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RESEARCH ARTICLE

CHARACTERIZATION OF WASTEWATER FROM HEALTH FACILITIES: CASE OF THE HOSPITAL OF TREICHVILLE IN ABIDJAN, CÔTE D'IVOIRE

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Abstract

The aim of this study was to identify pollutants and contaminants in the wastewater generated by the Treichville Hospital, to assess their potential impact on the environment and public health, and to propose appropriate treatment and management methods to reduce this impact. The methodology used for this study included the selection of four sampling points in the hospital's wastewater system. Samples were collected and analyzed for different parameters, including overall pollution parameters (pH, temperature, dissolved oxygen, etc.) and drug residues (anticancer drugs and antibiotics). The results showed that the wastewater generated by the Hospital of Treichville is highly contaminated with organic matter. Ammonium levels in the wastewater discharges from Treichville Hospital were high. All targeted anticancer and antibiotic molecules were detected in the wastewater of the hospital. Concentrations of 5-fluorouracil were above the PNEC (predicted no effect concentration), while concentrations of cyclophosphamide and ifosfamide were below the PNEC. These results indicate that the presence of drug residues in the environment poses a potential risk to human and ecosystem health. In conclusion, measures must be taken to effectively treat these wastewaters to minimize their impact on the environment and public health.

Introduction:-

Hospitals contribute to the pollution of aquatic environments, which must be considered in a comprehensive approach to health and environmental risk assessment **(Orias and Perrodin, 2014)**. Health care facilities are known to produce substantial amounts of wastewater due to their intensive use of water for patient care, disinfection, drug preparation, catering, and cleaning **(Carraro et al., 2016)**. Such wastewater may contain pollutants and pathogens, which can lead to environmental and public health problems if not treated properly **(Akin, 2016)**. Moreover, rapid population growth in many developing countries, including Côte d'Ivoire, has resulted in increased demand for potable water and higher wastewater generation, placing additional strain on existing wastewater treatment

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infrastructure, which may not be capable of effectively treating all the wastewater produced. Effective wastewater management is a critical issue for environmental sustainability and economic development **(D'Alessandro et al., 2016).** Health care facilities, particularly University Hospitals and Centers (UHCs), have a crucial role to play in promoting sustainable wastewater management practices and minimizing their impact on the environment and public health **(Hocquet et al., 2016)**. Drugs are an important component in disease management and contribute to improving the quality of life for patients **(Ajala et al., 2022)**. However, their use also has significant environmental consequences, particularly in terms of water contamination. Medication residues present in hospital wastewater can have adverse effects on the environment and public health **(Guennouni et al., 2022)**. Indeed, these residues can be discharged into surface or groundwater and enter the food chain, which can affect water quality and ecosystem health (Serna-Galvis et al., 2019). Hospitals are a source of aquatic pollution that must be taken into account in a general approach to assessing health and environmental risks **(Khan et al., 2021)**. These health care facilities are characterized by a high concentration of patients and the use of various chemical agents: biocides, laboratory reagents, cosmetics, and, of course, drugs **(Madden et al., 2009)**. Drugs residues prescribed to patients are ingested by 25%, and the rest are excreted in feces. In particular, anticancer drugs and antibiotics are poorly biodegradable in wastewater treatment plants **(Boillot et al., 2008)**. These medication residues can persist for quite some time, maintaining a highly toxic potential, and migrate into surface water and drinking water **(Jean et al., 2012)**. This issue raises questions about the quantity and quality of wastewater produced by Treichville Hospital, the pollutants and contaminants it contains, potential risks to the environment and public health, and appropriate treatment methods to enhance the quality of the water before it is discharged into the environment. The resolution of this issue requires an in-depth investigation of the physicochemical characteristics of the wastewater produced by Treichville Hospital, as well as the identification of wastewater treatment and management measures to mitigate the impact on the environment and public health. The general objective of this study is to identify the pollutants and contaminants present in the wastewater generated by Treichville University Hospital, evaluate their potential impact on the environment and public health, and propose appropriate treatment and management methods to reduce this impact.

