Patterns of Infections and Antimicrobial Drugs' Prescribing among Pregnant Women in Saudi Arabia

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Abstract

Background Antimicrobial agents are considered among the most commonly prescribed drugs in pregnancy given the increased susceptibility of infections during pregnancy. Antimicrobials can contribute to different maternal complications. Therefore, it is important to study their prescribing and utilization pattern. Such type of data regarding this issue is scarce in Saudi Arabia and this encouraged us to conduct this research. The aim of this study is to generate data about the most commonly prescribed antimicrobial agents during pregnancy, as well as their indicators and safety. **Methods** This is a retrospective study focusing on pregnant women with a known antimicrobial consumption at Johns Hopkins Aramco Healthcare (JHAH). The sample size was 344 pregnant women with 688 antimicrobial prescriptions. Data was collected about prevalence of infections and antimicrobial prescriptions in addition to drug safety during pregnancy using FDA risk categorization system. **Results** The results showed that Urinary Tract Infections (UTIs) were the most reported (59%) infectious diseases. Around 48% of pregnant women received antimicrobial medications at some point during their pregnancy. The top two antimicrobial agents based on prescription frequency were B-lactams (44.6%) and azole anti-fungals (30%). The prescribed drugs in the study were found to be from B, C and D classes according to the FDA risk classification system. **Conclusion** Overall antimicrobial prescribing practices were appropriate. The study revealed a high prevalence of antimicrobials prescribing during pregnancy that might pose risks to mothers and their fetuses. Future multi center studies are warranted to evaluate the rational prescribing of antimicrobial medications during pregnancy.

Background

Pregnancy is a critical period for women. Exposure to medications during this period might lead to adverse events that affect not only the pregnant woman but can also affect the fetus⁽¹⁾. Antimicrobials are commonly used among pregnant women because they are prone to different types of infections due to the lower immunity during that period⁽²⁾. Moreover, there is a unique concern pertaining to the different physiological changes that occur in volume of distribution, metabolism and clearance of drugs for both the mother and fetus⁽³⁾⁽⁴⁾. Antimicrobials yet remain important to reduce maternal mortality related to infections⁽⁵⁾. According to published literature, the most commonly reported infections among pregnant women are respiratory tract infections, urinary tract infections and sexually transmitted infections⁽⁶⁾⁽⁷⁾. Previous studies have also demonstrated that Penicillins are the most widely prescribed class of antimicrobial drugs during pregnancy as penicillins have the most robust safety data during this period⁽⁸⁾. In fact, data on antimicrobials use in pregnancy for different indications need to be studied to improve evidence-based care for this special population⁽⁴⁾.

A study conducted in Saudi Arabia for 11 months to assess antibiotic utilization pattern revealed that a high proportion of patients received antibiotics treatment prior to the availability of the results from bacterial culture tests. Ceftriaxone was the most frequently-prescribed antibiotic. Researchers

recommended obtaining strict protocols for practitioners to avoid the use of unnecessary antimicrobial drugs⁽⁹⁾.

In 2016, Al-Yamani et al, conducted a retrospective study in tertiary care hospital in Oman to evaluate the appropriateness of antimicrobials prescribing among patients admitted to acute care settings. Study results showed that only 63% of prescribed antimicrobial agents were selected appropriately and 79% of infections were treated empirically, while only 21% of patients have been treated based on obtained microorganism culture. It was also reported that 12% of empirical antimicrobials have been changed to match culture results. The most frequently prescribed antimicrobials were Piperacillin/tazobactam followed by Amoxicillin/clavulanic acid and clarithromycin⁽¹⁰⁾.

Another study was conducted in Canada in 2012 to investigate trends in anti-infective drugs use during pregnancy between 1998 and 2002. The study researchers observed a decline in broad spectrum antibiotics use over time. On the other hand, the use of other classes such as: Macrolides, Quinolones, Tetracyclines, Antimycotics and Antimicrobials that treat urinary tract infections was escalating. Use of Penicillins and Sulfonamides was also decreasing, while Cephalosporins, anti-protozoals and antimycobacterials showed no trend. Researchers explained that these data can be a result of the influence of evidence-based studies on prescription's trends during pregnancy among Canadian clinicians and warranted further investigations to understand such trends⁽¹¹⁾.

