

# The Impact of Wastewater Treatment Plants Transmitted Diseases on ITS Workforce



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**Abstract:** *This work represents the research, analysis, and recommendation of a study that examined how wastewater treatment plants in the National Water Company in Jeddah workers get exposed to diseases in those environments which later affects their health and performance. The work carried out enables the company to evaluate how the most important risk is that of the employees contracting hepatitis A. In this case, the research was carried on 300 workers on National Water Company in Jeddah who works in these plants. The research study method or design used was an epidemiology perspective cohort study. All these workers had a similar characteristic which was the work environment but differed in various factors such as age, gender, and family history. The aim of the prospective cohort study was to see how workers safety is an issue, how the disease affects the performance of the workers and the cost side as well as how the Human Recourse department finds it hard in finding new employees. In this regard, it is important to note that preventing the disease is considerably more cost-efficient for the company that has to pay for the medical treatment of the sick employees and hire new employees that will perform the work of those sick while they recover. The report ends with both engineering and health recommendations that should be put in place to curb all the issues that wastewater brings to the workers.*

**Keywords:** *Wastewater, Disease, Case Study; Jeddah; Treatment; Hepatitis A.*

## I. INTRODUCTION

In the daily routine people tend to use water in different purposes be it cleaning, washing, and cooking. This use of water changes the quality of water and this is how wastewater come into existence. We can define wastewater in these simple words “wastewater is the one which has been used by the people either in the industry or domestic purposes”. The same water form sewer. The sewer contains wastewater, microorganisms like bacteria, metals and the chemicals that are toxic in nature. This sewer has the ability to destroy the environment thus needed to be contained. To contain this sewer, the sewer system is established that consist of multiple pipeline systems that collect and transport sewer water to wastewater treatment plants.

Wastewater treatment plants serve multiple purposes. One purpose of these plants is to protect the environment from the negative impacts of sewer and to conserve the water from wastages.

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The treated water can be reused in industries and some domestic purposes as well as washing. These benefits are only one side of the story. The plight of the workers working on these plants is often ignored and not as come to light as it should be.

The workers on these wastewater treatment plants faced multiple problems. The overall environment of working on this plant is categorized as hazardous for human health. Some of the hazards include drowning and exposure to dangerous chemicals. According to "Ouda" the topmost risks workers on the wastewater treatment plant faced includes confined spaces which are often associated with exposure to high noise level and dangerous gas leakages make the things further worse. Other risks include drowning which is the result of slipping and falling, exposure to chemicals, gases and sometimes radioactive material present in the wastewater.[1]

Some of the diseases workers in the treatment plants are likely to experience gastroenteritis, infectious hepatitis, Serum hepatitis, aseptic meningitis, respiratory diseases, poliomyelitis, salmonellosis, typhoid fever, amoebic dysentery, and giardiasis. [1]

The most common causes of exposures to these chemicals include inhalation digestion and direct skin contact. Some of the components of wastewater are air-stripped during processes like aeration. If workers are not using the mask this dangerous material could easily be inhaled through the air and can cause respiratory problems especially those working near aerated tanks and dewatering processes. Another way of exposure is via contact. When workers contact the waste material the microorganism like bacteria enter the body through cuts and abrasions and cause infection and other diseases like hepatitis A. Some workers can digest dangerous material due to their own negligence. If they don't wash their hands properly, dangerous chemicals and microorganism can be transported to the human body [2]

## II. OBJECTIVES

The research is aim to explore the safety side of the wastewater treatment plants. The research will explore the safety conditions of the workers and will study in depth the health issues and their causes. The research will also try to establish the relation of these health risks and their impacts on the performance of the workers. The health of workers is directly linked with their performance. Better the workers performed, better is the production of the treatment plants. This study will focus on the cost of the production also and will try to find a relation between workers performance and the cost of production.



# The Impact of Wastewater Treatment Plants Transmitted Diseases on ITS Workforce

Another goal of this research is to find out the plant's management part in these challenges of the workers and will try to find the path to follow for the management.

