Bacterial Co-infections in HIV/AIDS-positive Subjects: A Systematic Review and Meta-analysis

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Key words: HIV/AIDS, bacterial co-infection, Iran


Background: Bacterial infections are the most common complications in people with HIV/AIDS. There has been no previous report on the prevalence of bacterial co-infections in Iranian HIV/AIDS-positive subjects.

Aim: To evaluate the frequency of bacterial infections in hospitalized HIV/AIDS-infected patients in Iran.

Materials and methods: Based on PRISMA guidelines, a computerized search in related data banks using relevant keywords was performed in both Persian and English languages for articles that were published until March 10, 2017. A total of 1118 original articles were systematically reviewed to identify eligible studies on the prevalence of bacterial co-infections in HIV/AIDS-infected patients from Iran. After screening for inclusion and exclusion criteria, we extracted data from 28 eligible articles for the meta-analysis.

Results: The overall bacterial infection rate among Iranian HIV/AIDS-positive individuals was estimated to be 48.6%. Gastrointestinal disorders (59.5%) were the most frequent bacterial infections in this group of patients followed by bacterial lymphadenopathy (38.9%), TB infection (38.2%), bacterial pneumonia (31.2%), brucellosis (26.3%), skin infections (13.3%) and sexually transmitted infections (9.7%). The prevalence of other bacterial infections including endocarditis, sepsis and Staphylococcus aureus (S. aureus) were 10%, 9.1%, and 6.9%, respectively.

Conclusion: The prevalence of a wide spectrum of bacterial co-infections, especially endemic infections, in Iranian HIV/AIDS-infected patients, is alarming and calls for urgent need to improve the currently applied diagnostic and preventive methods. In addition, timely treatment of these infections is pivotal to decrease the morbidity and mortality rates in HIV/AIDS-infected patients.

Abbreviations used in this article
HIV: human immunodeficiency virus; AIDS: acquired immunodeficiency syndrome; ELISA: enzyme linked immunosorbent assay; EIA: electrochemiluminescence immunoassay; MRSA: methicillin-resistant Staphylococcus aureus; TB: tuberculosis; PCR: polymerase chain reaction; NA: not available.

BACKGROUND

Human immunodeficiency virus (HIV) causes acquired immunodeficiency syndrome (AIDS) and is a significant problem for the global public health.¹ The virus targets the immune system and impairs both humoral and cellular immunity resulting in increased susceptibility of the host to a wide range of infections including bacterial, viral, fungal and parasitic infections.²,³ According to the latest reports of the World Health Organization (WHO), there were about 36.7 million (34.9 million adults and 1.8 million children <15) people living with HIV at the end of 2015 as well as 2.1 million new HIV infections worldwide in 2015.⁴ HIV infection is
rapidly expanding in the Middle East. In Iran, a country in the Middle East, the first case of HIV/AIDS was observed in Tehran in 1987. Reports on the prevalence of HIV/AIDS in Iran are different. Based on the performed studies, the number of HIV-infected individuals in Iran was estimated to be 93250. However, according to the total number of registered cases, by September 2014 there were 28663 people living with HIV in Iran and 6435 of these individuals developed primary infection to AIDS stage. Sexual contact with an infected partner is the most important route of HIV transmission worldwide. In Iran, needle-sharing injection drug use and then sexual contact are the two most important transmission routes. Due to suppression of the immune system in HIV-positive individuals, they are susceptible to many dangerous infectious diseases. Early prevention, diagnosis and treatment of these infections before the development of severe forms of the disease is important for reducing the related morbidity and mortality rates as well as associated health costs. Therefore, it will be useful to have an estimation of the prevalence of bacterial infections in Iranian HIV-positive individuals. Data on the spectrum of bacterial co-infections in HIV-infected patients from Iran have been sporadic. The aim of this paper was to evaluate the prevalence of bacterial infections in hospitalized HIV/AIDS-infected patients in Iran.