Data on medication use during pregnancy in 2016 in Nepali tertiary hospital has shown an increase of all drugs usage in the third trimester as 12.8% of used drugs were antimicrobials. The four most prescribed antimicrobials include Cefixime, Amoxicillin, Metronidazole and Ceftriaxone. The majority of prescribed medications were from FDA pregnancy category B⁽¹²⁾.

Another retrospective study was conducted in an antenatal clinic in rural Ghana. The study reported that around two-thirds of pregnant women attending the clinic received antibiotics prescriptions. The most commonly prescribed antibiotics were categorized under classes B, C and D according to FDA risk classification system. The study results have shown that 3.5% of antibacterial prescriptions were filled without proper diagnosis or justification⁽¹³⁾.

While the above-mentioned studies provide valuable information regarding antimicrobial use during pregnancy, unfortunately, there is scanty of information about this important topic in Saudi Arabia. To the best of our knowledge, this is the first study in Saudi Arabia that comprehensively considers prescribing or use patterns of antimicrobial drugs among pregnant women.

The aims of our study are; to identify the most common types of infections among pregnant women in Saudi hospital, to measure the prevalence of antimicrobial prescriptions among pregnant women, to assess prescribed antimicrobials' safety during pregnancy according to FDA risk categorization.

Methodology

Study design and site

This study is a retrospective observational study that was conducted to collect data for pregnant women with known antimicrobial utilization during pregnancy at Johns Hopkins Aramco Healthcare (JHAH) which is located in Eastern province of Saudi Arabia in Al Dhahran city. The data was collected from patients' electronic medical records (EMRs).

Sampling technique and sample selection procedure

Medical records for pregnant women as confirmed by positive Human Chorionic Gonadotropin test (hCG) who have delivered either through vaginal delivery or Caesarean section at JHAH were collected. Total number of pregnant women in December 2017 to February 2019 with positive hCG was 5124 and all of them have been screened. A sum of 2440 of these pregnant women had antimicrobial prescriptions and 344 of pregnant women who had prescribed antimicrobials between ages of 15-50 years old were selected randomly and included as the sample size in our study with a total number of 688 prescriptions.

Sample size calculation

To determine sample size for this study we have used power study. To prove the sample size adequacy for a study this is a very useful and frequently used tool in health research. The prevalence of antimicrobial drugs use among pregnant women in a Saudi Arabia is 3 percent⁽¹⁴⁾. Since our population size is unknown, to obtain an appropriate sample size from this population, we use the following formula: (see Formula 1 in the Supplementary Files)

Considering 20 percent missing/non response error rate, the adjusted sample size is 316.87. This is the minimum number, finally our targeted sample size for this study will be 320.

Inclusion criteria

Pregnant women who had normal pregnancy, attended to JHAH and received antimicrobial medications between December 2017 to February 2019 and delivered their babies at JHAH.

Age of patients ranged between 15-50 years as some women may got married earlier than 18th years old.

Exclusion criteria

Women with abortion or ectopic pregnancy. Women who were prescribed with antimicrobials for normal delivery prophylaxis and women with post cesarean delivery prophylaxis.

Data collection

Demographic data, clinical data, anti-infective medications and comorbidities were collected for pregnant women who met the study inclusion criteria. If the woman was prescribed antimicrobial agents at any point of pregnancy, all antimicrobial courses during her pregnancy were considered.

Definition of the study variables

Age of the pregnant at time of receiving antimicrobial (gestational age) was categorized to 15-24, 25-34, 35-44, and equal or older than 45 years of age.

Pregnancy Trimester was calculated after the woman's last menstrual period (LMP). It was divided into: First Trimester (1-12 weeks), Second Trimester (13-27 weeks) and Third Trimester (28-40 weeks).