Material and Method:-

Treichville is a suburb located in the southern part of Abidjan, which is the economic capital of Côte d'Ivoire (Ivory Coast) in West Africa. The Treichville Hospital is located between 5°17'37.09" North latitude and 4°0'13.88" West.

Sampling points:-

The selection of these sampling points in the hospital wastewater network was based on the specific target molecules being sought. These sampling points comprise both sewer and open drain locations. A total of four (4) sampling points were identified.

Sampling point P1 is a manhole that receives effluent from the medical clinic building, which houses the internal medicine and cancer departments, including the chemotherapy intensive care unit.

Sampling point P2 is another manhole situated in the Heart Institute's garden, which serves as a transit point for effluent from the medical, cancer, dermatology, and toilet water departments.

Sampling points P3 and P4 are respectively located upstream and downstream of an open collector that drains wastewater from the hospital to the outside environment. This collector receives wastewater primarily from the infectious diseases service.

Sampling : -

The 500 mL samples were collected in amber (dark) glass bottles that had been pre-heated to 550 °C to eliminate any organic residues. Sampling was conducted between 10 a.m. and 5 p.m. during the periods when hospitals experience the highest flow rates. The sampling took place over a period of 2 weeks (5 days), resulting in 28 samples per day and a total of 280 samples. All samples were immediately stored at -18 °C upon arrival at the laboratory until analysis. Three types of samples were collected for analysis of different parameters, approximately 90 samples per sample set :

Sample Set 1: Samples for analysis of antibiotic drugs
Sample Set 2: Samples for analysis of anticancer drugs
Sample Set 3 : Samples for global pollution parameters.

Analysis of global pollution :

The analysis of global pollution concerned physical parameters and chemical parameters. The physical parameters measured in situ are temperature (T° C) and pH (Table 2). As for the chemical parameters, these are oxygen demands (COD and BOD_5), nitrogen fractions (NH_4^+ ions, NO_3^- ions and Kjeldahl total nitrogen), suspended solids. They were determined according to standardized methods AFNOR (French Agency for Standardization) and CEAEQ (Centre of Expertise in Environmental Analysis of Quebec).

Table 2:- Standards for analysis of global pollution parameters.

Parameters	Analytical standards
pH	In situ
MES	AFNOR NF EN 872
DCO	AFNOR NF T90-101
BDO_5	NF, T90-103 AFNOR
NH_4^+ ions	AFNOR NF T90-013.
NO_2^- ions	AFNOR NF T90-013.
NO_3^- ions	AFNOR NF T90-013.
NitrogenNTK	AFNOR NF T90-110.

Drugs residues : -

The molecules were identified after an investigation at the Cancerology and Pediatric Oncology Services and the internal pharmacy of the Hospital of Treichville. The targeted pharmaceutical molecules include cyclophosphamide, Ifosfamide, 5-fluorouracil for anticancer drugs, and sulfamethoxazole, ofloxacin, and ciprofloxacin for antibiotics.

Analysis of drug residues in wastewater : -

Drug residues were extracted from wastewater under distinct conditions. The extraction protocols for each pharmaceutical molecule are described in the following protocols.

Extraction protocol for 5-fluorouracil, cyclophosphamide and ifosfamide : -

Samples were prepared using different steps. First, a volume of 6 mL of methanol was used for conditioning 1 at a flow rate of 1 mL/min. Then, a 3-minute pause was performed for wetting. For conditioning 2, a volume of 6 mL of distilled water at pH = 3 was used at a flow rate of 1 mL/min, followed by a 1-minute pause for wetting. Percolation was performed using 100 mL of wastewater at pH = 4 at a flow rate of 1 mL/min. For rinsing, 5 mL of distilled water at pH = 3 was used at a flow rate of 1 mL/min. The samples were then dried using nitrogen for 90 minutes. For elution 1, a volume of 5 mL of methanol was used at a flow rate of 1 mL/min, followed by a 4-minute pause for wetting the support. Finally, elution 2 was performed using 4 mL of methanol at a flow rate of 1 mL/min.