MATERIALS AND METHODS
SEARCH STRATEGY
A systematic search was conducted using PubMed, Scopus, Google Scholar, and ISI web of knowledge databases, as well as Scientific Information Database (www.sid.ir), IranDoc (www.irandoc.ac.ir), Iranmedex (www.iranmedex.ir), and Magiran (www.magiran.com) as national search databases in medical and life sciences, to create a library containing studies reporting on the prevalence of bacterial co-infections in HIV/AIDS-infected patients from Iran. Using the extracted terms from the MeSH database, “human immunodeficiency virus” OR “HIV” OR “acquired immunodeficiency syndrome” OR “AIDS” AND “bacterial infections” AND “Iran”, computer searching was performed both in Persian and English languages for articles that were published until March 10, 2017. We attempted to obtain any missing data through two supplementary methods, checking reference lists and hand searching of journals. The procedure was compliant with the PRISMA (Preferred reporting items for systematic review and meta-analyses) checklist.

STUDY SELECTION AND ELIGIBILITY CRITERIA
We checked all cross-sectional or cohort studies on bacterial-HIV co-infections for eligibility criteria to include in the meta-analysis. The PRISMA flow diagram shows study selection processes (Fig. 1).

Figure 1. Flow diagram of summarized study selection processes.
Inclusion criteria to selected studies were: 1) published paper in Persian and English languages, 2) the prevalence of co-infection with HIV only in Iranian people, and 3) cross-sectional and cohort studies. A large number of collected scientific documents and records were sequentially excluded according to the following eligibility criteria: 1) unpublished and duplicate data, 2) studies that were reported as abstracts or reviews and duplicates, 3) abstract list of congresses, 4) letters and case report studies, 5) assessment of prevalence of HIV/AIDS co-infections in other countries or citizens of other countries residing in Iran, 6) assessment of clinical syndromes in HIV/AIDS without microbiological profiles, no sufficient information and no accessible full text, 7) assessment of clinical infections among hospitalized patients except for the HIV/AIDS-positive subjects, 8) frequency of microflora prevalence in HIV/AIDS-positive individuals, 9) assessment of prevalence of viral, fungal and parasitic infections in HIV/AIDS patients, and 10) evaluation of prevalence rate of HIV/AIDS disease alone.

**DATA EXTRACTION**

To avoid mistakes in study selection process, screening and data extraction from reports were independently performed by two of the researchers after reviewing title, abstract and full text of all articles. Searches were performed in the identical approach. The extracted data in **Table 1** included: 1) first author, 2) year of the study 3) area (city) of the study, 4) sex, 5) age mean, 6) number of patients with HIV/AIDS, 7) HIV/AIDS detection methods, 8) type and number of bacterial infections, and 9) bacterial detection methods.

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**Table 1.** Frequency of bacterial infections in patients with HIV/AIDS in Iran

