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LEAD CONTENT ON FRIED FOODS AGAINST SELLER SANITATION AND FRIED FREQUENCY IN THE AREA OF SEMARANG CITY

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Abstract

Introduction: *Fried food is a snacks that is widely consumed and become a favorite food of Indonesian society, the food is usually consumed more than once in a single meal. However fried foods are also foods that are easily contaminated physically, microbiological and chemical. Preliminary study results indicate the presence of unqualified lead levels in fried foods. In the meantime, it has a toxic effect on the body that is mutagen, teratogen and carcinogen. This research aims to analyze the sanitation condition of sellers with a lead content on fried food in the subdistrict of Pedurungan Semarang.* ***Method:*** *This research was an analytical observational research with a cross sectional design study. Determination of the sample by the total sampling method of 38 fried food merchants and Bakwan fried samples. Data analysis was performed using a correlation test Rank Spearman. This research had been worthy of ethics through the commission of Ethics of Health Research Faculty of Public Health of Diponegoro University with number 285/EA/KEPK-FKM/2019.* ***Result and Discussion:*** *The lead rate of the average fried meal was 0.184 mg/kg and the fried frequency was 24 times in a moment. The results of a correlation analysis of Rank Spearman showed no significant link between the serving Mat material (p value = 0.008), the sanitary condition of snacks facilities (p value = 0.011) and the fried frequency (p value = 0.001) with a lead content in fried foods.* ***Conclusion:*** *The sanitation factor of the seller's facilities related to the lead content in the Sub-district of Pedurungan is the presentation base material, sanitary conditions and fried frequency.*

INTRODUCTION

Indonesia's food of snack consumption levels are expected to continue to increase. This is due to the increasingly crowded work activities so that the time to process the cuisine itself is limited. The results of the national survey showed an increase in the food consumption rate per capita in a year from 559,325 (year 2017) to 583,488 (year 2018). Snack Food that has been favorite by Indonesian people one of them is fried food. The National Socioeconomic Survey (SUSENAS) year 2018 shows 49% of households in Indonesia chose fried foods into his favorite snacks (1). It is because the food is sold at a cheap price, easy to find, practical, has a good taste and savory according to the tastes of most Indonesians (2).

Indonesian people also have a habit of eating more than one fruit in consuming fried foods, without observing the safety of fried foods. Most Indonesians also consider fried foods to be the most suitable snack food for their daily life. Meanwhile, fried food is a food that is easily contaminated physically, microbiological and chemical so as one of the donors of health problems in the food chain of the Indonesian people. One of the easy food contamination is contamination by metals, for example lead metal contamination.

Research in the year 2016 around the City of Garut obtained the result that the lead content in Bakwan with the highest rate of 0.2502 mg/L (3). The contamination is possible because the fried foods are often sold with the presentation openly and are in the area of high transportation activities. The more the number of vehicles with the gas that passed through, impacting the existence of Pb of 79-97% in ambient air. Pb of motor vehicles comes from the result of the combustion of additional materials (aditive) Pb on gasoline-based vehicles that will create a Pb in organic emissions. The usual alkyl-Pb compound is used as a mixture of gasoline to increase octane numbers (4).

The risk of lead contamination in fried foods increases when the practice of merchants that have not been in accordance with the principle of hygiene and sanitation in avoiding food from motor vehicle smoke exposure. The high exposure to pollutants can affect the lead content of fried foods, researchers who perform measurements show that the average Pb content of fried foods on the primary arterial road is greater than the fried foods on the local secondary road namely 0.2672 ppm and 0.2791 ppm. While the lead rate of fried foods on the local secondary road is 0.1851 ppm and 0.1911 ppm (5).

The selection of packaging materials for fried foods is also instrumental in preventing the lead contamination in fried foods. Other research results showed that there was a level of lead on fried food wrapped with a newspaper of 0.18 mg/L and fried food placed with newspaper mat of 0.16 mg/L (6). The explanation shows that the newspaper and ink paper can increase the risk of lead contamination in fried foods both used as serving mat materials and fried food wrap.

