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City of Columbus, Division of Sewerage and Drainage
Columbus, Ohio

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PREFACE

The Hazard Evaluations and Technical Assistance Branch (HETAB) of the National Institute for Occupational Safety and Health (NIOSH) conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

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ACKNOWLEDGMENTS AND AVAILABILITY OF REPORT

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Hepatitis among DOSD workers, Columbus, OH

NIOSH representatives conducted a health hazard evaluation at the City of Columbus, Division of Sewerage and Drainage (DOSD). We looked into employee concerns about getting hepatitis A, an infection of the liver, from exposure to sewage at work. This sheet summarizes what we did and found.

What NIOSH Did

- # We walked through the Jackson Pike Wastewater Treatment Plant (JPWWTP) and watched employees at work.
- # We looked at the personal protective equipment (PPE) policy.
- # We compared employees at JPWWTP and in maintenance (SMOC) with other city employees who don't work with sewage to see how many had ever had a hepatitis A infection in the past.

What NIOSH Found

- # Managers and employees don't communicate very well with each other. As a result there is confusion about some of the PPE policies and practices at DOSD.
- # The PPE policy is too general and not specific to employees' jobs.
- # There were not enough hand-washing stations or soaps at each station for all the DOSD employees.
- # DOSD employees did **not** have an increased risk of being infected with the hepatitis A virus.

What DOSD Managers Can Do

- # Evaluate each job for the potential for exposure to raw sewage and decide what PPE is appropriate.
- # Prepare a specific PPE policy that tells employees what PPE to use for which job and how to clean it after use.

- # Train new employees immediately and other employees at least every year about which PPE is appropriate for their job duties.
- # Give employees **on every shift** access to appropriate protective equipment to prevent exposure to raw sewage.
- # Require employees on every shift to use the uniforms and laundry service provided.
- # Provide hand-washing stations with clean water and mild soap wherever contact with raw sewage occurs.
- # Make sure all employees are up-to-date on tetanus-diphtheria shots.

What DOSD Employees Can Do

- # Wear clothing and equipment, such as a face shield, that will protect you if you think you may come in contact with sewage.
- # Always clean or discard soiled PPE immediately after use to avoid contaminating other parts of the facility such as hand railings and door knobs.
- # Use the uniform and laundry service provided. Don't take soiled uniforms home with you.
- # Do not eat, drink, or smoke while working, and always wash your hands before doing any of these activities.
- # Make sure your supervisors and/or union representatives are aware of any health and safety concerns you have.
- # Participate on health and safety committees to improve health and safety in your workplace.



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Health Hazard Evaluation Report 97-0294-2752
City of Columbus, Division of Sewerage and Drainage
Columbus, Ohio
September 1999

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SUMMARY

In August 1997, the National Institute for Occupational Safety and Health (NIOSH) received a request from employees of the City of Columbus, Division of Sewerage and Drainage (DOSD), to conduct a health hazard evaluation (HHE) at the Columbus wastewater treatment plants. The request concerned the potential for occupational transmission of hepatitis A and B viruses among workers exposed to raw sewage. In addition, the requesters reported a lack of available personal protective equipment (PPE) and mentioned there was no policy or training for PPE usage. In response to the HHE request, NIOSH investigators conducted an initial site visit to the Jackson Pike Wastewater Treatment Plant (JPWWTP) in October 1997, and subsequently conducted a seroprevalence survey of antibodies to hepatitis A virus (HAV) among wastewater employees and a comparison population of employees of other city agencies.

Our survey found that the group of participating Columbus wastewater employees had a prevalence of past HAV infection of 26%, versus 12% in the comparison group. However, after controlling for age (increased age is known to be related to increased prevalence of HAV infection) and race (possibly a surrogate for socioeconomic status, which has been related to prevalence of HAV infection), the prevalence of HAV infection between the two groups was found not to differ (adjusted prevalence ratio 1.3, 95% confidence interval, 0.7-2.4). In addition, among the wastewater employees, no specific workplace risk factors for HAV infection were identified.