FDA established five letter risk categories to indicate safety drug use during pregnancy as A, B, C, D or X. Drugs undergo FDA categories A or B are considered to be safe to use during pregnancy. FDA categories C could be given if benefit outweighs risk but for D and X categories, they are considered as harmful drugs, especially X drugs (if any) which are absolutely contraindicated.

Allergies towards drug or food have also been documented.

Drug resistance defined as the reduction in effectiveness of antimicrobials that happens when microorganisms change after exposure to antimicrobial drugs. The pathogen drug resistance was taken as reported by physicians in patients' EMRs.

Mode of delivery either vaginal or caesarean section (C-section) was also recorded.

Indication of the prescribed antimicrobials either for treatment of a known infection or as prophylaxis for pregnant women who are at high risk to get infection was also documented.

Complication that may occur for the pregnant women during the pregnancy period which is divided in this study to complication for preterm pregnancies (when baby born before 37 weeks of pregnancy) or complication for abortions. In addition to this, data about fetal complications if the fetus has been exposed to any complications or abnormalities during the pregnancy period was also collected. Maternal co-morbidities variable was defined as the presence of one or more additional diseases or disorders occurring with the infection during pregnancy. Gravida variable describes the total number of confirmed pregnancies that a woman has had, regardless of the outcome. Living children means children who lived beyond neonatal period. Duration of medication (Days) indicates duration of treatment of antimicrobials for the pregnant women.

Prescribed medications include antimicrobial agents which have been used to either kill or slow the growth of microbes, including antibacterial, antiviral, antifungal, and anti-parasitic drugs.

Pattern of infection designates the type of infection the pregnant woman has experienced which includes bacterial, fungal, viral, and parasitic diseases.

Data analysis

Data was analyzed by Statistical Package for Social Sciences (SPSS) software. Descriptive statistics was used to describe the study variables and items. Chi-square test/Fisher’s exact test was utilized to compare the proportions among groups. P-value below 0.05 is considered statistically significant.

Ethical consideration

The study received an ethical approval from the University IRB under the following number (IRB – UGS – 2018 – 5 – 048). It has also been approved by the Johns Hopkins Aramco Healthcare (JHAH) institution Review Board (IRB) under (IRB number 18-07).

Results

Our study revealed that the prevalence of antimicrobial prescription among pregnant women was 48% (Fig. 2). Mean age of the respondents were 19.19 (SD 6.33) years ranging from 15 to 49 years. More than half (55.4%) of the pregnant women were 25-34 years old, followed by 22.4% from 15-24 year age category, almost similar proportion were (21.3%) from 35-44 year age category and only few (0.9%) were equal or older than 45 age category. However, mean gestational age for women was 23.49 weeks (SD-10.35).

Around half of the antimicrobial prescriptions have been issued for pregnant women during the third trimester (47.4%), followed by prescriptions received during second trimester (30.9%). The lowest antimicrobials prescribing was during the first trimester (21.6%) as shown in table 1.

Table 1: Background characteristics of study variables (n=688)

Variables	Group	Frequency (n)	Percentage (%)
Age	15-24	154	22.4
	25-34	381	55.4
	35-44	147	21.3
	≥45	6	0.9
Pregnancy Trimester (n=685)	First	148	21.6
	Second	212	30.9
	Third	325	47.4
FDA category for safety drug use during pregnancy	Category A	0	0
	Category B	457	66.4
	Category C	224	32.6
	Category D	7	1.0
	Category X	0	0
Allergy	No	633	92.0
	Yes	55	8.0
	B-lactam	12	21.8
	Dopaminergic	11	20.0
	Quinolones	7	12.7
	NSAIDs	6	10.9
	Food Allergy	6	10.9
	Danazol	3	5.5
	Multi Drug Allergy	3	5.5
	Corticosteroids	2	3.6
	Tetracycline	2	3.6
	Miscellaneous	2	3.6
	Sulfa Drug	1	1.8
Drug Resistance (n=324)	No	272	84.0
	Yes	52	16.0