Extraction protocol for sulfamethoxazole, ciprofloxacin, and ofloxacin : -

Wastewater samples were treated according to the following protocol: conditioning was performed by adding 4 mL of methanol at a flow rate of 2 mL/min, followed by a second conditioning with 4 mL of distilled water. Percolation was performed using 50 mL of wastewater at a flow rate of 4 mL/min. The samples were then dried under nitrogen for 15 minutes at a flow rate of 5 mL/min. Finally, elution was performed using 5 mL of methanol/acetonitrile/formic acid (20/5/5) at a flow rate of 2 mL/min. This protocol allowed for the extraction of drug residues present in wastewater samples for further analysis.

Analysis conditions for 5-fluorouracil, cyclophosphamide and ifosfamide : -

The stationary phase used for this analysis is FactorFour VF-5ms with dimensions of 30 m*0.25 mm (internal diameter), with a particle size of 0.25 µm. The temperature program used for the analysis was as follows: at 0 min, the temperature was +90 °C. Then, from 0 to 7.5 min, it increased by +20 °C/min until it reached 240 °C. Then, from 7.5 to 14.5 min, the temperature increased by +10 °C/min until it reached 310 °C. From 14.5 to 15 min, the temperature was maintained at 310 °C. The carrier gas used was helium at a flow rate of 1 mL/min. The injected volume ranged from 1 to 2 µL. The injector used was a split/splitless at 280 °C in splitless mode. Finally, detection was performed using a mass spectrometer in electron impact ionization mode at -70 eV.

Analysis conditions for sulfamethoxazole, ciprofloxacin and ofloxacin : -
The stationary phase used for this analysis is ZORBAX Eclipse XDB-C18 with an internal dimension of 150 mm * 4.6 mm and a particle size of 5 µm. The analysis conditions are as follows: solvent A is water with 0.1% formic acid, solvent B is acetonitrile with 0.1% formic acid. The proportion of solvent B is 10% from 0 to 5 min, 30% from 5 to 8 min, 75% from 8 to 15 min, 90% from 15 to 15.5 min, and remains at 90% until 17 minutes. The flow rate is 1 mL/min, the injected volume is 100 µL, and detection is carried out by fluorimetry with excitation at 278 nm and emission at 450 nm.

Results:-

The indicators used to evaluate the general pollution level of wastewater samples from Treichville Hospital include pH, oxygen demand (COD, BOD_5), suspended solids (SS), and nitrogen fractions (total Kjeldahl nitrogen or TKN, NH_4^+ ions, NO_3^- ions, NO_2^- ions, and total nitrogen). Wastewater is the water that has been used in various domestic, industrial, or commercial processes and contains pollutants and contaminants. Wastewater characterization involves the analysis of various physical, chemical, and biological parameters to assess the water quality and determine appropriate treatment methods.

pH and suspended solids in wastewater : -
In assessing the quality of wastewater and its impact on the environment, important parameters include pH and suspended solids content. The wastewater samples from Treichville University Hospital were analyzed to determine these parameters, as shown in Table 3. The pH of the wastewater ranged from 5.7 to 8.1, with an average value of 7. This variation in pH indicates the presence of heterogeneous pharmaceutical residues in the wastewater, which can have significant effects on the environment and public health. pH is a measure of the acidity or alkalinity of a solution, with a scale of 0 to 14, where 7 is considered neutral **(Hocaoglu et al., 2021)**. It is a critical parameter in wastewater from healthcare facilities, as it can affect the growth and survival of aquatic microorganisms and the solubility of antibiotics in water. Most bacteria, including antibiotic-resistant bacteria, can grow within a pH range of 5 to 9, with an optimum range between 6.5 and 8.5 **(Boillot et al., 2008)**. pH values below 5 or above 8.5 can alter the growth and survival of microorganisms. The pH values measured in the wastewater of Treichville Hospital suggest that these waters constitute favorable environments for microbial growth. Some studies have shown that more acidic pH can promote the growth of certain antibiotic-resistant bacteria, while more alkaline pH can promote the growth of other antibiotic-resistant bacteria **(Le-Minh et al., 2010** ; **Mutuku et al., 2022)**. Wastewater may contain antibiotics and antibiotic residues from human and animal consumption, as well as antibiotic-resistant bacterial strains that are excreted in wastewater **(Pruden et al., 2013)**. These factors combined can create an environment that is conducive to the selection and spread of antibiotic-resistant bacterial strains in wastewater **(Karkman et al., 2018)**.