The written PPE policy, which had not been ratified by the union, was general and unspecific to the various duties and potential exposures of DOSD employees. In addition, PPE training was only given to employees who might need to use supplied air breathing apparatuses. PPE usage throughout the JPWWTP was observed to be inconsistent, and some employees reported not knowing what PPE was available and when it should be used. While most work areas at the JPWWTP had hand-washing facilities, many did not have soap or soap dispensers.

City of Columbus wastewater employees did not have an increased risk of being infected by the HAV, nor were any specific workplace factors for HAV infection identified among these employees. The Centers for Disease Control and Prevention does not currently include wastewater workers among the groups of persons at increased risk for HAV infection; the results of this survey are consistent with this position. However, many Columbus wastewater employees potentially exposed to raw sewage were not using PPE adequately and did not have access to appropriate hand-washing facilities; these employees may be at increased risk for contracting diseases from infectious organisms present in sewage. Recommendations include frequent and routine hand-washing, increased training and use of PPE, use of uniforms and laundry services, and up-dating tetanus-diphtheria immunizations.

Keywords: SIC 4952 (Sewerage systems): Wastewater, sewage, wastewater treatment plant, hepatitis A virus, HAV.

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INTRODUCTION

In August 1997, the National Institute for Occupational Safety and Health (NIOSH) received a request from employees of the City of Columbus, Division of Sewerage and Drainage (DOSD), to conduct a health hazard evaluation (HHE) at the Columbus wastewater treatment plants. The request concerned the potential for occupational transmission of hepatitis A and B viruses among workers exposed to raw sewage. In response to the HHE request, NIOSH investigators conducted an initial site visit to the Jackson Pike Wastewater Treatment Plant (JPWWTP) in October 1997. During that site visit, background information was collected, a walk-through evaluation was conducted, and personal protective equipment (PPE) usage was evaluated.

Following the initial assessment and subsequent meetings and discussions between NIOSH, City officials, employees, and representatives of the union (American Federation of State, County, and Municipal Employees [AFSCME] Local 1632), NIOSH investigators conducted a seroprevalence survey of antibodies to hepatitis A virus (HAV) among wastewater employees and a comparison population.* An interim letter containing preliminary results and recommendations was distributed on June 7, 1999.

BACKGROUND

Sewage Treatment

DOSD operates two large semi-aerobic activated-sludge treatment plants. The oldest of the

* Hepatitis B virus is primarily transmitted percutaneously, sexually, or perinatally. Because exposure to wastewater or sewage has not been found to be a potential risk factor for hepatitis B infection, potential occupational transmission of hepatitis B virus was not evaluated in this HHE.

two facilities, the JPWWTP, was originally built in 1908 and was replaced in 1937. Since 1937, improvements to this plant have included the addition of a parallel facility, which treats about 40% of the wastewater that flows through this site. The JPWWTP has approximately 100 employees and treats about 80,000,000 gallons of wastewater daily from the north, west, and central areas of the city. The second DOSD plant, the Southerly Wastewater Treatment Plant (SWWTP), has approximately 120 employees, was built in 1967 and treats about 70,000,000 gallons of wastewater daily from the eastern section of the city and from a local brewery. (DOSD management reported that there are no substantial differences [i.e. industrial versus non-industrial] in the sewage being treated at each plant.) In addition, there are approximately 150 sewer maintenance operation center (SMOC) employees who maintain over 3,380 miles of underground piping throughout the city.