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Area</th>
<th>Sex F/M</th>
<th>Age mean</th>
<th>Patients with HIV/AIDS (n)</th>
<th>HIV/AIDS detection methods</th>
<th>Bacterial infection (n)</th>
<th>Bacterial detection methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alavi et al.11</td>
<td>2009-2011</td>
<td>Ahvaz</td>
<td>8 male</td>
<td>32.7</td>
<td>8</td>
<td>EIA Western-blot</td>
<td>Tuberculosis (8)</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Alavi et al.12</td>
<td>2007-2008</td>
<td>Ahvaz</td>
<td>NA</td>
<td>NA</td>
<td>3</td>
<td>NA</td>
<td>Tuberculosis [Legionella pneumophila (3)]</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Alavi et al.3</td>
<td>2001–2003</td>
<td>Ahvaz</td>
<td>40 male</td>
<td>25±6.3</td>
<td>40</td>
<td>ELISA Western-blot</td>
<td>Tuberculosis (20)</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Alavi et al.3</td>
<td>2001–2003</td>
<td>Ahvaz</td>
<td>40 male</td>
<td>25±6.3</td>
<td>40</td>
<td>ELISA Western-blot</td>
<td>Tuberculosis (20)</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Makiani et al.13</td>
<td>2013-2014</td>
<td>Bandar Abbas</td>
<td>NA</td>
<td>NA</td>
<td>28</td>
<td>NA</td>
<td>Tuberculosis (8)</td>
<td>Phenotypic and genotypic</td>
</tr>
<tr>
<td>Mamani et al.14</td>
<td>2013</td>
<td>Hamedan</td>
<td>NA</td>
<td>NA</td>
<td>18</td>
<td>NA</td>
<td>Tuberculosis (17)</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Mirzaei et al.15</td>
<td>1997-2011</td>
<td>Hamadan</td>
<td>64/521</td>
<td>32.5</td>
<td>585</td>
<td>ELISA Western-blot</td>
<td>Tuberculosis (21)</td>
<td>NA</td>
</tr>
<tr>
<td>Alizade et al.1</td>
<td>2014</td>
<td>Kerman</td>
<td>6/43</td>
<td>NA</td>
<td>49</td>
<td>NA</td>
<td>Diarrheagenic Escherichia coli (49)</td>
<td>Phenotypic and genotypic</td>
</tr>
<tr>
<td>Honarvar et al.16</td>
<td>2012-2013</td>
<td>Shiraz</td>
<td>NA</td>
<td>NA</td>
<td>9</td>
<td>NA</td>
<td>Tuberculosis (9)</td>
<td>Phenotypic and genotypic</td>
</tr>
<tr>
<td>Hassan-zadeh et al.17</td>
<td>2011-2012</td>
<td>Shiraz</td>
<td>60/120</td>
<td>20-80</td>
<td>180</td>
<td>NA</td>
<td>MRSA (23)</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Rezaee et al.18</td>
<td>2013</td>
<td>Sanandaj</td>
<td>10/79</td>
<td>33.31±7.47</td>
<td>89</td>
<td>ELISA Western-blot</td>
<td>Brucellosis (18)</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Rad et al.19</td>
<td>2007</td>
<td>Sanandaj</td>
<td>2/68</td>
<td>34.07±7.6</td>
<td>70</td>
<td>NA</td>
<td>Skin diseases [Folliculitis (21), Furuncle (7), Skin TB (3), Abscess (1), Bacillary angiomatosis (1)]</td>
<td>Phenotypic</td>
</tr>
<tr>
<td>Study</td>
<td>Year</td>
<td>Location</td>
<td>Sample Size</td>
<td>Age (Mean ± SD)</td>
<td>Test Method</td>
<td>Diagnoses</td>
<td>Type of Test</td>
<td></td>
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<tr>
<td>---------------</td>
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<td>--------------</td>
<td>-------------</td>
<td>----------------</td>
<td>-------------</td>
<td>-----------------------------------------------</td>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td>Sharifzadeh et al.²⁰</td>
<td>2011-2013</td>
<td>Tehran</td>
<td>22/78</td>
<td>32.3 ± 10.0</td>
<td>ELISA</td>
<td>Pneumonia [M. tuberculosis (28), other bacterial agents (53)]</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Kafí et al.²¹</td>
<td>2011</td>
<td>Tehran</td>
<td>5/38</td>
<td>20-52 ± 0.0</td>
<td>NA</td>
<td>Western-blot</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Abdollahi et al.²²</td>
<td>2010-2011</td>
<td>Tehran</td>
<td>15/99</td>
<td>37.5 ± 3.3</td>
<td>PCR</td>
<td>H. pylori (30)</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Sheikholeslami et al.²³</td>
<td>2010-2011</td>
<td>Tehran</td>
<td>14/112</td>
<td>35.12 ± 12.6</td>
<td>NA</td>
<td>Pneumonia [M. tuberculosis (28), other bacterial agents (53)]</td>
<td>Phenotypic and genotypic</td>
<td></td>
</tr>
<tr>
<td>Abdollahi et al.²⁴</td>
<td>2010</td>
<td>Tehran</td>
<td>22/68</td>
<td>36.5 ± 1.03</td>
<td>ELISA</td>
<td>H. pylori (66)</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Mohammadnejad et al.²⁵</td>
<td>2008-2009</td>
<td>Tehran</td>
<td>6/65</td>
<td>35 ± 8.1</td>
<td>ELISA</td>
<td>Tuberculosis (20)</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Hajiabdolbaghi et al.²⁶</td>
<td>2007-2008</td>
<td>Tehran</td>
<td>35/149</td>
<td>37.6 ± 18.4</td>
<td>Western-blot</td>
<td>Brucellosis (66)</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Foroughi et al.²⁷</td>
<td>2007-2008</td>
<td>Tehran</td>
<td>55/221</td>
<td>34.8 ± 8.49</td>
<td>Western-blot</td>
<td>Folliculitis (9)</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Hadadi et al.²⁸</td>
<td>2006-2009</td>
<td>Tehran</td>
<td>9/63</td>
<td>37.2 ± 8.9</td>
<td>NA</td>
<td>Lymphadenopathy [Tuberculosis (24), S. pyogen (2), S. aureus (2)]</td>
<td>Phenotypic and genotypic</td>
<td></td>
</tr>
<tr>
<td>Tabarsi et al.²⁹</td>
<td>2005-2007</td>
<td>Tehran</td>
<td>65 male</td>
<td>38 ± 8</td>
<td>ELISA</td>
<td>Tuberculosis (65)</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Jam et al.³⁰</td>
<td>2006-2007</td>
<td>Tehran</td>
<td>27/235</td>
<td>30 ± 262</td>
<td>NA</td>
<td>Tuberculosis (63)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Badie et al.³¹</td>
<td>2004-2008</td>
<td>Tehran</td>
<td>94/356</td>
<td>36 ± 450</td>
<td>Western-blot</td>
<td>Syphilis (24)</td>
<td>Phenotypic</td>
<td></td>
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<tr>
<td>Seyed Alinaghi et al.³²</td>
<td>2000-2005</td>
<td>Tehran</td>
<td>177 male</td>
<td>35 ± 177</td>
<td>ELISA</td>
<td>Pneumonia [M. tuberculosis (62), other bacterial pneumonia (333)]</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Farma et al.³³</td>
<td>2001</td>
<td>Tehran</td>
<td>NA</td>
<td>NA ± 85</td>
<td>NA</td>
<td>Tuberculosis (15)</td>
<td>Phenotypic</td>
<td></td>
</tr>
<tr>
<td>Foroushani et al.³⁴</td>
<td>2001-2010</td>
<td>West Azerbaijan</td>
<td>1223/1337</td>
<td>31-65 ± 98</td>
<td>NA</td>
<td>Tuberculosis (98)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Sharifimood et al.²</td>
<td>2000-2005</td>
<td>Zahedan</td>
<td>47/5</td>
<td>21-54 ± 52</td>
<td>ELISA</td>
<td>Tuberculosis (28)</td>
<td>Phenotypic</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Forest plot of frequency of bacterial infections in patients with HIV/AIDS in Iran.