## III. PREVIOUS WORK

One of the major findings on the causes of the health risks and incident happened on the plants in the past include poor training of workers deployed over these plants. The state of training even these days is pathetic mostly in developing countries. Most of the incidents happen on the plants can be prevented easily by giving basic safety training to these workers. The situation is alarming in some parts of the world including Africa, Middle East including KSA and South Asia where it is observed that most workers even don't have the basic knowledge of safety while working on the treatment plants. Even when the management provides all the necessary safety equipment and follows all the precautionary measures, incidents cannot be stopped due to poor training of workers. [3]

Thus, as studied by Spellman and Welsh [3], the leading cause of incidents in a pretreatment plant is that employees do not correctly understand essential safety measurements such as the meaning of the limit of a dangerous level of explosive gases like methane. The methane gets formed during the metabolic degradation of organic components present in the wastewater by the bacteria added as part of the water secondary treatment process. Failing to monitor this important safety issue may result, as in the described case of Katy's Creek, to the accumulation of methane in the surroundings of the wastewater treatment plant. Once accumulated, even a single vibration may ignite the methane resulting in its explosion that can prove lethal for human life. The Occupational Safety and Health Administration (OSHA) have listed six core reasons for injuries that pose a serious problem to the safety of workers on the treatment plants [4]. These reasons include accumulation of the highly toxic hydrogen sulfide, use of dangerous chemical compounds such as chlorine and hydrochloric acid, waterborne diseases caused by the pathogens and drowning. A positive development taking place in this regard is the industries management changing attitude towards the safety measurements partially due to a strong push by the governments. Now, it is necessary to install and also maintain the ventilation valves where it is necessary for example in confined spaces. These valves play more than one role at a time. On one hand, they are used to avoid the accumulation of hazardous gases like methane, on the other hand, they enable workers to divert the gas away from the confined places towards the suitable places to avoid higher accumulation of gases that can cause an explosion [3]. Similarly, it is compulsory for the managers to take measures to control the harmful microorganisms like bacteria present in the sludge to prevent the accumulation of especially hazardous pathogens responsible for the infection of diphtheria, and meningitis, among others [5]

## IV. METHODOLOGY

The project methodology involved an observational case study method of research in the span of 10 weeks to make sure complete and authentic results. Wastewater treatment process

exposes employees to harmful chemicals and bacteria. These harmful chemicals affect workers performance negatively and increase the production cost and medical expenses for plant management. The methodology explores the various methods to be used to gather proper information to help management in getting a proper solution to these problems.

### A. Fieldwork Technique

One of the methods used was fieldwork technique. This is a quantitative method applied to collect data keeping an objective in mind to understand, observe and interact with people in their natural settings. In this research, our field research will fulfill all the requirements of field work. Field research will revolve around 300 employees and will include watching, interviewing, and use of documents to observe how the employees perform their duties while they are healthy or sick. The research will explore the availability of personal protective equipment. It will observe if the available equipment is adequate or cannot meet the need of all the workers. At this point, the study will also focus on the training of workers to wear these equipment if they are trained enough to use these types of equipment effectively or not

### B. Laboratory Samples

The second method to collect the data used in this research is the laboratory technician. In this method, the blood test of every worker will be taken under the study to test for the presence of hepatitis A virus which is the most common disease present in the wastewater treatment plant workers. This will involve collecting their blood samples and taking them to the laboratory to conduct the test to confirm the presence of hepatitis A and other diseases.

## V. RESULTS

300 workers were selected as a sample from the National Water Company in Jeddah for this research. The research was aimed to find out the emerging effects of diseases in the workers resulted from the hazardous environment of the wastewater treatment plant. To give a better picture about the sample. The females involved in the study was 32 while the total number of males involved in the research was 268, showing that 10.67% of the workers in this case study were women and 89.33% of the total number of employees who participated in this research were men. The reason behind the high percentage of men workers in the study is due to the very high number of male compared to women working in the company. The sample represents the true percentage of females working in the company.

The study also focused on the occupations of the workers and a prevailing ration of diseases among them. The purpose to include the occupation of the workers was to find out the section of workers that are more affected by the health risks and reasons behind high ratio of diseases.