The wastewater treatment at both plants is mostly biological, although mechanical equipment and certain chemicals are used to collect and dispose of the materials in the sewage. Sewage flows to the treatment plants and is screened to remove large debris. Sand and grit are then removed to the local landfill using a large overhead crane and bucket. The sewage then enters the pre-aeration tanks where grease floats to the top. From the pre-aeration tanks, the sewage passes to the primary clarifying tanks, where heavier suspended organic materials, called raw primary sludge, settle to the bottom and are pumped into a gravity thickener tank to go through the solids stream processes. Grease and oils are skimmed from the top, dried, and removed to the local landfill. From here, the partially-clarified liquid sewage flows through a series of aeration tanks, where air and bacteria are mixed into the liquid to facilitate the breakdown of the sewage. The remaining clarified liquid portion flows to chlorination and de-chlorination tanks to further disinfect and aerate the water, which is then discharged into the rivers next to each plant. Meanwhile, the raw primary sludge, known as waste activated sludge, is concentrated and further processed by anaerobic digestion, which reduces the

amount of biodegradable organic material. Some of this digested sludge is trucked to local farms under the city's Land Application Program. The rest is incinerated, and the resulting fly ash is removed to the local landfill. The methane gas collected from the anaerobic digestion process is used as fuel for the incinerators.

The HHE request primarily concerned the potential for occupational transmission of hepatitis A and B viruses among employees exposed to raw sewage. During the opening conference, NIOSH investigators further learned that employees were concerned about several PPE issues, including a lack of PPE training and official policy. Some employees also reported not knowing what PPE is available and mentioned that they have requested certain PPE and have been unable to obtain it. Uniforms and uniform cleaning are provided by the city; however, few employees reportedly take advantage of the service. Employees also mentioned a lack of hand-washing stations, soap, and soap dispensers.

Hepatitis

Hepatitis is a term describing inflammation of the liver. There are many known causes of hepatitis; some of the most common causes are infectious agents. The most common infectious agents which cause hepatitis are the hepatitis viruses, of which there are several types. HAV is spread primarily by fecal/oral routes (often resulting from inadequate hand-washing) and may be spread via contaminated food or water. The Centers for Disease Control and Prevention (CDC) lists the following adults as being at increased risk for HAV infection: travelers to or workers in developing countries, homosexual men, injecting drug users, persons receiving solvent-detergent-treated clotting factor concentrates, and persons who work with non-human primates (some non-human primates not born in captivity are susceptible to HAV infection).¹ Identification of groups at increased risk is particularly important because an effective HAV vaccine is now available and indications for its use are being evaluated.^{1,2}

In adults, HAV infection usually causes an acute illness which most commonly includes fever, malaise, loss of appetite, nausea, abdominal pain, and jaundice (yellow coloring of the skin). These symptoms usually last less than two months. Some patients experience a prolonged (more than three months) period of jaundice following an episode of acute hepatitis. Relapsing hepatitis (with relapses occurring for up to a year) has been reported in as many as 15% of persons with HAV infection. Persons with hepatitis due to HAV are most infectious during the week or two before onset of jaundice and for a few days afterward. Persons who are infected with HAV develop antibodies to HAV; these antibodies to HAV are an indication of past infection and are protective against future infection. The presence of antibody to HAV is not an indicator of chronic hepatitis and does not mean that the person with the antibody is contagious. Chronic infection with HAV does not occur.¹

HAV in Wastewater and Sewage Workers

The potential for occupational HAV transmission among wastewater and sewage workers is an area of active research. Although HAV has been shown to survive in groundwater for weeks,³ work-related cases of HAV transmission among workers exposed to sewage have not been reported to the CDC.¹ Several seroprevalence studies for HAV infection have been done among wastewater workers in other countries. Some have found increased seroprevalence of antibody to HAV among wastewater workers compared to other occupational groups;^{4,5,6} others have not.⁷ One study found that the prevalence of antibodies to HAV was not significantly greater among sewage workers than among a comparison group, but exposure to sewage was an independent risk factor for HAV seropositivity.⁸ A recent study from the United Kingdom found that reported occupational exposure to raw sewage was a risk factor for past HAV infection.⁹ In general, incomplete information regarding the comparability of study groups (groups of sewage workers and comparison workers), as well

as regional variations in HAV seroprevalence, make it difficult to apply the results of these international seroprevalence studies to workers in the United States.