The results indicate that the wastewater from Treichville Hospital contains an average suspended solids concentration of approximately 160 mg/L, with a range of 147 to 172 mg/L. This is higher than the range reported by **Boillot et al. (2008)**, which ranged from 46 to 298 mg/L. The World Health Organization (WHO) recommends that the concentration of suspended solids in wastewater be less than or equal to 20 mg/L for safe use **(WHO, 2012).** The suspended solids concentration of 160 mg/L in the wastewater of Treichville Hospital is much higher than the WHO reference, which suggests poor waste and wastewater management in the hospital. This high concentration of suspended solids can also impact the effectiveness of physical and biological treatments during wastewater treatment **(Pai et al., 2007)**.

Table 3:- pH and suspended solids (SSM) values of wastewater from the Treichville hospital.

Parameters	Values (mg/L)			
	Min	Max	Average	Median
Temperature (°C)	25,10	25,5	25,25	25,37
pH	5,72	8,15	6,91	7,50
Solidssuspended (SS)	147,55	172,50	159,52	165,75

Oxygen demands (COD and BOD_5) : -
Table 4 displays the values for COD and BOD_5 obtained from wastewater analyses conducted at Treichville Hospital. The COD values range between 504 and 578 mg/L, indicating a relatively high concentration of organic matter in the wastewater. This can pose an environmental problem if not treated prior to release into aquatic

environments, as microorganisms present in the water may consume oxygen to degrade the organic matter, leading to decreased dissolved oxygen content in the water. This can have adverse effects on aquatic ecosystems, as some organisms require sufficient oxygen levels to survive . BOD_5 values range from 457 to 527 mg/L, indicating a relatively high amount of biodegradable organic matter in the wastewater, which can also lead to oxygen consumption by microorganisms during degradation.

The average COD/BOD_5 ratio is 1.1, indicating that the organic matter present in the wastewater is relatively difficult to degrade biologically. A high COD/BOD_5 ratio suggests a significant proportion of non-biodegradable organic matter, which may be indicative of pollution by non-biodegradable substances, such as toxic chemicals or heavy metals. These substances can interfere with the biodegradation process of organic matter and can be harmful to the environment if released into nature. Wastewater treatment processes, such as settling, aeration, filtration, disinfection, etc., can be employed to reduce the COD/BOD_5 ratio and remove organic matter and other contaminants from the water prior to discharge into nature, thereby avoiding negative environmental impacts **(Ponsá et al., 2008).**

Table 4:- Oxygen demand values (COD and BOD_5) of wastewater from CHU Treichville.

