

## PATHOGENIC PROFILE OF FEMALE PATIENTS WITH GENITAL TRACT INFECTIONS IN A TERTIARY HOSPITAL IN SUB-SAHARAN AFRICA'S SETTING

Nana Njamen T<sup>1,2\*</sup>, Tchente Nguetack C<sup>1,3</sup>, Njamen Nana C,<sup>1</sup> Ntoleack Nkemtendong P<sup>4</sup>, Okalla C<sup>3,6</sup>, Belley Priso E<sup>1,4</sup>, Assob NJC<sup>5</sup> and Ngowe Ngowe M<sup>2,4</sup>

<sup>1</sup>Department of Obstetrics and Gynecology, Douala General Hospital, Cameroon.

<sup>2</sup>Department of Surgery, Obstetrics and Gynecology. Faculty of Health Sciences, University of Buea, Cameroon.

<sup>3</sup>Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Cameroon.

<sup>4</sup>Faculty of Medicine and Biomedical Sciences, University of Yaoundé I, Cameroon.

<sup>5</sup>Department of Medical Laboratory Sciences, Faculty of Health Sciences, University of Buea, Cameroon.

<sup>6</sup>Department of Bacteriology, Douala General Hospital, Cameroon.

\***Corresponding author:** Dr Nana Njamen Théophile. Department of Surgery, Obstetrics and Gynecology. Faculty of Health Sciences, University of Buea, Cameroon. (237)677654819, [njanatheo@yahoo.fr](mailto:njanatheo@yahoo.fr)

### ABSTRACT

**Background:** For several decades, Sexually Transmitted Infections (STIs) have been a public health concern in Cameroon. Currently the practice of self-medication, traditional treatment, street drugs, and misconceptions about STIs complicate the management due to microbial resistance and clinical manifestations increasingly sneaky.

**Objective:** To identify the current pathogens profile in a series of patients suffering from STIs, that could improve the ongoing management of patients in our milieu.

**Patients and Methods:** It was a cross-sectional and prospective study that took place in the Gynecology / Obstetrics and Bacteriology Departments of the Douala General Hospital (DGH) from October 1<sup>st</sup>, 2015 to November 31<sup>st</sup>, 2017. Patients with HIV or viral STIs were excluded.

**Results:** Of the 720 patients recruited, 704 (97.7%) were retained; 16 were excluded due to: non-pathogenic bacteria (8 patients, 1.1%); genital condyloma (3 patients, 0.4%) and HIV (5 patients, 0.6%). The average age was  $30.9 \pm 8.0$  years and 67% were between 20 and 34 years; 51.7% were married; 84.1% had a secondary or university level of education. One hundred and twenty-three (17.4%) patients were asymptomatic and 131 (18.6%) patients had chronic pelvic pain. *Chlamydia trachomatis* (33.17%) and *Mycoplasma spp* (*Ureaplasma urealyticum* (19.09%) and *Mycoplasma hominis* (13.12%)) were the most commonly pathogens found; followed by *Candida albicans* (10.5%), *Staphylococcus aureus* (6.7%), *Gardnerella vaginalis* (4.9%), *Klebsiella pneumoniae* (4.41%), and *Escherichia coli* (3.82). *Streptococcus agalactiae* (1.68%), *Treponema pallidum* (0.95%), *Trichomonas vaginalis* (0.95%) and *Neisseria gonorrhoea* (0.71%).

**Conclusion:** We observed a very low rate of *Neisseria gonorrhoea*, mainly to the benefit of *Chlamydia trachomatis*, *Ureaplasma urealyticum* and *Mycoplasma hominis* infections. The asymptomatic nature of these infections in nearly one-quarter of the patients increases the need of proper sensitization of populations on the importance of primary prevention and that the current approach of syndromic treatment of STIs in Cameroon should be revised.

**Keys words:** Pathogens, Genital tract infections, sexually transmitted diseases.

## INTRODUCTION

Sexually transmitted infections (STIs) have been a public health problem in Cameroon for several decades, during which bacterial genital infections with *Chlamydia trachomatis* and *Neisseria Gonorrhoea* are described as being the most common [1]. The syndromic treatment approach is still relevant in our context where unfortunately the clinic is sometimes misleading [2]; In view of our environment subject to potential bacteriological mutations due to self-medication, inappropriate prescriptions of antibiotics (in terms of dosage, quality and duration of treatments) and the enthusiasm of populations for traditional medicine of which the contours are not yet well controlled, it was appropriate to conduct this study to know the current pathogens profile of Cameroonian women suffering from genital infections and consequently improve their care.