METHODS

Following the opening conference, a walk-through evaluation of the JPWWTP was conducted to observe work practices and identify areas of potential concern. After the walk-through evaluation, the NIOSH medical officer talked with several employees who reportedly had been diagnosed with hepatitis A and who requested to be interviewed. The NIOSH industrial hygienist evaluated the PPE program, observed employees' use of PPE during routine duties, and observed work practices and hand washing among employees.

Based partly on the findings of this initial site visit, a seroprevalence survey was conducted. The goal of this seroprevalence survey was primarily to address two questions: (1) Have Columbus wastewater workers (who work with sewage or wastewater) been infected with HAV more commonly than other workers from Columbus who do not work with wastewater? and (2) Among the wastewater workers, can occupational risk factors be identified which may be related to past HAV infection? We tested for the presence of antibody to HAV among Columbus city wastewater workers and a group of Columbus city workers not occupationally exposed to wastewater. From June 29–July 1, 1998, the survey was conducted among employees at JPWWTP, and from July 14–15, 1998, the survey was conducted among employees of SMOC. The JPWWTP employees primarily work only at that sewage treatment plant; the SMOC employees work throughout the City performing maintenance operations. Due to anticipated poor participation among employees at the SWWTP, that plant was not surveyed in this HHE. In December 1998–January 1999, surveys were conducted among groups of employees of the Columbus Electric Division and the Columbus Recreation Department; these employees served as comparison groups. In April 1999, each

study participant was informed in writing of his or her test results.

The survey consisted of a questionnaire (including questions concerning work, medical history, and relevant socio-economic factors), and tests for antibody to HAV in blood (wastewater workers only) and saliva (both wastewater and comparison groups). The study was approved by the NIOSH Human Subjects Review Board and informed consent was obtained prior to employee participation. For those sewer workers who had had a blood test for antibody to HAV performed by the City of Columbus in the three months prior to the survey, no additional blood test was done; these participants were asked to complete a medical release form so that NIOSH could obtain that test result from the City. Blood samples collected by NIOSH were analyzed for HAV antibody by the Hepatitis Reference Laboratory of the CDC using standard assays (HAVAB, Abbott Laboratories, Abbott Park, North Chicago, Illinois). Blood testing for antibody to HAV was not performed among the comparison groups. All participants in the survey had a saliva sample collected using Saliva Sampler® collectors (Saliva Diagnostic Systems, Inc., Vancouver, Washington); samples were tested for antibody to HAV (immunoglobulin G) at the Central Public Health Laboratory in London, England, following published methods.¹⁰ The saliva sample results were used for all data analyses.

Analyses were done using SAS software (Version 6.12). Participants whose saliva test result was indeterminate were excluded from any statistical modeling. Multivariable regression models were developed to evaluate occupational risk factors for HAV infection while controlling for the effect of non-occupational factors. To assess the relationships between antibody to HAV status and occupational risk factors, these models generated adjusted prevalence ratios (PR) and 95% confidence

intervals (CI) for the prevalence ratio.** Because 19 participants (administrative personnel) from the wastewater sites reported that they never had contact with sewage, they were grouped with the “unexposed” participants in the model comparing HAV antibody prevalence between the exposed and unexposed workers. Non-occupational factors that were considered included: race, household contact with a person having jaundice or hepatitis, travel to areas where HAV is common, education level, being born outside the U.S., gender, age, and household income level.

