URINARY BACTERIAL PROFILE AND ANTIBIOTIC SUSCEPTIBILITY PATTERN AMONG PREGNANT WOMEN AT RAHIMA MOOSA MOTHER AND CHILD HOSPITAL

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Medicine in Obstetrics and Gynaecology.

Johannesburg, 13th November 2020

DECLARATION

I, Dr Ogbonnaya Orji, declare that this research report is my own, unaided work. It is being submitted for the degree of Master of Medicine (MMed) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

(Signature of candidate)

13/ 11/2020

DEDICATION

I dedicate this MMed to my wife Lufuno Orji and children Adannaya, Chimamanda, and Kachinamere.

PRESENTATIONS

Chris Hani Baragwanath Academic Hospital research meeting: 01/06/2019

Rahima Moosa Mother and Child Hospital morning meeting: 10/10/2019

Presented at the WITS research day: 23 /10/2019

Presented at the FIDSSA Congress: 07-09 /11/ 2019

Presented at the SASOG 2020: 07-11/03/2020

ABSTRACT

Background: Urinary tract infection (UTI) in pregnancy is associated with significant morbidity for both the mother and the fetus. The aim of this study was to determine the prevalence, urinary bacterial susceptibility, and resistance patterns among pregnant women with a possible UTI at Rahima Moosa Mother and Child Hospital (RMMCH) in Johannesburg.

Methods: This was a retrospective, cross-sectional study describing urine microscopy, sensitivity and culture (MC&S) results from the National Health Laboratory Services data and a medical record review at the RMMCH from January 2017 to December 2017.

Results: Urine microscopy, cultures and sensitivities were performed on 1984 specimens belonging to pregnant women who presented with symptoms and/signs of a UTI. Three hundred and thirty-three (16.8%) had positive bacterial cultures. *Escherichia coli* was the commonest bacterial isolate (50.1%). Other microorganisms isolated included *Klebsiella species* (14.4%) and *Enterococcus faecalis* (12.9%). Approximately 98% of organisms were sensitive to cephalexin/ cefazolin. Cefuroxime (95.2%), ceftriaxone/cefotaxime (94.4%) and nitrofurantoin (81.9%) demonstrated microbiocidal effectiveness as indicated. Most bacteria were resistant to ampicillin (84.4%), cotrimoxazole (55.6%) and amoxicillin/clavulanic acid (co-amoxiclav) (50.2%).

Conclusion: *Escherichia coli* was the commonest pathogen causing UTIs in pregnancy with *Enterococcus faecalis* increasing in prevalence. Cephalexin / cefazolin, cefuroxime, ceftriaxone / cefotaxime, and nitrofurantoin had the best microbiocidal activities against the organisms causing UTI in pregnant women.

Keywords: UTI, SENSITIVITY, PATHOGEN, PREGNANCY

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LIST OF ABBREVIATIONS

ABU	Asymptomatic bacteriuria
CFC	Colony forming unit
HIV	Human immunodeficiency virus
HJH	Helen Joseph Hospital
ICU	Intensive care unit
MC&S	Microscopy Culture and Sensitivity/Susceptibility
NHLS	National Health Laboratory Service
REDCap	Research Electronic data capture
RMMCH	Rahima Moosa Mother and Child Hospital
UTI	Urinary tract infection/s
WITS	University of the Witwatersrand

JOURNAL ARTICLE

Urinary Bacterial Profile and Antibiotic Susceptibility Pattern among Pregnant Women

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Conflict of interest:

The researcher and co-authors have no conflicts of interest to declare.

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isolated included *Klebsiella species* (14.4%) and *Enterococcus faecalis* (12.9%). Approximately 98% of organisms were sensitive to cephalexin/ cefazolin. Cefuroxime (95.2%), ceftriaxone/cefotaxime (94.4%) and nitrofurantoin (81.9%) demonstrated microbiocidal effectiveness as indicated. Most bacteria were resistant to ampicillin (84.4%), cotrimoxazole (55.6%) and amoxicillin/clavulanic acid (co-amoxiclav) (50.2%).

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Keywords: UTI, SENSITIVITY, PATHOGEN, PREGNANCY

Urinary Bacterial Profile and Antibiotic Susceptibility Pattern among Pregnant Women in Rahima Moosa Mother and Child Hospital between 1 January 2017 and 31 December 2017

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Conclusion: *Escherichia coli* was the commonest pathogen causing UTIs in pregnancy with *Enterococcus faecalis* increasing in prevalence. Cephalexin / cefazolin, cefuroxime, ceftriaxone / cefotaxime, and nitrofurantoin had the best microbiocidal activities against the organisms causing UTI in pregnant women.

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INTRODUCTION

Several changes occur during pregnancy that predispose pregnant women to urinary tract infections (UTIs). Physiological, physical, mechanical and hormonal changes result in increased urinary stasis. Altered urine composition with elevated glucose levels coupled with a short urethra (3 – 4 cm in women) increases the predisposition to UTIs in pregnant women.[1]

UTIs are among the commonest bacterial infections complicating pregnancy.[2,3] They may present with symptoms of urethritis, cystitis or pyelonephritis or remain asymptomatic.[3] The significance of UTI in pregnancy, in view of its associated maternal and fetal morbidity and mortality, has been widely evaluated and the prevalence of UTI in pregnancy ranges between 2 – 10% globally.[3,4,5]

The occurrence of UTI in pregnancy is increased by several factors. The highest incidence has been reported in African-American multiparous women, while the lowest incidence occurs among affluent Caucasian women of low parity.[3] Poor socio-economic status is a significant risk factor, with indigent women having a five-fold increased risk of acquiring UTIs.[6] Other risk factors include increasing maternal age, high parity, reduced immune function, poor perineal hygiene, a history of recurrent UTI, diabetes mellitus, neurogenic ureteric retention, anatomic or functional urinary tract abnormalities and increased frequency of sexual activity.[7,8]

Studies in developing countries show that UTIs are usually present at the first antenatal visit and less than 1% of women develop bacteriuria after a negative screen in early pregnancy. UTI in pregnancy contributes to significant maternal and perinatal morbidity and mortality. Maternal complications include overt pyelonephritis in 25 - 40% of previously asymptomatic women as the pregnancy progresses, and in 1 – 2% in those with symptomatic infections.[9] Other maternal complications include

anaemia, miscarriages, preterm labour, hypertension, pre-eclampsia, puerperal sepsis, chronic pyelonephritis and occasionally, renal failure.[5,10]

Fetal risk factors include intrauterine growth restriction, prematurity, low birthweight and fetal death.[10,11]

Causative organisms arise from the normal vaginal, perineal and faecal flora.[3,12] These include *Escherichia coli, Staphylococcus aureus, Staphylococcus faecalis, Proteus mirabilis, Klebsiella species,* and *Streptococcus species* among others. There are numerous reports of resistance to antimicrobials by urinary tract pathogens.[11,12] Antimicrobial resistance in these organisms occurs because of broad-spectrum antibiotic abuse in humans and in animal feeds.[10,11]

Antibiotic resistance is frequently observed in nosocomial settings, however it is also becoming apparent in community-acquired UTIs, with an increasing incidence of Gram-positive cocci e.g. *Staphylococci* sp. and Gram-negative organisms such as *Klebsiella* sp. becoming more prevalent.[13,14]

Urinary tract infections may present as acute infections and the administration of antibiotics may be necessary while awaiting MC&S results to prevent and/or reduce maternal and fetal morbidity and mortality especially in low-resourced countries.