	B-lactam	20	38.5
	Multi Drug Resistance (MDR)	17	32.7
	Quinolones	15	28.8
Mode of Delivery (n=344)	Vaginal delivery	245	71.2
	Caesarian section	99	28.7
Indication of antibiotic use	Treatment	681	99.0
	Prophylaxis	7	1.0
Mother Comorbidities (n=344)	No	198	56.9
	Yes	146	42.4
Maternal complications	Complication for Abortions (A)	205	29.8
	Complication for Preterm pregnancies (P)	152	22.1
Fetal complications (n=344)	No	297	86.3
	Yes	47	13.6

FDA categorization for drug safety use during pregnancy in the study fell into classes B, C and D. However, both classes A and X antimicrobials have not been prescribed. Most of the drugs fell into class B (66.4%) followed by class C and class D with (32.6%) and (1.0%) respectively as shown in table 1.

The vast majority of included patients has no known allergies (NKA) (92.0%) to the prescribed drugs. Beta lactams antibiotics accounted for (21.8%) of active drug allergy occur among pregnant women followed by dopaminergic drugs and quinolones with (20.0%) and (12.7%) respectively. About 10% of patients had Nonsteroidal anti-inflammatory drugs (NSAIDs) allergy or food allergy. The other active drug allergies were danazol (5.5%), multiple Drug Allergy (5.5%), tetracycline (3.6%), corticosteroids (3.6%), miscellaneous (3.6%) and sulfonamides (1.8%) as shown in table 1.

Majority of patients did not experience any bacterial resistance (84.0%). According to the susceptibility tests that were obtained with cultures, microorganisms were most likely resistant to B-lactam antibiotics (34.7%), followed by multi drug resistance (MDR) (32.7%) and quinolones (28.8%) as shown in table 1.

Around three quarters of participating pregnant women have delivered through vaginal delivery (71.2%). However, the rest underwent caesarian section (28.7%). Gravida mean $\pm$ SD was 3.12 ± 2.37 with range 1 to 13 pregnancies as shown in table 1 and 2.

Most of the pregnant women were prescribed with antimicrobials to treat infections (99.0%) and only (1.0%) were used as prophylaxis. Median (IQR) of duration of taking antimicrobial was 7.0 (2.0) with range of 1-120 days as shown in table 1 and 2.

Around half of the mother were following up for their pregnancy without any comorbidities (56.9%). Mean $\pm$ SD of number of term pregnancies was 2.17 ± 1.77 . Complications experienced by pregnant women were mainly preterm birth (22.1%) and abortions (29.8%). Most of the babies had no complications after their mothers received antimicrobial drugs (86.3%). Whereas around (13.6%) of babies had complications that was not explained in the medical records. Mean $\pm$ SD of number of living children was 2.36 ± 1.78 with range of 0 to 8 living children as shown in table 1 and 2.

Table 2: Mean, Standard Deviation (SD), 95% Confidence Interval (CI) of Mean and Range for some study variables

Variables	Mean $\pm$ SD or Median (IQR)	95% CI of Mean	Range
Age	19.19 ± 6.33	L-28.72, U-29.67	17 to 48
Gestational Age (week)	23.49 ± 10.35	L-22.71, U-24.27	1 to 41
Gravida	3.12 ± 2.37	L-2.94, U-3.30	1 to 13
Number of Term of pregnancies	2.17 ± 1.77	L-2.03, U-2.30	0 to 8
Number of Living children (L)	2.36 ± 1.78	L-2.23, U-2.50	0 to 8
Duration of taking medicine (Days)	7.0 (2.0)	---	1 to 120

Table 3: Pattern of infection among pregnant women from Eastern region Saudi Arabia (n=587)

Pattern of infections affecting pregnant women:

The majority of pregnant women considered in this study suffered from bacterial infections (64.0%). Urinary tract infections (UTI) from bacterial infection had the highest prevalence among pregnant women (59.3%) followed by fungal infections (34.5%). Other types included upper respiratory tract infection

Variables	Group	Frequency (n)	Percentage (%)
Pattern of Infection	Bacterial Infection	376	64.0
	Urinary Tract Infection	223	59.3
	Upper respiratory tract infection	72	19.1
	Skin and soft-tissue infection	36	9.5
	Intra-abdominal infection	24	6.3
	Lower respiratory tract infection	11	2.9
	Eye infection	10	2.6
	Fungal Infection	203	34.5
	Parasitic Infection	4	0.6
	Viral Infection	4	0.6

(19.1%), skin and soft tissue infection (9.5%), intraabdominal infection (6.3%), lower respiratory tract infection (2.9%), and eye infection (2.6%). Parasitic infection (0.6%) and viral infection (0.6%) were the lowest infections among pregnant women as shown in table 3.