RESULTS

Environmental Results

Although DOSD managers did provide NIOSH investigators with a copy of a written PPE policy, it was general and not specific to the various duties and potential exposures of DOSD employees and had also not been ratified by the union. In addition, PPE

** The prevalence ratio estimate is a measure of association which represents the prevalence of a health outcome among the “exposed” group (those having the risk factor) relative to the prevalence among the “unexposed” group (those without the risk factor). A prevalence ratio of 1 means that no association between the risk factor and the outcome has been found, while a prevalence ratio of 2 would mean that a person in the exposed group is 2 times more likely to have the outcome than a person in the unexposed group. The 95% confidence interval is a range of values within which we are 95% confident that the true prevalence ratio lies. If the 95% confidence interval for the prevalence ratio does not include 1, then we can be confident that any increased prevalence of an outcome, indicated by the prevalence ratio, is not likely due to chance. Conversely, if 1 is included in the confidence interval, we conclude that we do not have convincing evidence of an association between the risk factor and the health outcome.

training was only given to those employees who might need to use a supplied air breathing apparatus. PPE usage throughout the plant was inconsistent and employees reported not knowing what PPE was available nor when it should be used. Interviews with employees revealed that while most knew PPE was available, they did not know which equipment to use with which job. Several employees mentioned that they requested certain PPE, such as long-sleeve gloves and face shields, and that it was never ordered for them. Uniforms and uniform cleaning, although provided by the city, were used infrequently. Employees who did use the uniforms did not usually take advantage of the cleaning service but instead would either hang them in their lockers for re-use or would take them home to be laundered.

While most work areas at the JPWWTP had hand-washing facilities, with the exception of the digester control buildings, many did not have soap or soap dispensers.

Medical Results

Participation rates and other characteristics of the HHE participants by work location are presented in Table 1. Participation rates among the four groups ranged from 74 % to 88%. The group of recreation workers included more women and more persons with at least some college education. The wastewater workers (both JPWWTP and SMOC workers) were, on average, older and were more likely to have reported a history of having jaundice or hepatitis than the workers in the comparison groups. None of the participants had received the HAV vaccine.

Among the wastewater workers, 34 agreed to have the blood test performed, and medical records were obtained for 123 other participants; therefore, blood test results were available for 157 (95% of the 166 participating) wastewater workers. All 305 participants (wastewater and comparison groups) provided saliva samples. Three participants had saliva test results of “indeterminate;” these three were excluded from statistical analyses.

Overall, 59 (19%) of all participants tested positive for antibody to HAV. The SMOC group had the highest percentage of antibody-positive workers (31%). Crude (without adjustment for possible confounders) results of the saliva testing by work location are presented in Table 2. Among the 22 participants who reported a history of jaundice or hepatitis in the past (21 of whom were wastewater workers – Table 1), only 9 (41%) had antibody to HAV. Eighteen participants (10 sewage and 8 recreation/electrical employees) reported having a household contact with a person who had jaundice or hepatitis in the past; of those, 5 (28%) tested positive for antibody to HAV.

Sensitivity and Specificity of the Saliva Test Compared to the Blood Test

Comparison of the matched blood and saliva tests for antibody to HAV, for the 157 participants with both types of tests done, is presented in Table 3. These data show that the saliva test was 99% specific and 84% sensitive. In other words, 99% of participants who had a negative serum antibody to HAV test also had a negative saliva antibody to HAV test, while 84% of participants who had positive serum antibody to HAV test also had a positive saliva antibody to HAV test.

Analysis of Anti-HAV Prevalence Between Exposed and Unexposed Groups

The non-occupational risk factors that demonstrated an effect on the relationship between exposure to sewage and past HAV infection included age and race. After controlling for these factors, work as a wastewater worker was not associated with antibody to HAV (PR=1.3; 95% CI 0.7–2.4).

Analysis of Potential Risk Factors Among Wastewater Workers

The following variables were assessed as potential risk factors for antibody to HAV among the wastewater workers from JPWWTP and SMOC: work as a maintenance worker (SMOC), exposure to the mists from the JPWWTP settling ponds, lack of a place to wash up after completing a task, contact with sewage as reported by the participant, expected contact with sewage as determined for each job title jointly by management and union representatives, not washing before eating, eating in the work area, lack of a designated eating area, not eating in the designated eating area, not wearing face shield, and not wearing gloves. Among the nonoccupational risk factors evaluated, age and race were again found to be the important factors related to both the potential occupational risk factors and past HAV infection. A positive association, though not statistically significant, was found between prevalence of anti-HAV and eating in the work area (PR 1.6; 95% CI 0.7–3.5) and work as a maintenance worker (relative to work in the treatment plant) (PR 1.4; 95% CI 0.6–2.9).