The aim of this study was to determine the antibiotic sensitivity pattern among pregnant women with symptomatic UTIs and to describe the pathogenicity and antibiotic susceptibility among the causative bacterial organisms.[15]

Knowledge of the local bacterial and susceptibility patterns can inform the judicious use of empiric therapy.[16]

METHODS:

Setting

The study was conducted at the RMMCH, which is a regional hospital affiliated to the Department of Obstetrics and Gynaecology at the University of the Witwatersrand. The hospital serves a population of approximately 200 000 women and children draining 3 regions in the Gauteng province.[17] An average of 1 700 women attend the antenatal clinic on a monthly basis, including high and low-risk women.

This was a retrospective, cross-sectional study describing urine microscopy, culture and sensitivity (MC&S) results obtained from the National Health Laboratory Service

database which were reviewed with corresponding maternal case files, between January 2017 to December 2017.

Only data of pregnant women who presented with symptoms/signs of a UTI and had urine MC&S results available were included in the study. Data recorded included patient demographic details, age, parity, booking status, gestation at sample collection and haemoglobin levels. Fetal and maternal outcomes were reviewed.

Data was collected and managed using REDCap (Research Electronic Data Capture) electronic data capture tools hosted at the University of the Witwatersrand. REDCap is a secure, web-based application designed to support data capture for research studies.[19,20] The biostatisticians at WITS assisted in the analysis phase of the study. The data was analysed using Stata® version 13.0.15.[21] Descriptive data was expressed using means with ranges and medians with standard deviations. The study was approved by the Human Research Ethics Committee. (M181070).

RESULTS

Among the 1 984 urine samples collected, 333 (16.8%) were laboratory confirmed cases of UTI.

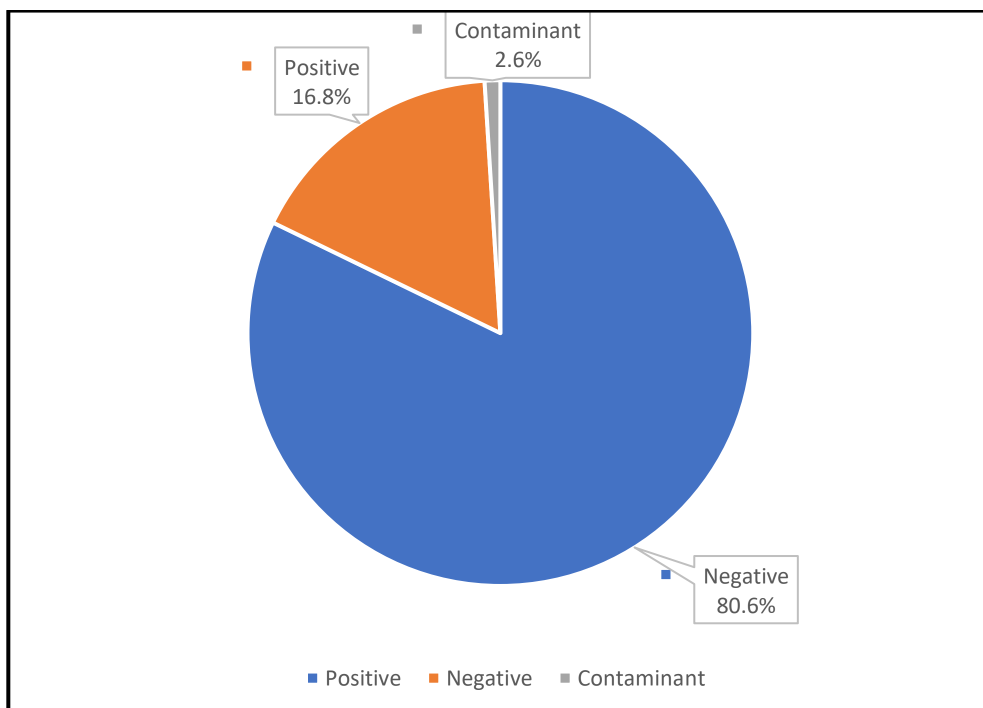

Figure 1: Culture results of urine specimens submitted for MC&S

Three hundred and twenty-four women (97.3%) booked for antenatal care. The ages of the study cohort ranged between 16 - 44 years, with the majority (58.9%) in the 20-29-year age group. There were 52 (15.6%) HIV infected women. The haemoglobin levels at booking ranged between 4.5 g/dl and 16.1 g/dl.

The highest frequency of UTIs observed (n=229, 68.8%) were from specimens taken in the third trimester.

Nitrofurantoin was the most used antibiotic (45.1%) in our outpatient unit. Eighty-eight (26.4%) women required a repeat course of antibiotics. Pyelonephritis was diagnosed in 16 (4.9%) women who were admitted for further management.

Table 1: Demographic, antenatal and treatment data of women with positive MC&S cultures

Variable	Number N= 333	Percentages (%)
Age (years)		
<20	39	11.7
20 – 29	170	51.1
30 - 39	110	33.0
>40	14	4.2
Parity		
0	132	39.7
1	68	20.4
2	81	24.3
3	36	10.8
4	15	4.5
5	1	0.3
Gravidity		
1	106	31.9
2	72	21.6
3	75	22.5
4	45	13.5
5	18	5.4
6	16	4.8
7	1	0.3
Trimester during which urine MC&S was done		
First trimester	2	0.6
Second trimester	102	30.6
Third trimester	229	68.8
ANC attendance (at least once)		
Booked	324	97.3
Unbooked	9	2.7
HIV		
Negative	281	84.4

Positive	52	15.6
Antibiotic used at the time of urine MC&S		
Ampicillin	69	20.7
Co-amoxiclav	14	4.2
Cephalexin / cefazolin	54	16.2
Cefuroxime	34	10.2
Ceftriaxone / cefotaxime	9	2.7
Nitrofurantoin	150	45.1
Gentamicin	3	0.9

Gestational ages ranged between 26 to 40 weeks gestation and birthweights from 619 g to 4 495 g respectively. There were 315 livebirths (94.6%),14 stillbirths (4.2%) and four early neonatal deaths (1.2%) with a perinatal mortality rate of 53/1000 live births. Three hundred and nine women (92.8%) were discharged, without complications while 21 (6.3%) developed puerperal sepsis and a woman demised from multiple organ failure as a result of puerperal sepsis. Three women experienced postpartum haemorrhage.

