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**Treating HIV-Positive/Non-AIDS Patients for Community-Acquired
Pneumonia with ART**

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Catia Cillóniz¹ · Antonella Ielpo² · Antoni Torres¹

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Abstract

Purpose of Review This article reviews the most recent publications on community-acquired pneumonia (CAP) in the HIV-infected population on antiretroviral therapy (ART), focusing on epidemiology, prognostic factors, etiology, and antimicrobial therapy. The data discussed here were mainly obtained from a non-systematic review using Medline and references from relevant articles.

Recent Findings CAP remains a major cause of morbidity and mortality among HIV-infected patients and incurs high health costs despite the introduction of ART.

Summary HIV-infected patients are generally known to be more susceptible to bacterial pneumonia. *Streptococcus pneumoniae* is the most frequently reported pathogen in HIV-infected patients on ART, who present a higher rate of bacteremia than non-HIV-infected patients. Several studies have also examined microbial etiology and prognostic factors of CAP in HIV-infected patients on ART. Despite the high rate of bacterial pneumonia in these patients, mortality rates are not higher than in patients without HIV infection.

23
Keywords Community-acquired pneumonia · Treatment · HIV infection

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Introduction

26 According to the World Health Organization (WHO), at the
27 end of 2016, there were approximately 36.7 million people
28 living with human immunodeficiency virus (HIV): 25.6 mil-
29 lion in Africa, 3.5 million in Southeast Asia, 3.3 million in the
30 Americas, 2.4 million in Europe, 1.5 million in the Western
31 Pacific, and 360,000 in the Eastern Mediterranean. By mid-

2017, approximately 20.9 million people living with HIV 32
were receiving active antiretroviral therapy (ART), including 33
seven out of every 10 pregnant women living with HIV [1]. In 34
2016, 1.8 million people became newly infected with HIV [2]. 35
The introduction of active ART has changed the epidemiology 36
of HIV infection and acquired immune deficiency syndrome 37
(AIDS) worldwide [3, 4]. However, community-acquired 38
pneumonia (CAP) remains a frequent cause of morbidity 39
and mortality among HIV-infected patients on ART, and in- 40
curs high health costs [4–6]. Some associated factors that con- 41
tribute to the high incidence of CAP in HIV-infected patients 42
on ART are active or passive smoking, alcohol abuse, and 43
intravenous drug use [7**]. 44

Although ART reduces viral replication and systemic in- 45
flammation and improves immune response, the risk of pneu- 46
monia remains high in these patients in part because they 47
present altered immunity and their immune activation persists 48
even when they receive therapy [6]. The incidence of CAP in 49
HIV-infected patients on ART is reported to be between 2.5 50
and 8 cases per 1000 patients per year [8]. The risk of CAP in 51
HIV-infected patients on ART and the probability of mixed 52
infections or pneumonia caused by intracellular pathogens is 53
inversely associated with the CD4 cell count [6, 7**, 9]. 54

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✉ Catia Cillóniz
catiacilloniz@yahoo.com

✉ Antoni Torres
atorres@clinic.cat

¹ Department of Pulmonary Medicine, Institut Clinic del Tòrax,
Hospital Clinic of Barcelona – Institut d’Investigacions Biomèdiques
August Pi i Sunyer (IDIBAPS), University of Barcelona (UB) - SGR
911- Ciber de Enfermedades Respiratorias (Ciberes), C/ Villarreal
170, 08036 Barcelona, Spain

² Department of Medicine and Surgery, Respiratory Disease, and Lung
Function Unit, University of Parma, Parma, Italy

Q1

55 Mortality in HIV-infected patients on ART with CAP ranges
 56 from 6 to 9% [9, 10]; in patients with severe CAP, however,
 57 it may be above 30% [11, 12]. *Streptococcus pneumoniae*
 58 (pneumococcus) is the main pathogen involved in CAP in both
 59 HIV-infected patients on ART and the general population
 60 [9, 13, 14]. HIV is a known risk factor for invasive pneumo-
 61 coccal disease (IPD); even when receiving ART, HIV-infected
 62 patients on ART had a 20-fold increased risk of IPD [7, 15, 16].