DISCUSSION AND CONCLUSIONS

Our survey found that the group of participating Columbus wastewater workers had a prevalence of past HAV infection of 26%, compared to 12% in the comparison group. However, after controlling for age (increased age is known to be related to increased prevalence of HAV infection) and race (possibly a surrogate for socioeconomic status, which has been related to prevalence of HAV infection), the prevalence of HAV infection did not differ between the two groups. In addition, among the wastewater workers, no specific workplace risk factors for HAV infection were identified.

This survey has several limitations. Original survey plans called for surveying workers from the SWWTP; however, that survey was not done. Although the demographic characteristics of the workers and the sewage handling procedures at the two plants are similar, we are not able to comment on the prevalence of past HAV infection among workers at the plant which was not surveyed. In addition, it is possible that a larger number of participants would have provided greater statistical power to detect differences between the groups being evaluated. Second, the saliva test used was found to have a sensitivity of 84% compared to the serum test (meaning that there are some persons who are antibody-positive, but who tested negative by the saliva test). The saliva test was used to compare the two groups because of concerns over potentially poor participation with a blood test. Because there is no reason for the sensitivity of the saliva test to differ between the exposed and unexposed groups, there is no reason to believe that the sensitivity of the saliva test is a major factor in the negative findings of this survey. However, if a test with a higher sensitivity were used, it might have improved the statistical power of the survey to detect differences between the groups.

When performing this survey, one of our goals was to find a comparison (unexposed) group that accurately reflected the background prevalence of antibody to HAV among working-age adults in the community around Columbus. Because the background prevalence of antibody to HAV in Columbus is not known, we cannot say our goal was achieved. The CDC reports that, in one survey, antibody to HAV prevalence in the general population was found to vary from between 18% (for 20–29 year olds) to 49% (for 40–49 year olds).¹ Another survey, however, found a prevalence of past HAV infection of 12% among non-Hispanics (CDC, unpublished data); this is the same as the background rate of HAV infection found in our survey. We note, but cannot account for, the low prevalence of past HAV infection in the electric workers.

Sewage and wastewater at various treatment stages inherently contain potentially infectious organisms.

Employees should take appropriate health and safety precautions to minimize their exposure to sewage and wastewater. Some exposures at the facilities and in maintenance operations are unpredictable and may be unavoidable; however, many of the routine duties, including sample collection, pressure washing, and some maintenance procedures, are known to involve high potential for direct contact with sewage. At JPWWTP and in SMOC, the use of PPE to protect against these exposures is often not required.

RECOMMENDATIONS

CDC does not currently include wastewater workers among the groups of persons at increased risk for HAV infection;¹ the results of this survey are consistent with that position. However, due to the limitations of our survey, further data addressing the potential for occupational transmission of HAV among wastewater workers in the U.S. are needed. Persons wishing to obtain immunity from hepatitis A virus infection should discuss with their personal physician or another qualified health professional risk factors for hepatitis A virus infection, past testing for antibody to hepatitis A (if done), and the use of the HAV vaccine.

The original goals of the City medical surveillance program for hepatitis among Columbus wastewater workers should be reviewed. Ongoing surveillance for hepatitis and antibody to HAV among Columbus wastewater workers by the City of Columbus, if continued, should be performed with specific objectives in mind. To use the surveillance data to assess the prevalence of HAV infection among wastewater workers and the potential relationship to occupational risk factors, data concerning potential occupational and non-occupational risk factors for HAV infection (similar to those evaluated in this survey) should be collected along with the medical data. To use the surveillance data to assess the **incidence** (the number of **new** cases per time period) of HAV infection potentially related to occupational exposures among wastewater workers, more thought needs to be given to the planning of the surveillance

program so that useful data are collected (for example, the timing of the medical testing relative to the start of work will have to be addressed to ensure that a true baseline is established).