Figure 3. Funnel plot of the meta-analysis on bacterial co-infections in Iranian HIV/AIDS-positive subjects.
STATISTICAL ANALYSIS

Due to heterogeneity or inconsistency, all data synthesis was performed based on random-effects model. We checked for variability in study results with a chi-squared test (Cochrane Q-test) (p<0.05 was considered statistically significant) and I-squared index. Data were pooled through the fixed-effects model to calculate the frequency of bacterial infections among the HIV/AIDS-positive people in Iran. The outcome was expressed as percentage and 95% confidence intervals (95% CIs). Assessments of the possibility of risk of publication bias across studies which is due to unpublished data with negative results was showed by produce asymmetry in funnel plots. We conducted meta-analyses in Comprehensive Meta-Analysis (CMA) software version 2.2 (Biostat, Englewood, NJ, USA) and GraphPad InStat software version 3.

RESULTS

STUDY CHARACTERISTICS

Twenty-eight published papers in Persian and English were collected according to the eligibility of the studies for inclusion in this review. After search from electronic bibliographic sources, a total of 1118 studies were identified. Duplicates were removed and 1053 articles remained. Of these, 253 studies were selected for abstract evaluation. Reviewing the abstracts led to the removal of 204 articles because topics were not relevant and did not meet the criteria. Eventually, 49 full text articles were evaluated in more details and 24 papers were excluded due to non-eligibility of studies for reasons such as being non-original, not presenting sufficient data, and not reporting co-infections. Three additional studies that met the criteria for inclusion were added to our meta-analysis after checking the references (Fig. 1).

Table 1 shows the main characteristics of 28 included studies that were found by up to March 10, 2017. Most of the studies were reported from Tehran (14 times), followed by Ahvaz (3 times), Shiraz, Hamadan, Zahedan, and Sanandaj (each with 2 studies), and Bandar Abbas, Kerman and West Azerbaijan (each with 1 study). A total of 3378 people living with HIV/AIDS were included in the studies. The overall bacterial infection rate among Iranian HIV/AIDS-positive individuals was estimated to be 48.6% (95% confidence interval [CI]: 35 to 62.4) (Fig. 2). In most studies, diagnosis of HIV/AIDS infection was performed using enzyme-linked immunosorbent assay (ELISA) and confirmed using western-blot method. As depicted in Fig. 3, the funnel plot was used to identify the presence of publication bias.

