidities; and belonging to a non-Western migrant population all increase the risk of hospitalisation and/or death. The observed hospitalisation rates and mortality in PWH diagnosed with COVID-19 were very low in those aged below 50 years, but quickly increased in the older age strata. Independent of these general risk factors, having a low current CD4 cell count, and to a lesser extent uncontrolled HIV replication and a prior AIDS diagnosis, were also identified as risk factors. We did not observe an apparent protective effect of the concomitant use of tenofovir disoproxil, nor of any other commonly used antiretroviral agent, as has been reported by other cohorts[26]. Other Western COVID-19 cohorts of PWH found similar patterns of risk factors for severe COVID-19 outcomes[23,31,36–42].

Hospitalisation and mortality

The observed hospitalisation rate was 6.8% in all PWH diagnosed with COVID-19, and 1.2% were admitted to the ICU. The observed mortality rate in hospitalised individuals was 13.0%, and 31.3% for those admitted to the ICU. The mortality in PWH diagnosed with COVID-19 who were not hospitalised was very low (0.4%). Both the hospitalisation and mortality rates in non-hospitalised individuals is likely to represent an overestimation given that most cases of asymptomatic SARS-CoV-2 infection will have passed undiagnosed[43]. Furthermore eight of the nine PWH who were recorded as having died of COVID-19 without having been hospitalised, were already in poor health and living in nursing homes.

Migrant populations

In our study, migrants born in sub-Saharan Africa or Latin America and the Caribbean were at increased risk of hospitalisation and COVID-19-related mortality independent of age, comorbidities and HIV-related parameters. However, these findings should be interpreted with caution because of the limited number of events available for analysis, and the possibility of residual confounding. Migrant

populations in the Netherlands have been shown to be at greater risk of acquiring SARS-CoV-2 compared to the general population[44]. This may be related to a greater likelihood of a lower socio-economic status, which is associated with more crowded and multi-generational housing conditions, higher residential neighbourhood population density, and employment in front-line jobs where SARS-CoV-2 exposure is more likely[44]. Additionally, people with a migrant background with mild COVID-19 symptoms may be less willing to be tested and/or have more barriers to access testing, further increasing the estimates for the risk of serious outcomes in these populations[45].

Another factor that may contribute further to the observed higher risk of severe outcomes in PWH from non-Western migrant groups compared to PWH from the general Dutch population, could be a reduced willingness to be vaccinated against SARS-CoV-2[46–49]. However, it should be noted that most of the observed COVID-19-related mortality occurred before PWH became eligible for the national SARS-CoV-2 vaccination programme. Hence a lower vaccination rate could – at best – only partially explain the increased risk of hospitalisation and mortality in migrants.

Conclusions

We observed a low incidence of severe COVID-19 outcomes in the Dutch population of people living with HIV, very similar to what was observed in other Westerns cohorts of PWH. A major strength of our analysis is that we were able to account for both general and HIV-specific risk factors for severe COVID-19. As a result, we found that underlying comorbidities and other general risk factors for severe COVID-19-related outcomes play a larger role than HIV-related factors in PWH on antiretroviral therapy with well-controlled HIV infection and preserved CD4 cell counts.

Although in Western countries the risk of developing severe COVID-19 is slightly higher in the population of PWH as a whole compared to the general population, this risk is not distributed equally throughout the PWH population. It was found to be greater for:

- older people;
- those with (multiple) comorbidities;
- non-Western minority migrant groups; and
- those with less favourable HIV-related parameters (a small subgroup).

To illustrate this point, in the 707 PWH diagnosed with COVID-19 who were below the age of 50, with a CD4 cell count over 500, and no comorbidities, just 1.7% were hospitalised and none died of COVID-19.

Comorbidities are more prevalent in many populations of PWH than in the general population, either because of a higher prevalence of general risk factors for these comorbidities but possibly also because of the direct effects of HIV itself, as well as (prior) exposure to severe immune deficiency and antiretroviral therapy-related toxicities. As this higher comorbidity burden puts populations of well-treated PWH at increased risk for severe COVID-19 outcomes, HIV care providers should continue to prioritise addressing genuine concerns, misunderstandings, misinformation and other barriers to COVID-19 vaccination in PWH. This is important because vaccination (including timely application of boosters) remains a vitally important strategy for lowering the burden of severe COVID-19 disease in the population of PWH[50].

