



# **Infections in Childcare Facility in Benghazi Medical Centre**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/AJPR/2024/v14i3329

## **Open Peer Review History:**

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/113850>

**Original Research Article**

**Received: 26/12/2023**

**Accepted: 01/03/2024**

**Published: 06/03/2024**

## **ABSTRACT**

Nowadays, as a result of an increasing proportion of families in which parents are in funded jobs, there has been a steady increase in the demand for care of young children. The present study investigated infections in childcare facility and The samples were taken by sterile cotton swabs from 39 different places, to know the different types of bacteria that in the nursery. the results revealed that, 6 different types of dangerous bacteria which are (*Staphylococcus aureus*, *Klebsiella pneumonia*, *pseudomonas Aeruginosa*, *streptococcus viridians*, *Corynebacterium*, *Diphtheria*, *bacillus*, and *Enterobacteriaceae Serratia*). All of the isolate's bacteria were found resistant to at least two antibiotics. Thirteen antibiotics were used in the sensitivity test which are: Cefotaxime, Azithromycin, Tetracycline, *Vancomycin*, *Cefixime*, *ceftolozane-tazobactam* test Doxycycline, Ciprofloxacin, Ampicillin, Cefotazime, *Amikacin*, and Oxacillin. According to this study, 34% of isolates bacteria was (*Staphylococcus aureus*) and the most common diseases were (Influenza and Diarrhea).

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**Keywords:** Child; day-care; contaminations; infectious diseases; prevention.

## 1. INTRODUCTION

“As a consequence of the percentage of households where both parents work for a living is rising, there has been a stable increase in the demand for children care. This is provided by informal arrangements for example care by relatives and friends, and by formal child care. When youngsters congregate, the risk of illness rises wherever they go. This problem is most noticeable in babies and young children who would typically clean their noses or wash their eyes with their hands before handling toys or interacting with other kids. These kids then touch their noses and rub their eyes, which is how the virus spreads from one child's nose or eyes to another through hands or toys, and the next kid rubs his own nose or eyes. This is one of the reasons why kids get sick a lot in their early years of life because their bodies are building an immunity to infections” [1].

The scientific literature also recognizes that control measures to reduce transmission of infectious diseases are effective and necessary to minimize the unfavourable consequences for collective health that can result from day care in groups [2-4] recommending infection control standards and practices for environments in which children are cared for together [5-8].

“The higher of infections in children attending child care centres can be reduced by applying infection control policies. Despite this, such policies are unlikely to be put into practice without significant support, in the form of training, important advice and basic information that can be provided for workers in child care centres by the public health and clinical community. In numerous child care facilities, the staff simply cannot care for a sick child due to space or staff limitations. Every childcare facility should have a written set of clear policies which will inform and explain to both staff and parents how they can deal with children who are ill when they arrive at the facility, or who become ill whilst they are in these care facilities. Such policies will provide a rigid framework that will help both staff and parents make decisions when children are ill. Each facility staff member should understand the importance of illness avoidance in their day to day work routines. Practices such as appropriate hand washing, diapering, toileting, and food preparation, will limit the spread of bacteria and

viruses and will promote a healthy child care environment” [9].

“There are many factors that influence the risks of introduction and spread of infections in child care settings. These factors include the personal hygiene and health status of the staff who are working in centre and the children (as well as their ages) and the situation of the facility (e.g. environmental sanitation, space and quality, food-handling practices, policies for attendance, and ratio of children to caregivers” [10]).

“Studying day care-associated infectious disease dynamics aids in formulating evidence-based guidelines for disease control, thereby supporting day care centres in their continuous efforts to provide their child population with a safe and hygienic environment. Illness is common in children. While kids have developed resistance to the pathogens that are common in their own homes, they will be exposed to a variety of new pathogens when they are around other children” [11].

Long stretches of time might be spent by kids in nursery facilities. A child's risk of contracting an infection increases with the amount of time they spend in these environments and the number of other children they interact with. Therefore, while it is never practically possible to completely avoid infection, it is possible to significantly lower the risk. Thankfully, there are a few easy tactics and exercises that can significantly reduce the risk of infection in nursery environments [12].

