

Investigation of a Collective Diarrhea Outbreak among Cadets of a Certain Training Unit Located in Neipu Township, Pingtung County

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Introduction

Around 11 o'clock in the morning of July 17, 2006, somebody called up Pingtung County Health Bureau and reported a suspected group incident of having gastrointestinal symptoms, such as abdominal pain, diarrhea, and abnormally high body temperature ($>38\text{°C}$), which involved, at the time the report was made, more than one hundred persons among the cadets of a certain training unit located in Neipu Township of Pingtung County. The situation met all

requirements of an epidemiological cluster in terms of number of people affected, closeness of timing and locality of individual cases, so it was mandatory for the health authorities to launch an immediate official epidemiological investigation into the outbreak. Therefore, a small ad hoc investigating task force was duly assembled with specialists from Field Epidemiology Training Program of Taiwan CDC, Fifth Branch of the CDC, and local Pingtung County Health Bureau and they went over to the training unit to proceed with the needed task. Their investigation objectives were to understand the real scale of the outbreak, transmission route(s), the pathogenic microorganisms involved, and the triggering factors. After those pieces of information became known, they would make recommendations of necessary preventive and controlling measures to curb its continuous spread or to prevent similar situations from happening again in the future.

Site and subjects of the investigation

The place was a training barracks area under the jurisdiction of a certain unit, and there happened to be two corps (Corps A and Corps B) of cadets being trained there starting from June 20, 2006. The training course was supposed to last for one month and the cadets were all male. Corps A was made of four companies (Company 1 to Company 4) with a total of 591 cadets, and none of them had fallen sick when this report was written and submitted. However, the other four companies (Company 5 to Company 8) of cadets under the command of Corps B were all victimized in this incident. With no exception, each company had cadets suffering from diarrhea or dysentery. Therefore, the investigating team made the entire 637 cadets belonging to Corps B the subjects of their investigation.

Scale of the outbreak

Altogether, Corps B had a total of 209 cadets affected by this wave of diarrhea outbreaks. Among the sick ones there were 39 cadets belonging to Company 5, 75 to Company 6, 59 to Company 7, and 36 to Company 8. The final overall attacking rate of the disease reached as high as 32.8% for Corps B, but zilch for Corps A. In the early stage of the outbreak, 43 cadets were struck with symptoms and went to the barracks clinic seeking for medical help. According to the medical history records of those 43 patients filed at the clinic, the showing-up rates of their symptoms, listed in a decreasing order, were diarrhea 100.0%, abdominal pain 48.8%, nausea 20.9%, fever 18.6%, and vomiting 4.7%. Eventually all 209 sick cadets were sent to the nearby Long Cyuan Veterans Hospital in Pingtung County for care and treatments. Generally speaking, their symptoms were not that serious and most of them had mild diarrhea. Therefore, only 19 cadets were temporarily detained for a short while by the hospital for further examination, and 27 cadets hospitalized for treatments. Besides, there was one cadet finding himself fallen sick at home, while taking the weekend off, and was rushed to Zuoying Military Hospital where he was hospitalized for treatments.

Deduction of the transmission route and infection source

When the task force looked into the relevant patient records at the barracks clinic as well as those at Long Cyuan Veterans Hospital, it was discovered that as early as July 15, first 3 individual dysentery cases showed up already. On the next day (July 16) another 15 cases reported sick, and the total appeared on July 17 reached 191 cases. The epidemiological diagram drawn based on this onset date information obviously displayed a single peak distribution trend, which means the transmission route of this very outbreak may well be through a co-infection

(Figure 1) [1]. Since all drinking water of the entire camp comes from the same underground source, yet no one in Corps A has been affected by the attack of diarrhea, we can safely rule out the possibility of transmitting through the water supply system. Besides, the fact that the outbreak did stop by itself without any artificial alteration or treatment of the water supply, such as chlorination process, also indicates the barracks water supply has nothing to do with the outbreak of diarrhea. Furthermore, the two corps actually shared the same kitchen, except each corps has its own cooks to prepare three regular meals separately, and they normally had different dishes of food for each meal. If a problem dish shows up in a single meal, we can imagine the consequence would be a massive outbreak of diarrhea cases first appearing in a short period of time and then being halted right after. This sudden huge increase in number of cases followed by a sudden halt is a typical phenomenon of food poisoning. That is exactly what the investigation team suspected when they looked at the diagram.