The study found that maintenance workers were more affected as some most of them were infected by diseases followed by operation workers. Table I Shows the percentages of the groups participated in the research.

These results include gender wise sickness, categories wise sickness and age wise sick workers.

**TABLE- I: Number of workers and Number Sick found in the sample, grouped by Gender, Age, and Occupation**

Category	Male	Female	<40 years	>40 years	Architecture and construction	Maintenance workers	Cleaners	Engineers	Operation Workers
Numbers of workers out of 300	268	33	156	144	56	59	111	15	59
Number of Sick workers out of total 59	54	5	31	28	0	43	2	0	15

**VI. DISCUSSION**

**A. Safety**

The safety of the workers were the main focus of this study because the wastewater treatment plant environment considered as hazard environment that demands a lot of precautions. The safety of workers here focused on how to avoid the sickness and infections while working at the plant or while doing maintenance. When it comes to safety there are a lot of factors that affect the health of workers. The first factor is the inadequate personal protection equipment (PPE's). Observation from the field finds that most of the workers don't use personal protective equipment while working on the treatment plant either intentionally or due to the higher management that failed to provide the workers with basic protective equipment. This personal protection equipment includes footwear, gloves, and bodysuit which are used by workers working in a dangerous environment.

The results of this research produce some interesting as well as alarming results regarding safety side of the treatment plant workers. The highest sufferer is those that are doing maintenance plant. Most of the workers related to maintenance works are suffering from different types of diseases including hepatitis A. Previous work suggest that cleaners are at the highest risk of getting sick due to their kind of work of cleaning the company [4]. The second most sufferer is the operation working doing the different process with some of them are suffering from different diseases.

**B. Performance**

This was found in the research that the sickness of the workers resulted in poor performance. Many of them opt for leave in the sickness and some of them decided to never return to this hazardous environment. During ten weeks of the research period, some 19.67% of the workers got sick. Due to the unavailability of a huge number of workers, it was hard for management to keep the plant well operational. This resulted in transferring the work of these sick workers on the remaining workers. The remaining workers were compelled to do the extra work. The created the overworking situation for the remaining workers. This also affected the performance

of these health workers in a negative way. The ultimate damage of all this situation was the low productivity of the plant.

The productivity of the plant affected in two ways. The first way is the shortage of labor that resulted in low productivity, other reason being the low performance of the remaining workers. Low productivity of any plant means a high cost of operation. Even while different researchers have found mixed and different results prevalence various diseases depending on the work environment, they all conclude that such risk has decreased [4].

**C. Cost**

Cost of a plant is directly linked to the rate of production. As stated above the cost of production at the studied plant was quite high due to low production. The low production was the result of poor performance of the workers. The high cost of the plant was due to three reasons. The first reason was the expenses to cure the sick workers, the medical bills were being paid by the company. The second reason being the low productivity of the plant. The third reason was the costly process of hiring new workers to fill the gap left by the sick workers.

The research found the socking results during the study time period of ten weeks. The financial situation of the company takes a turn in these 10 weeks from a financially strong position to a weak financial position due to the high cost of treatment plant operation due to the above-stated reasons. Thus, we just observed the amount of spending the company was doing in catering for the sick workers on insurance and hospitals, the hiring of new workers, and how the performance of the workers was affected by this issue. [4]

**D. Human Resource**

Human resource department of any company play the main role in running the company and is also responsible for the welfare of the workers. The company focused on by the research was facing a difficult challenge. The challenge was the supply of manpower to keep running the wastewater treatment plant. After the departure of the sick workers (either released, retired or expat workers sent to their home countries). The HR department of the company decided to hire new workers but the process was not as smooth as they were expecting. The company was facing two critical challenges. First, the reputation of the company tarnished due to a high number of sick workers.

# The Impact of Wastewater Treatment Plants Transmitted Diseases on ITS Workforce

The second challenge was the financial situation of the company that was also not in a good shape.

The company tried to attract maximum candidates by giving ads on different platforms. But only 20 candidates came for the interview. Most of them were unwilling to work due to two reasons. The first reason was the information they got about the previous workers of the company. The second reason was the less pay offered to them. In the end, only 2 out of 20 candidates were willing to work in a hazardous environment for low pay.