“One important idea regarding infectious disease is the ‘infectious dose’, this is the number of pathogens that are needed to make a person ill. The ‘infectious dose’ varies from pathogen to pathogen and from person to person, for example: salmonella pathogens. It takes between 1000 and 10,000 cells to make a healthy person ill, but as little as a few hundred to make a small child or elderly person ill.

Another example is *Vero cytogenic E.coli* it takes less than five of the VTEC (*Vero cytogenic E.coli*) pathogens to make healthy adults ill, so it will come as no surprise to know that cases of renal failure and deaths (which are not uncommon in cases of VTEC) are much more likely in small children and elderly people” [13-15]. “The spread of infections in child care centers is facilitated by crowding and microbial

contamination of the childcare environment, as well as the unhygienic behaviors and greater susceptibility of young children” [16].

“Child care workers and other adult contacts are also at increased risk of infections such as upper respiratory tract infection, gastroenteritis and hepatitis A. Concern has been expressed about acquisition of cytomegalovirus (CMV) by pregnant carriers, which may cause severe congenital infection, and parvovirus which may be associated with intrauterine death or stillbirth due to fetal hydrops” [17].

## 2. METHODS

The study was conducted in the child care center of Benghazi Medical Centre (BMC) in Benghazi in 2017. This study a cross-sectional study, it was based on swabs were taken from different places in the childcare center to know the different types of bacteria that could exist in the nursery. The samples were taken by sterile cotton swabs from 31 different places. The first 10 samples were taken in March 2017 from the following places (the handle out of the main entrance door, playing table in the TV room, chairs, beds, toys, studying tables, and staff office).

The second set of swabs were taken at June 2017 from different places (the handle out of the main entrance door, beds, changing table, toys, carpet, windows, eating tables, staff office, broom, wall, chair, building up game, and carpet of the playing room, toilet (tap water1, tap water2, toilet seat 1, toilet seat2)

## 3. RESULTS

Cultural and biochemical characterization of bacteria isolated from targeted sites showed the presence of seven species of bacteria, namely: *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Streptococcus viridians*, *Staphylococcus aureus*, *Corynebacterium diphtheria*, *Bacillus*, *Serratia*. They were identified as follows:

**Identification of *Klebsiella pneumoniae*:** Gram-negative rods gave positive citrate and urease test. It appeared lactose fermented mucoid pink colonies on MacConkey agar (Fig. 8) and confirmed by TSI media (acid in butt and slant with production of gas and H<sub>2</sub>S) (Fig. 9).

**Identification of *Pseudomonas aeruginosa*:** Gram negative rod, motile, gave large, flat, haemolytic colonies on blood agar (Fig. 10). The isolates have a distinctive smell due to

aminoacetophenone production, whereas on MacConkey agar, it showed non-lactose fermenting colonies with yellow-green pigment (Fig. 11) their biochemical reaction gave positive oxidase test (Fig. 12).

**Identification of *Staphylococcus aureus*:** Which appeared as yellow colonies on blood agar (Fig. 13) and gave orange colonies on MacConkey agar (Fig. 14). The identification was by production of catalase enzyme (Fig. 15) both coagulase test (Fig. 16) and DNase test showed a positive reaction (Fig. 17).

**Identification of *Streptococcus viridians*:** Gram positive, diplococci non capsulated bacteria, facultative anaerobic, producing a green coloration on blood agar (Fig. 18) or alpha-haemolytic and resistant to (op) optochin antibiotic disc, (Fig. 19).

**Identification of *Corynebacterium*:** Gram positive, aerobic, rod shape (Fig. 20), cultivated on blood agar (Fig. 21) with 5% defibrinated sheep blood smooth convex colonies with entire margin cultivation 24 hours, 37°C in an aerobic atmosphere enriched with 5% carbon dioxide [18]. For species differentiation further testing required.