Table 4: Pattern of prescribed antimicrobials among pregnant women from Eastern region Saudi Arabia (n=688)

Variables	Group	Frequency (n)	Percentage (%)
Prescribe medication	B-lactams	307	44.6
	Azoles	208	30.2
	Macrolides	53	7.7
	Quinolones	46	6.7
	Other antibiotics	45	6.5
	Aminoglycosides	11	1.6
	Antiviral	6	0.9
	Other anti-fungal	6	0.9
	Antimalarial	5	0.7
	Tetracycline	1	0.1

Patterns of antimicrobial prescribing among pregnant women including systemic and/or topical routes:

The most frequent antimicrobial prescriptions among pregnant women were B-lactams (44.6%) followed by azoles prescriptions (30.2%). The other antimicrobial prescriptions were not as frequent and this included macrolides (7.7%), quinolones (6.7%) and other antibiotics (6.5%). The least prescribed antimicrobials were aminoglycosides (1.6%), antiviral (0.9%), other anti-fungal (0.9%), antimalarial (0.7%) and tetracycline (0.1%) as shown in table 4.

Table 5: Descriptive statistics for microbiological culture among pregnant mothers from Eastern region Saudi Arabia (n=656)

Variables	Group	Frequency (n)	Percentage (%)
Microbiological culture	No Isolate	366	55.8
	No Growth	82	12.5
	Escherichia coli	57	8.7
	Mixed flora	55	8.4
	Streptococcus agalactiae	23	3.5
	Klebsiella pneumoniae	19	2.9
	Candida albicans	18	2.7
	ESBL E. Coli	7	1.1
	Staphylococcus Aureus	6	.9
	Acinetobacter baumannii complex	3	.5
	Candida glabrata	3	.5
	Lactobacillus species	3	.5
	Campylobacter jejuni	2	.3
	Enterobacter aerogenes	2	.3
	Enterobacter cloacae	2	.3
	Enterococcus faecalis	2	.3
	Staphylococcus epidermidis	2	.3
	Diphtheroid bacilli	1	.2
	Helicobacter Pylori	1	.2
	Pseudomonas aeruginosa	1	.2
	Staphylococcus haemolyticus	1	.2
	Total	656	100.0

More than half of the pregnant women who had prescribed antimicrobials were treated empirically 55.8%. Microbiological cultures have been requested for the remainder 44.2% where 12.5% of them revealed no growth. Escherichia coli bacteria has been identified in 8.7% of performed cultures followed by mixed

flora 8.4%. Other pathogens were *Streptococcus agalactiae* 3.5%, *Klebsiella pneumoniae* 2.9%, *Candida albicans* 2.7%, Extended-Spectrum Beta-Lactamase (ESBL)-producing *E. coli* 1.1% and *Staphylococcus Aureus* 0.9%. Around (0.5%) has been accounted for the following pathogens: *Acinetobacter baumannii* complex, *Candida glabrata* and *Lactobacillus* species. Other pathogens identified were: *Campylobacter jejuni*, *Enterobacter aerogenes*, *Enterobacter cloacae*, *Enterococcus faecalis* and *Staphylococcus epidermidis* with (0.3%) prevalence. The lowest percent (0.2%) for the following organisms: *Diphtheroid bacilli*, *Helicobacter Pylori*, *Pseudomonas aeruginosa* and *Staphylococcus haemolyticus*. The prescribed antimicrobial classes are described in table 5.