CHARACTERISTICS OF INFECTION

Tuberculosis (TB) infection

From 1997 to 2014, a total of 17 relevant studies were evaluated co-infections HIV/AIDS and tuberculosis (TB) in Iranian subjects. The prevalence of TB infection was 38.2% (95% CI: 26.1 to 52). Phenotypic methods such as smear and culture from sputum samples and chest X-rays were used to identify TB infection. Tuberculin skin test (TST) for latent tuberculosis infection (LTBI) and rarely genotypic were also used.

Bacterial pneumonia

Five studies reported co-infections HIV/AIDS and bacterial pneumonia in Iran. Bacterial pneumonia prevalence in this patient was 31.2% (95% CI: 13.2 to 57.4). The most important causes of bacterial pneumonia were Legionella pneumophila (1.63%), Mycobacterium tuberculosis (M. tuberculosis) (46.9%) and unknown bacterial agents (51.3%).

Brucellosis

In this review, there were only 3 studies to evaluate the sero-prevalence of HIV/AIDS co-infections and Brucella infection in Iran where brucellosis is endemic. Positive serologic brucellosis was observed in 26.3% (95% CI: 3.9 to 75.8) of HIV-infected patients. Phenotypic procedures used for the diagnosis of brucellosis were serological tests including Wright, Coombs-Wright, 2ME (2-mercaptoethanol) and ELISA for detection of IgM and IgG antibodies.

Skin diseases

Skin and soft tissue infection including folliculitis, furuncle, skin TB, abscess, and bacillary angiomatosis were detected in 4 studies. Frequency of bacterial infection among HIV positive patients with skin manifestation was 13.3% (95% CI: 3.4 to 39.9). Histopathological examination, skin test and other relevant microbiological methods were used for skin diseases diagnosis.

Sexually transmitted infections (STI)

Syphilis, gonorrhea and vulvovaginitis were three type of sexually transmitted infections among Iranian the HIV/AIDS-positive subjects. Frequency of sexually transmitted infections among HIV positive patients was 9.7% (95% CI: 5.5 to 16.6). Microbiological techniques were the most important methods for detection of these diseases.
Gastrointestinal disorders

Four studies were assessed for gastrointestinal disorders in Iranian HIV/AIDS-positive patients. Gastrointestinal disorders include typhoid, diarrheagenic *E. coli* (DEC) and *H. pylori* infections showed the highest prevalence of HIV/HBV co-infection. The prevalence of these three types of infections were 59.5% (95% CI: 25.7 to 86.2).

Bacterial lymphadenopathy

*M. tuberculosis*, *Streptococcus pyogenes* (*S. pyogen*), and *Staphylococcus aureus* (*S. aureus*) were the three most common bacterial agents for lymphadenopathy. Bacterial lymphadenopathy rate was found to be 38.9% (95% CI: 28.4 to 50.5).

The prevalence of other bacterial infections including endocarditis, sepsis and *S. aureus* were 10% (95% CI: 20 to 37.7), 9.1% (95% CI: 5 to 16.1), and 6.9% (95% CI: 1.5 to 26.5), respectively.

DISCUSSION

In Iran, the prevalence of HIV infection classified as being concentrated epidemics due to low incidence in the general population (0.02%), and high prevalence among injecting drug users, 13.8%.8,36 The comprehensive report on HIV in Pakistan revealed that the number of people living with HIV is estimated to be 130000, (0.1%).37

Generally, HIV infection is rapidly diagnosed based on the presence or absence of HIV antibodies.4 Our review revealed ELISA and western-blot methods as the most widely used techniques in Iran. Among opportunistic infections affecting people living with HIV/AIDS, bacterial infections are the most common. This study shows that the overall bacterial infection rate among the Iranian HIV/AIDS-positive individuals was 48.6%. According to the WHO data, TB is the most common life-threatening opportunistic infection in HIV/AIDS-positive individuals and one third of the HIV-positive population in the world is estimated to have co-infection with TB.38,39 The incidence of TB infection is approximately 30% in HIV-infected patients in the world.40 In the present study, the prevalence of TB infection in Iranian HIV/AIDS-positive patients was high (38.2%). This prevalence rate is higher than those reported from South Ethiopia (18.2%)41 and Southern India (18.9%)42, but lower than those reported from South Africa (70%)43 and Vietnam (72.5%)44.