## PATIENTS AND METHODS

It was a cross-sectional and prospective study that took place in the Gynecology / Obstetrics and Bacteriology departments of Douala General Hospital (DGH) from October 1<sup>st</sup> 2015 to November 31<sup>st</sup> 2017. The target population was sexually active women aged 15 and over who had a genital infection; recruitment was consecutive. Those included were all whose gynecological and biological examinations were performed respectively in the departments of Gynecology / Obstetrics and bacteriology of the DGH with identification of pathogenic bacteria. Were excluded, those who had benefited from syndromic treatment or self-medication of antibiotics one week before the biological examinations requested; patients with HIV or viral STIs and patients whose bacteriology did not reveal any pathogenic germs

After informed consent of patients whose presenting complaints were suggestive of genital infection and of those consulting for gynecological checkup, data collection was done in 3 steps:

1. An interview using a pre-tested questionnaire on the socio-demographic data (age, level of education, marital status) and the clinical manifestations.
2. The gynecological examination looked at the anamnesis that is the presenting complaint (pelvic pain, secondary dyspareunia, secondary dysmenorrhoea); at the clinic looking at pelvic tenderness in the abdominal palpation, pain in the mobilization of the cervix (Sign of Chandelier) and annex, the presence and appearance of

pathological leucorrhoea (creamy, yellowish, greenish), the presence of vulvar ulceration.

3. Samples and biological analyses were done by the team of biologists. Each vaginal swab was done with sterile swabs in the posterior sac and endocervix for cervico-vaginal secretions and serosities; the dry tubes were used for blood sampling. Once the samples were taken, they were immediately treated for bacterial, parasitic and mycosis agents. The technical approach included:

A fresh microscopic examination of cervico-vaginal secretions in search of flagellate and mobile trichomonas and yeasts.

A microscopic examination with a black background for the examination of serosities (chancres).

The detection of variable Gram coccobacilli and mycoplasmas by gram and fluochrome staining respectively.

A Whiff test for the examination of vaginal secretions in search of *Gardnerella vaginalis*.

Culture of endocervix samples on chocolate agar media and CO<sub>2</sub>-rich atmosphere for difficult-growing seeds (*Neisseria gonorrhoea*).

A culture of the samples taken from the Douglas bagulose on Sabouraud agar for the isolation of *Candida* strains and Chapman agar for *Staphylococcus aureus*.

A detailed examination of the colonies after 48 hours incubation taking into account their number, type, morphology, the production or non-production of pigment and the biochemical characteristics of seeded germs (presence of arginine for *Mycoplasma hominis* and urea for *Ureaplasma urealyticum* (Mycfast Evolution 3 Culture Media is a liquid method based on the ability of *M. hominis* and *U. urealyticum* to metabolise urea and arginine, respectively. The presence of genital mycoplasmas is indicated by a change in colour with the aid of phenol red. This changes the colour of the media from yellow to orange or red owing to the release of ammonia with significant concentration measurements  $\geq 10^4$  UCC / mL for each isolated species).

The detection of circulating IgG antibodies of *Chlamydia trachomatis* by serological methods (*Chlamydia trachomatis* IgG/IgM EIA (Viricell SL): considering the limits of the serology with respect to the IgA and IgM antibodies in their incapacity to objectify the recent or current infections, we considered the antibodies IgG that are of diagnostic

interest for levels of titre  $\geq 1/64$ . However, the acute or chronic character of the infection was then dependent on the clinical picture of the patients.

The detection of treponema was done by specific serological tests (TPHA) and non-specific activity (VDRL). For this study, we considered patients who were positive for both tests (TPHA + / VDRL +) (ABON, Alere).

The detection of HIV and HBS antigen was done by rapid serological tests (ABON, Alere). If the test was positive, a confirmatory immunoenzymatic assay (ELISA) was performed for HIV testing.

The analysis of the biological data made, the validation of the results obtained was confirmed by the biologists and the collection of these results was done in the registers of the laboratory for the appreciation of the variables concerning the profile of the germs met.