64 Vaccination (pneumococcal conjugate [PCV13] and poly-
 65 saccharide vaccines [PPV23]) represents one of the most im-
 66 portant preventive strategies for CAP in HIV-infected patients
 67 on ART [17]. Implementation of programs to help patients
 68 comply with ART and early diagnosis of suspected HIV-
 69 infected patients are key measures for improving CAP
 70 management.

71 **Global Epidemiology of CAP in HIV-Infected**
 72 **Adult Patients**

73 The introduction of ART changed the global epidemiology of
 74 pulmonary infection in the HIV-infected population [18] by
 75 reducing the incidence of opportunistic pulmonary infections.
 76 In high-income countries, such as Europe and the USA, bac-
 77 terial pneumonia (especially pneumococcal pneumonia) is the
 78 predominant lung disease in the HIV-infected population on
 79 ART [4, 9].

80 A Brazilian study of CAP in HIV-infected adult patients
 81 receiving ART for at least 60 days reported an incidence of
 82 pneumonia of 3.07 cases per 100 persons-years. Viral load and
 83 CD4 cell counts were identified as predictive factors for pneu-
 84 monia. Uncontrolled HIV infection (detectable viral load)
 85 doubled the risk for pneumonia, while time-updated increases
 86 in CD4 cell counts represented a protective factor [19].
 87 Analyzing more than 10,000 patients in 34 countries, the
 88 EuroSIDA cohort study reported an incidence of 0.53 cases
 89 per 100 persons-year and identified low CD4 cell count (200–
 90 349 cells/ μ l), current smoking, and higher viral load as risk
 91 factors for pneumonia [20]. Similarly, Mussini et al. [21] re-
 92 ported an incidence of 0.56 cases of pneumonia per 100
 93 persons-year and found the probabilities of first episode of
 94 bacterial pneumonia at 3, 5, 10, and 14 years after ART initi-
 95 ation to be 2%, 2.9%, 4.3%, and 5.7% respectively. The fac-
 96 tors associated with the first episode of bacterial pneumonia
 97 were low nadir CD4⁺, low current CD4, high CD8⁺, low he-
 98 moglobin, unfavorable virological outcome, older age, male
 99 gender, non-Italian nationality, smoking, and longer time to
 100 ART initiation.

101 In a 10-year study of survival of HIV-infected patients ad-
 102 mitted to the ICU in the UK between 1999 and 2009 [22], it
 103 was observed that respiratory disease remains the main cause
 104 of ICU admission. The proportion of patients on ART prior to

ICU admission increased from 37% in the early period (1999–
 2005) to 60% in the late period (2006–2009). In patients new-
 ly diagnosed with HIV, the rates of survival to ICU and hos-
 pital discharge were 69% and 57% respectively. In patients
 with known HIV diagnosis, survival to ICU and hospital dis-
 charge was 80% and 74% respectively.

Another UK study [23] of the implementation of automated
 HIV testing for pneumonia patients admitted to the ICU re-
 ported that prior to this measure, the HIV testing rate in pa-
 tients with pneumonia within 2 weeks of admission was 29%.
 After the implementation of automated HIV testing to all ad-
 mitted patients, 80% of ICU patients with pneumonia were
 tested for HIV infection within 48 h and 73% with 24 h.
 Adopting universal testing for HIV in patients with pneumo-
 nia admitted to ICU is mandatory in order to reduce morbidity
 and mortality.

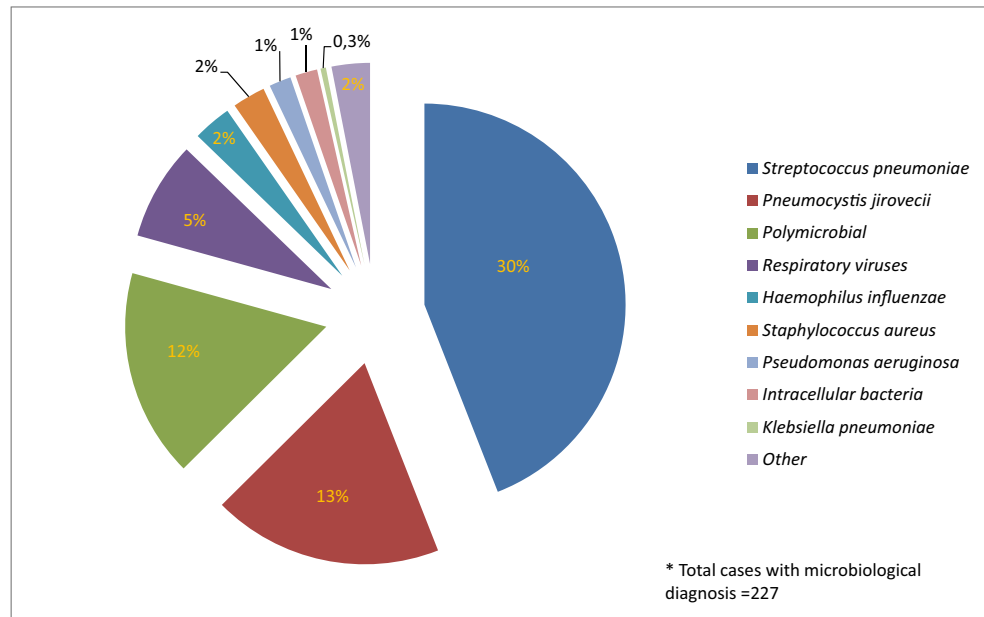
121 **Microbial Etiology of CAP in HIV-Infected**
 122 **Patients**