Parameters	Values (mg/L)		
	Minimum	Maximum	Average
DCO (mg/L)	504,12	578	541,74
DBO_5(mg/L)	457,41	527,43	492,84
DCO/BDO_5	1,1		

Nitrogen forms : -

The table 5 presented in this study provides the results of the analysis of nitrogen forms found in water samples from the wastewater of Treichville Hospital. The forms of nitrogen measured include total nitrogen, ammoniacal nitrogen (NH_4^+), NO_3^- ions, NO_2^- ions, and Kjeldahl total nitrogen (NTK). The purpose of this analysis is to assess the quality and level of pollution of the wastewater. Nitrogen compounds are commonly associated with organic matter and nutrients, which are often found in wastewater pollutants. Ammoniacal nitrogen (NH_4^+) and total nitrogen Kjeldahl (NTK) are indicators of organic load, while nitrate (NO_3^-) and nitrite (NO_2^-) ions are used to assess the level of nitrate pollution. The measurement of total nitrogen provides a comprehensive evaluation of all nitrogen forms present in water, whether organic or inorganic **(Taguchi and Nakata, 2009)**.

The presence of nitrogen in wastewater can lead to eutrophication of aquatic environments. Hospital wastewater contains organic nitrogen and ammonia nitrogen, with organic nitrogen coming from living cells (e.g., patient organs), and ammonia nitrogen coming from the decomposition of organic nitrogen by bacteria and direct releases (e.g., urine and patient excrement) **(Verlicchi, 2018)**. Elevated levels of ammonium ions in wastewater discharges from Treichville Hospital were observed, ranging from 14 to 25 mg/L. These levels are relatively high and can negatively affect water quality and the aquatic ecosystem **(Adon et al., 2019)**.

Ammonium can promote the growth of algae and aquatic plants, which can lead to a decrease in dissolved oxygen in the water and disturb aquatic life. Moreover, ammonium can be converted to nitrate and nitrite by nitrifying bacteria, which can also cause environmental problems if levels are too high. Excess nitrogen in wastewater can also cause problems, such as excessive algal blooms in receiving water bodies, leading to a reduction in dissolved oxygen levels, and death of fish and other aquatic organisms **(Perrodin et al., 2013)**.

The range of total Kjeldahl nitrogen values found in the wastewater samples was 43 to 50 mg/L. The discharge of wastewater into the environment is regulated by international standards that vary by country and region. For instance, the limit for ammonia releases to surface water in the United States is a monthly average of 1.26 mg/L and an annual average of 0.97 mg/L, while the European Union's Water Framework Directive (WFD) sets environmental quality standards for hazardous substances, including ammonia, with a limit of 0.05 mg/L for natural surface waters and 0.5 mg/L for artificial surface water and groundwater **(Cooper and Hiscock, 2023)**. When wastewater containing high levels of ammonium ions is discharged into drinking water sources, it can be converted into nitrites and nitrates, which can be harmful to human health, especially infants **(Soro et al., 2023)**.

Table 5:-Values of nitrogen parameters.

Parameters	Values (mg/L)		
	Minimum	Maximum	Average
NTK	19	23	21
NO_3^- ions	0,52	0,58	0,55
NO_2^- ions	0,04	0,08	0,06
NH_4^+ ions	14,20	25,60	20
Total nitrogen	43,70	50,35	47,02

Drugs residues : -

All targeted anticancer and antibiotic molecules were detected in the wastewater of the Treichville Hospital (CHU). The analysis of wastewater from the Treichville Hospital allowed the detection of the presence of all targeted anticancer and antibiotic molecules. These results show that these molecules are used in the treatment of patients and are subsequently excreted into the wastewater.