Table 2 shows the overall organism isolate sensitivities to antimicrobials. The frequency of reporting of susceptibility depended on the isolate grown, against the antibiotic it was sensitive to.

Amikacin and imipenem had the highest overall potency of 100% each. The following cephalosporins demonstrated high bactericidal activity: cephalexin/ cefazolin (97.6%), cefuroxime (95.1%) and ceftriaxone/cefotaxime (94.4%). Gentamicin was bactericidal in 87.3% of cases.

Microbes demonstrated 81.9% sensitivity to nitrofurantoin, while piperacillin/tazobactam had an overall potency of 70.0% with resistance of 15.0%. Co-amoxiclav, cotrimoxazole and ampicillin were less than 50% effective against the studied organisms, as showed in Table 2. Intermediate resistance was observed with gentamicin (3.4%), nitrofurantoin (16.5%) and piperacillin/tazobactam (15.0%).

Table 2: Isolated bacterial sensitivity patterns to reported antimicrobials

Antimicrobial	Frequency of reporting	Sensitivity N (%)		
		S	R	I
Amikacin	120	120 (100)	0 (0)	0 (0)
Amoxicillin	89	34(38.2)	55(61.8)	0 (0)
Ampicillin	66	11 (16.7)	55 (83.3)	0 (0)
Co-amoxiclav	243	121 (49.8)	122 (50.2)	0 (0)
Co-trimoxazole	27	12 (44.4)	15 (55.6)	0 (0)
Cephalexin/cefazolin	127	124 (97.4)	3 (2.4)	0 (0)
Ceftriaxone/cefotaxime	217	206 (94.4)	11 (5.6)	0 (0)
Cefuroxime	206	196 (95.1)	10 (4.9)	0 (0)
Gentamicin	237	207 (87.3)	22 (9.3)	8 (3.4)
Imipenem	68	68 (100.0)	0 (0)	0 (0)
Nitrofurantoin	193	158 (81.9)	3 (15.0)	32 (16.5)
Piperacillin/Tazobactam	20	14 (70.0)	3 (15.0)	3 (15.0)

(Notes: 'S': Sensitive; 'R': Resistant; 'I': Intermediate resistance to the drugs)

The most frequently occurring bacterial isolates in this study and their antibiotic sensitivities are noted in Table 3. The incidences of E. *coli* sensitivity to the cephalosporins and nitrofurantoin are indicated as follows: cefazolin/cephalexin (91.6%), cefuroxime (88.3%), ceftriaxone/cefotaxime (87%), and (76.6%) to nitrofurantoin. Amikacin was 100.0% potent against *E. coli* and *Klebsiella species* Notably, *E. coli* and *P. mirabilis* showed low susceptibility to ampicillin and co-trimoxazole.

Table 3: Antibiotic susceptibility patterns of the 5 most frequently isolated micro-organisms

ANTIBIOTIC	*E. coli* n (%)	*P. mirabilis* n (%)	*Klebsiella sp* n (%)	*S. agalactiae* n (%)	*E. faecalis* n (%)
Amikacin	90 (100.0)	0 (0.0)	26 (100.0)	0 (0.0)	13 (100.0)
Amoxicillin	116 (64.2)	34 (100.0)	39 (75.0)	0 (0.0)	50 (100.0)
Ampicillin	88 (6.1)	22 (91.7)	43 (2.3)	22 (14.2)	24 (100.0)
Cefazolin/ Cephalexin	56 (91.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Ceftriaxone /Cefotaxime	87 (88.3)	0 (0.0)	10 (76.1)	3 (75.0)	19 (100.0)
Cefuroxime	98 (88.3))	0 (0.0)	50 (100.0)	0 (0.0)	0 (0.0)
Co-amoxiclav	94 (26.08)	0 (0.0)	7 (63.6)	6 (54.5)	22 (100.0)
Co-trimoxazole	11 (43.8)	12 (100.0)	0 (0.0)	0 (0.0)	34 (59.4)
Gentamicin	18 (87,3)	0 (0.0)	3 (75.0)	0 (0.0)	7 (90.0)
Imipenem	0 (0.0)	0 (0.0)	20 (100.0)	0 (0.0)	0 (0.0)
Nitrofurantoin	132 (76.6)	0 (0.0)	0 (0.0)	6 (42.9)	18 (94.3)
Piperacillin/ Tazobactam	8 (33.3)	1 (25.0)	4 (36.4)	2 (23.8)	0 (0.0)

(Not all the samples were assessed against all antibiotics - NA)

DISCUSSION

The prevalence of culture-positive urinary tract infections in pregnant women in this study was 16.8 %. This is was similar to the prevalence reported from Sudan[22] and Tanzania,[23] lower than reported from Niger[24,] Libya[25] and Saudi Arabia[26]. Our findings were relatively higher than those of studies conducted in parts of Ethiopia,[27] Gondar,[28] and Bahir Dar.[29] The variation in prevalence may be due to the difference in sample size and geographical location.

E. coli was the most common bacterium isolated in this study, which is similar to several other studies.[10,11,14] This finding suggests that most organisms causing UTI are from the lower gastrointestinal tract which acts as a reservoir for organisms such as *E. coli.*[7] The prevalence of *E. coli* infected samples in this study was 50.1% which is lower than findings in studies done in developed countries.[31] However, it is higher than recent findings in South Africa (40%),[32] and areas like the north (30.5%) and south (38.0%) of Nigeria,[33] Pakistan (38.%)[34] and southern India(43.9%).[5]

Klebsiella species was the next most common organism isolated in this study, accounting for 14.4% of positive cultures, and is similar to a study done in KwaZulu-Natal (20%).[32] *Enterococcus faecalis* (12.9%) was the most frequent Gram-positive organism detected and had been noted as a significant bacterial isolate from women with UTI in pregnancy in other studies.[35]

Empirical therapy should be commenced as soon as urine samples are taken and modified once culture results become available to prevent serious morbidity.[36]

In this study, *S. aureus* (60%) and *P. mirabilis* (50.4%), showed moderate sensitivity to nitrofurantoin. Other studies have also demonstrated good sensitivity of bacterial isolates from urine of pregnant women with or without symptoms of UTI to nitrofurantoin.[5,10,32,37] Hence, the recommendation of nitrofurantoin as a first line drug for the treatment of UTI in pregnancy.[5,10,33] The University of the Witwatersrand's obstetric protocol recommends the use of nitrofurantoin at a dose of 100 mg orally, 6 hourly for 5 days or cefuroxime at a dose of 500 mg orally, twice daily for 5 days as empirical therapy.[38,39]

The use of nitrofurantoin in pregnancy is supported by the most recent ACOG Committee Opinion which concluded that in the second and third trimester it was a suitable choice. In the first trimester it can be used if there are no other suitable alternatives. [40]

In the present study *E. coli*, the most common isolate, was resistant to ampicillin, cotrimoxazole and co-amoxiclav. which is a source of concern if the patient is late in the third trimester and in need of treatment.