**Identification of *Bacillus*:** *Bacillus* is a genus of Gram-positive, rod-shaped bacteria (Fig. 22) and a member of the phylum Firmicutes, showed gray non hemolytic colonies on blood agar (Fig. 23). “*Bacillus* species can be obligate aerobes (oxygen reliant), or facultative anaerobes (having the ability to be aerobic or anaerobic). They will test positive for the enzyme catalase when there has been oxygen used or present” [18-20]. Ubiquitous in nature, *Bacillus* includes both free-living (non-parasitic) and parasitic pathogenic species, they grow in Sheep blood agar (SBA) Colonies are non-hemolytic, flat or slightly convex with irregular edges and ground-glass appearance. There are often comma-shaped projections from the colony edge producing a “Medusa-head” colony. No growth on MacConkey agar [21].

**Identification of *Serratia. spp*:** Genus of Gram-negative, facultatively anaerobic, red pigment on MacConkey agar Fig. 24, endospore forming [22] rod-shaped bacteria of the *Enterobacteriaceae* family. “The most common and pathogenic of the species in the genus, *S. marcescens*, this normally the only pathogen and usually causes nosocomial infections. However, rare

strains of *S. plymuthica*, *S. liquefaciens*, *S. rubidaea*, and *S. odoriferae* have caused diseases through infection” [23] “*S. marcescens* is typically found in showers, toilet bowls, and around wetted tiles. Members of this genus produce characteristic red pigment, prodigious, and can be distinguished from other members of the *Enterobacteriaceae* family by their unique

production of three enzymes: DNAs, lipase, and gelatinase” [23].

Levels of antibiotic resistance were obtained among the bacterial isolates and ranged between (6.7% - 80%) the highest ranges of bacteria were 80% *S. aureus* and 60% *Bacillus Spp* All the bacterial isolates from the daycare were resistance towards two or more antibiotic.

