

Health Hazard Evaluation of Deepwater Horizon Response Workers

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Health Hazard Evaluation Interim Report 6
September 13, 2010



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The cover photo shows the sunset over the Gulf Waters west of Venice, Louisiana during the Deepwater Horizon response: June 2010.



National Institute for Occupational
Safety and Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati OH 45226-1998

September 13, 2010
HETA 2010-0115

Fred Tremmel
Deepwater Horizon ICP
1597 Highway 311
Houma, LA 70395

Dear Mr. Tremmel:

On May 28, 2010, the National Institute for Occupational Safety and Health (NIOSH) received a request from BP for a health hazard evaluation (HHE). The request asked NIOSH to evaluate potential exposures and health effects among workers involved in Deepwater Horizon Response activities. NIOSH sent an initial team of HHE investigators on June 2, 2010, followed by additional teams.


This letter is the sixth in a series of interim reports. As this information is cleared for posting, we will make it available on the NIOSH website (www.cdc.gov/niosh/hhe). When all field activity and data analyses are complete we will compile the interim reports into a final report.

This report (Interim Report #6) includes several discrete components of our investigation. For each, we provide background, describe our methods, report the findings, and provide conclusions and, where appropriate, interim recommendations. The components included in this report are as follows:

- 6A – Evaluation of Acute Health Effects among Attendees at a United State Coast Guard Safety and Administrative Meeting; June 18, 2010
- 6B – Evaluation of response workers hospitalized in Louisiana from May 28 through June 22, 2010

Thank you for your cooperation with this evaluation. If you have any questions, please do not hesitate to contact me at 513.841.4382 or atepper@cdc.gov.

Sincerely yours,

A handwritten signature in black ink that reads "Allison Tepper". The signature is written in a cursive, flowing style.

Allison Tepper, PhD

Chief

Hazard Evaluations and Technical

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2 Enclosures

cc:

Mr. David Dutton, BP

Mr. Mark Saperstein, BP

Dr. Richard Heron, BP

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CDR Laura Weems, USCG

Mr. Clint Guidry, LA Shrimp Association

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Dr. Raoul Ratard, LA DHHS

Mr. Brock Lamont, CDC

Interim Report #6A

Evaluation of Acute Health Effects among Attendees at a United States Coast Guard Safety and Administrative Meeting, June 18, 2010

Lead Author: Christine West

Contributing Authors: John Gibbins and Charles Mueller

Introduction

To assess acute health symptoms among off-shore response workers and United States Coast Guard (USCG) personnel, NIOSH investigators administered a health symptom survey at the June 18, 2010 safety and administrative meeting held at the Venice, Louisiana, Field Operations Branch (FOB). Meeting attendees were either USCG personnel providing safety oversight to off-shore vessels or administrative/command services at the Venice FOB, or civilian contractors providing safety oversight for other responders working off-shore. Topics typically covered at this meeting included safety procedures, weather and seas forecast, heat stress prevention, the daily plan of operations as outlined in the Branch Action Plan, and various administrative items related to active duty and reserve USCG service.

Methods

Surveys were administered to attendees at the 0600 safety and administrative meeting on June 18, 2010. Respondents were asked to report symptoms they experienced while working during response activities, whether they had exposures to oil and dispersants, and whether they had skin contact with the oil during their response activities.

NIOSH investigators assessed the relationships of upper respiratory symptoms¹, lower respiratory symptoms², and cough to self-reported exposures to oil and dispersants. They also assessed the relationship between symptoms of skin irritation³ and skin contact with oil. Bivariate analyses were done using Fisher's exact test (SAS 9.2, SAS Institute, Cary, North Carolina) and prevalence ratios were calculated. All tests were two-tailed, and statistical significance was set at $p < 0.05$.

Results

A total of 74 attendees completed the survey. Of these, 53 (73%) were USCG members and 21 (28%) were employed by contractors. The age and sex distributions of respondents were similar to those of the comparison (unexposed) group. The comparison group had been recruited from the Venice FOB and the Venice Commanders' Camp and reported that they had not worked on boats and had no exposures to oil, dispersant, cleaner, or other chemicals (See Table 1). A higher percentage (82%) of USCG meeting attendees reported that they were white compared to the unexposed group (40%).