Discussion

The present study describes the overall practices of prescribing antimicrobial agents in pregnant women and the common types of infectious diseases occur during pregnancy in a Saudi Arabian hospital. All anti-infective agents' exposure and related infectious diseases during pregnancy were carefully identified and recorded. The antimicrobial classes have been reviewed and evaluated. The safety of these medications was assessed according to FDA pregnancy risk categorization. To the best of our knowledge, this is the first study conducted in the Middle East that thoroughly study and evaluate anti-infective medications prescribing and use during pregnancy. This research project is expected to help in generating knowledge about the prevalence of infections types during pregnancy, developing a better utilization of antimicrobials for pregnant women during their pregnancies, improving antimicrobials prescribing for pregnant women regarding the safe selection of antimicrobial regimens and shedding light on the prescribing patterns of different antimicrobials among pregnant women and improving the compliance with international guidelines.

Indications for antimicrobial use

The most prevalent infectious diseases among pregnant women in JHAH were urinary tract infections. In fact, these results are consistent with the most common infections found among pregnant women at Quebec Canada with the superiority of upper respiratory tract infections in their results. The raising of upper respiratory tract infections in Canada was expected for their country region as they have long and rigorous winters(17). The reason behind the high prevalence of urinary tract infection is the physiological changes that arise in gestational period when the uterus grows and block the drainage of urine from bladder, thus creating a susceptible media for infections(18). The second most common infection in JHAH is fungal infection. Vaginal infection occurs when there is an overgrowth of bacteria that naturally lives in the vagina which in pregnancy can be influenced by hormonal fluctuations(19). Similar findings have been revealed from a study conducted in tertiary level hospital in Addis Ababa from November 2011 to April 2012 where around 1 in 5 pregnant women will develop vaginal infections(20).

Prevalence of antimicrobial exposure

Forty-eight percent of pregnant women in our study have received antimicrobial medication during their pregnancies. This is higher than the prevalence of anti-infective use reported in a study conducted in 2012 in Quebec Canada⁽¹¹⁾, however, it was less than the documented antibiotic use in a recent study conducted in an antenatal clinic in rural Ghana⁽¹³⁾.

Classes of prescribed antimicrobials

The top two antimicrobial agents based on prescription frequency were B-lactams and azole antifungals. This is conforming with the findings of the study conducted in Quebec Canada, where penicillins was the most prescribed antimicrobial class, while the next top three antimicrobials were macrolides, quinolones and antifungal agents subsequently⁽¹¹⁾. This is also in agreement with the findings of the Ganian study where beta lactam antibiotics i.e. cephalosporins and penicillins also represented the majority of antibiotics used in an antenatal clinic in rural Ghana⁽¹³⁾ and as reported in another study conducted in a hospital in Western Nepal⁽¹²⁾. According to FDA risk categorization, penicillins and cephalosporins are considered safe option in pregnancy. Azoles if used systemically could be teratogenic in animal and human. However, topical azoles are not or are minimally absorbed and hence are allowed at any stage of pregnancy⁽²⁰⁾⁽²¹⁾. In our data, the prescription of azoles for pregnant women was systemic and topical.

Pregnancy risk categories

The majority of antimicrobial drugs prescribed to our study participants belong to FDA category B (66.4%), followed by (32.6%) from category C and (1.0%) from category D which is considered harmful as per FDA recommendations. No antimicrobials from category A or X have been documented in our study. Similar findings have been revealed from a study conducted in an antenatal clinic in rural Ghana between 2011 and 2015 where antimicrobials taken by pregnant women were mainly from FDA category B (69.6%), with less drugs prescribed from categories C (2.9%) and D (0.5%) whereas classes A and X antimicrobials have not been prescribed⁽¹³⁾.

Drug use per trimester

In our study, antimicrobials were prescribed in all three trimesters with highest prevalence in the third trimester. A similar study shows total medication use during pregnancy was maximum in the third trimester with an average of (3.88) drugs per patient followed by second trimester (3.05) drugs per patient and first trimester (3.01) drugs per patient trimesters⁽¹²⁾. These data might be acceptable as during the third trimester the fetus grows larger and the body organs become mature⁽²²⁾. Another study⁽²³⁾ found that the prevalence of prescribed medication was higher in the first trimester (47.0%). In JHAH, most study participants who have received the anti-infective medication in the first trimester were before confirming pregnancy.