There was poor documentation of repeat cultures, as well as the use of prophylactic urinary antimicrobials to prevent recurrent infections, particularly in those patients

with acute pyelonephritis. Only 50% of cases of pyelonephritis had repeat cultures either during admission or at follow up.

Standard treatment guidelines and the essential medicines list for South Africa recommend repeat urine cultures: at least two consecutive urine specimens should be negative for growth of organisms to confirm eradication.[41,42,43] Most patients with positive cultures are asymptomatic and can be detected only with routine surveillance cultures.[4,9,12] Those admitted for a UTI (pyelonephritis) should receive intravenous antibiotics for 24 to 48 hours or until severe symptoms improve. Once patients are afebrile for at least 48 hours, they can be managed with oral antibiotics and discharged to complete 10 to 14 days of treatment and followed up at the antenatal clinic.[32,41]

There was a 0.45% incidence of pyelonephritis in this study, which is similar to reported ranges from 0.5% to 2.0% in the literature.[32] Some studies demonstrated a relationship between UTI in pregnant women and the risk of poor perinatal outcomes.[43] However, authors like Chen et al. concluded that there were no increased risks of adverse pregnancy outcomes in women, and neonates born to women with urinary tract infections.[44]

LIMITATIONS

The limitations of this study were the small sample size, the inherent shortcomings of a retrospective study and that it was confined to one hospital.
There was also poor documentation of results from case files and hospital information, which is essential for clinical audits. Approximately 14% of the files were not retrieved, as some were lost.

RECOMMENDATIONS

- Patient records should be updated, and relevant information documented.
- A repeat culture one to two weeks after completion of therapy is recommended to ensure eradication of bacteriuria.
- Better designed prospective studies on larger populations are needed to evaluate the impact of UTI in pregnant women in our setting.

CONCLUSION

Escherichia coli was the commonest bacteria isolated from the urine of pregnant women with UTI in our setting. Cephalosporins, such as ceftriaxone, cephalexin, cefuroxime and cheaper, more readily available antibiotics like nitrofurantoin may be administered empirically because of their high microbicidal and wide spectrum of activity against microorganisms causing UTI in pregnancy as seen in this study.

Healthcare professionals should discuss the appropriate use of antimicrobials with patients and encourage them to complete the recommended duration of treatment to prevent antibiotic resistance.

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DISCLOSURE

The authors report no conflict of interest in this study.

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Appendix A: Approved Research Protocol

1. Introduction

1.1 Background

Several changes occurring during pregnancy predispose pregnant women to urinary tract infections (UTIs). Physiological, physical, mechanical, and hormonal changes result in increased urinary stasis. Altered urine composition with elevated glucose levels in the presence of a short urethra (3 – 4 cm in women) increases the predisposition to UTIs in pregnancy. (1)

UTIs during pregnancy are associated with risks to both the fetus and the mother, including pyelonephritis, preterm birth, low birth weight, hypertension, pre-eclampsia and increased perinatal mortality (1).

UTIs may be classified as either asymptomatic or symptomatic. Asymptomatic bacteriuria (ABU) is a condition characterised by presence of bacteria in two consecutive clear-voided urine specimens, both yielding positive cultures ($\geq 10^5$ cfu/ml) of the same uro-pathogen, in a patient without classical symptoms. Patients with significant bacteriuria and symptoms attributable to the urinary tract are said to have symptomatic bacteriuria (2)

1.2 Epidemiology

Globally, urinary tract infections and its associated complications cause nearly 150 million deaths/year worldwide. The condition can develop in 40% - 50% of women during pregnancy (3).

2.0 Literature analysis and critique

Naturally, the genito-urinary tract is sterile. Thus, colonisation of the genito-urinary tract by pathogens results in infection. The microorganisms causing urinary tract infections usually originate from the gastro-intestinal flora of the host. During pregnancy, bacteriuria occurs when bacteria from a faecal source gain access to the

bladder by ascending the relatively short female urethra (4). If left untreated, UTIs can lead to complications in pregnant women which adversely affect both the mother and fetus. These complications include anaemia, preeclampsia, renal failure and septicaemia; and may affect the fetus resulting in intrauterine growth restriction, prematurity or impaired cognitive development in the case of pyelonephritis. There is a significant statistical correlation between UTI in pregnancy and mental impairment in children (5). The signs and symptoms of UTIs are dysuria (pain or burning on micturition), frequent urination, urgency, haematuria (blood or mucus in the urine), cramps or pain in the lower abdomen, dyspareunia (pain during sexual intercourse) and cystitis (pain, pressure or tenderness over the bladder). When infection spreads to the kidneys causing pyelonephritis, the patient may experience back pain, chills, fever, nausea and vomiting (6).

The risk of UTIs increases from the sixth week of pregnancy and reaches a peak in the 22nd to 24th weeks. Risk factors for UTI in pregnancy include lower socio-economic status, individual hygiene practices, sickle cell trait, anaemia, increasing parity and age, frequency of intercourse, lack of prenatal and antenatal care, prior history of a UTI, urinary tract abnormalities and medical conditions such as diabetes mellitus (7). Both Gram-negative and Gram-positive organisms causes UTIs. However, Gram-negative organisms especially *Escherichia coli (E Coli*) is the most commonly community-acquired UTI pathogen and is responsible for 75 - 95% of cases. The remaining infections are usually caused by *Gram-negative Enterobacteriaceae* or *Gram-positive cocci (GPC)* (8).

Asymptomatic bacteriuria (ASB) affects 2 - 4% of pregnant women (9). The lower urinary tract is mostly involved. The changes in the urinary tract as described above enhance the progression from ASB to symptomatic bacteriuria if untreated, culminating in acute pyelonephritis in 20 - 50% of cases, and adverse obstetric

outcomes including prematurity, anaemia, and increased fetal morbidity and mortality rates. Acute pyelonephritis involves the upper urinary tract encompassing the renal parenchyma and ureters; and is the most common cause of non-obstetric hospitalisation (10).