Residues of anticancer drugs : -

The anticancer molecules detected in the wastewater of the Treichville Hospital (CHU) are 5-fluorouracil, cyclophosphamide, and ifosfamide, which are reported in Table 6. The concentrations of anticancer residues are 0.56 µg/L, 0.42 µg/L, and 0.58 µg/L, respectively, for 5-fluorouracil, cyclophosphamide, and ifosfamide. These values are within the concentration ranges of these anticancer residues detected by other authors. These ranges are between 6 ng/L and 12 µg/L for cyclophosphamide, from 4 ng/L to 10.6 µg/L for ifosfamide, and from 0.9 ng/L to 124 µg/L for 5-fluorouracil. These values are within the concentration ranges of these anticancer residues detected by **Heath (2011)**; **Kosjek et al. (2013); Kosjek and Česen et al. (2016)**. The mean mass concentrations of the three anticancer molecules measured in the wastewater of the Treichville Hospital are relatively low, ranging from 0.42 µg/L to 0.58 µg/L, with a relatively low standard deviation as well. It is interesting to note that the highest mean concentration was measured for ifosfamide, while the lowest was measured for cyclophosphamide. The relatively low standard deviations for the three molecules suggest some homogeneity in the measured concentrations, although further analyses would be necessary to confirm this trend. This shows that these molecules are the most administered to patients in the treatment of cancer-related pathologies in this hospital facility **(Blatter and Rottenberg, 2015)**. Some authors have indicated that these anticancer molecules are the most prescribed in chemotherapy. The unmetabolized fractions excreted by patients are about 70% **(Touraud et al., 2011)**. We noticed that the concentrations of anticancer residues obtained in the wastewater samples are almost similar. This shows that these molecules are the most administered to patients in the treatment of cancer-related pathologies in this hospital facility. These results are in agreement with those of (**Besse and Garric, 2008**). Indeed, these authors have indicated that these anticancer molecules are the most prescribed in chemotherapy. The unmetabolized fractions excreted by patients are about 70% **(Souza et al., 2018)**.

Table 6:- Levels of cancer drug residues in wastewater at Treichville Hospital.

Parameters	Levels concentrations (µg/L)		
	5-fluorouracil	Cyclophosphamid	Ifosfamid
Minimum	0,050	0,015	0,04
Maximum	2,15	1,8	1,5
Average	0,56	0,42	0,58

Residues of antibiotic drugs :-

The antibiotic molecules sought in the waters of the Treichville University Hospital are ciprofloxacin, ofloxacin, and sulfamethoxazole. The measured concentrations are indicated in Table 7. The mass concentrations of the antibiotic molecules Ciprofloxacin, Ofloxacin, and Sulfamethoxazole were measured in wastewater. The results show that the average concentration of Ciprofloxacin is 21 µg/L, with a standard deviation of 7 µg/L. The average concentration of Ofloxacin is 0.5 µg/L, with a standard deviation of 0.3 µg/L. Finally, the average concentration of Sulfamethoxazole is 2 µg/L, with a standard deviation of 1 µg/L. When comparing the average mass concentrations of the three antibiotic molecules detected in the water, a significant disparity between the values is observed. Ciprofloxacin has a much higher concentration than the other molecules, with an average of 21 µg/L, while Ofloxacin has a much lower average concentration of only 0.5 µg/L. Sulfamethoxazole is between the two, with an average concentration of 2 µg/L. This difference in concentration between the detected molecules may be due to factors such as the frequency of drug use and prescribed doses. Indeed, Ciprofloxacin has been considered a potent antimicrobial recommended for the treatment of various diseases caused by extended-spectrum beta-lactamase (ESBL) bacteria (**Watier et al., 2017**). A surveillance study conducted in Europe in 2010 indicated that second-generation quinolone consumption was on average three times higher than that of first and third generations (**Adriaenssens et al., 2011**). Second-generation quinolones such as ciprofloxacin accounted for 73% of total consumption. In addition, fluoroquinolones are the most frequently prescribed antibiotic families (80 % of medical prescriptions). Among fluoroquinolones, ciprofloxacin and ofloxacin are the fourth and fifth most prescribed antibiotics in French hospitals. Unlike other drug families, fluoroquinolones are capable of persisting in the environment (**Klein et al., 2018**). The concentrations of antibiotic molecules measured in these wastewater samples from the Treichville University Hospital have shown that ciprofloxacin is the most present in the samples. Its concentration is 20 times that of ofloxacin and 10 times that of sulfamethoxazole. Indeed, ciprofloxacin has been considered a potent antimicrobial recommended for the treatment of various diseases caused by extended-spectrum beta-lactamase (ESBL) bacteria (**Amin et al., 2020**). A surveillance study conducted in Europe in 2010 indicated that second-generation quinolone consumption was on average three times higher than that of first and third generations. Second-generation quinolones such as ciprofloxacin accounted for 73% of total consumption. In addition, fluoroquinolones (FQ) are the most frequently prescribed antibiotic families (80% of medical prescriptions) (**Högberg et al., 2014**). Among fluoroquinolones, ciprofloxacin (CIP) and ofloxacin are the fourth and fifth most prescribed antibiotics in French hospitals. Unlike other drug families, fluoroquinolones are capable of persisting in the environment (**Kümmerer, 2001**).