123 Despite advances in microbiological tests, microbial diagnosis
 124 is achieved in only 40–50% of CAP cases [9, 13]. The bac-
 125 terial etiology of pneumonia is similar in HIV-infected pa-
 126 tients on ART and in the uninfected population [24, 25].
 127 Factors that have an impact on microbial etiology in CAP
 128 are the characteristics of the population, the geographical area
 129 (developed or developing countries), and the methodology
 130 applied to microbial diagnosis [6, 26].

131 A recent prospective observational study of 331 adult CAP
 132 cases in HIV-infected patients from Spain [13] described the
 133 microbial etiology in this population. The most frequently
 134 detected microorganisms were *S. pneumoniae* (30%),
 135 *P. jirovecii* (13%), mixed etiology (11%), respiratory viruses
 136 (5%), *Haemophilus influenzae* (2%), *Staphylococcus aureus*
 137 (2%), and *Legionella pneumophila* (1%). *S. pneumoniae* was
 138 the most frequent microorganism in the group with a CD4+
 139 cell count of ≥ 200 cell/mm³ and *P. jirovecii* in the group of
 140 patients with a CD4+ cell count of < 200 cells/mm³ and in
 141 patients with HIV-RNA ≥ 200 copies/mL. The authors also
 142 reported that ≤ 5 days of symptoms (OR 2.6, 95% CI 1.5–
 143 4.4), C-reactive protein level ≥ 22 mg/dL (OR 4.3, 95% CI
 144 2.3–8.2), and hepatitis C-virus co-infection (OR 2.3, 95% CI
 145 1.4–3.9) were predictors of bacterial CAP, whereas a WBC
 146 count $\leq 4000 \times 10^9$ cells/L (OR 3.7, 95% CI 1.2–11.5), LDH
 147 ≥ 598 U/L (OR 12.9, 95% CI 4.2–39.7), and multilobar infil-
 148 tration (OR 5.8, 95% CI 1.9–19.5) were predictors of
 149 *P. jirovecii*. In that study, HIV infection had been diagnosed
 150 prior to hospital admission in 83% of patients, and 51% of
 151 patients were on ART; the other 17% were diagnosed with
 152 HIV infection during the pneumonia episode (Fig. 1).

153 Pneumococcal pneumonia in HIV-infected patients fre-
 154 quently presents with bacteremia and invasive pneumonia

Fig. 1 Microbial etiology in HIV-infected patients with CAP



155 [7^{**}, 9]. In an earlier Spanish study of the microbial etiology of
 156 CAP in HIV-infected patients, 15% of the study population
 157 presented bacteremia, and pneumococcus was the main patho-
 158 gen involved [13^{**}]. In a study of 129 HIV-infected adult
 159 patients with CAP, the factors that predicted bacteremia were
 160 positive urinary antigen detection and the absence of ART
 161 [27].

162 *Pseudomonas aeruginosa* is also a cause of pneumonia in
 163 HIV-infected patients and is reported in fewer than 6% of CAP
 164 cases [13^{**}, 28]. Risk factors associated with *P. aeruginosa*
 165 CAP in HIV-infected patients are previous antibiotic therapy,
 166 neutropenia, and a low CD4 count [29].