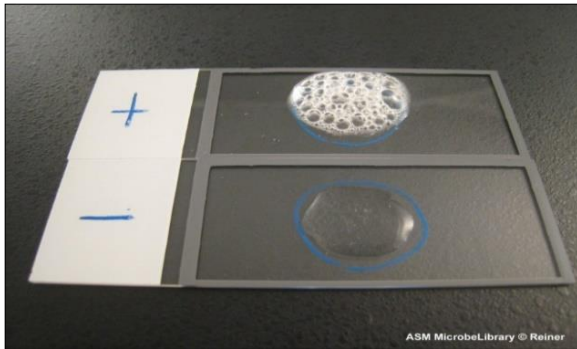


Fig. 1. Catalase test



Fig. 2. Coagulase



Fig. 3. Citrate utilization test

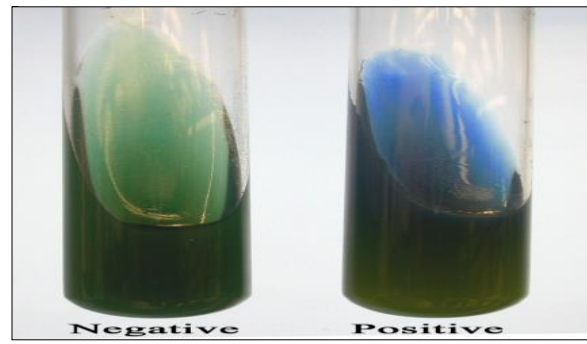


Fig. 4. Urease test

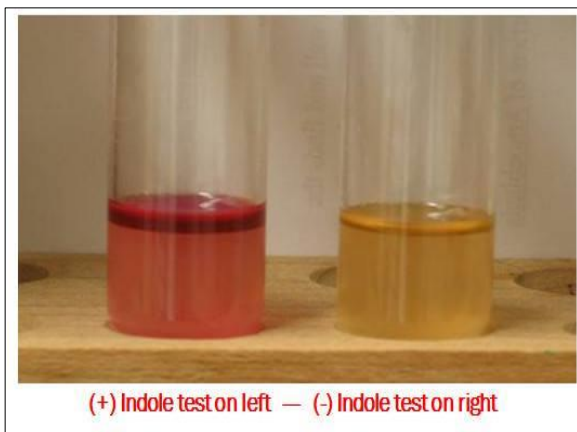


Fig. 5. TSI test

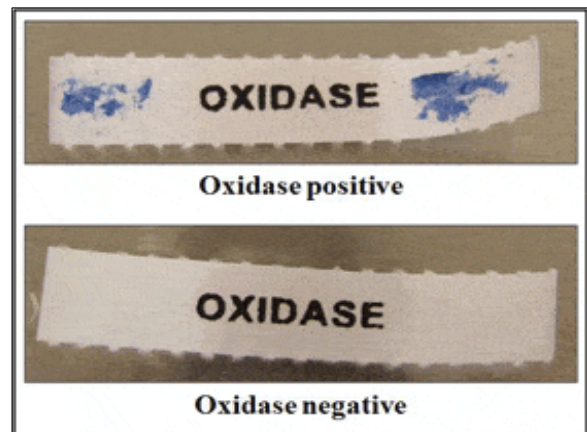


Fig. 6. Oxidase test



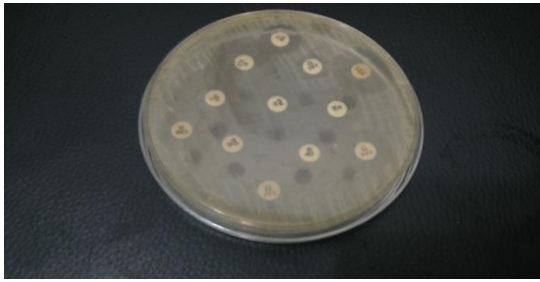


Fig. 7. Sensitivity test to antibiotics



Fig. 8. K. pneumoniae on

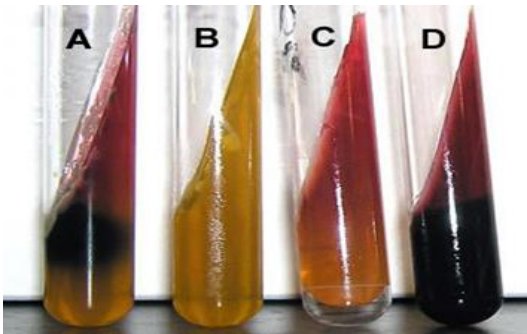


Fig. 9. k. pneumoniae on MacConkey



Fig. 10. pseudomonas aeruginosa on blood agar

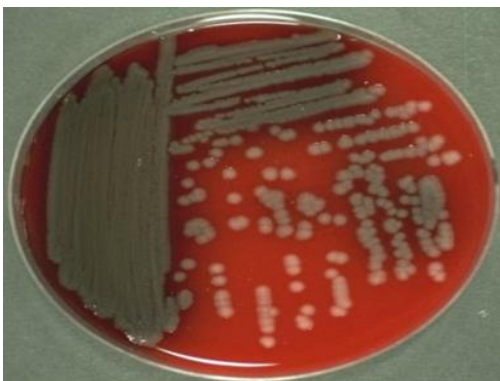


Fig. 11. Pseudomonas aeruginosa on MacConkey Agar



Fig. 12. Pseudomonas aeruginosa on oxidase test



Fig. 13. S. aureus on blood agar



Fig. 14. S. aureus on MacConkey agar



Fig. 15. *S. aureus* on catalase



Fig. 16. *S. aureus* on coagulase

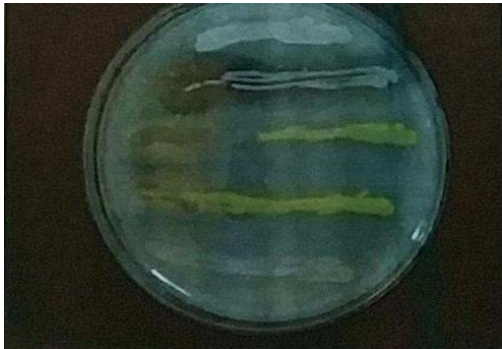


Fig. 17. *S. aureus* on DNA test

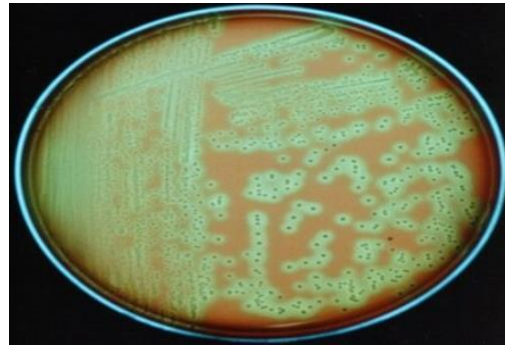


Fig. 18. Viridians on blood agar



Fig. 19. Viridians resistant to (op)optochin antibiotic



Fig. 20. Corynebacterium on blood agar

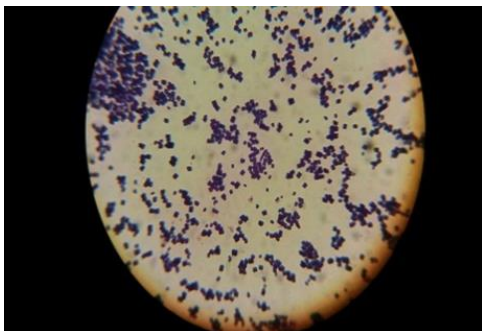


Fig. 21. Corynebacterium on microscope

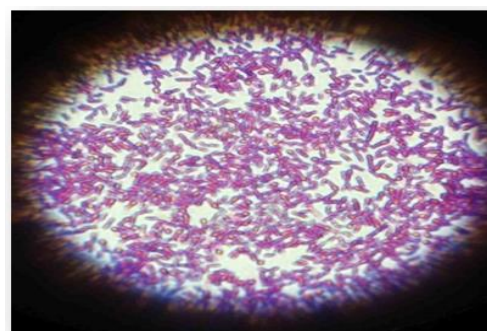


Fig. 22. Bacillus under microscope

Table 1. Table of antibiotic resistance