**Data analysis.** The data collected was computerized and analyzed in the Microsoft Office Excel 2007 calculation software. Descriptive statistics were used to calculate frequencies and proportions. Quantitative variables were described by their mean, standard deviation, median, maximum and minimum while the qualitative variables were described by their size and percentage. The level of significance was set at P less than 0.05. The results were presented in the form of tables and figure.

**Ethical considerations:** This study was conducted with:

- The authorization of the ethic committee of the Douala General Hospital.

-The informed consent of the patients

## RESULTS

Of the 720 patients recruited, 704 (97.7%) were retained; 16 were excluded due to: non-pathogenic bacteria found (8 patients, 1.1%); genital condyloma (3 patients, 0.4%) and HIV (5 patients, 0.6%).

The average age was  $30.9 \pm 8.0$  years and 67% were between 20 and 34 years; 51.7% were married; 84.1% had a level of secondary or university education.

One hundred and twenty-three (17.4%) patients were asymptomatic and 131 (18.6%) patients had chronic pelvic pain. Pelvic pains, leucorrhoea and vulvar pruritus were the main clinical manifestations.

NB: The asymptomatic cases concerned those who consulted for a gynecological checkup, or for infertility, without any clinical manifestation associated.

**Table 1: Sociodemographic characteristics**

Age group (Years)	Number of cases	Percentage (%)
[15-20[	53	7.5
[20-25[	127	18.0
[25-30[	159	22.6
[30-35[	191	27.1
[35-40[	78	11.1
[40-45[	54	7.7
[45-50[	28	4
[50-55[	14	2
<b>Total</b>	<b>704</b>	<b>100</b>
<b>Level of education</b>		
Less educated	27	3.8
Primary	85	12.1
Secondary	243	34.5
University	349	49.6
<b>TOTAL</b>	<b>704</b>	<b>100</b>
<b>Marital status</b>		
Married	364	51.7
Single	313	44.5
Unmarried	27	3.8
<b>Total</b>	<b>704</b>	<b>100</b>

**Table 2 : Clinical Manifestations**

Clinical Manifestations	Number of cases	%
Asymptomatic	123	17.4
Chronic pelvic	131	18.6
Acute pelvic pain + Fever	45	6.3
Vulvar itching	96	13.6
Deep dyspareunia	93	13.2
Secondary dysmenorrhea	64	9
Offensive leucorrhoea	64	9
Mild dyspareunia	22	3.1
Purulent leucorrhoea	18	2.5
Creamy leucorrhoea	48	6.8
<b>TOTAL</b>	<b>704</b>	<b>100</b>

They were monomicrobial infections in 620 patients (88.1%) and polymicrobial infections in 84 patients (11.9%).

Chlamydia trachomatis and Mycoplasma infections (Ureaplasma urealyticum and Mycoplasma hominis) were the most commonly encountered pathogens. On the other hand, the rate of Neisseria gonorrhoea was low (0.71%).

DISCUSSION

Socio-demographic characteristics (Table I)

The average age of our series was 30.9 years with extreme ages of 16 and 55; 67% (472 patients) were between 20 and 34 years old. Belley et al. in 2009 on a series of 250 cases at the Douala General Hospital (DGH) had reported an average age of 32 years with extreme ages of 18 years and 45 years [20]. Ngaba et al in a series of 102 cases reported an average age of 28.7 years with extremes of 15 and 49 years [3].

Table 3: Pathogens found per patient

Pathogens	Number of cases	%
<i>Chlamydia trachomatis</i>	246	34.9
<i>Ureaplasma urealyticum</i>	104	14.7
<i>Mycoplasma hominis</i>	68	9.6
<i>Mycoplasma hominis</i> + <i>Ureaplasma urealyticum</i>	24	3.4
<i>Chlamydia t.</i> + <i>Ureaplasma</i> + <i>Mycoplasma h.</i> + <i>E coli</i>	9	1.2
<i>Chlamydia t.</i> + <i>Ureaplasma</i> + <i>Mycoplasma h.</i> + <i>St aureus</i>	9	1.2
<i>Chlamydia t.</i> + <i>Ureaplasma</i> + <i>Klebsiella pneumoniae</i>	14	1.9
<i>Gardnerella vaginalis</i>	21	2.9
<i>Gardnerella vaginalis</i> + <i>Candida</i>	20	2.8
<i>Staphylococcus aureus</i>	47	6.6
<i>Neisseria gonorrhoea</i>	6	0.8
<i>Klebsiella pneumoniae</i>	23	3.2
<i>Escherichia coli</i>	15	2.1
<i>Escherichia coli</i> + <i>Candida</i>	8	1.1
<i>Streptococcus agalactiae</i>	14	1.9
<i>Treponema pallidum</i>	8	1.1
<i>Trichomonas vaginalis</i>	8	1.1
<i>Candida albicans</i>	60	8.5
<b>Total</b>	<b>704</b>	<b>100</b>