Diagnosis of UTI in South Africa is challenging, as limited resources do not permit routine urine culture at the first antenatal visit. Therefore, other screening methods have been proposed including urine dipsticks (recommended method for antenatal screening in the public sector in South Africa), bioluminescence assays, Gram-staining, microscopic urinalysis and dipslide urine cultures (11). Dipslide urine cultures show a detection rate for asymptomatic bacteriuria comparable to that of urine culture. However, the gold standard for the diagnosis of UTIs during pregnancy is urine culture (12). Urine specimens are plated onto a blood agar medium along with a selective and differential agar such as MacConkey agar for Gram-negative organisms and colistin-nalidixic acid agar for Gram-positive organisms (13)

The treatment of choice for asymptomatic bacteriuria and cystitis are oral antibiotics as per "The Pocket Guide to Antibiotic Prescribing for Adults in South Africa, 2015". guidelines. Therapy is started on an empiric basis, before culture results are available and MC&S performed to confirm sterility after treatment. Co-amoxiclav 1g po 12 hourly before the 3rd trimester or Cefuroxime 250 mg po 8 hourly is preferred in the 3rd trimester, due to the decreased risk of necrotizing enterocolitis associated with co - amoxiclav. The duration of treatment is five days for cystitis and
14 days for pyelonephritis (14).

Another treatment recommendation in the Guidelines for Maternity Care in South Africa uses either empiric treatment with nitrofurantoin 100 mg orally 6 hourly for five days or co-trimoxazole 960 mg orally twice daily for five days, after urine specimens

have been submitted for MC&S. If the urine culture is positive for bacterial growth, the antibiotics should be changed accordingly (12).

Acute pyelonephritis is a common and serious cause of fever in pregnancy and may precipitate pre-term labour. The patient usually appears unwell and presents with costovertebral angle tenderness, fever and chills. Management includes admission to hospital and stabilisation of vital signs. Blood investigations for a full blood count and urea and electrolytes, including a blood culture should be drawn. A midstream urine sample must be submitted for MC&S. The patient should be assessed for evidence of preterm labour. An infusion of ceftriaxone at a dose of 1 g daily should be started. During this time, the fetus must be closely monitored for signs of distress. Oral treatment may be started 24 – 48 hours after the fever subsides. Adjust the antibiotics, according to the MCS results, if necessary. The total duration of treatment should be at least 7 days. Treat other complications e.g. dehydration, nausea etc. as they arise. Following recovery, the urine should be retested to confirm clearance of the infection, and the patient should continue routine follow-up at the antenatal clinic (15).

Those with recurrent UTIs are given prophylactic antibiotics, cotrimoxazole 40/200 mg orally once a day or nitrofurantoin 100 mg po once daily for the duration of the pregnancy (16).

Drug resistance among bacteria causing UTIs is concerning as it is associated with an increased cost of treatment. The indiscriminate and inappropriate use of drugs, lack of proper investigations and poor knowledge of the local pathogenic bacteria and their susceptibility and resistance patterns to empirically used antibiotics are often the main causes of drug resistance in developing countries. Changes in the local

microorganism behaviour and distribution, antibiotic susceptibility patterns and emerging drug resistance need to be described to update recommendations for optimal empirical therapy and inform good clinical practice, (17).

This study was designed to determine the prevalence and describe the bacteria associated with UTIs among pregnant women attending the antenatal clinic at RMMCH. Findings from this study should inform a pragmatic, evidence-based approach to the commencement of antibiotics during pregnancy.

3. Aim

The aim of our study was to determine the prevalence of, and to describe the antibiotic effectiveness against UTI-causing bacteria among pregnant women at RMMCH.

4. Study objectives:

4.1. To determine the demographic obstetric data of pregnant women with UTIs at RMMCH between 1 January 2017 to 31 December 2017.

4.2. To determine the prevalence of confirmed UTIs in pregnancy at RMMCH between 1 January 2017 to 31 December 2017.

4.3. To describe the organisms cultured on urine samples performed on women at RMMCH.

4.4. To describe the drug sensitivity and resistance patterns during the studied period.

5. Subjects and Methods

5.1 Setting

The RMMCH is a regional hospital in Johannesburg, South Africa which services communities in region B and C of Gauteng. It is a maternity and paediatric hospital affiliated with the University of Witwatersrand. In 2017 there were 12 863 deliveries of which 7 705 were vaginal births and 4 909 caesarean section deliveries.

Approximately 2 000 patients attend the antenatal clinic per month, of which 220 (21%) are HIV positive at delivery, and 148 (15%) neonates PCR HIV+ at birth.

The hospital has 320 beds and a 4-bed adult high care facility. There are no intensive care (ICU) facilities available and critically ill women are referred to the Helen Joseph Hospital (HJH) ICU, or any other tertiary facility with an ICU bed available. The National Health Laboratory Services (NHLS) provides laboratory services.

5.2 Methodology

5.2.1 Study Setting and Population

The study will describe urine MC&S results of pregnant women at RMMCH between 1 January 2017 and 31 December 2017.

5.2.2 Study Design

This is a retrospective, descriptive study.

5.3 Study Population

5.3.1 Inclusion criteria

All pregnant women who had results available for urine MC&S between 1 January 2017 to 31 December 2017 at RMMCH.

5.4 Sampling and Sample size

All relevant files during the defined study period will be retrieved and evaluated. It is not possible to accurately predict the sample size as all pregnant women diagnosed at antenatal clinic or admitted for urinary tract infections between 1 January 2017 and 31 December 2017 will be included.

5.5 Data collection

The researcher shall do the data collection. All urine MC&S results from pregnant women between 1 January 2017 and 31 December 2017 shall be retrieved from the NHLS at RMMCH. Permission to use this data will be sought from the NHLS once (Appendix A) permission has been obtained from the WITS Health Research Ethics Committee to do this study.

Patients that had urinalysis and urine microscopy, culture and sensitivity testing during the study period will be identified. Their files will then be drawn from the hospital records. The study cases will be assigned a number. Other details will be recorded separately and accessed solely by the researcher ensuring anonymity Relevant data will be recorded on a Redcap data sheet. (Appendix B).

5.6 Data analysis

5.6.1 Methods

Descriptive statistics will be used. Study data will be collected and managed using REDCap electronic data capture tools hosted at the University of the Witwatersrand. REDCap (Research Electronic Data Capture) (18), is a secure, web-based application designed to support data capture for research studies.

5.6.2 Statistical tests

Section A: The demographic survey section. This will include subcategories within the study sample by which data can be analyzed. These subcategories will include age, parity, details of the pregnancy such as gestational age, and booking blood. *Section B:* Details relating to the gestational age at the time of collection of urine for MC&S. *Section C*: Details relating to the culture results and antimicrobial substances present.