In addition, repeated use of cooking oil can also increase the risk of lead contamination in fried foods, the more frequency and the longer the frying time causes the oil quality to decline. It is characterized by increased levels of peroxide number, free fatty acids, types of weights, viscosity and decreased number of iod and its clarity (7). Increasing the number of peroxide indicates the instabilization and rupture of the compound into a shorter carbon chain by a metal catalyst (8). The 2015 study in Yogyakarta carried out a frying retry test of 4 times with a *Kruskal-wallis* test obtained the result of a P value of 0.010, which means there is an influence of frying frequency on increasing number of peroxide in bulk cooking oil (9).

Lead is a very toxic heavy metal in small quantities can cause impact for the human body. The greater the pollution and exposure time then the lead concentration on food will increase so that food should be contamination-free during the preparation, processing, serving and storage process (10). Lead toxicity can negatively affect the body's nervous system damage and blood disorders that can cause encephalopathy and edema in the cerebellum. At low concentrations can lead to cognitive-behavioral disorders, lead toxicity also increases oxidative stress, neurological disorders, affects the concentration of sodium ions, other severe health complications, and even death (11).

Pedurungan Sub-district is a subdistrict that has the highest population, recorded in December 2018 for 192,798 people. The results of preliminary survey conducted in the Sub-district of Pedurungan found many snacks vendors, one of which is fried food, one of the snacks is quite crowded intended by the buyer. In the results of the measurement of the lead rate in fried food at some point of Pedurungan Sub-district, when the end of the survey showed that three samples of fried foods that were measured positively containing lead. The measurement was conducted by the Center for Health Laboratory and Medical Equipment Testing of Central Java province. The lead rate in the first sample is 0.450 mg/kg, the second is 0.409 mg/kg and a third sample of 0.491 mg/kg. The results were compared to the Regulation of Head of the Indonesian Foods and Drugs Authority No. 23 year of 2017 about the Maximum Limits of Heavy Metal Contamination in Processed Food,

showed that the sample rate has exceeded the set quality standards should be 0.25 mg/kg (12). This research aims to analyse the sanitation of sellers ' facilities, serving mat material and frequency of frying with a lead content in fried foods in the Sub-district of Pedurungan Semarang.

METHOD

This research was an analytical observational research with a cross-sectional approach. The population in the research was all food traders who sell in Pedurungan Sub-district, which was 54 traders. The measurement of lead levels in fried foods was using the method of *Atomic Absorbtion Spectrophotometery (AAS)* with dry instructions. This research had been worthy of ethics through health Research Ethics Commission of the Faculty of Public Health of Diponegoro University with number 285/EA/KEPK-FKM/2019.

Sampling of these research uses a total sampling method with certain considerations, aimed at the data obtained in accordance with the benchmarks that researchers had prescribed. The number of samples in this study was the number of samples that meet the research inclusion criteria of 38 fried food merchants and fried foods. The criteria for the inclusion were fried food traders selling in the Sub-district of Pedurungan in July to August 2019.

Merchants who used carts, fry food in place and sell food type Bakwan. The sample of fried food was Bakwan type. Among all types of fried foods, Bakwan was a fried food that requires more flour raw materials. Fried products derived from vegetable food and containing starch will absorb more oil than animal foodstuffs (13). Therefore, Bakwan had a big risk of lead contaminated because more absorb oil when frying.

In addition, lead contamination in the Bakwan could also occur due to the content of the vegetable used. One of them was vegetable cabbage. Lead contamination in the cabbage was caused by the use of fertilizers, pesticides and distance planting from the highway and how to treat it before processing. In the research in 2016 in some Karo District showed the results of the lead content on cabbage leaves, which cabbage in the unwashed state has a higher lead rate than the already-washed that is 6.19 ppm and 4.79 ppm (14).

The variables measured were the frequency of frying, serving base materials and sanitation of seller facilities. Data was analyzed using a correlation test Rank Spearman due to undistribution of normal data. Correlation *Rank Spearman* test with ratio scale performed on variable frying frequency with lead rate on fried food. While the correlation *Rank Spearman* test of ordinal scale is done in the variable of the base material of the presentation and sanitation means of sellers with a level of lead on fried food.

RESULT

Descriptive Analysis Results

Lead Rate on Fried Food and Frying Frequency

The average level of lead in fried foods in Pedurungan Sub-district is 0.184 mg/kg. The minimum and maximum value of lead levels in fried foods is 0.005 and 0.905 mg/kg.