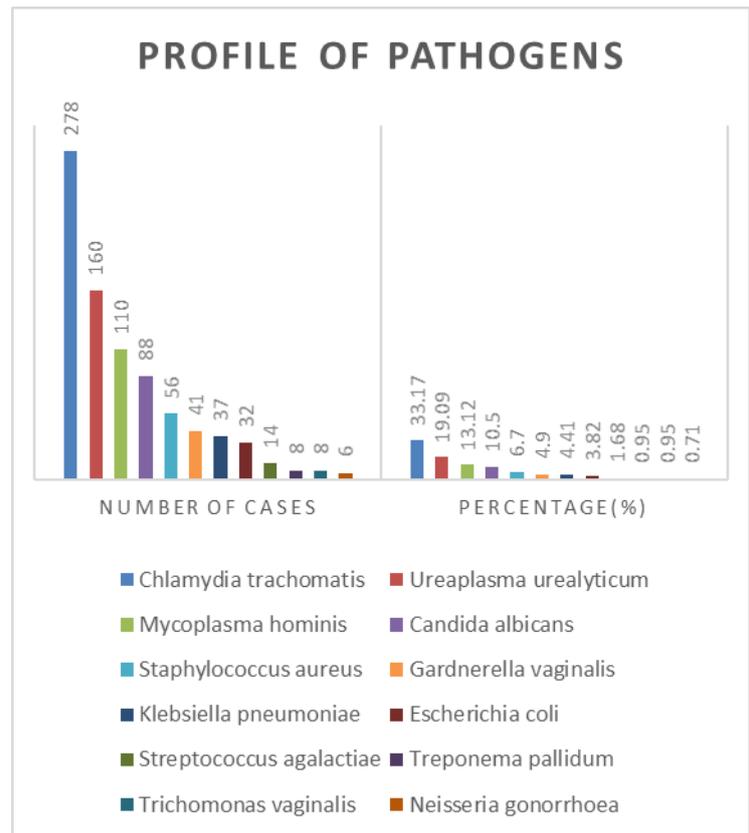


Figure 1: Profile of pathogens encountered

These data are similar to those of Marks et al, who reported an average age of 28 years with extremes of 23 to 33 years in a series of 296 cases in the locality of Honiara (Solomon Islands) [4]. These are essentially young populations in sexual activity; young people and especially women belong to the most vulnerable groups to STIs in our environment [1,5]. In 49.6% (or 349 patients), the university level of study predominated. Ngaba et al made the same observation in their series with a higher level of study that predominated in 49.2% of cases [3]. This could be explained by the link between the level of education and the understanding of the stakes of a possible genital infection. Married women were the majority in our study (364 patients, or 51.7%) followed by single (313 patients, or 44.5%). Mboudou et al observed on a series of 415 cases, 72.5% (301 cases) of married women and 24.3% (101 cases) of single [6]. The predominance of married women in our series could be explained by the fact that they enjoy a certain financial stability and are therefore much more concerned with their state of health, hence their presence in consultation.

### Clinical manifestations (Table 3)

In contrast to the noisy nature of the symptoms that were previously evident in at least *Neisseria gonorrhoea* and *Chlamydia trachomatis* [7], only 6.3% of patients had acute pelvic inflammatory disease.

### Pathogens per patient (Table 2)

We found polymicrobial infections in 11.9% of patients. For some authors, the polymicrobial appearance of crops is observed very frequently (21 to 43% of cases) [8,9,10]; and about 5% to 8% of salpingitis due to gonococcus are co-infected with *Chlamydia trachomatis* [11,12].