Specimen collection and test results

Between July 17 and July 19, both the hospital and the health bureau collected a total of 39 specimens of human rectal swabs and 9 stool samples (each of the 6 cooks working for Corps B provided both type specimens). Some of those specimens were sent to the nearby Fifth Branch of Taiwan CDC located in Kaohsiung City while others found their way to Kunyang Laboratory of Taiwan CDC in Taipei City. The sender enquired specifically a checklist of examination items, which comprised of all commonly seen dysentery-causing *Vibrio cholerae*, *Salmonella typhi* /*paratyphi*, *Shigella*, *Staphylococcus aureus* (including enterotoxin), *Bacillus cereus*, *Vibrio parahaemolyticus*, other *Salmonella*, and Norovirus. Other than that, the health bureau also managed to get 8 samples of the leftovers of the supper dishes served in the evening of July 15 (stewed pork feet

with chopped onion, stir fried pakchoi with garlic cloves, garlic flavored fried Chinese kale, wontons in spicy sauce, taro rolls, sauteed minced meat, cooked rice, and turnip/pork bone soup); samples of the leftovers of 6 courses served as breakfast on July 16 (hamburger, chicken pie, shredded onion, ketchup, scrambled egg with corn, and milk tea); 9 leftover samples of the lunch dishes of the same day (fried chicken pie, fried fish filet, wontons in spicy sauce, fried rape with garlic cloves, scrambled egg with onion, red pepper with dried turnip, sauteed minced meat, Frog-spawn - a cold chewy Feng-yuan dessert, and cooked rice); and also 9 samples of the supper dishes on that day (pork slices in Sacha sauce, fried cabbage with garlic cloves, Ants Climbing a Tree ;X bean threads with ground meat, deep fried taro balls, scrambled egg and tomato, sauteed minced meat, cooked rice, seaweed soup with egg flower, and slices of large watermelon). Aside from those, the health bureau also collected 7 samples of environmental specimens, which included a sample of kitchen water for utility purposes, a sample of reverse osmosis treated kitchen water for cooking purposes, 4 samples of cuffing board swab, and 1 sample of food processing countertop surface swab. All those specimens were shipped to Bureau of Food and Drug Analysis (located in Taipei City) for tests and analysis, and the specified examination targeting items included *Staphylococcus aureus* (including enterotoxin), *Bacillus cereus* (including diarrheal enterotoxin), *Vibrio parahaemolyticus*, *Salmonella*, pathogenic *Escherichia coli*, and *Clostridium perfringens*.

As to the test results of those human body specimens, one sick cadet's stool sample was found norovirus positive, and *Staphylococcus aureus* (including B type enterotoxin) was detected in another patient's rectal swab specimen. The human body specimens taken from the 6 cooks of Corps B turned out to be negative to all pathogenic bacteria and viruses that were targeted. Among the environmental specimens, however, one swab taken from a cuffing board surface gave positive results of *Bacillus cereus* and diarrheal enterotoxin. So far as those

samples of dish leftovers were concerned, the laboratory testing results indicated that the leftover sample of the stir-fried pakchoi with garlic cloves, served as part of July 15 supper, showed the presence of *Bacillus cereus* (in the amount of 3.9×10^4 CFU/g) and diarrheal enterotoxin. In addition, the shredded onion served at the next morning breakfast gave positive result of *Staphylococcus aureus* (in the amount of 2.1×10^4 CFU/g), but no enterotoxin was found.