Table 1. Results of Descriptive Analysis

Variabel	f	Mean	Median	SD	Min	Max
Lead Fried food levels	38	0.184	0.054	0.256	0.005	0.905
Fried Frequency	38	23.50	21.00	8.947	10	48

If the result of the test of the lead is compared with the Regulation of Head of the Indonesian Foods and Drugs Authority No. 23 year of 2017 about the Maximum Limits of Heavy Metal Contamination in Processed Food, there are several samples that have exceeded the quality standards that have been determined, namely at 0.25 mg/kg (12). Out of 38 samples are 10 unqualified samples of fried foods. The average lead rate in the unqualified fried food is 0.553 mg/kg. The lowest lead rate on unqualified fried foods is 0.2860 mg/kg. Then a fried food trader in the average Pedurungan Sub-district did a frying 24 times during the observation. The average fried food trader selling from 3 to 11 p.m. The frying frequency is done 10 times the minimum fried food trader and maximum 48 times a moment in observation. Cooking oil used by fried food vendors in the subdistrict of Pedurungan most are bulk oil with an initial condition of selling a new mixed oil with a long time.

Serving and Packaging Material

The Data in table 2 shows the fried food merchant in the Sub-district of Pedurungan showed 12 people (31.58%) still utilize the newspaper/paper used inked as the base of serving fried food. The fried food trader whose presentation was still directly exposed by the metal from the cart was 14 merchants (36.84%). And food vendors who have been using clean containers as a complement to the presentation of fried food is showed 16 respondents (42.11%).

Fried food vendors in the Sub-district of Pedurungan use both colored and clear plastics as the packaging, which has the same comparison of 50% (19 people). 28 respondents like food trader (73.68%) use the oil paper as the flow. A fried food trader of 11 respondents (28.95%) still utilizing the Used newspaper/ paper as an additional ingredient of fried food wrapping (table 2).

Table 2. Frequency Distribution of Observation and Packaging Material

Serving and Packaging Materials	f	%
Serving Mat		
Grounded from used paper inked/newspaper		
Yes	12	31.58
No	26	68.42
Directly exposed to metallic materials from wagons like aluminum		
Yes	12	36.84
No	24	63.16
Wearing containers in a clean state		
Yes	16	42.11
No	22	57.89
Wrapping		
Wearing colored plastic		
Yes	19	50.00
No	19	50.00
Wrapped with newspaper/paper colored used		
Yes	11	28.95
No	27	71.05
Grounded oil paper		
Yes	28	73.68
No	10	26.32
Wear clear plastica		
Yes	19	50.00
No	19	50.00

Food vendors who yield a lead rate on fried foods are not eligible (30.0%) still use the newspaper as its presentation mat. Conditions of fried food with a lead content exceeding the Threshold Limit Value (TLV) (60.0%) directly exposed by aluminum and (80.0%) not placed on a clean container (table 4).

Sanitary Conditions of Seller Facility

The data in table 3 shows the food vendors who already have a sanitary condition of good seller is 71.1% (27 respondents). The means of sellers of fried food vendors who sanitated still bad only 28.9% (11 respondents). The results of the observation on table 3 data showed that all fried food merchants were 38 respondents (100%) the seller's means are not closed and easily polluted. All fried food vendors also do not provide a cover for the frying pan after frying it and dough ingredients are used.

Table 3. Observation Result of Seller Facility Sanitation Condition

Sanitation Facilities Seller	f	%
Vending facilities are closed and not easily polluted pollutants		
Yes	0	0.00
No	38	100.00
There is a cauldron cover after frying		
Yes	0	0.00
No	38	100.00
The seller's facility is clean		
Yes	31	81.58
No	7	18.42
Separate ready-to-go grocery and grocery storage		
Yes	38	38.00
No	0	0.00
Where the dough material is covered		
Yes	3	7.89
No	35	92.11
Bins		
Available bins		
Yes	34	89.47
No	4	10.53
Has a cover		
Yes	0	0.00
No	38	100.00
Not easily leaking		
Yes	20	52.63
No	18	47.37
Easy to clean		
Yes	34	89.47
No	4	10.53
There is clean water for hand washing and cooking utensils		
Yes	27	71.05
No	11	28.95

Condition of merchant seller is in net condition of 81.58% (31 respondents). Grocery and food storage is ready for fried food vendors are all in a separate state. In addition, fried food vendors who have provided easy-to-clean trash can 34 respondents (89.47%). However, the trash 100% has no cover and 47.37% easy to leak. Then, fried food vendors who have provided clean water for hand washing and cookware used showed 27 respondents (71.05%).