Isolate Bacteria	DO+	SXT	Cip	IMP	CAZ	CIX	AZM	TE	VA+	FOX	CT_	AK	OX+	OP+	D+N	R	S
<i>Bacillus Spp</i>	R	R	S	S	R	R	R	R	R	R	R	S	R	-	-	60	20
<i>Bacillus</i>	K	R	S	S	R	R	R	R	R	R	R	S	R	-	-	60	20
<i>Corynebacterium Spp</i>	R	R	S	S	R	R	R	S	R	R	R	R	S	-	-	3.33	7.46
<i>S. Aureus</i>	S	R	S	S	S	S	R	R	R	R	R	S	S	-	-	40	40
<i>Bacillus</i>	R	R	S	S	R	R	S	S	R	R	S	S	S	-	-	3.33	7.46
<i>K. pneumonia</i>	-	S	S	S	R	S	R	R	R	-	R	R	-	-	-	3.33	20
<i>Viridians</i>	S	R	S	S	S	S	R	R	R	R	S	S	R	R	-	7.46	7.46
<i>K. pneumoniae</i>	-	R	S	S	R	R	S	S	-	R	S	S	-	-	-	7.26	40
<i>Serratia. Spp</i>	-	R	S	S	S	R	S	S	-	R	R	R	-	-	-	3.33	3.33
<i>Serratia .spp</i>	-	R	S	S	R	R	S	S	-	R	R	R	-	-	-	40	7.26
Coagulase Negative. Staph	S	R	S	S	R	R	S	S	S	S	-	S	S	-	S	20	7.66
<i>CN</i>	R	R	R	S	R	R	S	R	R	S	-	S	R	-	S	3.53	3.33
<i>K. pneumoniae</i>	-	R	S	S	R	R	R	R	-	R	S	S	-	-	-	40	7.26
<i>Streptavidin's</i>	S	R	S	S	S	S	S	R	S	R	-	S	S	R	-	7.26	60
<i>K. pneumoniae</i>	-	R	S	S	S	R	S	S	-	R	S	S	-	-	-	20	7.46
<i>Pseudomonas Aeruginosa</i>	-	R	S	R	R	R	S	R	-	R	S	S	-	-	-	40	7.26
<i>Bacillus. Spp</i>	S	S	S	S	R	R	S	S	S	R	-	S	S	-	-	20	60
<i>Serratia. Spp</i>	R	S	S	R	R	R	S	S	-	R	S	S	-	-	-	3.33	40
<i>S. aureus</i>	S	R	S	S	S	R	S	R	S	R	-	S	R	-	-	3.33	7.46
<i>K. pneumoniae</i>	-	R	S	S	R	R	S	S	-	S	S	S	-	-	-	20	7.46
<i>S. aureus</i>	S	R	S	S	R	R	R	R	S	R	-	S	R	-	-	40	3.33
<i>Serratia</i>	-	R	S	S	R	R	R	R	-	S	S	S	-	-	-	3.33	3.33