Bacterial pneumonia is frequent among HIV/AIDS-positive patients in the world and a preventable cause of death in this population.45 Bacterial pneumonia is 25-fold more common in HIV-infected versus HIV-negative subjects.45 *M. tuberculosis* and *S. pneumoniae* are the two major microorganisms responsible for pneumonia in HIV-positive patients of developing and developed countries, respectively.35,46 In Iran, the most important causes of bacterial pneumonia were unknown bacterial agents, *M. tuberculosis* and *Legionella pneumophila*.

Brucellosis is an endemic disease in Iran and a risk factor for HIV/AIDS-positive subjects.18 These patients are highly susceptible to brucellosis because elimination of the intra-cellular *Brucella* infection requires both humoral and cellular immune responses.24 Therefore, information about the prevalence of brucellosis in the HIV-infected groups is necessary. However, only a few studies, mostly case report, have evaluated the co-infection of brucellosis in HIV-infected patients.47 In a report from Spain, the relationship between the two infections with a low rate of brucellosis in HIV-positive patients.48 In the current study, the prevalence of HIV/AIDS co-infected with brucellosis was 26.3%.

Association between skin and soft tissue manifestations with HIV is common.49 Cutaneous disorders are an important manifestation of HIV infections and occur in more than 90% of HIV-infected patients.50 In our study, the prevalence of bacterial infections responsible for cutaneous disorders among HIV-positive patients was 13.3%. Similar results have been reported by Chawhan et al. (12.7%).50 Ulcerative and non-ulcerative STI, as a risk factor for HIV infection, facilitate HIV transmission.51 The most common STI infections in HIV-positive patients are *Treponema pallidum*, *Chlamydia trachomatis* and *Neisseria gonorrhoeae* infections.38 In this study, gonorrhea was the most common STI with a prevalence of 17.1%. The mean prevalence of HIV-STI co-infection in Iran was 9.7%, which is lower than those reported from Africa (11.3%), Asia (17.4%), Europe (14.7%), and North America (16.1%).51

Gastrointestinal disorders are a commonly reported distress occurring in HIV-infected patients.52 These disorders affect HIV morbidity and mortality and can be correlated to numerous factors, including opportunistic infections.52 In the present study, typhoid, diarrheagenic *E. coli* (DEC), and *H. pylori* infections were the most common gastrointestinal infections in Iran (59.5%). The incidence of *H. pylori* infection in Iranian HIV/AIDS-positive subjects was 62.4% (95% CI: 50.5 to 73). However, it was lower than those reported by Geraghty et al. (71.6%)53,
and higher than those reported by Hestvik et al. (22.5%)\(^4\), Lichterfeld et al. (23%)\(^5\), and Sud et al. (47.9%)\(^6\). The high prevalence of *H. pylori* in the Iranian HIV-infected patients may be attributed to the 90% incidence of *H. pylori* rate of bacteria in Iran.\(^7\) DECs are responsible for diarrhea in HIV-infected individuals and are more common in HIV-positive than healthy subjects.\(^8\) Typhoid fever, or typhoid, is an acute systemic bacterial infection caused by *Salmonella enterica* serovar Typhi.\(^9\) HIV-associated typhoid fever is a health problem mainly in developing countries.\(^10\) A prevalence of 9.6% (95% CI: 4.1 to 21.1) for typhoid fever in HIV/AIDS patients in Iran is lower than that reported by Agwu et al. from Nigeria (44.2%)\(^11\), but higher than that reported by Crump et al. from Northern Tanzania (1.2%)\(^12\).

Lymphadenopathy is a common clinical finding at any stage of HIV/AIDS disease.\(^13\) A wide range of etiologic agents are responsible for lymphadenopathy in patients infected with HIV including TB and opportunistic infections.\(^14\) According to the results of this study, the prevalence of bacterial lymphadenopathy was 38.9%. In the present study, TB was the most frequent cause of lymphadenopathy in HIV-infected subjects (33.3%). Similar results have been reported from Brazil and India.\(^15\)

The prevalence of bacterial sepsis in HIV-infected patients is estimated to be 1,000 cases per 100,000 patients.\(^16\) Sepsis or septic shock infection is a systemic illness occurring due to bacterial invasion into sterile sites of the body, and also as a result of weak innate immune response in HIV-infected patients. Sepsis accounts for a high rate of morbidity and mortality worldwide.\(^17-19\) The prevalence of the co-occurrence of sepsis due to bacterial agents and HIV/AIDS in Iranian patients was 9.1%, which is lower than those reported by Silva et al. (36.1%)\(^20\), Moreira et al. (11.4%)\(^21\), Alebachew et al. (31%)\(^22\), and Taramasso et al. (70%)\(^23\).