Condition of sanitation of sellers with the content of the lead fried food exceeds the TLV (30.0%) still in dirty condition. The proportion of food sellers who have a lead food that exceeds the TLV (100.0%) the dough condition is still open. In addition, the food trader who has a lead food dish above the TLV all has a means of open sellers and does not provide a cover for the frying pan (table 4).

Table 4. Distribution Mat Serving and Sanitizing the Seller's Means of Frying Food With a Lead Content Does Not Qualify

Variable	Lead Content on Fried Foods (Does Not Qualify)	
	f	%
Serving Mat		
Using the newspaper	3	30.00
Not using newspapers	7	70.00
Direct exposure to Aluminium	6	60.00
No direct exposure to aluminium	4	40.00
Using a clean container	2	20.00
Not using clean containers	8	80.00
Sanitary Conditions of Seller Facility		
Open Seller	10	100.00
No cauldron cover	10	100.00

Variable	Lead Content on Fried Foods (Does Not Qualify)	
	f	%
Clean seller	7	70.00
Dirty Vending Facilities	3	30.00
Separate ready-to-go grocery and food storage	10	100.00
Closed Dough Ingredients	0	0.00
Open Dough Ingredients	10	100.00
Available bins	9	90.00
No trash cans available	1	10.00

Variable Correlation Analysis Result with Lead Content on Fried Food

The results of correlation *Rank Spearman* test on the presentation base material variable with a lead content on the fried food obtained the value P = 0.008. The analysis means there is a correlation between the serving base material with the lead content on the fried food. The correlation coefficient is positively valued at 0.424 but has a weak strength of the correlation.

Correlation *Rank Spearman* test result on table 3 between the variables of the frying frequency with a lead content on the fried food obtained the value of p = 0.001 < 0.05, which means there is a link between the frequency of frying with the lead content on the fried food. The correlation coefficient is a positive value of 0.525 which demonstrates strong correlation direction strength. The more the frequency of frying, the higher the lead content on the fried food.

Table 5. Link Between Frying Frequency, Serving Base Material and Sanitation Condition of Vendor With Lead Content in Fried Food

Variabel	p-value	Coefficient Correlatian (r)
Frying Frequency	0.001	0.525
Serving Mat Material	0.008	0.424
Sanitary conditions of seller facilities	0.011	0.409

Correlation *Rank Spearman* test result on the table 5 between the variables sanitary condition of sellers with a lead content on fried food obtained the value of P = 0.011 < 0.05, which means there is a correlation between the condition of sanitation of sellers with the content of lead in fried foods. The correlation coefficient is positively valued at 0.409 but has a weak strength of the correlation (table 5).

DISCUSSION

Presenters Material with Lead Content on Fried Food

The correlation between the two variables is supported by the observation results of this study. Use of used paper/newspaper can increase lead contamination in fried food because lead is one of the ingredients used as pigment/dye material (15). The lead in the ink contained in the paper can contaminate the fried food that has just been raised from the frying pan due to the habit of the trader who directly pour the fried food into the presentation without regard to the slicer process first. The risk of contamination may increase due to the hot fried food conditions and the residual cooking oil that has not been entirely leak through can facilitate the paper used as serving mat attached to the fried food. The contamination led to the lead of the newspaper's color inks moving into fried foods.

The lead contamination factor in other fried foods is the presentation base material used. Unsafe serving mat material is a material that contains or has been contaminated with lead basically such as paper hvs used ink or not, newspapers and magazines used. In addition, fried foods that are directly exposed to basic metal carts such as aluminum is an unsafe base on the fried food.

The hot fried food condition and the residual cooking oil that has not been entirely leak through can facilitate the paper used as serving mat stick to the fried food. The results of the 2018 in the city of Batam showed an extensive influence on the use of newspaper paper against the content of lead compounds (Pb) on fried foods. Lead contamination in fried foods occurs as a result of the paper exposure used as a wrapper and placed just as a fried food mat. Lead level in fried food wrapped with a newspaper of 0.18 mg/L. While the lead rate in fried food placed with a newspaper mat of 0.16 mg/L (6).