Table 7:-Levels of antibiotic residues measured in wastewater from the CHU de Treichville.

Statistical parameters	Level of antibiotic molecules (µg/L)		
	Ciprofloxacin	Ofloxacin	Sulfamethoxazole
Minimum	14,2	0,01	0,7
Maximum	37,4	2,1	4
Average	21	0,5	2

Comparison of drug concentrations to rejection thresholds :-

The concentrations of drug residues measured in the wastewater of the Treichville Hospital were compared to the Predicted No Effect Concentration (PNEC) of each chemical substance (Table 8). The PNEC is the highest concentration of a chemical substance that does not pose a risk to the environment **(Cunha et al., 2019)**. The data presented in the table compare the levels of drug residues detected in the wastewater of the Treichville CHU with the corresponding PNEC values. The PNEC represents the highest concentration of a chemical substance that does not pose a risk to the environment. Based on this data, it was observed that the levels of 5-fluorouracil and sulfamethoxazole are higher than their respective PNEC values, suggesting a potential risk to the environment. In contrast, the levels of cyclophosphamide and ifosfamide are lower than their PNEC values, indicating that there is little risk associated with the presence of these substances in the wastewater of the Treichville hospital. The levels of ofloxacin are approximately equal to their PNEC value, while the levels of ciprofloxacin are significantly higher than their PNEC value, suggesting a potential risk to the environment associated with this substance **(De Souza et al., 2009)**.

Table 8:- Levels of dosage drugs and their PNECs.

Residuesdrugs	Levels (µg/L)	PNEC ($\mu g/L^{-1}$)	Levels comparaison
5-fluorouracil	0,56	> 0,1	[5-FU] >PNEC
Cyclophosphamide	0,42	< 1	[CP] <PNEC
Ifosfamid	0,58	< 1	[IF] <PNEC
Sulfamethoxazole	2,33	0,1-1	[SMX] >PNEC
Ofloxacin	0,43	0,1-1	[OFX] ≈ PNEC
Ciprofloxacin	21,4	0,1-1	[CIP] >PNEC

Conclusion:-

The wastewater generated by the Treichville Hospital is heavily contaminated by organic matter, which can be attributed to the presence of hospital waste and other sources of pollution. The high organic load of this wastewater can lead to a decrease in dissolved oxygen in water bodies, which can affect aquatic fauna and flora. In comparison with World Health Organization (WHO) guidelines, these values are higher than the recommended standards, indicating that the wastewater of the Treichville University Hospital does not comply with the recommended water quality standards for the protection of human health and the environment. Therefore, measures must be taken to effectively treat this wastewater in order to minimize its impact on the environment and public health. he detected anticancer molecules are 5-fluorouracil, cyclophosphamide, and ifosfamide, while the detected antibiotics are ciprofloxacin, ofloxacin, and sulfamethoxazole. The concentrations of 5-fluorouracil are higher than the PNEC, while the concentrations of cyclophosphamide and ifosfamide are lower than the PNEC. These results indicate that the presence of drug residues in the environment poses a potential risk to human health and the ecosystem. The presence of anticancer molecules, even at relatively low concentrations, is concerning due to their potential carcinogenicity and toxicity. Similarly, the presence of antibiotics in the environment may contribute to the development of antibiotic-resistant bacteria, which could have serious consequences for human health.

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