Results of a kitchen and dining hall inspection

A staff member of Food Hygiene Section, Pingtung County Health Bureau went over to the barracks and duly carried out a general inspection of the Corps B kitchen, dining hall, and cooks. She noticed quite a few less than ideal situations around the kitchen that could be corrected or improved, which included the failure of screen doors of the kitchen to shut tight, too many flies present in the kitchen, some of the cuts on the cutting boards being too deep, too much grease found on the stove and the kitchen floor, the temperatures in the freezer and refrigerator not in appropriate ranges, and cooked foods not sealed properly before put into the cold storage. She also noticed that some of the cooks wearing their fingernails in excessive length, dirty work clothes, and watches, which were not allowed by the regulations. As to the dining hall for the cadets, because its screen doors also could not be shut tight, there were many flies in the hall. Worse yet, she even spotted two wild birds somehow having entered and hiding in the dining hall. Outside the kitchen and dining hall, the surroundings were a big mess so to speak and infested with lots of flies, and many stray dogs running around in the neighborhood. All these findings illustrated that the overall management of the barracks environment hygiene needed reinforcement. Especially once the cut imprints on the cutting board get too deep, the void in those cuts will allow dirt and filthy things to accumulate and be embedded inside, and provide a good environment for rapid growth of pathogenic microorganisms.

We understand that when the temperature of a refrigerated vegetable storage missing the appropriate range combined with the cooked food items stored inside being not sealed properly would probably turn the storage into a breeding ground of pathogenic microorganisms. These two shortcomings might have everything to do with the occurrence of such a collective diarrhea incident by *Bacillus cereus*.

A study on the responsible pathogenic microorganism and where it came from

According to the blood examination results of the 27 sick cadets hospitalized at Long Cyuan Veterans Hospital, 19 of them showing their leukocyte (white blood cell) counts above normal range (4,000~10,000/ μ l), and the actual values scattered between 10,020 and 14,470/ μ l. Among these 19 with excessive white blood cells, 18 also showed somewhat above normal range (40~65%) neutrophil ratios (the ratio of the only one cadet being left out was actually not certain because his white blood cells were not categorized). Overall speaking, among the 27 examined inpatient blood samples, there was 1 person having this ratio over 65%, 4 persons having ratios higher than 70%, 9 persons higher than 80%, and another 4 persons higher than 90%. However, none of those people showed a ratio of lymphocytes above the normal range (20~45%). Therefore, we deduced that the pathogen causing the collective diarrhea event among Corps B cadets was likely some microorganism of bacterial kind. Despite of that, there was one sick cadet who they found his stool sample containing norovirus. This particular cadet, however, gave only diarrheal and feverish symptoms, but without vomiting or even feeling nausea, and both his white blood cell count (10,590/ μ l) and neutrophil ratio (83.4%) were above the normal ranges as the rest sick cadets. However, the only case situation made us believe that norovirus could not be the pathogen of this group diarrhea incident [2, 3]. Furthermore, among the temporarily detained and hospitalized cadets, as many as 36 were treated with 400 mg antibiotics Sulfamethoxazole/trimethoprim (taking 2

tablets every 8 hours for a duration of 25 days) successfully, and they were all obviously getting much better within 1~3 days.

In view of the fact that no one of Corps B fell sick with diarrheal symptoms before the supper of July 15, we would suspect that supper to be most likely the responsible cause of the outbreak. Besides, laboratory results indeed singled out one dish served at that supper, the stir-fried pakchoi with garlic cloves, being tainted by *Bacillus cereus* (along with diarrheal enterotoxin), so this contaminated dish might well be the food item causing the outbreak. We are also aware that even two days after that supper, *Bacillus cereus* was still detectable in a swab specimen taken from the surface of one cuffing board used for processing cooked foods in the kitchen. It sounds quite reasonable to assume that *Bacillus cereus* was the major pathogenic microorganism involved in this group diarrhea outbreak. On the other side of the token, it is known that the typical incubation period for *Bacillus cereus* to set off diarrhea symptom is 6~24 hours [4]. And the fact that no sufferers of this group diarrheal outbreak started to show the same symptom beyond that specific range after they consumed the suspected contaminated dish, the stir-fried pakchoi with garlic cloves, at the July 15 supper, once again verified that *Bacillus cereus* was the responsible pathogenic microorganism. In literature we saw reports written by experts emphasized that symptoms caused by this particular kind of bacteria were generally not severe, and indeed this may explain why that although so many cadets fell sick, no sufferers in this outbreak were seriously harmed at the end [5]. This could be another convincing evidence indicating the involvement of *Bacillus cereus* in this incident. Furthermore, we learnt food poison cases caused by *Bacillus cereus* could be through one of many types of tainted food items including different cereals like cooked rice, meat products like sausages and meat sauce, various vegetable dishes, and puddings [6]. The most optimum temperature for its growth is reported to be 30°C but it can

propagate at any temperature in the range of 10~45°C Therefore, some of the shortcomings revealed by our kitchen inspection, such as the temperature of the kitchen cold storage being too high, the stored cooked foods not sealed properly, and a rather regular dish, sauteed minced meat, being repeatedly cooked, told us there was a general problem in their food storage process, which probably provided a favorable environment for proliferation of all kinds of pathogens.