S= Sensitive, R= resistant, Do= Doxycycline, SXT=Septrin, Cip= Ciprofloxacin, Imp= Impicillin, Caz= Cefotaxime, Cix= Cefotaxime, Azm=Azithromycin, TE= Tetracycline, VA+= Vancomycin, Fox= Cefoxitine, CT- =ceftolozane-tazobactam, AK=Amikacin, OX+= Oxacillin,





Fig. 23. Bacillus on blood agar

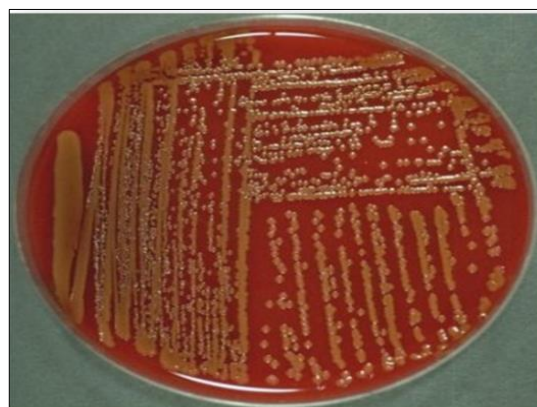


Fig. 24. Serratia on MacConkey

#### 4. DISCUSSION

According to the swabs results that were taken from the nursery in Benghazi Medical Center, the highest rates of bacteria were *S. aureus* 34.5%. It was found in (kid's games, carpet nursery, window glass, broom, wall, children's chairs, games installation, bathroom wall, toilet and rug).

It is recognized as a common cause of boils and soft tissue infections as well as more serious conditions such as pneumonia or bloodstream infections [24]. It also may cause infection in bone, brain and heart [25].

Followed by *Bacillus. Spp* 17.24% the most two bacillus species that considered medically significant are *B. anthracis* which causes "anthrax" and *B. cereus* which causes food poisoning [26]. These two types of bacteria were found in (children bed, Bed change diapers, carpet nursery, bathroom faucet and External door handle).

In addition, both *K. pneumoniae* and *Serratia. spp* have the equal rates with 13.8%. *Serratia* is an opportunistic human pathogen. *K. pneumoniae* is a normal flora in the human intestines, mouth and skin [27], but it's well known as an important cause of community-acquired bacterial pneumonia, and most frequent site of infection is in the urinary tract [28]. As well as, both of them can cause infections in Blood stream, wounds [29-30].

According to the Centers for Disease Control and Prevention (CDC) there are an estimated 51,000 healthcare-associated *P. aeruginosa* infections every year in the United States healthcare centers [31].

Common hospital-associated *P. aeruginosa* infections include Urinary tract infection, wounds and burns and also bloodstream infections [32].

Furthermore, *Diphtheria. spp* and *S. viridians* with rate 3.4%. It's a pathogenic bacterium, causes (*Diphtheria*).

Although, these occurrences were not too high, the presence of such bacteria in child day care could cause a serious health risk, especially diphtheria. According to Centers for Disease Control and Prevention (CDC) it was a major cause of illness and death among children, diphtheria is known as childhood disease and own a comprehensive routine vaccination programs, in developed countries the coverage of vaccination is high, but it's low in some countries as (India, Indonesia). So, the circulation of toxigenic *C. diphtheria* continues.

In 2013, 4,680 diphtheria cases globally were reported to the world Health Organization (WHO) [33], and also infection maybe occur to kids which vaccines already exist, or they were under the age of vaccination or even has been abandoned [34].