The explanation shows that the newspaper can increase the risk of lead contamination in fried foods both used as a serving base material and a fried food wrap. The more time and temperature of serving fried foods will increase the number of lead metals that are detached from the packaging into the fried food food. Research in 2018 in Korea indicates there is a strong correlation between the residual concentration and the Pb migration from packaging paper to foodstuffs. The approximate range/distribution of lead intake is calculated from the migration concentration and daily food intake, the yield is 5.00×10^{-4} µg kg^{-1} bw day^{-1} and the risk of Pb exposure is 0.014% (16).

Sellers also still allow the serving of unpedestal fried food (36.84%) so it is directly exposed by the metal from the cart material, where the food vendors almost everything uses aluminum. Research on the material of metal equipment obtained the test result of the lead concentration laboratory on rice cooked on some

cookware (iron, new stainless steel, new aluminum) of 0.01 ± 0.01 mg/kg (17). Aluminum metal can also be one of the factors of lead contamination in fried foods.

Observations carried out in ten countries from Africa, Asia and Central America regarding exposure of metal to aluminium cookware showed a lead content in cooking simulation results. Fifteen (36%) sample releases N1 µg per serving in the first dish, with a maximum exposure of 177 µg per serving of a frying pan originating from Indonesia. From the results of field observations, it is suspected that the craftsmen produce these items using used aluminium in the production process (18).

The observation also shows that some fried food vendors in the Sub-district of Pedurungan still use black plastic or other colors as the packaging is 50%. The results of a review on harmful additives in black plastics show the results of the most frequent lead levels detected in the category of clothing and accessories as well as toys, and most rarely detected in food contact category, concentrations above 5,000 ppm are always associated with PVC products. The lead rate of the average food contact category is 40.5 ppm with the lowest value of 5.9 ppm and the highest 101 ppm (19).

Correlation of Frying Frequency with Lead Content on Fried Food

The correlation between these variables is demonstrated with the result of the test of lead levels in cooking oil and fried foods. The result of the analysis of the lead rate in the bulk cooking oil obtained the lead level before frying 0.087 mg/kg and after frying the amount of 0.152 mg/kg. The results of the analysis in bulk cooking oil after frying the maximum limit is more than 0.1 ppm. Then the results of the analysis indicated that the increase of 74.7% is 0.065 mg/kg from before to after the frying pan. The increase took place after 27 times the frying pan. In the results of fried foods that are deep in the oil samples obtained by the result of a lead rate of 0.315 mg/kg, that the lead rate has exceeded the quality standards should be (12).

The observation shows that the average trader performs the repetition of a frying pan, the habit is because the trader only takes a short time of 5-6 minutes until the fried food is ready to be lifted. The average of fried food vendors in Pedurungan Sub-district sell for 6 hours a day. The more time a sale is possible will increase the number of frying pans made. The use of cooking oil in a lot of frying due to deep frying also possible reuse of the used cooking oil (20).

Continuous frying loops can cause damage to the used cooking oil. The frying repetition experiment was done 4 times with *Kruskal-wallis* test obtained the result of p value 0.010. The analysis means there is a frying pan frequency influence to increase the number of peroxide numbers in bulk cooking oil (9). In other research shows that bulk cooking oil and packaging oil brand A, B, C are worth using for frying only twice. This is due to the increase of peroxide figures and free fatty acid numbers (FFA) which has exceeded the standard threshold of SNI 01-3741-2013 on the third frying pan (21).

As many times the frequency and length of frying is performed, it can cause oil quality to decline and damage to oil. It is characterized by increased levels of peroxide number, free fatty acids, types of weights, viscosity and decreased number of iod and its clarity (7). Increase peroxide number due to direct contact between cooking oil and air during frying process. The usual frying pan system using aluminium frying pan (22).

The value of peroxide will increase with the increasing frequency of heating in all types of oil (sunflower oil, coconut, peanut, mustard, palm and soy). The oxidation state in oil is influenced by the number of frying pans (23). The increase in the number of peroxide indicates that the instability and rupture of the compound becomes a shorter carbon chain by a metal catalyst (8).