### Profile of identified pathogens (Figure 1)

*Chlamydia trachomatis* and *Mycoplasma* infections (*Ureaplasma urealyticum* and *Mycoplasma hominis*) were the most recovered. *Chlamydia trachomatis* infection is the most prevalent sexually transmitted bacterial infection in the world, with approximately 90 million cases per year; in the United States 40 to 50% of non-gonococcal urethritis is due to *Chlamydia trachomatis* infection; their role in the occurrence of pelvic inflammatory diseases and ectopic pregnancies is currently known [13]. The prevalence of *Chlamydia* infections is increasing in France and will reach 1.6% among women aged 18 to 44 and 3.2% among those aged 18 to 29 years [14]. Despite numerous controversies about the pathogenicity of *Mycoplasmas* [15, 16, 17], the deleterious role of certain species (*Mycoplasma hominis*, *ureaplasma urealyticum*, *Mycoplasma genitalium*) on the female or even male genital tract is known [15,18, 19,20]; hence the obligation of treatment when the biological diagnosis is positive, irrespective of the symptomatology which is most often sneaky [21]. Contrary to the literature that incriminates *Neisseria gonorrhoea* among the main germs found in sexually transmitted bacterial infections [22], our study finds it at a very negligible rate, or 0.71%. Surveillance networks in France have observed an increase in the number of female gonorrhoea since 2005 after a period of decrease until 1998 and stability until 2004 [23].

**Enterobacteria:** It should be noted that enterobacteria found in our series such as: *Escherichia coli*, *Streptococcus agalactiae*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, come from the commensal flora digestive and oropharyngeal. On the other hand, vaginitis of sexually transmitted origin should always be eliminated in case of positive diagnosis. Ngaba *et al* in their series found 11.78%

Enterobacteria, 8.82% *Staphylococcus aureus* and 1.96% *Streptococcus* spp [3].

***Gardnerella vaginalis:*** *Gardnerella vaginalis* is the pathogen responsible for the initiation of Bacterial vaginosis. Bacterial vaginosis (BV) is the most prevalent cause of symptomatic vaginal discharge and is associated with complications of reproductive health, such as preterm birth and acquisition or transmission of sexually transmitted infections (STIs), including human immunodeficiency virus infection [24,25]. It is clear that BV is characterized by dramatic changes in the vaginal flora, from lactobacillus predominance to a marked decrease in lactobacilli, particularly those producing hydrogen peroxide [26]. Lactobacilli are replaced by the facultative anaerobe *Gardnerella vaginalis*, and strictly anaerobic bacteria markedly increase in concentration [27]. As reviewed elsewhere [28,29], the epidemiology of BV strongly indicates that it is acquired via sexual transmission.

The prevalence of *Gardnerella vaginalis* in our series was 5 %, less than 30.4% found by Ngaba *et al* [3].

***Candida albicans:*** The polymorphic fungus *Candida albicans* (CA) is a member of the normal human microbiome. In most individuals, CA resides as a lifelong, harmless commensal. Under certain circumstances, however, CA can cause infections that range from superficial infections of the skin to life-threatening systemic infections. Predisposing factors for Vulvo-Vaginal Candidiasis include diabetes mellitus, use of antibiotics, oral contraception, pregnancy and hormone therapy [30]. 15 % (13 cases) of our patients suffering from vulvo-vaginal candidiasis were pregnant; during pregnancy the vaginal milieu become too acidic, therefore enhance the proliferation of *Candida albicans*. In 7 % (6 cases) their partners complained from penis itching, justifying the possibility of sexual transmission of *Candida albicans*. The prevalence of CA was 10.5 % in our series, less than 32.35 % found by Ngaba *et al* [3].

***Trichomonas vaginalis:*** Based on estimates of the World Health Organization (WHO) from 2008, *Trichomonas vaginalis* (TV) is the most prevalent non-viral STI worldwide, affecting more than 276 million people every year [22]. *Trichomonas vaginalis* is the most common STI in Africa [31]. As trichomoniasis is not a life-threatening disease, it was often belittled as a “nuisance infection” in the past. A large number of studies from the last 20 years or so, however, have shown that underlying TV infections

increase the risk of adverse pregnancy outcomes and contagion with HIV virus [32].

This is an alarming finding, given the fact that HIV and TV are often jointly epidemic in many parts of the world. Our study found a prevalence of 1.1 % not to distant from 1% and 1.9 % obtained respectively by Ngaba *et al* and Isiaka *et al* in HIV uninfected women [3, 33].

**Treponema pallidum:** We found a prevalence of 1.1% of *Treponema pallidum* infection in our series. Syphilis remains a public health problem in Africa with rates of 9.1% and 9.3% observed among women in West African regions [34,35].