167 *Legionella pneumophila* accounts for approximately 9% of
 168 all adult HIV-associated pneumonias [10]. Other intracellular
 169 pathogens causing CAP in HIV-infected patients include
 170 *Mycoplasma pneumoniae*, *Chlamydomphila pneumoniae*, and
 171 *Coxiella burnetii* [30]. A recent published case-control study
 172 that compared the clinical presentation and outcomes (length
 173 of hospital stay, ICU admission, and 30-day mortality) of
 174 *L. pneumophila* pneumonia in HIV-infected patients (32
 175 cases) and non-HIV-infected patients (96 controls) reported
 176 that clinical presentation and outcomes in HIV-infected pa-
 177 tients with *Legionella* pneumonia did not differ from patients
 178 without HIV infection. The authors suggest that *Legionella*
 179 infection affected with more frequently patients with correct
 180 immunological status [31].

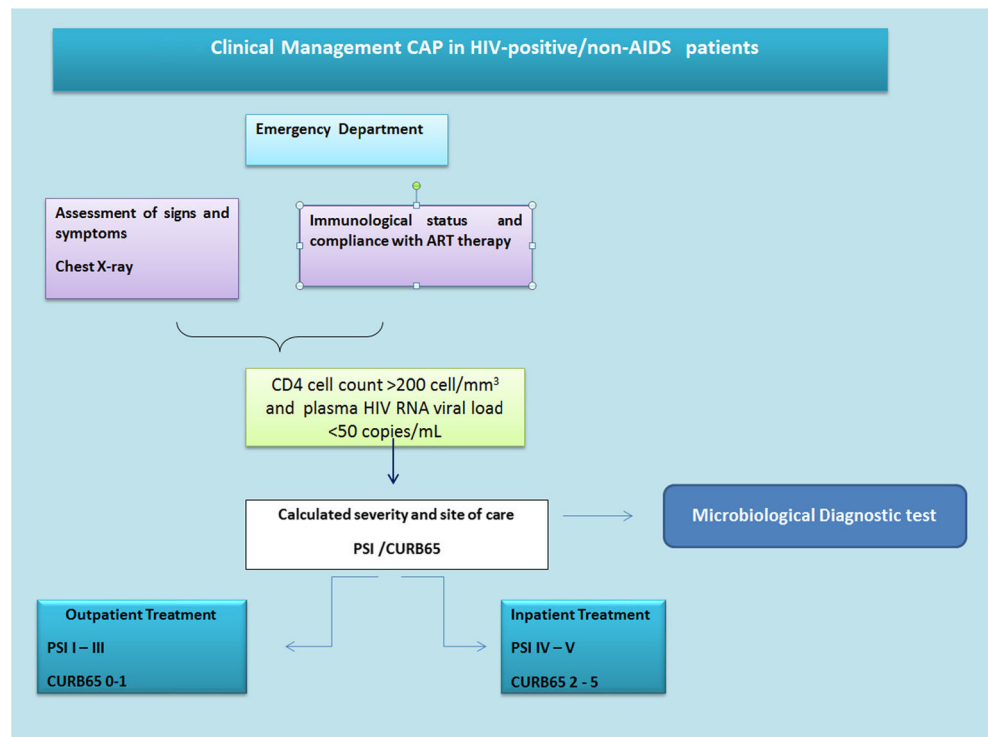
181 **Severity of CAP and Site of Care**

182 To determine the site of care, microbiological testing and the
 183 choice of empiric antibiotic therapy, it is important to assess

the pneumonia severity (Fig. 2). Severity scores for
 predicting short-term mortality have been developed in order
 to allow more objective decisions regarding hospitalization
 to be taken in the general population [32, 33]. The most
 frequent scores are the Pneumonia Severity Index (PSI), rec-
 ommended by the IDSA/ATS guidelines, and the CURB-65
 criteria recommended by the BTS guidelines. However, few
 studies have validated these severity scores in the HIV-
 infected population [10, 34]. In 2008, evaluating the PSI
 score in HIV-infected patients with CAP, Curran et al. [10]
 reported that it accurately predicted high-risk pneumonia and
 mortality. The authors suggested that the combination of
 CD4 cell count value and PSI risk class would help to iden-
 tify patients requiring hospitalization. More recently, a study
 investigating the use of CURB65 in HIV-infected patients
 reported that a higher CURB65 score and a CD4 count lower
 than 200 cells/mL were both associated with worse out-
 comes [34]. The authors concluded that the CURB65 score
 plus CD4 cell count could be used in HIV-infected patients
 with CAP.