Microbiological culture and empiric treatment

Almost half of patients had microbiological cultures prior to the initiation of antimicrobial agents that revealed negative results in 12.5% of the cultures. However, in the positive cultures, the most predominant microorganism was *Escherichia coli*, followed by *Streptococcus agalactiae*, *Klebsiella pneumoniae*, *Candida albicans*, ESBL *E. Coli* and *Staphylococcus Aureus*. Al Yamani et al, reported similar results where the most common organisms in their hospital were gram-negative bacteria (*Escherichia coli*, followed by *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, methicillin-resistant *Staphylococcus aureus* (MRSA), and *Acinetobacter*). In their institution the practice differed in obtaining the cultures before the antimicrobial course initiation, cultures were collected in only one-quarter of their patients⁽¹⁰⁾. This can reflect the attitude of JHAH practitioners in considering the bacterial culture and its importance before prescribing Antimicrobials.

Study limitations and recommendations for future research

Limitations

The current study has several limitations. First, as antimicrobial prescribing during pregnancy was evaluated in a single center and every antimicrobial prescribing was considered as an encounter and was counted as a separate file for statistical purposes, hence caution is required for generalizing the findings to the entire population. Second, the poor medical documentation lead to a lack of information regarding treatment indication. For this reason, we could not explain or connect the use of antimicrobials to the disease state or maternal & fetal consequences. The poor documentation in addition resulted in a lot of missing data which in turn prevent us from correlating antimicrobial use with demographic data. Also, the study was retrospective chart review. Nevertheless, the study investigated the prescribing patterns of antimicrobial agents during pregnancy. It highlights the general prescribing practices and most common infections at the Johns Hopkins Aramco Healthcare hospital in Dhahran city.

Conclusion

Our study revealed a high prevalence of antimicrobials prescribing during pregnancy that might pose risks to mothers and their fetuses. Different approaches are needed to increase health care providers as well as pregnant women awareness about the common types of infections during pregnancy and how to prevent them. The study has identified a gap in training and a need for educational programs to avoid prescribing FDA category C & D antimicrobials unless well indicated and benefits outweighs the risk. Further studies are warranted in order to identify factors associated with such antimicrobial prescribing and to generalize the results to the rest of the Kingdom.

Declarations

Ethics approval and consent to participate

The study received an ethical approval from the University IRB under the following number (IRB – UGS – 2018 – 5 – 048). It has also been approved by the Johns Hopkins Aramco Healthcare (JHAH) institution Review Board (IRB) under (IRB number 18-07).

Consent for publication

All authors have given verbal consent for publication.

Availability of data and material

All data and materials are available upon request.

Competing interests

All authors declare that they have no any kind of competing interests.

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Authors' contributions

Mohamed A. Baraka and Lina Hussain ALLehaibi have contributed equally to the study design, conduction, analysis, writing and all other project phases. Duaa Alsulaiman, Mohamed Ashraful Islam, Hind Nasser AlSuwaidan, Badriyah S. Alotaibi and Amany Alboghdadly have contributed to the conception and design of the study. Mohamed A. Baraka, Ali H. Homoud, Fuad H. Al-Ghamdi, Mastour S Al Ghamdi contributed to the generation, collection, assembly, analysis and/or interpretation of data. All authors have contributed to drafting and revision of the manuscript. All authors approved the final version of the manuscript.

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Figures

Figure 1

Sample selection procedures.

PREVALENCE OF ANTIMICROBIAL PRESCRIPTIONS AMONG PREGNANT WOMEN (N=5124)

- Pregnant women without antimicrobial prescriptions
- Pregnant women with antimicrobial prescriptions

Figure 2

Prevalence of antimicrobial exposure among pregnant women in Saudi Arabia Out of 5124 pregnant women attended to the hospital between December 2017 and February 2019, 2440 of them were exposed to antimicrobials for different indications and 2684 women have not been exposed to such medications.

Supplementary Files

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