Table 1: Characteristics of all ATHENA cohort participants and individuals diagnosed with COVID-19

	All PWH	COVID-19, not hospitalised	Hospitalised with COVID-19
N	21,289	2,143	158
Age, years	51.2 (41.4-59.1)	48.8 (39.1-56.7)	58.1 (51.7-65.2)
Male sex	81.9%	80.0%	77.2%
HIV transmission category			
MSM	63.6%	63.6%	41.8%
Other men	18.3%	16.3%	35.4%
Women	18.1%	20.0%	22.8%
Region of origin			
Netherlands / Europe / North America	70.2%	59.6%	51.3%
Sub-Saharan Africa	12.0%	11.6%	20.3%
Latin America / Caribbean	12.6%	16.2%	18.4%
Other	5.2%	12.6%	10.1%
Years known to be living with HIV	12.5 (7.2-18.6)	11.9 (6.6-17.7)	16.0 (9.6-22.5)
On ART	97.9%	98.5%	99.3%
Current ART containing			
Tenofovir disoproxil	29.9%	29.6%	25.7%
Tenofovir alafenamide	42.8%	42.8%	44.7%
Abacavir	17.1%	15.0%	21.1%
Non-nucleoside RT inhibitor	31.1%	31.2%	29.6%
Protease inhibitor	15.7%	12.8%	23.0%
Integrase inhibitor	56.7%	59.9%	58.6%
HIV viral load >200 cps/mL	3.2%	2.2%	7.1%
Current CD4 count, mm^3	690 (510-908)	710 (533-901)	605 (400-830)
Nadir CD4 count, mm^3	248 (119-380)	260 (130-400)	160 (60-270)
Prior AIDS diagnosis	22.2%	18.1%	38.6%
Comorbidities			
Obesity (BMI>30 kg/m^2)	12.4%	13.8%	31.1%
Diabetes mellitus type 2	5.2%	4.6%	16.6%
Cardiovascular disease	3.6%	2.6%	8.6%
Stroke	1.8%	1.7%	7.3%
Hypertension (grade 2+ or on medication)	13.4%	11.8%	25.2%
Non-AIDS-defining malignancy	3.5%	2.4%	5.3%
Chronic kidney disease (eGFR<30 ml/min)	0.8%	0.6%	3.3%
Multimorbidity count			
0	69.0%	70.7%	37.8%
1	23.1%	22.4%	36.4%
2 or more	7.9%	6.9%	25.8%

Legend: *N (%) or median (IQR), as appropriate; MSM = men who have sex with men; eGFR = estimated glomerular filtration rate.*

Table 2: Independent predictors of hospitalisation among people living with HIV who were diagnosed with COVID-19