An interesting study assessing the predictive value of ana-
 lytical markers of full blood count that can be assessed in the
 emergency department in 160 HIV-infected patients with CAP
 (49% of them on ART) reported that higher red blood cell
 distribution width (RDW) (OR = 1.2, 95% CI 1.1–1.4, *p* =
 0.013) and a lower number of lymphocytes (OR 2.2, 95%
 CI 1.1–2.2, *p* = 0.035) were independent predictors of admis-
 sion to ICU in the multivariate analysis. The small number of
 cases analyzed was a limitation, but the combination of sever-
 ity scores and laboratory data such as RDW and lymphocytes
 may be a good predictor for prognosis in HIV-infected pa-
 tients with CAP [35].

Fig. 2 Clinical management CAP in HIV-positive/non AIDS patients



216 **Microbial Diagnosis of CAP**

217 Microbiological diagnosis of CAP continues to be based on
 218 respiratory samples or blood culture. The most important ap-
 219 plication of these methods is in the determination of antibiotic
 220 susceptibility patterns that allow the selection of appropriate
 221 antimicrobial therapy, which is an important factor for reduc-
 222 ing mortality [36].

223 In general, international guidelines recommend standard
 224 microbiological investigation [37, 38]. In the case of patients
 225 with low to mild pneumonia, microbiological diagnosis is
 226 optional. Extensive microbiological diagnosis is recommend-
 227 ed in cases of severe pneumonia or in cases that do not re-
 228 spond to empiric antibiotic therapy. However, if clinically in-
 229 dicated, an extensive microbiological diagnosis should be per-
 230 formed (Fig. 3).

Microbiological test	Outpatient	Inpatient low severity	Inpatient non ICU moderate severity	Inpatients ICU high severity
Sputum culture	None routinely	X	X	X
Pneumococcal urinary antigen test		None routinely	X	X
<i>Legionella</i> urinary antigen test			X	X
Blood culture			X	X
Invasive respiratory tract sample culture				X
Others				X
Specific guidelines recommendations:				
*Outpatients with failure of antibiotic therapy: sputum culture, urinary antigen test for <i>Legionella pneumoniae</i> and <i>Streptococcus pneumoniae</i> .				
*Positive urinary antigen test for <i>pneumococcus</i> or <i>Legionella</i> : sputum and blood culture for positive urinary antigen test for pneumococcus and sputum culture for positive urinary antigen test for <i>Legionella</i> .				
*Severe obstructive lung disease: sputum culture				
*Severe obstructive lung disease: sputum culture Cavitary infiltrates: sputum culture (bacterias, fungal and mycobacterias) and blood culture.				
*Active alcoholism: sputum and blood culture, urinary antigen test for pneumococcus and <i>Legionella</i> .				
* Severe CAP admitted to intensive care unit (ICU): sputum and blood culture, urinary antigen test for pneumococcus and <i>Legionella</i> , tracheal aspirate or bronchoalveolar lavage culture.				
* Epidemiological factor or specific risk factors suggesting pathogen: urinary antigen test for <i>Legionella</i> (Legionnaires disease), influenza test during influenza season				

Fig. 3 International guideline recommendation for microbiological diagnostic test in CAP