*S. viridians* is normally found in mouth, gastrointestinal system, upper respiratory tract and genitourinary tract. The *S. viridians* normally do not harm healthy people but may cause disease in people with compromised immune systems. One of the diseases is called Endocarditis: the inflammation of the inner lining of the heart. This can damage the heart's valves and lead to heart failure [35]. There are some diseases whose risk is increased for children like:

"Otitis media, it's one of the most common bacterial infection in childhood, and a common



cause of auditory acuity in childhood” [36]. “Respiratory infections, and are the most common cause of childhood disease and Children who attend daycare are suffering more sever and more in number, Finally the diarrheal diseases, these diseases are an important problem in daycare centers where the microbes are transmitted by direct contact, person to person, or indirectly. Kids who attend daycare have an increased risk of being hospitalized, and also Rotavirus infection is responsible for 20 to 60% of hospital admissions of children due to diarrhea. And Studies show that increased frequency of respiratory disease and diarrhea at daycare centers where hand washing is insufficient, also changing Diaper is considered as a high risk for transmission of enteric pathogens between children and workers at daycare centers” [37].

**Antimicrobial Susceptibility:** Among the isolated bacteria there were high levels of them resistant to antibiotics (6.7%-80%). Over the past decades, there were many antimicrobial classes that have been developed. Unfortunately, bacterial resistance against antibiotics has been shown in all its varieties. Some bacteria that where be found in the nursery and could be develop their resistance to antibiotics are; *S. aureus* (Methicillin-Resistant *S. Aureus*) and Carbapenem-Resistant *Enterobacteriaceae*. According to WHO *S. aureus* (Methicillin-Resistant *S. Aureus* MRSA) can be very serious, where in U.S there were 11,285 Deaths Per year.

Moreover, Carbapenem-Resistant *Enterobacteriaceae* is Resistant to nearly all the available antibiotics [38]. In addition, the most type of (CRE) is *K. pneumoniae*. *P. aeruginosa*, may become Multi Drug Resistant (MDR) and its infection is often sever and difficult to treat [39]. In addition to unsanitary practices and young children's increased sensitivity, child care facilities' overcrowding and microbial contamination of the environment all contribute to the development of diseases. For these reasons we recommended that, maintain receiving the advised vaccinations at the proper ages, It is important for childcare providers to be up to date on their vaccinations. The main strategy for decreasing transmission of infection is to wash hands with warm running water and soap. Every surface and item should be selected with ease of cleaning in mind. To eradicate germs from contaminated goods, toys and surfaces should be vigorously cleaned every day with water and a neutral detergent. When controlling enteric

illness outbreaks, disinfectants should be used as an adjunct; in these cases, the disinfectant should be selected according to the pathogen. Consult a hospital microbiologist or infection surveillance specialist for specific guidance. The best ways to prevent the spread of enteric infections are to make sure that carers have not changed diapers before handling food during the same shift, that there is little to no contact between younger children and older children, and that staff members do not care for both age groups simultaneously. Child care providers should get rigorous in-service training that addresses illness transmission pathways, vaccinations, and cleanliness (including regular hand washing).

## 5. CONCLUSION

It has been found that, there are several harmful bacteria (*S. aureus*, *K. pneumonia*, *P. aeruginosa*, *S. viridians*, *C. diphtheria*, *bacillus* and *Enterobacteriaceae Serratia*.) and some of them resistant to different types of antibiotics (Cefotaxime, Azithromycin, Tetracycline, Vancomycin, Cefoxitin, ceftolozane- tazobactam test Doxycycline, Septrin, Ciprofloxacin, Ampicillin, Cefotazime, Amikacin, Oxacillin). These harmful bacteria spread inside the child day care and it's had negatively effect on their health. Especially, the nursery is located inside the hospital that makes the possibility of increasing spread of bacteria more than any other nursery. Finally, infection control policies should be implemented in the correct manner to prevent transmission of infection among children and staff.

## CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented and published in the conference: 3<sup>rd</sup> Libyan Conference on Medical and Pharmaceutical Sciences 2019, Janzur 2019Web Link of the proceeding: <https://www.researchgate.net/profile/Rima-Ali>

## CONSENT

It is not applicable.

## ETHICAL APPROVAL

There were no ethical issues and this study was conducted after submitting an official application paper from the Arab Medical University to BMC Hospital and it was officially approved for data collection.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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