## E. Management

In the selected company for the research, the researchers found that the management of the company was facing a hefty challenge and responsibility. The management of the company was also part of the problem. They did not fulfill their responsibility to provide the adequate safety equipment and training to protect the workers. 59 workers out of 300 workers were sick and this shows the negligence of the management. It is the company's responsibility to guide and train the workers to protect them self from the hazards. [6] According to Mara [7], some of the nations such as the US where according to the California Department of Health Services always recommend immunization for workers working in the wastewater treatment plants. The researched company was not immunizing the workers and thus played an important role in a high ratio of sickness in workers.

## VII. CONCLUSION AND RECOMMENDATIONS

The study revolved around 300 workers from the wastewater treatment plant in the National Water Company in Jeddah. The results and findings of the study show that the increasing diseases from the wastewater treatment plant pose the serious dangers and problems to the workers. Few of the diseases that workers on the treatment plants suffer include Hepatitis A, aseptic meningitis, respiratory diseases, respiratory and poliomyelitis among others. These infections are detrimental to the health of workers and at the same time a big challenge for the company also. These diseases reduce the performance of the workers. Low performance of the workers can reduce the productivity of the treatment plant. Low productivity means high cost of the production.

To ensure the safety of workers management of the company can take several steps. These steps can be divided into two major parts. First part is the engineering controls while the second part is administrative controls. According to John Saunders [8], by engineering solutions controls involve isolation while administrative controls include avoidance. In simple words, engineering controls are the possible interventions that are used to mitigate the worker's exposure to all types of chemical, physical and biological agents. The engineering controls can be divided into two parts. First is the non-ventilation engineering controls second is the ventilation engineering controls.

The engineering solutions can help in reducing the hazard environment in our case study. For example, a better ventilation system can reduce the chance of exposure of the chemicals to the workers. This type of modification is necessary in the maintenance area because of the most cases of infections reported in maintenance workers. To avoid the exposure of lethal gases, a series of valves can be introduced to avoid the accumulation of gases and will also allow the

workers to divert the extra gases to enter in the confined places.

The other engineering solution is the training of workers to protect them from different chemicals and diseases. The company can also provide better PPE's. The company should try to find out the reasons behind the high rate of diseases. Once they detected the problem it becomes easy to make changes in the plant to avoid these dangers. For example, to finish the high concentration of pathogens in the water that causes hepatitis virus, the company can introduce a UV lamp purification system of the water that helps to reduce the concentration of pathogens in the water.

Engineering controls involve measures include replacing more dangerous materials with fewer hazard materials, better designing of work processes and use of adequate equipment's to avoid dangers for the workers. According to Saunders [8], the non-ventilation solution involves eliminating the process emission rate significantly. This can be done by establishing well-fitting lids to all the liquid containers in the wastewater treatment plants. This type of controls can be helpful in the treatment plants like the one studied in this research to reduce the hazards to workers. Examples of non-ventilation engineering controls include enclosures, seals, jigs and handling aids.

The other engineering control recommendation is the use of local exhaust ventilation. This type of solution works to contain the polluted air at the source before it contacts the workers. Other recommendations include according to Hanjra, et al [6] use of personal protective equipment's to avoid all health hazards problems. The personal protective equipment includes the various material an employee can wear or use to help protect them from harmful substances as well as getting hurt. When it comes to protecting the eyes and the face, the worker is recommended to wear protective safety glasses, goggles, and face shields. Besides PPE's implementation of environmental performance index (EPI) info program can help a lot in safety of workers.

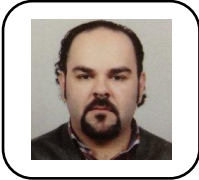
As part of health protective measures, this study recommends vaccination for sewage treatment workers to eliminate the risk of contracting Hepatitis A virus [7] The vaccination should be provided by the government to all workers. These workers should also be educated on the symptoms of hepatitis A virus so that they can recognize the symptoms early enough and seek medical attention as well as take measures to protect their loved ones.

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