Figure 4. Empiric therapy for CAP in HIV-infected Patients on ART

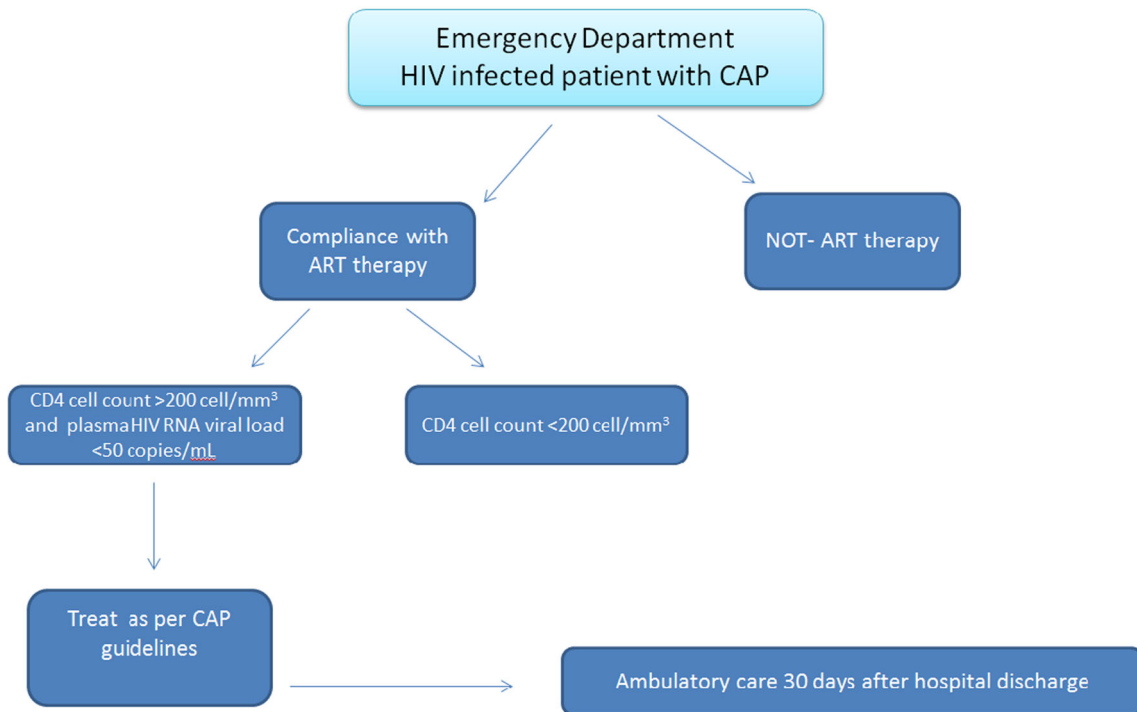


Fig. 4 Empiric therapy for CAP in HIV-infected patients on ART

231 Blood cultures, sputum staining, sputum culture, and urinary
 232 primary antigen testing for *Legionella* and pneumococcus should
 233 be carried out in patients with severe CAP. Since influenza
 234 viruses present in seasonal epidemics, rapid antigen or direct
 235 fluorescent antibody testing is recommended to guide decisions
 236 regarding antiviral therapy and may help to reduce the
 237 use of antibacterial agents.

238 In recent years, the development and implementation of
 239 molecular diagnostic tests for pneumonia have been major
 240 advances in the microbiological diagnosis of respiratory pathogens.
 241 These technologies achieve rapid results (within 1–2 h) and may
 242 be useful in the decision management of patients, especially with
 243 regard to the early initiation of appropriate antimicrobial therapy,
 244 a factor associated with mortality. The rapid identification of
 245 antibiotic resistant pathogens is also central to timely isolation
 246 of patients. However, the main limitations of these technologies
 247 are their reduced ability to differentiate between colonization and
 248 infection and their cost-effectiveness [39].

250 **Microbiome**

251 A new challenge for microbiologists and clinicians has arisen
 252 with the study of the pulmonary microbiome, which has changed
 253 our current concept of pneumonia [40]. It is

254 now known that the lungs are a dynamic microbiological
 255 ecosystem, and the new data show us that pneumonia involves
 256 a dysbiosis or alteration of the lung microbiome [39, 41].

257
 258 An interesting study addressed by Iwai et al. [42**] compared
 259 oral and airway microbiota in patients with and without HIV-
 260 infection. The authors reported that HIV-infected patients with
 261 pneumonia have an increased abundance of phylogenetically
 262 distinct taxa, which included Firmicutes and Prevotellaceae
 263 compared with the presence of Proteobacteria-enriched
 264 communities in non-HIV-infected patients with pneumonia.
 265 A second interest study published by the same authors compared
 266 the lung microbiome between HIV-infected patients from
 267 Ugandan with pneumonia to pneumonia patients from San
 268 Francisco. The authors reported that the microbiome
 269 composition of lower airway of HIV-infected patients with
 270 pneumonia in Uganda was significantly different from those
 271 in San Francisco. The author suggested that these differences
 272 may be due to the clinical status, age, and/or pneumonia
 273 type across the geographically distinct cohorts. The profile
 274 of microbiome in Uganda patients was enriched by
 275 Proteobacteria, being *Pseudomonas aeruginosa* the pathogen
 276 more frequently detected. On the other hand, lung microbiome
 277 in patients from San Francisco was enriched for Firmicutes
 278 and Actinobacteria [43].