¹ Upper respiratory symptom was defined as a positive response to nose irritation, sinus problems or sore throat.

² Lower respiratory symptom was defined as a positive response to trouble breathing, short of breath, chest tightness, or wheezing.

³ Skin irritation was defined as a positive response to itchy skin, red skin, or rash.

Table 2 presents symptoms, grouped by type, for meeting attendees and the comparison group. Overall, the most frequently reported symptoms in both groups were upper respiratory irritation, headaches, and any heat stress symptom (as defined in table 2). No respondents reported shortness of breath or wheezing.

Table 3 presents the results of the bivariate analyses regarding symptoms and exposures among the 74 USCG meeting attendees. The prevalences of upper respiratory symptoms and cough among those exposed to oil (Prevalence Ratios: upper respiratory—undefined; cough—11.7) were significantly greater than among those not exposed. Likewise, the prevalences of upper respiratory symptoms and cough among those exposed to dispersant (Prevalence Ratios: upper respiratory—7.3; cough—9.6) were also significantly greater than among those not exposed. In contrast, there were no statistically significant differences between the prevalences of lower respiratory symptoms for respondents reporting exposure to oil or exposure to dispersants and those not reporting exposure. The prevalence of skin irritation among those reporting skin contact with oil (50%) was significantly greater than the prevalence for those without skin contact (9%) (Prevalence Ratio=5.6, $p=0.02$).

Summary

Overall, the types of symptoms reported among USCG members and contractor safety personnel and by response workers who reported no exposures to oil, dispersant, cleaner, or other chemicals were similar. Headaches, however, were reported more frequently in those surveyed at the USCG safety meeting. Symptoms related to heat exposure were the most frequent in all groups. Those reporting exposure to oil and dispersants had significantly higher prevalences of upper respiratory symptoms and cough than those not exposed. The dispersants used in the response are known to cause upper airway irritation and could have contributed to these symptoms. Also, any remaining volatiles in the oil are irritants and could cause upper airway irritation and cough. Added to these chemical exposures are the possibilities of exposure to road and gravel dust at the marina and docks, tobacco smoke (personal smoking and second-hand exposure), and upper respiratory infections resulting from crowded work and living conditions. The NIOSH survey did not account for these factors. Although the statistical analysis indicated an increased risk of upper respiratory irritation associated with oil and dispersant exposures, it is important to keep in mind that only a small number of respondents reported these symptoms and exposure to oil or dispersant. In addition, these findings from a convenience sample of workers from one response location may not apply to other workers in different locations or performing different duties.

Recommendations:

- Workers who continue to experience symptoms should seek out health care from physicians familiar with occupational medicine principles to determine the work-relatedness of their condition.
- As recommended in previous NIOSH reports, workers should have access to information about occupational health issues and exposures related to the oil spill and the oil industry in general, and the specific hazards that were found in the Deepwater Horizon response. See: Health Effects from Crude Oil and Oil Dispersant Exposure in NIOSH-OSHA Interim Guidance for Protecting Deepwater Horizon Response Workers and Volunteers [<http://www.cdc.gov/niosh/topics/oilspillresponse/protecting/#effects>].

Table 1. Health symptom survey—demographics		
	USCG Meeting Attendees	Unexposed*
Number of participants	74	103
Age range	19–60	18–70
Race		
White	82%	40%
Hispanic	14%	29%
Asian	3%	9%
Black	1%	19%
Other	0%	3%
Not given	0%	0%
Male	96%	96%
Days worked oil spill	0–60	0–45
Days worked boat	0–40	0
Employer		
USCG	53 (73%)	N/A
Other	21 (28%)	N/A
*Participants were recruited from the Venice Field Operations Branch and the Venice Commanders' Camp. Those who reported that they had not worked on boats and had no exposures to oil, dispersant, cleaner, or other chemicals were included in this group.		