Descriptive statistics will be used for both categorical and continuous data. Frequency and proportion tables will be used for categorical variables such as ANC attendance, while standard deviations and means will be reported for continuous variables such as age if normally distributed. Medians and interquartile ranges will be used for non-normally distributed data.

Prevalence will be calculated as: number of confirmed UTIs / total number of pregnant women tested.

The biostatisticians at WITS will be asked to assist in data analysis using recommended version of the STATA statistical software package. (This will be described in the completed research report).

5.7 Ethics

Anonymity of the patients included in the study shall been maintained. Permission had been granted by the CEO at RMMCH to do this study (Appendix C). Application for ethical clearance will be submitted to the WITS Health Research Ethics Committee. The study will be registered with the National Health Research Database.

6. Bias

The study is retrospective and will be performed by a single researcher. Therefore, there may be hindsight bias. There will also not be a control group for comparison.

7. Limitations

The study will be done at one centre only. It is retrospective chart review. It is not possible to know whether the samples were correctly collected and whether contamination was avoided. Further, some patient's files may not be found during data collection.

8. Funding

Item	**Cost**
Stationary, printing, binding, and photocopies	R 1 200

All costs will be borne by the researcher.

9. Conclusion

The results may be presented as oral or poster presentations at academic events/conferences. Results from this study may be included in academic journals/publications and help provide new insights on the management of UTI in pregnancy within a resource constrained environment.

Timing

2018	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**
Protocol development	*	*											
Submission			*										
Correction				*									
Ethics					*								
Data collection						*							
2019	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**
Data collection							*						
Analysis								*	*				
Write up									*	*	*		
Marking											*	*	
Corrections													*

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Appendix B: Data collection sheet

My First Instrument

Record ID	______________
Age	______________
Parity	______________
Gravidity	______________
Gestational Age at first u mc and s weeks	______________
GA U- MC and S days	______________
ANC attendance	☐ booked ☐ unbooked ☐ unknown
Haemoglobin at booking	______________
Haemaglobin - last recorded before delivery	______________
Syphilis	○ positive ○ negative ○ unknown
titre	______________
treated	○ yes 3 doses ○ 2 doses ○ 1 dose ○ not documented
HIV	○ Yes ○ No
CD4 Count	______________
Viral load last before MC and S	______________
viral load before delivery	______________

Antiretroviral drugs	◯ Yes ◯ No

Urine appearance

	present	absent
clear	◯	◯
bloody	◯	◯
other	◯	◯

If other appearance	__________________
culture result	◯ positive ◯ negative ◯ contaminant ◯ other
if culture other	__________________

Microscopy

Leucocytes	__________________
Erythrocytes	__________________
Epithelial cells	__________________

	OBSERVED	NOT OBSERVED
Bacteria	☐	☐
Casts	☐	☐
Crystals	☐	☐
Parasites	☐	☐
Yeast cells	☐	☐

Bacteria grown	☐ E Coli ☐ Pseudamonas aeriginosa ☐ Klebsiella sp. ☐ Ureaplasma urealyticum ☐ Strep agalactiae ☐ Proteus mirabilis ☐ Other
Bacteria grown other	__________________

	Sensitive	Resistant	Intermediate
Co-trimoxazole	○	○	○
Ampicillin	○	○	○
Co-amoxiclav	○	○	○
Cefazolin	○	○	○
Cefuroxime	○	○	○
Ceftriaxone/Cefotaxime	○	○	○
Amikacin	○	○	○
Tazocin	○	○	○
Imipenem	○	○	○
Nitrofurantoin	○	○	○
Other drug	○	○	○

bacterial sensitivity pattern 2

	Sensitive	Resistant	Intermediate
Cotrimoxazole 2	○	○	○
Ampicillin 2	○	○	○
Co amoxiclav 2	○	○	○
Cefazolin 2	○	○	○
Cefuroxime 2	○	○	○
Ceftriaxone/Cefotaxime 2	○	○	○
Amikacin 2	○	○	○
Tazocin 2	○	○	○
Imipenem 2	○	○	○
Nitrofurantoin 2	○	○	○
Other drug 2	○	○	○

casts observed	○ Yes ○ No
if casts	☐ amorphous ☐ hyaline ☐ other
crystals observed	○ Yes ○ No
if crystal	☐ Uric acid crystal ☐ Calcium oxalate crystal ☐ Calcium Phosphate crystal ☐ Bilirubin crystal ☐ Magnesium ammonium Phosphate(Struvite) ☐ other
parasites observed	○ Yes ○ No

Parasites observed options	☐ trichamonas ☐ bilharzia haematobium ☐ bilharzia mansoni ☐ bacterial vaginosis ☐ other
yeasts observed	______________________
if yeast is present	☐ Fungal hyphae ☐ yeast cells

	present	absent
Gram- positive cocci	○	○
Gram- negative cocci	○	○
Gram - positive bacilli	○	○
Gram- negative bacilli	○	○

ANTIMICROBIAL SUBSTANCES	○ ABSENT ○ PRESENT

	yes	no
Bacterial growth	○	○
Mixed growth on culture, please resubmit	○	○

antibiotic at the time of Urine MC and S	☐ Cotrimoxazole ☐ Ampicillin ☐ Co-Amoxilav ☐ Cefazolin ☐ Cefuroxime ☐ Ceftriaxone/ Cefotaxime ☐ Amikacin ☐ Tazocin ☐ Imipenem ☐ Nitrofurantoin ☐ fluconazole ☐ clotrimazole ☐ flagyl ☐ other
antibiotic other	______________________
repeat course of antibiotics	○ Yes ○ No

repeat course antibiotics	☐ Cotrimoxazole ☐ Ampicillin ☐ Co-Amoxilav ☐ Cefazolin ☐ Cefuroxime ☐ Ceftriaxone/ Cefotaxime ☐ Amikacin ☐ Tazocin ☐ Imipenem ☐ Nitrofurantoin ☐ fluconazole ☐ clotrimazole ☐ flagyl ☐ other
repeat course other	______________________
Was the patient admitted with a UTI or pyelonephritis?	◯ Yes ◯ No
In hospital treatment	☐ Cotrimoxazole ☐ Ampicillin ☐ Co-Amoxilav ☐ Cefazolin ☐ Cefuroxime ☐ Ceftriaxone/ Cefotaxime ☐ Amikacin ☐ Tazocin ☐ Imipenem ☐ Nitrofurantoin ☐ fluconazole ☐ clotrimazole ☐ flagyl ☐ other
in hospital other	______________________
Number of babies	◯ 1 ◯ 2 ◯ 3
birthweight	______________________
Outcome of baby	◯ alive ◯ stillbirth ◯ early neonatal death
birthweight 2	______________________
Outcome of baby 2	◯ alive ◯ stillbirth ◯ early neonatal death
birthweight 3	______________________

