



RESEARCH ARTICLE

Prevalence of Bacterial Flora in Major Hospital Sewages in Awka, Nigeria

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ABSTRACT

Sewage samples collected from Regina Caeli, Beacon, Ifebi and Divine Hospitals all located in Awka, Nigeria were subjected to bacteriological analysis using the cultural method. The coliforms, total bacterial counts as well as the identities of the isolates were established. Eight bacteria were isolated, characterized and identified on the basis of their morphological and biochemical characteristics. They were the species of *Klebsiella*, *Salmonella*, *Shigella*, *Escherichia*, *Streptococcus*, *Staphylococcus*, *Pseudomonas* and *Bacillus*. All isolates but *Streptococcus* were present in the sample from Regina Caeli hospital while *Salmonella*, *Escherichia*, *Streptococcus*, *Staphylococcus* and *Pseudomonas* species present in the sample from Beacon hospital. The species of *Klebsiella*, *Salmonella*, *Escherichia* and *Bacillus* were isolated from the samples from Ifebi hospital while the sample from Divine hospital had the species of *Salmonella*, *Escherichia*, *Streptococcus*, *Staphylococcus*, *Pseudomonas* and *Bacillus* only. *Escherichia* sp had the highest count of 4.4×10^3 cfu/ml and 3.7×10^3 cfu/ml in the samples from Regina Caeli and Divine hospitals respectively. *Salmonella* sp had the highest count 4.4×10^3 cfu/ml in the sample from Ifebi hospital while *Staphylococcus* sp had the highest count of 4.1×10^3 cfu/ml in the sample from Divine hospital. Some of these microorganisms are known to cause various diseases of man including diarrhea, dysentery and typhoid fever, therefore, adequate treatment and disposal of the sewage must be carried out to ensure that it did not constitute a health hazard to the people within the hospital environment.

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INTRODUCTION

Sewage is referred to as any water whose quality has been adversely abused by anthropogenic influence. This includes liquid waste discharged from homes, industries, agricultural and commercial sectors. Health care wastes consist of both organic and inorganic substances including pathogenic microorganisms. Hospital sewage comprises both liquid and dissolved substances generated within the hospital environment and some have been classified as harmful, dangerous and hazardous (FEPA, 1991).

Hospital sewage originates from laboratories, wards, and laundries and is unique because hospitals employ toxic chemicals and hazardous materials for diagnostic and treatment purposes (Okpokwasili, 2000). The main groups of hospital sewage are the general wastes which are composed largely of non-hazardous particles such as kitchen wastes, papers and plastics, part of human foetus,

blood and body fluid; infectious wastes which include culture and stock of infectious agents from laboratory waste water; sharp wastes such as knife, needle, broken glasses, scalpels that could cause damages to the handlers; pharmaceutical products that have been returned from wards; contaminated or expired products; chemical wastes which are made up of discarded solid, liquid and gaseous chemicals and radioactive wastes which include solid, liquid and gaseous waste contaminated with radioactive materials generated from in-vitro analysis of body tissues and fluids.

Hospital sewage usually contains a variety of pollution indicator and pathogenic bacterial species that come from residential patients. The variations and concentrations of these bacteria depend on the amount of antibiotics, detergents and radioactive substances which may be disposed of in sewage and the environmental conditions such as temperature, humidity and nutritional

state (Al-Shahwani *et al.*, 1986). Connection of hospital effluent to the municipal sewage network may create problems such as public health risks and imbalance of the microbial communities in the sewage, which in turn, affect the biological treatment process (Newerow, 1978).

Sewage generated in the industries and principally from health care institutions such as hospitals may represent a serious health hazard. Children, adults and animals all have the potential to come into contact with the waste, which may pose severe health risks to them. The chemicals used for the staining, cleaning of equipment and surroundings may be potentially harmful to the laboratory technicians and the environment, hence in this work, the bacterial present in the hospital sewage in Awka, Nigeria were isolated, characterized and identified.

MATERIALS AND METHODS

Samples collection and processing

Samples were collected from Beacon, Ifebi, Divine and Regina Caeli hospitals, all located in Awka, Nigeria and taken to the Microbiology laboratory where they were separately enriched and serially-diluted before the bacterial isolation.

Bacterial Isolation Coliforms

One milliliter of the serially-diluted samples (10^{-4}) was separately introduced into sterile culture plates and sterile Eosin methylene blue (EMB) agar added. The mixtures were gently mixed and allowed to solidify after which the plates were incubated at 35°C for 48 hours. The coliform bacteria were thereafter counted, characterized and identified.

Total Bacterial Count

One milliliter of the serially-diluted samples (10^{-4}) were separately introduced into sterile culture plates and sterile nutrient agar (NA) added. Ketoconazole was introduced at a concentration of 0.05mg/ml to inhibit fungal growth. Incubation was carried out at 28°C for 24 hours after which the bacterial colonies that developed were counted and the values recorded.

Characterization and Identification of the Isolates

The isolates were characterized morphologically and biochemically. Gram staining, oxidase, spore, motility, catalase, methyl red, Voges Proksaur, citrate utilization, indole, coagulase and sugar fermentation tests were carried out as done by Cruickshank *et al.* (1980). They were identified according to the scheme of Holt *et al.* (1994).