Table 2. Health symptom survey—by group

	USCG Meeting Attendees	Unexposed*
Number of participants	74	103
Injuries		
Scrapes or cuts	7 (10%)	11 (11%)
Burns by fire	0	1 (1%)
Chemical burns	1 (1%)	0
Bad Sunburn	8 (11%)	8 (8%)
Constitutional symptoms		
Headaches	15 (20%)	5 (5%)
Feeling faint, dizziness, fatigue or exhaustion, or weakness	9 (12%)	13 (13%)
Eye and upper respiratory symptoms		
Itchy eyes	9 (12%)	5 (5%)
Nose irritation, sinus problems, or sore throat	13 (18%)	16 (16%)
Metallic taste	1 (1%)	0
Lower respiratory symptoms		
Coughing	12 (16%)	8 (8%)
Trouble breathing, short of breath, chest tightness, or wheezing	3 (4%)	4 (4%)
Cardiovascular symptoms		
Fast heart beat	1 (1%)	1 (1%)
Chest pressure	0	0
Gastrointestinal symptoms		
Nausea or vomiting	3 (4%)	3 (3%)
Stomach cramps or diarrhea	8 (11%)	7 (7%)
Skin symptoms		
Itchy skin, red skin, or rash	9 (12%)	8 (8%)
Musculoskeletal symptoms		
Hand, shoulder, or back pain	6 (8%)	6 (6%)
Psychosocial symptoms		
Feeling worried or stressed	2 (3%)	4 (4%)
Feeling pressured	1 (1%)	2 (2%)
Feeling depressed or hopeless	0	1 (1%)
Feeling short tempered	2 (3%)	4 (4%)
Frequent changes in mood	1 (1%)	3 (3%)
Heat stress symptoms†		
Any	21 (28%)‡	21 (20%)
4 or more symptoms	1 (1%)	3 (3%)

*Participants were recruited from the Venice Field Operations Branch and the Venice Commanders' Camp. Those who reported that they had not worked on boats and had no exposures to oil, dispersant, cleaner, or other chemicals were included in this group.

†Headache, dizziness, feeling faint, fatigue or exhaustion, weakness, fast heartbeat, nausea, red skin, or hot and dry skin.

‡15 of 21 (71%) people reporting any heat stress symptom reported headache.

Table 3. Prevalences and prevalence ratios for symptoms by exposures

Symptoms	Exposure							
	Oil				Dispersant			
	Exposed n=32	Unexposed* n=34	Prevalence Ratio (PR)	P value	Exposed n=13	Unexposed n=47	PR	P value
Upper respiratory†	13 (41%)	0	Undefined	<0.01	8 (62%)	4 (9%)	7.3	<.01
Cough	11 (34%)	1 (3%)	11.7	<0.01	8 (62%)	3 (6%)	9.6	<0.01
Lower respiratory‡	3 (9%)	0	Undefined	0.11	1 (8%)	1 (2%)	3.6	0.39

*Group defined as 74 United States Coast Guard meeting attendees who completed survey; not all participants answered every question.

†Upper respiratory symptom was defined as a positive response to nose irritation, sinus problems or sore throat.

‡Lower respiratory symptom was defined as a positive response to trouble breathing, short of breath, chest tightness, or wheezing

Interim Report #6B

Evaluation of Response Workers Hospitalized in Louisiana from May 28 through June 22, 2010

Lead Authors: Melody Kawamoto and Judith Eisenberg

Contributing Author: Bruce Bernard

Evaluation

Four weeks after the April 20, 2010, BP Deepwater Horizon explosion, the Louisiana Department of Health and Hospitals (LA DHH) set up an oil spill surveillance system to capture reports of human exposures to odors or fumes, skin contact with contaminated water or objects, and heat stress [<http://www.dhh.louisiana.gov/reports.asp?Detail=791>]. This surveillance system relies on data supplied by sentinel surveillance sites, including hospital emergency departments, outpatient clinics, physicians' offices, and the Louisiana Poison Center. Reports of Deepwater Horizon response workers hospitalized in Louisiana are captured through this system.

On May 28, 2010, BP submitted a request for a NIOSH health hazard evaluation (HHE) that included a request for an investigation of the May 26, 2010, hospitalizations of seven Louisiana fishermen working in the BP Deepwater Horizon Response Vessels of Opportunity program. The fishermen were hospitalized for symptoms that were believed to be related to exposures during response activities. LA DHH provided the hospitalized workers' medical records and other sources provided additional information. The findings and conclusions were reported in HHE interim report #1 [http://www.cdc.gov/niosh/hhe/pdfs/interim_report_1.pdf]. This report includes an update to and clarification of that information.