Sewage and wastewater at various treatment stages inherently contain potentially infectious organisms. Management and employees should institute appropriate health and safety precautions to minimize employee exposure to sewage and wastewater. Some exposures are unpredictable, and may be unavoidable; however, many routine duties are known to have potential for direct contact with sewage.

The following recommendations are provided to help minimize exposure to raw sewage and increase employee awareness of the importance of good hygiene and the appropriate use of PPE while at work:

21. Periodic training regarding standard hygiene practices should continue to be conducted, reviewing issues such as:

- a. Frequent and routine hand washing. This is the most effective safeguard in preventing infection by agents present in sewage.
- b. Use of available on-site showers, lockers, and laundry services for washing work clothes. Work clothes should not be worn home or outside the immediate work environment.
- c. Use of available on-site showers, lockers, and laundry services for washing work clothes. Work clothes should not be worn home or outside the immediate work environment.
- d. Eating, drinking, or smoking while working. Employees should always wash their hands and face before engaging in these activities or using the restroom.
- e. Cleaning PPE, such as protective clothing, boots, gloves, goggles, and face shields. These should be either properly cleaned (immediately after they are used) or discarded.

f. Face shields. Models that fit over employees' hard hats should be made available for all jobs in which there is a potential for spray or high-pressure sewage leaks, or when sludge is aerosolized.

2. Hand-washing stations with clean water and mild soap should be readily available wherever contact with wastewater, sewage, or sludge may occur. In the case of the maintenance workers, portable equipment, including clean water and soap, should be available on the maintenance trucks or wherever the maintenance work is taking place.

3. Appropriate PPE should be required for all job duties likely to result in exposure to sewage, untreated or partially-treated wastewater, or sludge. This PPE could include goggles, face shields, liquid-repellant coveralls, and gloves. Management and employee representatives should work together to determine which job duties are likely to result in this type of exposure and which type of PPE is needed and make sure the written PPE policy reflects these findings. Adequate access to all PPE should be provided for employees on all shifts. A qualified health and safety professional should provide training or retraining in the use of appropriate PPE, especially for new employees.

4. Management, the union, and employees should continue to work together on health and safety committees, which are an ideal means of improving communication between employees and management regarding working conditions.

5. Because common skin wounds in "dirty" environments are at risk of being contaminated with tetanus-causing bacteria, management should insure that all employees are up-to-date on tetanus-diphtheria immunizations.

REFERENCES

1. CDC [1996]. Prevention of hepatitis A through active or passive immunization: recommendations of the Advisory Committee on

Immunization Practices (ACIP). Centers for Disease Control and Prevention. *MMWR* 45(No. RR-15).

2. CDC [1997]. Hepatitis A vaccination programs in communities with high rates of hepatitis A. Centers for Disease Control and Prevention. *MMWR* 46(26):600-603.

3. Bloch AB, Stramer SL, Smith JD, et al. [1990]. Recovery of hepatitis A virus from a water supply responsible for a common source outbreak of hepatitis A. *Am J Public Health* 80:428-430.

4. Skinhoj P, Hollinger FB, Hovind-Hougen K, Lous P [1981]. Infectious liver diseases in three groups of Copenhagen workers: correlation of hepatitis A infection to sewage exposure. *Arch Env Health* 36:139-143.

5. Poole CJM, Shakespeare AT [1993]. Should sewage workers and caretakers for people with learning disabilities be vaccinated for hepatitis A? *BMJ* 306:1102.

6. Heng BH, Goh KT, Doraisingham S, Quek GH [1994]. Prevalence of hepatitis A virus infection among sewage workers in Singapore. *Epidemiol Infect* 113:121-128.