RESULTS

The bacteria isolated from the hospital sewage are shown in Table 1. They were characterized and identified as the species of *Klebsiella*, *Salmonella*, *Shigella*, *Escherichia*, *Streptococcus*, *Staphylococcus*, *Pseudomonas* and *Bacillus*. The gram negative rods were most frequently isolated. The total bacterial counts of the hospital sewage are presented in Table 2. The samples from Regina Caeli hospital had the highest count while

those from Beacon hospital had the lowest count. All the species of bacteria isolated except *Streptococcus* sp were present in the samples from Regina Caeli hospital while the samples from Beacon hospital contained all but the species of *Klebsiella*, *Shigella* and *Bacillus*. The samples from Ifebi hospital contained only the species of *Klebsiella*, *Salmonella*, *Escherichia* and *Bacillus* while the species of *Salmonella*, *Escherichia*, *Streptococcus*, *Pseudomonas* and *Bacillus* only were present in the samples from Divine hospital. The species of *Escherichia* had the highest counts of 4.4×10^3 and 3.7×10^3 in the samples from Regina Caeli and Beacon hospitals respectively, while the species of *Salmonella* had the highest count of 4.4×10^3 in the sample from Ifebi hospital. The highest count of 4.1×10^3 was obtained for *Staphylococcus* sp in the samples from Divine hospital.

Table 1: Bacteria isolated from the hospital sewage

Bacteria	Regina Caeli	Beacon	Ifebi	Divine
<i>Klebsiella</i>	+	-	+	-
<i>Salmonella</i>	+	+	+	+
<i>Shigella</i>	+	-	-	-
<i>Escherichia</i>	+	+	+	+
<i>Streptococcus</i>	-	+	-	+
<i>Staphylococcus</i>	+	+	-	-
<i>Pseudomonas</i>	+	+	-	+
<i>Bacillus</i>	+	-	+	+

+ = Present; - = Absent

DISCUSSION

There is growing awareness of the impact on the environment of sewage discharges. Several studies have been reported on various aspects relating to industrial and domestic sewage (Marzouk *et al.*, 1979). Al-Shahwani *et al.* (1986) examined hospital sewage for total coliforms, faecal coliforms, faecal Streptococci, Staphylococci, *Klebsiella* and fluorescent *Pseudomonas*. Wheeler *et al.* (1980) examined domestic and hospital sewage for *Pseudomonas aeruginosa* and *Escherichia coli*, and found that in domestic sewage, the numbers were usually less than 30,000 per 100ml whereas counts above 500,000 per 100ml were frequently obtained in hospital sewage.

Ezenobi and Okpokwasili (2004) carried out the bacteriological and physico-chemical studies of sewage from two hospitals in Port Harcourt. The total numbers of *Salmonella typhi* and *Shigella dysenteriae* were 4.46×10^8 and 2.57×10^8 respectively. The MPN values for total coliforms, faecal coliforms and faecal streptococci comprised between 1600 and 11,000 MPN/100ml, 500 and 1600 MPN/100ml and 200 and 1700 MPN/100ml respectively. The bacterial counts of the hospital sewage samples varied from one hospital to another. These variations could be as a result of individual composition of the samples, which relate to the source of the samples. Also the variation and concentration of microorganisms might be due to environmental conditions such as temperature, humidity and nutritional state of the sewage samples (Al-Shahwani *et al.*, 1986).

These organisms isolated from the sewage samples are pathogenic and cause disease of humans such as typhoid fever, gastroenteritis, sore throat, diarrhea etc. these diseases if left untreated will lead to death. The occurrence of these organisms in high numbers is an

Table 2: Total bacterial counts of the hospital sewage (Cfu/ml)

Hospital	<i>Kleb</i>	<i>Sal</i>	<i>Shig</i>	<i>E. coli</i>	<i>Strep</i>	<i>Staph</i>	<i>Pseud</i>	<i>Baci</i>
Regina Caeli	3.7x10 ³	3.6x10 ³	3.0x10 ³	4.4x10 ³	1.6x10 ³	3.7x10 ³	2.8x10 ³	3.8x10 ³
Beacon	2.5x10 ³	3.2x10 ³	2.5x10 ³	3.7x10 ³	2.5x10 ³	3.5x10 ³	2.3x10 ³	3.4x10 ³
Ifebi	2.3x10 ³	4.4x10 ³	4.0x10 ³	2.5x10 ³	2.1x10 ³	4.0x10 ³	1.9x10 ³	3.7x10 ³
Divine	3.5x10 ³	3.7x10 ³	3.6x10 ³	3.5x10 ³	1.7x10 ³	4.1x10 ³	2.7x10 ³	3.2x10 ³

Key: *Kleb* = *Klebsiella*; *Sal* = *Salmonella*; *Shig* = *Shigella*; *E. coli* = *Escherichia coli*; *Strep* = *Streptococcus*; *Staph* = *Staphylococcus*; *Pseud* = *Pseudomonas*; *Baci* = *Bacillus*

indication that the hospital sewage was not treated before discharging into the environment. Hospital sewage must be adequately treated before discharge to avoid the health risk it may pose to the public.

Conclusion

The bacteria isolated from the hospital sewage examined were species of *Klebsiella*, *Escherichia*, *Bacillus*, *Pseudomonas*, *Salmonella*, *Shigella*, *Staphylococcus* and *Streptococcus*. Since these organisms are pathogenic and cause diseases in man, their presence in high numbers in hospital sewage is a health risk. Hospital sewage must therefore not be discharged into the environment without adequate treatment.

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