Although all seven of the fishermen were hospitalized on the same day, their symptoms could not be linked to a specific common exposure, such as the chemical dispersant that some of the fishermen had originally suspected. They worked on five different vessels that were not operating in the area of dispersant use. Visual descriptions of oil or oil-related exposures and descriptions of odors varied from vessel to vessel, suggesting different vessel locations and different exposures. This is consistent with BP reports that the five vessels were not operating close to each other. Most of the seven fishermen reported symptoms that included headache, upper respiratory irritation or congestion, and nausea. Although these symptoms had disappeared or decreased in severity by the time the fishermen arrived at the hospital, they were admitted for observation as a precaution because they had reported chemical exposure. Two fishermen were hospitalized for potentially serious medical problems that were unrelated to toxic effects of oil or chemical exposure. All seven patients were discharged when their condition was determined to be stable or test results were negative. Six were discharged within 1 day of admission and the seventh was discharged after an additional day of testing. NIOSH investigators concluded that the symptoms of headache, upper respiratory irritation or congestion, and nausea were unlikely to be related to dispersant exposure. Work-related factors (e.g., unpleasant odors and their unspecified sources, heat, and fatigue) might have contributed to symptoms, whether the worker had pre-existing medical conditions or was previously healthy.

LA DHH received reports of 10 response workers who were hospitalized after the May 26, 2010, hospitalizations of the seven fishermen. As part of the HHE, NIOSH investigators reviewed these workers' hospital records. These response workers were admitted for hospitalization from May 28 to June 22, 2010. They had more diverse job duties and work locations than the first seven hospitalized workers. Eight workers were involved in oil spill cleanup, either offshore or onshore, and two reported doing other work (Table 1). One of the offshore cleanup workers had not yet started working in oil-contaminated waters at the time of hospitalization and one was a safety officer. Five workers, onshore and offshore, identified heat as a major problem. Five workers (one of whom had also reported heat exposure) reported exposures to oil, hydrocarbons, or dispersant. Only one worker did not report exposures to heat, oil, or chemicals.

The five workers who reported heat exposure also reported a variety of work-related and personal risk factors for heat illness; several reported multiple risk factors (Table 2). All five of these workers had evidence of dehydration or a diagnosis of heat exhaustion or possible heat stroke (Table 3). Review of the hospital records showed that two had symptoms consistent with heat cramps. All five had complications of heat illness, such as muscle damage (rhabdomyolysis) or involvement of the central nervous system (drowsiness, slurred speech, or possible seizure), kidneys (no urine output), or heart (abnormal rhythm and rate). Response workers admitted for heat illness were hospitalized from 1 to 6 nights (a longer hospital stay reflected the severity of the worker's condition).

The five response workers who reported exposure to oil, hydrocarbons, or dispersant were hospitalized from 1 to 3 nights. Their medical records did not include information to identify specific chemicals, indicate how they came into contact with those chemicals, or how long they were exposed. For one worker, the first mention of chemical exposure was in a recommendation given at the time of discharge. One of the five workers who reported chemical exposure was hospitalized for heat illness and two others were hospitalized for problems that could be explained by pre-existing medical conditions. The fourth worker was given a diagnosis of probable respiratory toxicity, which was based on his reported exposure to chemicals. However, at the time of hospital admission, his chest and respiratory symptoms had cleared and his chest and lungs were normal on physical examination. He was discharged without further evaluation of his lungs and instructed to use a respirator while working. The fifth worker was admitted because of a possible neurologic emergency. Evaluations by a neurologist and further testing did not show abnormalities or indicate a possible cause. He was instructed to avoid exposure to oil and, if exposed, to use a respirator. The medical records of the two workers who were instructed to use a respirator did not include sufficient detail about their oil and chemical exposures to determine whether their symptoms or diagnoses could have been related to chemical exposure and whether respiratory protection was necessary or would be protective.

Three workers were hospitalized for potentially serious medical problems that are common in the United States (e.g., elevated blood pressure, chest pain or pressure). All three had personal medical risk factors that could explain their symptoms, two reported exposure to oil or chemicals, and none reported exposure to heat.