Methicillin-resistant *S. aureus* (MRSA) infection is common in the general population; however, it is more prevalent in HIV-infected patients. HIV infection is a contributing factor to the higher prevalence of MRSA colonization.\(^24\) The prevalence of MRSA infections was 12.8% in Iran which is higher than the global prevalence average (6.9%) and the prevalence in North America (8.8%).\(^25\)

Infective endocarditis (IE) is a condition with significant morbidity and mortality which is related to many risk factors including female sex, older age, injection drug use and heart diseases.\(^26\) Infection happens in higher rates in HIV-infected compared with HIV-negative patients.\(^27\) *S. aureus* is the most common bacterial pathogen isolated from IE.\(^28\) Similar results were obtained in the present study. The prevalence of bacterial endocarditis-HIV co-infection in the Iranian HIV-infected patients was 10% which is consistent with the results reported by Smith et al. (11.5%).\(^29\)

**CONCLUSION**

A wide spectrum of bacterial co-infections is seen in Iranian HIV/AIDS-infected patients. The high prevalence of some bacterial infections including TB infection, gastrointestinal disorders and bacterial lymphadenopathy causes a real concern for the proper management of these diseases in HIV-infected patients. This calls for strategies to provide quick diagnosis and drug treatments in order to reduce the morbidity and mortality resulting from bacterial co-infections. Also, preventive strategies against bacterial infections that are endemic in Iran such as TB, brucellosis and *H. pylori* infections may help improving the care of HIV-infected Iranian patients with bacterial co-infections.

**REFERENCES**


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Введение: Бактериальные инфекции являются наиболее распространённым осложнением среди больных с ВИЧ / СПИДом. До сих пор не представлены научные сообщения о распространении бактериальных коинфекций среди ВИЧ-инфицированных больных из Ирана.

Цель: Установить частоту бактериальных инфекций у ВИЧ-инфицированных больных из Ирана.

Материалы и методы: Был осуществлен компьютерный поиск в соответствующих базах данных с использованием ключевых слов на основе принципов PRISMA (Preferred reporting items for systematic reviews и meta analyses) статей как на персидском, так и на английском языках, опубликованных до 10 марта 2017 года. Всего было проанализировано 1118 статей для определения соответствующих нашей цели исследований по распространению бактериальных коинфекций среди ВИЧ-инфицированных больных из Ирана. После проверки критериев включения и исключения поиска мы извлекли данные из 28 соответствующих нашей цели статей для метаанализа.

Результаты: Общий уровень бактериальных инфекций среди иранских ВИЧ-положительных больных составил 48.6%. Желудочно-кишечные расстройства (59.5%) являются наиболее распространёнными бактериальными инфекциями в этой группе, за ними следуют бактериальная лимфаденопатия...
(38.9%), туберкулёзная инфекция (38.2%), бактериальная пневмония (31.2%), бруцеллёз 13.3%) и инфекции, передающиеся половым путём (9.7%). Распространённость других бактериальных инфекций, включая эндокардит, сепсис и Staphylococcus aureus (S. aureus) составила 10%, 9.1% и 6.9% соответственно.

Выводы: Распространение широкого спектра бактериальных конъюнктив, особенно эндемических инфекций среди пациентов, затронутых ВИЧ / СПИДом из Ирана, вызывает тревогу и требует неотложных действий в совершенствовании диагностических и профилактических методов, используемых в настоящее время. Кроме того, своевременное лечение этих инфекций должно быть руководящим принципом снижения смертности и заболеваемости ВИЧ-инфицированных больных.

Сокращения:
HIV: вирус иммунодефицита человека; СПИД: синдром приобретённого иммунодефицита; ELISA: фермент-связанный иммуносорбентный анализ; ЭИД: электрохимолюминесцентный иммунный тест; MRSA: устойчивый к метициллину Staphylococcus aureus; ТБ: туберкулёз; ПЦР: полимеразная цепная реакция; НН: не наличествует