7. DeSerres G, Levesque B, Higgins R, et al. [1995]. Need for vaccination of sewer workers against leptospirosis and hepatitis A. *Occ Env Med* 52:505-507.

8. Cadilhac P, Roudot-Thoraval F [1996]. Seroprevalence of hepatitis A virus infection among sewage workers in the Parisian area, France. *Euro J Epi* 12:237-240.

9. Brugha R, et al. [1998]. Risk of hepatitis A infection in sewage workers. *Occup Environ Med* 55:567-569.

10. Parry JV, Perry KR, Mortimer PP [1987]. Sensitive assays for viral antibodies in saliva: an alternative to tests on serum. *Lancet* ii:72-75.

**Table 1 – Description of Participants
HETA 97-0294, Columbus Wastewater Workers**

	TP ¹	Maint ²	Recreation ³	Electric ⁴	All Groups
Participants (participation rate)	69 (82%)	97 (74%)	70 (80%)	69 (88%)	305 (80%)
Mean age (range)	47(23–69)	46(27–74)	39(20–63)	38(20–54)	43 (20–74)
Male	67(97%)	95(98%)	42(60%)	66(96%)	270 (89%)
Race ⁵	62 (90%)	56 (58%)	30 (43%)	59 (86%)	207 (68%)
Hispanic ⁶	2 (3%)	3 (3%)	2 (3%)	0	7 (2%)
Education ⁷	30 (43%)	32 (33%)	63 (90%)	21 (30%)	146 (48%)
Income ⁸	43 (63%)	45 (48%)	23 (34%)	51 (75%)	162 (55%)
Travel ⁹	35 (51%)	40 (41%)	25 (36%)	29 (42%)	129 (42%)
Foreign Birth ¹⁰	2 (3%)	4 (4%)	1 (1%)	0	7 (2%)
Hepatitis ¹¹	9 (13%)	12 (12%)	1 (1%)	0	22 (7%)
Assoc with Hep. ¹²	5 (7%)	5 (5%)	5 (7%)	3 (4%)	18 (6%)

¹ Treatment plant

² Maintenance workers

³ Recreation workers worked among 26 different centers; employees from 22 (85%) of the centers participated in the survey

⁴ Electric workers

⁵ Number (%) white

⁶ Number (%) reporting Spanish or Hispanic ancestry

⁷ Number (%) reporting at least some college education

⁸ Number (%) of respondents reporting family income of \$40,000 or greater

⁹ Number (%) reporting travel at least once to Mexico, South America, Central America, Asia, Africa, or the Caribbean

¹⁰ Number (%) reporting birth outside the United States

¹¹ Number (%) reporting ever having jaundice or hepatitis

¹² Number (%) reporting having lived with a person who had jaundice or hepatitis

**Table 2 – Saliva Antibody to HAV Testing by Work Location
HETA 97–0294, Columbus Wastewater Workers¹**

	JP ²	SMOC ³	Sub-total 'Exposed'	Recreation	Electric	Sub-total 'Unexposed'	Total
# Tests	67	96	163	70	69	139	302
# (%) Tests Positive	12 (18%)	30 (31%)	42 (26%)	14 (20%)	3 (4%)	17 (12%)	59 (20%)

¹ Indeterminate saliva test results were excluded from analyses.

² Jackson Pike

³ Sewer Maintenance Operations Center

**Table 3 – Comparisons of the Serum and Saliva Testing for Antibody to HAV
HETA 97–0294, Columbus Wastewater Workers**

Serum Test	Saliva Test			Total
	Positive	Negative	Indeterminate	
Positive	41 ^a	6	2	49
Negative	0	107 ^b	1	108
TOTAL	41	113	3	157

^a Sensitivity of Saliva test $41/49 = 84\%$

^b Specificity of Saliva test $107/108 = 99\%$

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