The Deepwater Horizon Houma Command Center issued Heat Stress Management Plans for onshore and offshore cleanup task forces on June 8, 2010. The New Orleans Unified Area Command Center issued an update in early August.

As this report was being finalized, LA DHH received an additional report of a response worker who was hospitalized in late July for severe heat illness with complications. Information from this hospitalization

is not included here because the findings and diagnoses in the medical records do not indicate a need to change the conclusions and recommendations of this report.

Conclusions

The conditions of the 10 hospitalized response workers in this report were more severe than the conditions of the seven fishermen response workers hospitalized on May 26, 2010.

Heat

- Although the 10 hospitalized workers had a number of different work tasks and work locations, five had reports of heat exposure and evidence of heat illness. The severity of their illnesses and complications indicates the importance of preventing heat illness.
- The variety of work-related and personal risk factors indicates the need for multiple protective measures.
- While a pre-placement evaluation might have protected those with personal risk factors, environmental and work-related factors (e.g., temperature, humidity, strenuous work, long hours, and use of personal protective equipment) need to be addressed.
- Four of the five workers reporting heat exposure had a diagnosis of dehydration, which contributes to the severity of heat illness. Dehydration and its adverse health consequences can be prevented by increasing fluid intake before, during, and after strenuous work in hot environments.
- Three hospitalized workers had a diagnosis of rhabdomyolysis, which was probably caused by excessive muscle activity during strenuous work. Byproducts of muscle damage (e.g., myoglobin) circulating in the bloodstream can cause acute kidney damage or failure. The extent of the muscle damage and the presence of dehydration increase the severity of the kidney damage.
- Despite the implementation of the Deepwater Horizon Heat Stress Management Plans in early June, heat continued to be a problem.

Oil and Chemicals

- The reports of exposure to dispersant by some of the fishermen hospitalized on May 26, 2010, could not be verified by descriptions of their exposures. The variety of descriptions they gave was consistent with BP reports that the vessels were not operating in the same area. The remaining hospitalized response workers described in this report were admitted to hospitals on different dates and were not working in the same location. Thus, their exposures to oil and chemicals were likely to be different.
- For all 17 hospitalized response workers (the original seven fishermen and the 10 other response workers), descriptions of what they saw and what they smelled were not specific enough to identify hazards. Missing were descriptions of what they were doing and what chemicals, if any, they worked with or were exposed to. Details were unavailable about how they were exposed, when their exposures began, how frequent and for how long they were exposed, how much they were exposed, the timing of the onset of symptoms in relation to their exposure, and the use of protective measures. Detailed work and exposure histories are important to identify hazards, estimate exposure potential, and determine work-relatedness of symptoms.

- The diagnosis of probable respiratory toxicity was based on reported exposures and symptoms that had cleared by the time of hospitalization. It was not based on objective physical examination findings and additional testing had not been done to confirm or rule out the diagnosis.
- Measures to prevent an illness caused by one exposure may increase the risk for other illnesses. For example, use of a chemical-resistant suit may increase the risk for heat illness and certain respirators may increase the physiological load on the user. Thus, the use of respirators should not be recommended without sufficient evidence that a potential for harmful inhalation exposure exists. Occupational Safety and Health Administration regulations for use of personal protective equipment such as respirators may require workers to have medical evaluations and clearances.

Pre-placement Evaluations

- Five of the hospitalized workers had personal risk factors that might have been detected by a pre-placement evaluation. Training, advice, and treatment based on pre-evaluation results might have prevented the acute illnesses that led to their hospitalization.

Occupational Safety and Health Knowledge and Awareness

- Increased worker knowledge about their possible exposures, risk factors for work-related illnesses, and possible work-related illnesses would improve the work and exposure histories they give to healthcare providers. This would allow identification of exposures that might have contributed to the illness and, as a result, better diagnoses.
- Increased healthcare provider awareness of the importance of work and exposure histories and knowledge of the factors that should be considered before determining work-relatedness would improve discharge diagnoses.
- Increased healthcare provider awareness of when to consult an occupational medicine specialist would improve discharge diagnoses and lead to more appropriate recommendations for protective measures.