Q3 t1.1 Table 1 International guidelines for the management and treatment for community-acquired pneumonia

t1.2 Pneumonia severity	Low severity	Moderate severity	High severity
t1.3 GNAC guidelines	<ul style="list-style-type: none"> • Moxifloxacin or levofloxacin: 5 to 7 days • Amoxicillin or amoxicillin-clavulanate (7 days) + macrolide (azithromycin 3–5 days or clarithromycin 7 days) • Cefditoren is an alternative with is not possible use amoxicillin or quinolones 	<ul style="list-style-type: none"> • Third-generation (e.g., cefotaxime or ceftriaxone) cephalosporin or • Amoxicillin-clavulanate + macrolide (azithromycin or clarithromycin) • Moxifloxacin or fluoroquinolone monotherapy 	<ul style="list-style-type: none"> • Non-antipseudomonal cephalosporin in high dose (ceftriaxone 2 g/24 h, cefotaxime 2 g/6–8 h) + macrolide (azithromycin 500 mg/day or clarithromycin 500 mg/12 h) • Alternative: moxifloxacin (400 mg/24 h) or levofloxacin (500 mg/12 h) instead of macrolides
t1.4 BTS guidelines	<ul style="list-style-type: none"> • CURB65 scores 0–1 • Treat with oral amoxicillin or doxycycline or clarithromycin 	<ul style="list-style-type: none"> • CURB65 score 2 • Treat with oral/intravenous amoxicillin + clarithromycin or doxycycline, moxifloxacin, or levofloxacin 	<ul style="list-style-type: none"> • CURB65 scores 3–5 • Treat with co-amoxiclav plus clarithromycin/benzylpenicillin plus levofloxacin or ciprofloxacin/or cephalosporin plus clarithromycin
t1.5 ATS/IDSA guidelines	<ul style="list-style-type: none"> • PSI OR CURB65 score to guide outpatient treatment • Treat with macrolide or doxycycline: patients with low risk of drug-resistant pneumococcus • Treat with fluoroquinolone or β-lactam + macrolide: patients with high risk of drug-resistant pneumococcus 	<ul style="list-style-type: none"> • Direct admission to ICU: septic shock requiring vasopressor support and /or respiratory failure requiring intubation and ventilation. • β-Lactam plus a macrolide or fluoroquinolone 	
t1.6 ERS/ESCMID guidelines	<ul style="list-style-type: none"> • CURB65 to guide outpatient treatment • Treatment: <ul style="list-style-type: none"> *Aminopenicillin ± macrolide *Aminopenicillin/b-lactamase inhibitor ± macrolide *Non-antipseudomonal cephalosporin II or III + macrolide *Cefotaxime or ceftriaxone ± macrolide *Penicillin G ± macrolide 	<ul style="list-style-type: none"> • ICU admission: acute respiratory failure, severe sepsis, or septic shock and radiographic extension of infiltrates/severely decompensated comorbidities • No risk factors for <i>P. aeruginosa</i>: non-antipseudomonal cephalosporin III + macrolide or non-antipseudomonal cephalosporin III + moxifloxacin or levofloxacin • Risk factors for <i>P. aeruginosa</i>: antipseudomonal cephalosporin or acyl ureidopenicillin/β-lactamase inhibitor or carbapenem (meropenem preferred) plus ciprofloxacin or plus macrolide + aminoglycoside (gentamicin, tobramycin, or amikacin) 	

References: [35, 36, 39, 40]

279 The new investigations about the lung microbiome in HIV-
 280 infected patients have provided novel insights and new knowl-
 281 edge about the mechanisms of microbial pathogenesis in
 282 pneumonia in this population.

283 **Initial Empiric Therapy**

284 When a HIV-infected patient with CAP is admitted to the
 285 emergency department, clinicians should check the immuno-
 Q2 286 logical status (CD4+ cell/count) and compliance with ART. If
 287 patients are on ART and have a CD4 lymphocyte count of >
 288 200 cells/mm³, the empiric antibiotic therapy for CAP is sim-
 289 ilar to that administered in the general population [13**] and
 290 complies with the international guidelines recommendations
 291 for CAP [37, 38, 44, 45]. All patients will be visited within
 292 30 days after hospital discharge and followed up on an outpa-
 293 tient basis (Fig. 4).