Outcome of baby 3	○ alive ○ stillbirth ○ early neonatal death
Gestation at delivery w/d	____________________
Outcome of mother	☐ Discharged well ☐ Peurperal sepsis ☐ TAH ☐ Demise ☐ Other
Other notes on mother	____________________

Appendix C: Permission from Rahima Moosa Mother and Child hospital

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

RAHIMA MOOSA MOTHER AND CHILD HOSPITAL

Enquiries	: Karen Marshall
Tel	: (011) 470 9284
Fax	: 086 553 4623
Email	: Karen.Marshall@wits.ac.za

TITLE OF RESEARCH PROJECT:
"Urinary bacterial profile and antibiotic susceptibility pattern among pregnant women in Rahima moosa Mother and Child Hospital form January 2017 to December 2017"

NAME OF RESEARCHER:
Dr Ogbonnaya Orji

DEPARTMENT:
Obstetrics and Gynaecology

SUPERVISOR:
Dr Zandile Dlamini

Dear Dr Orji,

Permission is granted for you to conduct the research as indicated in the title above.

The terms under which this permission is granted is contained in the Researcher Declaration form that you have signed. Failure to comply with these conditions will result in the withdrawal of such permission.

It is crucial for you to inform the Research Coordinator, Karen Marshall of the actual start and end dates of your study. This could be done by e-mail.

Should the study commence more than 12 months after receipt of this approval letter you will have to go through the process of applying again.

You are strongly advised to keep a signed copy of the declaration form so as to ensure that the terms of this agreement are complied with at all times.

Yours sincerely,

DR FREW BENSON
CLINICAL EXECUTIVE
2018:07:02

ADDRESS: Cnr FUEL & OUDSTHOORN STREET CORONATIONVILLE 2093 / PRIVATE BAG X20 NEWCLARE 2112 JHB

Appendix D: National Health Laboratory Service Approval

Academic Affairs and Research
Modderfontein Road, Sandringham, 2031
Tel: +27 (0)11 386 6142
Fax: +27 (0)11 386 6296
Email: babatyi.kgokong@nhls.ac.za
Web: www.nhls.ac.za

06 December 2018

Applicant: Dr Ogbonnaya Orji
Institution: Rahima Moosa Mother and Child Hospital
Department: Obstetrics and Gynaecology
Email: ogbonnayaorji27@yahoo.com
Cell: 082 413 723 7523

Re: Approval to access National Health Laboratory Service (NHLS) Data

Your application to undertake a research project "**Urinary Bacterial profile and Antibiotic Susceptibility Pattern among Pregnant Women in Rahima Moosa Mother and Child Hospital**" using data from the NHLS database has been reviewed. This letter serves to advise that the application has been approved and the required data will be made available to you to conduct the proposed study as outlined in the submitted application.

Please note that final approval is granted on your compliance with the NHLS conditions of service and that the study can only be undertaken provided that the following conditions have been met.

- Processes are discussed with the relevant NHLS departments (i.e. Information Management Unit and Operations Office) and are agreed upon.
- Confidentiality is maintained at participant and institutional level and there is no disclosure of personal information or confidential information as described by the NHLS policy.
- A final report of the research study and any published paper resulting from this study are submitted and addressed to the NHLS Academic Affairs and Research office and the NHLS has been acknowledged appropriately.
- NHLS Data cannot be used to track patients as no pre-approval/consent is obtained from Patients.

Please note that this letter constitutes provisional approval by the NHLS Academic Affairs and Research Office. Any data related queries may be directed as follows: NHLS Corporate Data Warehouse, contact number: 011 386 6074 email: zarina.sabat@nhls.ac.za

Dr Babatyi Malope-Kgokong
National Manager: Academic Affairs and Research

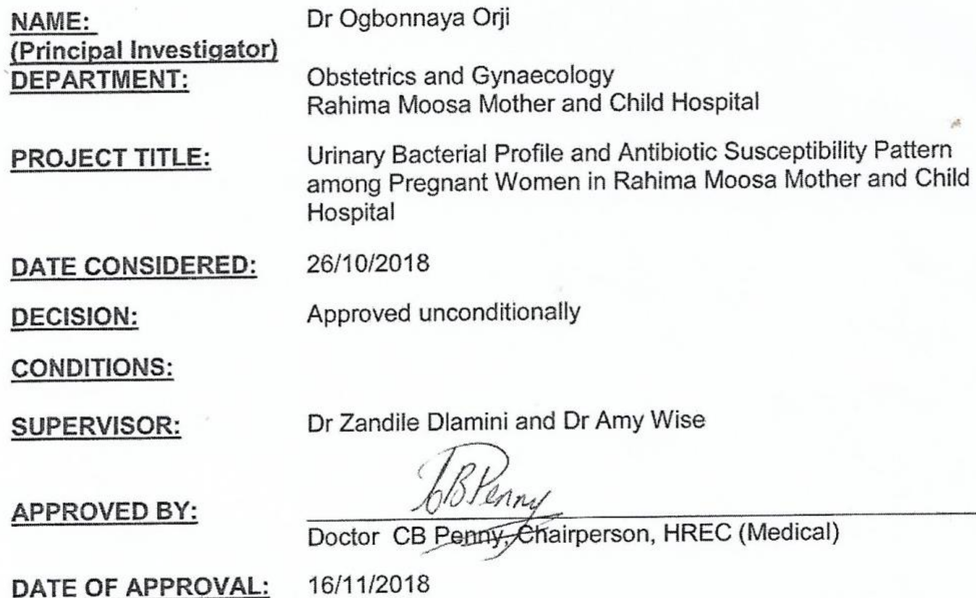
Chairperson Prof Eric Buch Acting CEO Dr Karmani Chetty
Physical Address 1 Modderfontein Road, Sandringham, Johannesburg, South Africa Postal Address Private Bag X8, Sandringham, 2131, South Africa
Tel +27 (0) 11 386 6000/ 0860 00 NHLS(6457) www.nhls.ac.za
Practice number 5200296

Appendix E: Ethics Clearance

R14/49 Dr Ogbonnaya Orji

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M181070



NAME: (Principal Investigator) Dr Ogbonnaya Orji

DEPARTMENT: Obstetrics and Gynaecology
Rahima Moosa Mother and Child Hospital

PROJECT TITLE: Urinary Bacterial Profile and Antibiotic Susceptibility Pattern among Pregnant Women in Rahima Moosa Mother and Child Hospital

DATE CONSIDERED: 26/10/2018

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr Zandile Dlamini and Dr Amy Wise

APPROVED BY: Doctor CB Penny, Chairperson, HREC (Medical)

DATE OF APPROVAL: 16/11/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary on the Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in October and will therefore be due in the month of October each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

22 | 11 | 2018

Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Appendix F: Journal guidelines for SAIDJ

Southern African Journal of infectious disease

Submission guidelines

Overview

The author guidelines include information about the types of articles received for publication and preparing a manuscript for submission. Other relevant information about the journal's policies and the reviewing process can be found under the about section. The **compulsory cover letter** forms part of a submission and must be submitted together with all the required **forms.** All forms need to be completed in English.