Recommendations

What BP and Other Employers Can Do

In addition to the recommendations in earlier NIOSH HHE interim reports:

- Continue to investigate and follow-up reports of work-related illnesses (such as heat stress or chemical toxicity) to verify diagnoses, identify contributing factors, and improve preventive programs.
- Cooperate with state and local health departments, local medical societies, and local healthcare providers to improve local capacity for providing health care to response workers who have work-related illnesses or concerns. See “What state and local healthcare providers can do” (below).

What Response Workers Can Do

- Learn how to identify potential work-related hazards, the health effects of exposure, protective measures, and procedures for reporting exposures, illnesses, and concerns.
- Ask the healthcare providers who perform work-related medical evaluations about how job tasks and personal health conditions and habits could affect safety and health at work and what can be done to allow you to work safely.
- If recommended, see your personal doctor for evaluation and treatment of personal health conditions.

What State and Local Health Departments, Local Medical Societies, and Local Healthcare Providers Can Do

Improve local healthcare provider awareness of occupational health, particularly with regard to:

- Issues related to the oil industry in general and the specific hazards posed by the Deepwater Horizon response. See: <http://www.cdc.gov/niosh/topics/oilspillresponse/protecting/#effects>.
- Factors that should be considered before making a determination of work-relatedness, such as:
 - A potentially hazardous substance or agent exists in the workplace and there are logical explanations for how workers were exposed
 - Workers who have similar jobs or exposures in other workplaces developed the same illness; people with different types of jobs or exposures have not developed the illness
 - Workers with higher exposures are affected more than employees with lower exposures
 - For acute illnesses, symptoms begin when at work and improve when away from work
 - The proposed mechanism for the exposure to cause the disease makes sense biologically
 - Factors outside the workplace (such as family history; childhood, home, hobby, community, or previous job exposures; diet; and habits) cannot explain the illness
- In addition to personal protective equipment (e.g., respirators), the appropriateness of other measures (e.g., engineering or administrative controls) that could be effective in reducing harmful exposures and preventing illness.
- Factors that should be considered before making recommendations for use of personal protective equipment. See: <http://www.cdc.gov/niosh/topics/oilspillresponse/protecting/#ppe>.
- The role of occupational health professionals, such as occupational medicine physicians and occupational health nurses. See: <http://www.osha.gov/SLTC/healthprofessional/index.html>.

Table 1. Type of work, work location, and reported exposures of 10 response workers admitted for hospitalization in Louisiana from May 28 through June 22, 2010

Type of Work	No.	Work Location	No.	Reported Exposures		
				Heat (No.)	Oil and Chemicals (No.)	None* (No.)
Cleanup	8					
		Offshore	5	2†	4†	
		Onshore	2	1		1
		On and offshore	1	1		
Other	2					
		Onshore	1	1		
		On and offshore	1		1	
Total	10		10	5†	5†	1

*No exposures (e.g., heat, oil, or chemicals) reported.

†One of the hospitalized workers reported both heat and oil or chemical exposure.

Table 2. Risk factors for heat illness among five hospitalized workers reporting heat exposure*

Descriptions of heat	No.
One or more days working in sun or heat	4
Feeling hot or warm	2
Other work-related factors	No.
Strenuous work	2
Long hours	1
"Plastic suit"	1
Personal risk factors	No.
Age	1
Overweight	1
Recent infection	1
Alcohol	1
Medication	1
None or not specified	3

*Some individuals reported more than one risk factor.

Table 3. Symptoms, objective findings, and diagnoses of heat illness and complications among 5 hospitalized workers reporting heat exposure

Symptoms and Objective Findings	No.*	Heat Illness and Complications	No.*
Weakness, feeling faint, dizziness	2	Dehydration	4
Drowsy, slurred speech	1	Heat exhaustion (possible heat stroke)	2
Collapse	1	Fainting or seizure	1
Fast heart beat	1	Abnormal heart rhythm and rate	1
Nausea and vomiting	2	Acute kidney failure	1
Inability to urinate	1	Breakdown of skeletal muscle†	3
Muscle cramps or pain	2		

*Sum is greater than 5 because some individuals had more than one symptom, sign, or diagnosis.

†Rhabdomyolysis (serum creatine phosphokinase ranged from more than 1,000 to 4,301 units/liter).

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