The physical signs of damage to cooking oil are through color. The darker the color of the oil indicates the number of repeat frying pans and followed by an increase in the number of peroxide numbers. In the attempted repetition 5 times the frying pan indicates that there is a discoloration from the clear yellow to dark brown. And increased peroxide number with the highest value of 11.03 mekO_2/Kg in the 5th frying pan (24).

Correlation of Sanitation Conditions of the Seller with the Lead Content on Fried Food

Food vendors vending facilities in Pedurungan Sub-district are all not covered and easily polluted pollutants. Sanitation of the less-informed sellers will facilitate food contaminated by the contamination. On the Ministerial Decree of Ministry of Health of Republic Indonesia No. 942/MENKES/SK/2003 about Guidelines for Requirements of Hygiene Sanitation Food Services, explained that the safe snack is to have a means of construction sellers who avoid pollution from food. Building structure of the means of the seller must fulfill the requirements, among others: easy to clean, available clean water, food supplies, ready-made food storage, served, storage equipment, washing place (tools, hands, groceries) and bins (25). Therefore, if the seller has not fulfilled all these criteria is possible food served at risk of polluted contaminants.

Fried food vendors in the Sub-district of Pedurungan 100% of the selling facility is open, there is no cover for frying pans and fried food dough ingredients. The contamination is likely to occur before frying the dough. The contamination of the metal can be derived from the dust, sand, and conditions on the road itself. While the location of selling fried food merchants in Pedurungan Sub-district is still in the dense area of the vehicle, it shows the fried food is easily contaminated.

Observations conducted in 2017 were found all samples of positive fried food containing lead with conditions of selling at very close location and no distance to the edge of the highway. Then the condition of the merchandise is opened without a cover (26). The study on the lead contamination of fried food in 2018 street vendors showed that the average Pb content of fried food on the primary arterial road was greater than the fried food on the secondary local road (5).

Then the condition of frying pans that open during this break or rest can support lead contamination in cooking oil through airborne contaminants. Cooking oil can be contaminated with dust, sand from the activity source at the location of the sale itself. Lead metal contamination in cooking oil is possible to increase when the frying conditions are open. Lead (Pb) in the air can be absorbed into the cooking oil weighing the melting point of lead 327,5^{0}C, while the recommended frying pan temperature only 201^{0}C. It indicates that the lead (Pb) does not evaporate when the frying pan is performed (13).

Another important component of the seller is the availability of clean water for hand washing and cooking utensils. The observation show 28.95% of traders still do not provide enough clean water for hand washing and cooking utensils. Meanwhile, the source of food contamination can also be caused by food vendors or food handlers. Most of the food repellent still has a personal hygiene that lacks in food handlers because it does not wear personal protective equipment with complete, do not wash your hands with soap before and after processing or touching groceries (27).

The physical, chemical, and biological contaminants that may be carried away from the clothes or the body of the food can be polluting the dough of a fried food. The observation shows that many traders who do not use the APD in the form of aprons when handling food. Then the trader directly uses the hand without protective to stir the dough and mix the ingredients with the dough when frying. Meanwhile, some merchants after doing so do not wash their hands first.

All of these factors increase the risk of lead contamination in fried foods because every meal is supposed to be the process of handling the sanitation. Food additives are obliged to control the danger risks, starting from the raw materials, equipment used, facilities, production processes or processing so that food safety can be assured (9).

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CONCLUSION

The lead content in the fried food that is sold in the Sub-district of Pedurungan Semarang, the average still meet the specified TLV is 0.184 mg/kg. However, there are 10 sellers from 38 fried food vendors in the Sub-district of Pedurungan showing the result of lead rate in the food in the fried food has exceeded the TLV, the lead rate has the highest value of 0.905 mg/kg. The lead level has a correlation with several factors i.e. the presentation base material used (p value = 0.008) and the Frying frequency (p value = 0.001) that the trader does. The level of lead in fried foods is one of health problems in food chain that needs to be considered by people and government. Given the dangers and toxic impacts of lead that can interfere with health in the human body. The extension efforts on the application of snack sanitation hygiene on every street vendors should be carried out as a form of prevention. The optimization of snack logging is also necessary to improve the implementation of the training and supervision of snacks by the district health office/city.

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