Although our findings included a positive result of *Staphylococcus aureus* in the shredded onion served at the July 16 morning breakfast, yet its amount was only 2.1×10^4 CFU/g, which was not high enough to cause sickness. Besides, no enterotoxin was found in the food item, plus almost all sufferers (including the one whose rectal swab specimen gave the positive result of *Staphylococcus aureus*) did not show up diarrheal symptom till late on July 16 or even early on July 17, which did not fit well with the characteristic, very short incubation period of infection with *Staphylococcus aureus*. These factual indications could not support the assumption that *Staphylococcus aureus* happened to be the pathogen causing this group diarrhea outbreak [4].

Measures of prevention and control taken and further recommendations

Not only did Corps B send all its diarrheal cadets to Long Cyuan Veterans Hospital to receive needed medical care and treatments, it also followed the instructions given by the local county health bureau and Fifth Branch of Taiwan CDC to immediately proceed with a large scale, barracks-wide cleaning up and sterilization effort covering the entire inside and outside environment of the cadet living quarters, kitchen and dining hall areas. For the purpose of cuffing off possible infection routes through drinking water when the outbreak was first becoming obvious, the training facility immediately procured one hundred thousand units of bottled water to replace the existing drinking water supply. In view of the barracks having no tap water system; the health authorities

recommended the place to add a chlorination machine to its water storage tank to prevent bacterial gastrointestinal infectious diseases from occurring again. At the beginning stage of installation of the chlorination machine, it was recommended to adjust the chlorine concentration of the tank water to 0.5 ppm in order to achieve sterilization of the tank and the water supply tubing system as well. After that, the concentration was going to be lowered and maintained in the range of 0.1~0.2 ppm to keep the water relatively germ-free. Another great concern created by the outbreak was that those cadets were scheduled to complete the training course and go home on July 20. The health authorities recommended the physicians stationed at the camp to watch the cadets closely to see if any further diarrhea situations take place in their last few days of stay, and inform them how to execute self hygiene management in case of discovering themselves falling sick after they left the camp for home.

Limitation of the investigation

When this particular training unit accepted the investigation on July 18, the person in charge at the barracks somehow refused to allow the investigating team to carry out a questionnaire session for the cadets. Unfortunately this reluctance on the patient end made it impossible for the team to quickly assess and find the real reason for the group diarrhea outbreak, but instead, we had to wait seven more days until all laboratory results became available to be certain that the outbreak was no more than a simple food poisoning incident. Fortunately because the outbreak turned out to be a food poisoning event, there was relatively less uncertainty of further spread of the outbreak, which was good. However, without the questionnaire results, the team could not know exactly the date and time when those Corps B cadets started to have symptoms, and their behaviors before they got poisoned by foods. Of course, the team would not know better what sort of

symptoms and frequencies happened to each of those sickened cadets, which would hinder tremendously the team from making the right decisions of which specimens ought to be collected from the patients, and also very likely the reason why all human body specimens collected in this incidents failed to give any signs of bacterial microorganisms. Another consequence derived from no questionnaire session was that it became much more difficulty for the team to pinpoint and verify the meal causing the collective diarrhea outbreak was the July 15 supper or the July 16 breakfast, and even harder to single out the very dish that caused the outbreak. A twisted, imaginary scenario could be that in case this outbreak happened to be caused by some infectious pathogen instead, and the cadets finished the training, dismissed, and went home on July 20, then the spread outcome of this outbreak would be beyond imagination and disastrous. Therefore, to avoid such refusals in the future that interfere routine investigations to quickly determine whether notifiable infectious diseases were involved, it is suggested that local health authorities should observe the Law of the Communicable Disease Control and fine the offenders accordingly for obstructing outbreak investigation.

References

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Figure 1. Distribution of Onset Dates of Diarrhea! Cadets of Corps B at a Certain Training Outfit in Pingtung County.