Original Research Article

An original article provides an overview of innovative research in a field within or related to the focus and scope of the journal, presented according to a clear and well-structured format.

Word limit	3500 words (excluding the structured abstract and references)
Structured abstract	250 words to include a Background, Methods, Results and Conclusion
References	50 or less
Tables/Figures	no more than 7 Tables/Figure
Ethical statement	should be included in the manuscript
Compulsory supplementary file	ethical clearance letter/certificate

Cover Letter

The format of the compulsory cover letter forms part of your submission. Kindly download and complete, in English, the provided **cover letter**.

Anyone that has made a significant contribution to the research and the paper must be listed as an author in your cover letter. Contributions that fall short of meeting the criteria as stipulated in our policy should rather be mentioned in the 'Acknowledgements' section of the manuscript. Read our **authorship** guidelines and **author contribution** statement policies.

Original Research Article full structure

Title: The article's full title should contain a maximum of 95 characters (including spaces).

Abstract: The abstract, written in English, should be no longer than 250 words and must be written in the past tense. The abstract should give a succinct account of the objectives, methods, results and significance of the matter. The structured abstract for an Original Research article should consist of four paragraphs labelled Background, Methods, Results and Conclusion.

- Background: Summarise the social value (importance, relevance) and scientific value (knowledge gap) that your study addresses.
- Methods: Clearly express the basic design of the study, and name or briefly describe the methods used without going into excessive detail.
- Results: State the main findings.
- Conclusion: State your conclusion and any key implications or recommendations. Do not cite references and do not use abbreviations excessively in the abstract.

Introduction: The introduction must contain your argument for the social and scientific value of the study, as well as the aim and objectives:

- Social value: The first part of the introduction should make a clear and logical argument for the importance or relevance of the study. Your argument should be supported by use of evidence from the literature.
- Scientific value: The second part of the introduction should make a clear and logical argument for the originality of the study. This should include a summary of what is already known about the research question or specific topic and should clarify the knowledge gap that this study will address. Your argument should be supported by use of evidence from the literature.
- Conceptual framework: In some research articles it will also be important to describe the underlying theoretical basis for the research and how these theories are linked together in a conceptual framework. The theoretical evidence used to construct the conceptual framework should be referenced from the literature.
- Aim and objectives: The introduction should conclude with a clear summary of the aim and objectives of this study.

Research methods and design: This must address the following:

- Study design: An outline of the type of study design.
- Setting: A description of the setting for the study; for example, the type of community from which the participants came or the nature of the health system and services in which the study is conducted.
- Study population and sampling strategy: Describe the study population and any inclusion or exclusion criteria. Describe the intended sample size and your sample size calculation or justification. Describe the sampling strategy used. Describe in practical terms how this was implemented.
- Intervention (if appropriate): If there were intervention and comparison groups, describe the intervention in detail and what happened to the comparison groups.
- Data collection: Define the data collection tools that were used and their validity. Describe in practical terms how data were collected, and any key issues involved, e.g. language barriers.

- Data analysis: Describe how data were captured, checked and cleaned. Describe the analysis process, for example, the statistical tests used, or steps followed in qualitative data analysis.
- Ethical considerations: Approval must have been obtained for all studies from the author's institution or other relevant ethics committee and the institution's name and permit numbers should be stated here.

Results: Present the results of your study in a logical sequence that addresses the aim and objectives of your study. Use tables and figures as required to present your findings. Use quotations as required to establish your interpretation of qualitative data. All units should conform to the **SI convention** and be abbreviated accordingly. Metric units and their international symbols are used throughout, as is the decimal point (not the decimal comma).

Discussion: The discussion section should address the following four elements:

- Key findings: Summarise the key findings without reiterating details of the results.
- Discussion of key findings: Explain how the key findings relate to previous research or to existing knowledge, practice or policy.
- Strengths and limitations: Describe the strengths and limitations of your methods and what the reader should take into account when interpreting your results.
- Implications or recommendations: State the implications of your study or recommendations for future research (questions that remain unanswered), policy or practice. Make sure that the recommendations flow directly from your findings.

Conclusion: Provide a brief conclusion that summarises the results and their meaning or significance in relation to each objective of the study.

Acknowledgements: Those who contributed to the work but do not meet our authorship criteria should be listed in the Acknowledgments with a description of the contribution. Authors are responsible for ensuring that anyone named in the Acknowledgments agrees to be named.
Also provide the following, each under their own heading:

- Competing interests: This section should list specific competing interests associated with any of the authors. If authors declare that no competing interests exist, the article will include a statement to this effect: *The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.* Read our **policy on competing interests**.
- Author contributions: All authors must meet the criteria for authorship as outlined in the **authorship** policy and **author contribution** statement policies.
- Funding: Provide information on funding if relevant
- Disclaimer: A statement that the views expressed in the submitted article are his or her own and not an official position of the institution or funder.

References: Authors should provide direct references to original research sources whenever possible. References should not be used by authors, editors, or peer reviewers to promote self-interests. Refer to the journal referencing style downloadable on our *Formatting Requirements* page.

Appendix G: Plagiarism Declaration

PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I DR OGBONNAYA ORJI (Student number: 2048292) am a student registered for the degree of MMED (OBST / GYNAE) in the academic year 2020.

I hereby declare the following:

- I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- I have followed the required conventions in referencing the thoughts and ideas of others.
- I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.
- I have included as an appendix a report from "Turnitin" (or other approved plagiarism detection) software indicating the level of plagiarism in my research document.

Signature: ______________ Date: 18/08/2020

1

Appendix H: Turnitin plagiarism report

2048292:FINAL_DRAFT_(_MMED_2020).pdf

ORIGINALITY REPORT

3%	0%	0%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

#	Source	%
1	Submitted to UNIVERSITY OF LUSAKA Student Paper	2%
2	Submitted to Postgraduate Schools - Limkokwing University of Creative Technology Student Paper	<1%
3	Submitted to Copperbelt University Student Paper	<1%
4	Submitted to St Dominic College of Asia Student Paper	<1%

Exclude quotes	On	Exclude matches	< 1 words
Exclude bibliography	On		