## CONCLUSION

Our study reveals an almost absence of *Neisseria Gonorrhoea* bacterial infections, mainly to the benefit of *Chlamydia trachomatis*, *Ureaplasma urealyticum* and *Mycoplasma hominis* infections. The asymptomatic nature of these infections in nearly one-quarter of our patients justifies that the populations should be sensitized on the importance of primary prevention and that the current approach of syndromic treatment of STIs in Cameroon should be revised.

## REFERENCES

- [1]. Institut National de la Statistique et ICF International. Enquête Démographique et de Santé et à Indicateurs Multiples du Cameroun 2011. Calverton, Maryland : INS et ICF International; 2012
- [2]. National Policy, Standards and Guidelines for the Syndromic Management of Sexually Transmitted Infections in Cameroon 2007.
- [3]. Ngaba GP, Essomba EN, Koum CK, Ndzengue L, Bika C, Adiogo D. Profil des germes impliqués dans les infections cervico-vaginales chez la femme en âge de procréer à l'Hôpital de District de Bonassama. *Rev Med Phar.* 2014; 4(1):400-8.
- [4]. Marks M, Kako H, Butcher R, Lauri B, Puiahi E, Pitakaka R, Sokana O, Kilua G, Roth A, Solomon AW and Mabey DC. Prevalence of sexually transmitted infections in female clinic attendees in Honiara, Solomon Islands. *BMJ Open.* 2015; 5(4):22
- [5]. Belley E, Nana T, Imandy G, Okalla C, Egbe T, Doh AS. L'urgence d'une meilleure sensibilisation sur les infections génitales à *Chlamydia trachomatis* au Cameroun. *Health Sci Dis.* 2010;11(1):25-7.
- [6]. Mboudou ET, Foumane P, Lifang MF, Ze J, Dohbit SJ, Enama M. Female infertility and laparoscopic surgery: A series of 415 operations at the Yaoundé Gyneco-Obstetric and Pediatric Hospital, Cameroon. *Open J Obstet Gyneco.* 2013;(3):663-7.
- [7]. Siboulet A, Catalan F, Bohbot JM, Siboulet A. Maladies sexuellement transmissibles. Masson, Paris 1984.
- [8]. Saini S, Gupta N, Aparna, Batra G, Arora DR. Role of anaerobes in acute pelvic inflammatory disease *Indian J Med Microbiol* 2003. 21:189-92.
- [9]. Ayyagari A, Chakrabarti A, Singh K, Sapru S, Aggarwal KC. Bacteriology of diverse infections of female genital tract with particular reference to anaerobic bacteria *Ind J Med Microbiol* 1987. 5:189-95.
- [10]. Chaudhry R, Talwar V. Role of mixed bacterial flora of female genital tract infections with special reference to obligate anaerobes. Proceedings of the Ist Asian Congress on Anaerobic Bacteria in Health and Diseases, Mehta A, Kochar N, editors, 1987:184-89.
- [11]. Royal College of Obstetricians, Gynaecologists. Management of acute pelvic inflammatory disease. *RCOG Guidelines* 2003; 32: 1-9.
- [12]. Ness RB, Soper DE, Holley RL, Peipert J, Randall H, Sweet RL, Sondheimer SJ, Hendrix SL, Amortegui A, Trucco G, Songer T, Lave JR, Hillier SL, Bass DC, Kelsey SF. Effectiveness of inpatient and outpatient treatment strategies for women with pelvic inflammatory disease: results from the Pelvic Inflammatory Disease Evaluation and Clinical Health (PEACH) *Randomized Trial. Am J Obstet Gynecol.* 2002; 186(5):929-37.
- [13]. Gerbase AC, Rowley J T, Mertens T E. Global epidemiology of sexually transmitted diseases. *The Lancet* 1998; 351: 52-4.
- [14]. Goulet V, de Barbeyrac B, Raheison S., Prudhomme M., Semaille C., Warszawski J. Prevalence of *Chlamydia trachomatis*: results from the first national population-based survey in France *Sex Transm Infect* 2010; 86: 263-70.
- [15]. Taylor-Robinson D, McCormack WM. The Genital Mycoplasma. *N Engl J Med* 1980; 302: 1003-10.
- [16]. Hunter JM, Smith IW, Peutherer JF, MacCaley A, Tauch S, Young H. *Chlamydia trachomatis* and *Ureaplasma urealyticum* in men attending a sexually transmitted diseases clinic. *British J Ven Dis* 1981; 57:130-3.
- [17]. Crawshaw SC, Stoker DI, Sugrue DL, Haran MV. Evaluation of the significance of *Mycoplasma Hominis* and *Ureaplasma urealyticum* in female genital tract infection. A retrospective case note study. *Int J STD AIDS.* 1990;1(3):191-4.
- [18]. Taylor-Robinson D, Csoka GW, Prentice MJ. Hacus intraurethral inoculation of *Ureaplasma*. *Q J Med* 1977; 46: 309-26.
- [19]. Bhatt MM, Deodhar LP, Gogate AA, Vaidya PR, Patel MV. Mycoplasmas in female genital tract. *J Postgrad Med* 1985; 31:112-4, suppl 114A
- [20]. Taylor-Robinson D, Fuir PM, Hanna NF. Microbiological and serological study of non gonococcal urethritis with special reference to