	Univariable		Multivariable	
Risk factor	Odds ratio (95%CI)	P-value	Odds ratio (95%CI)	P-value
Male sex	0.78 (0.53-1.15)	0.21		
Age (per 10 years increase)	1.90 (1.64-2.20)	<0.0001	1.71 (1.44-2.03)	<0.0001
Region of birth				
Western	1.94 (1.24-3.04)	0.0036	-ref-	
Sub-Saharan Africa	1.41 (0.91-2.18)	0.12	2.06 (1.25-3.39)	0.0047
Latin America / Caribbean			1.31 (0.81-2.13)	0.28
Number diagnosed comorbidities (per 1 more)	2.29 (1.91-2.76)	<0.0001	1.73 (1.40-2.13)	<0.0001
Current CD4 cell count				
- 0 - 199	5.60 (2.88-1.10)	<0.0001	3.53 (1.65-7.57)	0.0012
- 200 - 499	2.07 (1.43-3.00)	0.0001	1.47 (0.98-2.20)	0.062
- 500+	-ref-		-ref-	
Nadir CD4 cell count (per 100 cells/mm^3 increase)	0.72 (0.64-0.80)	<0.0001		
HIV viral load >200 copies/mL	2.41 (1.49-3.92)	0.0004	1.98 (1.13-3.47)	0.017
Prior AIDS diagnosis	2.78 (1.97-3.93)	<0.0001	1.78 (1.16-2.72)	0.0010
Nucleoside-analogue RT inhibitor (NRTI)				
Tenofovir disoproxil	-ref-			
Tenofovir alafenamide	1.30 (0.86-1.97)	0.22		
Abacavir	1.63 (0.99-2.70)	0.058		
No NRTI	1.21 (0.67-2.16)	0.53		
Non-nucleoside RT inhibitor (NNRTI)				
EFV	-ref-			
DOR	0.43 (0.14-1.26)	0.12		
RPV	0.82 (0.35-1.96)	0.66		
Other	1.02 (0.47-2.22)	0.95		
No NNRTI	0.91 (4.8-1.73)	0.76		
Protease inhibitor (PI)				
DRV	-ref-			
ATV	0.36 (0.046-2.73)	0.32		
No PI	0.50 (0.33-0.76)	0.0010		
Integrase inhibitor (INSTI)				
DTG	-ref-			
BIC	1.06 (0.62-1.82)	0.82		
Other	1.02 (0.69-1.51)	0.19		
No INSTI	0.70 (0.41-1.20)	0.92		

Legend: 95% CI = 95% confidence interval.

Table 3: Characteristics of individuals diagnosed with COVID-19 who died of COVID-19 compared to those who survived

	Survived	Died of COVID-19
Number of individuals	2,270	31
Age, years	49.3 (39.6-57.0)	68.7 (60.9-78.2)
Male sex	79.8%	80.7%
HIV transmission category		
MSM	62.4%	45.2%
Other men	17.4%	35.5%
Women	20.2%	19.4%
Region of origin		
Netherlands / Europe / North America	59.3%	45.2%
Sub-Saharan Africa	12.2%	12.9%
Latin America / Caribbean	16.1%	32.3%
Other	12.5%	9.7%
Years known HIV-positive	12.1 (6.6-17.9)	22.1 (13.6-24.0)
On ART	98.6%	100%
HIV viral load >200 cps/mL	2.5%	3.3%
Current CD4 cell count, mm^3	710 (529-900)	417 (316-789)
Nadir CD4 cell count, mm^3	255 (130-390)	119 (62-220)
Prior AIDS diagnosis	19.3%	29.0%
Comorbidities		
Obesity (BMI>30)	15.0%	17.2%
Diabetes mellitus	5.2%	24.1%
Cardiovascular disease	2.9%	13.8%
Stroke	1.8%	27.6%
Hypertension (grade 2+ or on medication)	12.1%	55.2%
Non-AIDS-defining malignancy	2.5%	10.3%
Chronic kidney disease (eGFR<60 ml/min)	0.6%	20.7%
Multimorbidity count		
0	69.1%	17.2%
1	23.2%	31.0%
2	6.3%	27.6%
3	1.2%	13.8%
4 or more	0.2%	10.3%

Legend: N (%) or median (IQR), as appropriate; MSM = men who have sex with men; eGFR = estimated glomerular filtration rate.

Table 4: Independent predictors of mortality among people living with HIV who were diagnosed with COVID-19

Risk factor	Odds ratio (95%CI)	P-value
Age (per 10 years increase)	5.01 (3.18-8.17)	<0.0001
Region of birth		
Western	-ref-	
Sub-Saharan Africa	2.96 (0.72-12.1)	0.13
Latin America / Caribbean	3.32 (1.19-9.21)	0.021
Number of concomitantly diagnosed comorbidities (per 1 comorbidity increase)	2.11 (1.40-3.19)	<0.0001
Current CD4 cell count		
0-199	6.48 (1.22-34.54)	0.029
200-499	2.80 (1.15-6.84)	0.024
500+	-ref-	

Legend: 95% CI = 95% confidence interval.

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