294 Initial empiric therapy for CAP should be guided by the site
 295 of care, age, previous use of antibiotics within the previous

90 days, the presence of comorbidities (risk of resistant path- 296
 ogens), and drug intolerance. 297

Empiric antiviral therapy for influenza may be necessary 298
 when the clinical and epidemiological criteria are met. Several 299
 studies reported that 1 to 6% of patients hospitalized with 300
 H1N1 were HIV-infected [46, 47]. In an American study, 301
 HIV patients with influenza experienced similar rates of ICU 302
 admission (29% vs. 34%) and mortality (13% vs. 13%) to 303
 those of non-HIV patients [46]. Ormsby et al. [48] suggested 304
 that the 2009 H1N1 infection was more severe in HIV- 305
 infected patients with late and advanced HIV disease than in 306
 well-controlled patients on ART. 307

Two groups of antiviral drugs are currently available 308
 for influenza: M2-protein-inhibitors (amantadine and 309
 rimantadine) and neuraminidase inhibitors (zanamivir and 310
 oseltamivir). These antivirals should be administered with- 311
 in 48 h of symptom onset. In cases of severe pneumonia, 312
 medication is recommended even 48 h after symptom 313
 onset. 314

Empiric antibiotic therapies recommended by international 315
 guidelines are summarized in Table 1 [37, 40, 41*, 44]. 316

317 Drug interactions between ART and CAP antibiotic therapy
 318 represent an important issue for clinicians. However, pen-
 319 icillins, betalactam inhibitors, and levofloxacin do not interact
 320 with ART. For its part, moxifloxacin has a low interaction with
 321 atazanavir and lopinavir which are protease inhibitors. As
 322 moxifloxacin has been shown to prolong the QT interval,
 323 clinicians should exercise caution with its use, especially in
 324 the case of patients with pre-existing risk factors (bradycardia,
 325 long congenital QT, electrolyte imbalances). Caution is also
 326 required in these patients regarding the use of azithromycin
 327 since it may cause abnormal changes in the electrical activity
 328 of the heart, and since the interactions between atazanavir,
 329 lopinavir and saquinavir (protease inhibitors), and rilpivirine/
 330 FTC/TAF (NNRTIS) are low.

331 Clarithromycin presents more drug interaction with all
 332 classes of antiretrovirals (protease inhibitors, NNRTIS, entry
 333 and integrase inhibitors, and nucleoside/tide analogues) be-
 334 cause it can lead to a prolonged QT interval. In patients with
 335 long QT syndrome, cardiac disease, or in patients taking other
 336 QT-prolonging medications, this can increase the risk of life-
 337 threatening arrhythmias [49]. So the use of azithromycin is
 338 preferred. For more information on drug-drug interaction,
 339 consult

340 <https://www.hiv-druginteractions.org/checker>

341 **Conclusions**

342 Despite the advent of ART, pneumonia remains a major cause
 343 of disease in the HIV-infected population. Pulmonary infec-
 344 tions are also the main cause of ICU admission. *Streptococcus*
 345 *pneumoniae* (pneumococcus) remains the most frequently de-
 346 tected cause of CAP in HIV-positive/non-AIDS on ART. The
 347 clinical presentation and management of CAP are similar in
 348 HIV-infected patients on ART and in uninfected patients, and
 349 outcomes in HIV virologically suppressed patients on ART
 350 with > 350 CD4+ T cell counts/mm³ are similar to those in the
 351 general population. The general recommendation is that these
 352 patients do not need special treatment, admission, or sites of
 353 care. Treatment of HIV-positive/non-AIDS patients with CAP
 354 is also similar to that in the general population and should
 355 follow international guidelines.

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363 **Conflict of Interest** Catia Cillóniz, Antonella Ielpo and Antoni Torres no
 364 conflict of interest.

Human and Animal Rights and Informed Consent This article does not
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AUTHOR QUERIES

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- Q1. Please check if the affiliations are presented correctly 
- Q2. Please check if the reference citations captured in the sentence that begins with “If patients are on ART and have a CD4 lymphocyte...” are correct 
- Q3. Please check if Table 1 is presented/captured correctly 

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