- Mycoplasma genitalium*. *Genitourin Med* 1985; 61:319-24.
- [21]. Arya OP and Pratt BC. Persistent urethritis due to *Ureaplasma urealyticum* in conjugal or stable partnerships. *Genitourin Med* 1986; 62:329-32.
- [22]. WHO: Global incidence and prevalence of selected curable sexually transmitted infections – 2008. 2016.
- [23]. Nguyen E, Bouyssou A, Lassau F, Basselier B, Sednaoui P and Gallay A. Progression importante des infections à gonocoque en France : données des réseaux Renago et ResIST au 31 décembre 2009 *BEH* 2011 ; 26-27-28 : 301-4.
- [24]. Eschenbach DA. Bacterial vaginosis and anaerobes in obstetric-gynecologic infection. *Clin Infect Dis* 1993; 16:S282–7.
- [25]. Martin HL, Richardson BA, Nyange PM, Lavreys L, Hillier SL, Chohan B, Mandaliya K, Ndinya-Achola JO, Bwayo J, Kreiss J. Vaginal lactobacilli, microbial flora, and risk of human immunodeficiency virus type 1 and sexually transmitted disease acquisition. *J Infect Dis* 1999; 180(6):1863–8.
- 26- Eschenbach DA, Davick PR, Williams BL, Klebanoff SJ, Young-Smith K, Critchlow CM, Holmes KK. Prevalence of hydrogen peroxide-producing *Lactobacillus* species in normal women and women with bacterial vaginosis. *J Clin Microbiol* 1989; 27(2):251–6.
- [26]. Spiegel CA, Amsel R, Eschenbach D, Schoenknecht F, Holmes KK. Anaerobic bacteria in non-specific vaginitis. *N Engl J Med* 1980; 303: 601–7.
- [27]. Muzny CA, Schwebke JR. *Gardnerella vaginalis*: still a prime suspect in the pathogenesis of bacterial vaginosis. *Curr Infect Dis Reports* 2013; 15:130–5.
- [28]. Josey WE, Schwebke JR. The polymicrobial hypothesis of bacterial vaginosis causation: a reassessment. *Int J STD AIDS* 2008; 19:152–4.
- [29]. Fidel PL Jr. History and new insights into host defense against vaginal candidiasis. *Trends Microbiol.* 2004; 12:220-7.
- [30]. World Health Organization. Global Prevalence and Incidence of Selected Curable Sexually Transmitted Infections: Overview and Estimates. Geneva: WHO; 2001
- [31]. Kissinger P: *Trichomonas vaginalis*: a review of epidemiologic, clinical and treatment issues. *BMC Infect Dis.* 2015; 15: 307.
- [32]. Salamat A, Isiaka-Lawal, Charles Nwabuisi I, Olurotimi Fakeye, Rakiya Saidu, Kike T Adesina, Munirdeen A Ijaiya, Abdulgafar A Jimoh, Lukman O Omokanye. Pattern of sexually transmitted infections in human immunodeficiency virus positive women attending antenatal clinics in North-central Nigeria. *Sahel Med J* 2014;17:145-50.
- [33]. Rutgers S. Syphilis in pregnancy: a medical audit in a rural district. *Cent Afr J Med.* 1993 Dec; 39(12):248-53.
- [34]. Greenwood AM, D'Alessandro U, Sisay F, Greenwood BM. Treponemal infection and the outcome of pregnancy in a rural area of The Gambia, West Africa. *J Infect Dis.* 1992 Oct; 166(4):842-6.