


衛生福利部疾病管制署

An Outbreak of Acute Gastrointestinal Illness Following Consumption of Hydrogen Peroxide-contaminated Noodles at a Junior High School — Taiwan, April 2013

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Hydrogen peroxide (H₂O₂)

- **Powerful oxidizing agent in a form of colorless and odorless liquid**
- **Decomposition by light, heat, alkaline solution and enzymes (catalase/peroxidase)**
- **Uses:**
 - Disinfectant in home cleaning products and wound care
 - Bleaching agent in textile and paper industry
 - Antimicrobial/bleaching agent in food industry (food additive or sterilant for aseptic packaging)

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Hydrogen peroxide (H₂O₂)

- Food additives:


Country	Major Use Category	Target food items	Limitation for Use
Taiwan	Antimicrobial agent	Surimi-based products and any food products other than flour and flour-related products	Zero H ₂ O ₂ residue
Japan	Bleaching agent	All foods	Shall be removed or decomposed before the preparation of the finished food

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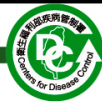
Effect of H₂O₂ on Human Health

- Exposure: ingestion, inhalation, mucosal exposure
- Damage: mucosa irritation or systemic air embolisms (gaseous oxygen)



The Journal of Emergency Medicine
2004;26:229-230.

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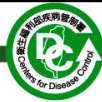


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Incidental Ingestion of H₂O₂

- **Incubation: 30 min – 2 hrs**
- **Symptom/sign: nausea, vomiting, abdominal fullness, diarrhea, gastrointestinal ulcers/bleeding/perforation, systemic embolization (stroke, gas in portal vein)**
- **Diagnosis based on clinical presentation and history of exposure**
- **Management: self-limited, symptomatic treatment**

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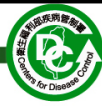


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The call

- **12:20, April 2, 2013 :**
 - Several students at a junior high school in Pintung County began to experience GI upset after lunch
- **12:50 – 13:30, April 2, 2013:**
 - Pintung County Health Department was notified by the school of the event of suspected food poisoning
 - Taiwan Food and Drug Administration and Taiwan Centers for Disease Control received the report and initiated the investigation

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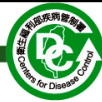


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Rapid Assessment of the Event

- **School setting:**
 - 1,520 students and 100 teaching staff; 33 classrooms
 - Serving lunch for ≥ 20 years; 8 kitchen staff
- **Onset of symptom/sign:**
 - 40 – 90 minutes (median, 1.2 hours) after lunch
 - Nausea, vomiting, dizziness or diarrhea
- **Extent of the event:**
 - Cumulative number of the ill (within 2 hours since lunch time): 157 (crude attack rate: 10 %)
 - Involving students in 82% (27) of total classrooms

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Objective

- **To identify the causative agent and possible food vehicle of this outbreak**

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


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Methods

- **Epidemiological investigation**
 - **Case-control study: to determine the possible food items associated with the illness**
- **Laboratory investigation**
 - **Bacterial culture, bacterial toxin and chemicals**
 - **Leftover, food products and human samples**
- **Environmental investigation**
 - **School kitchen, food providers**
 - **Sanitation, food preparation and supply chain process**

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Definition_Case-Control Study

Participants who ate lunch served by the kitchen of the school on April 2,	
With presence of any two of the four S/S (nausea, abdominal pain/fullness, vomiting or dizziness) after lunch	Case
Without S/S	Control

(note: Those who presented only one of the 4 S/S were not included in the controls to minimize the probability of misclassification.)

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Recruitment_Case-Control Study

- Recruitment of participants: from classrooms with ≥ 6 ill students since April 2

Grade	7	8	9	Total
No. of classrooms in the school	11	11	11	33
No. of classrooms with ill students	11	6	10	27
No. of classrooms with ≥ 6 ill students	6	2	3	11

- Self-administered questionnaire: for inquiring food history and clinical presentations
- Data management: SPSS (version 14.0) software for statistical analysis

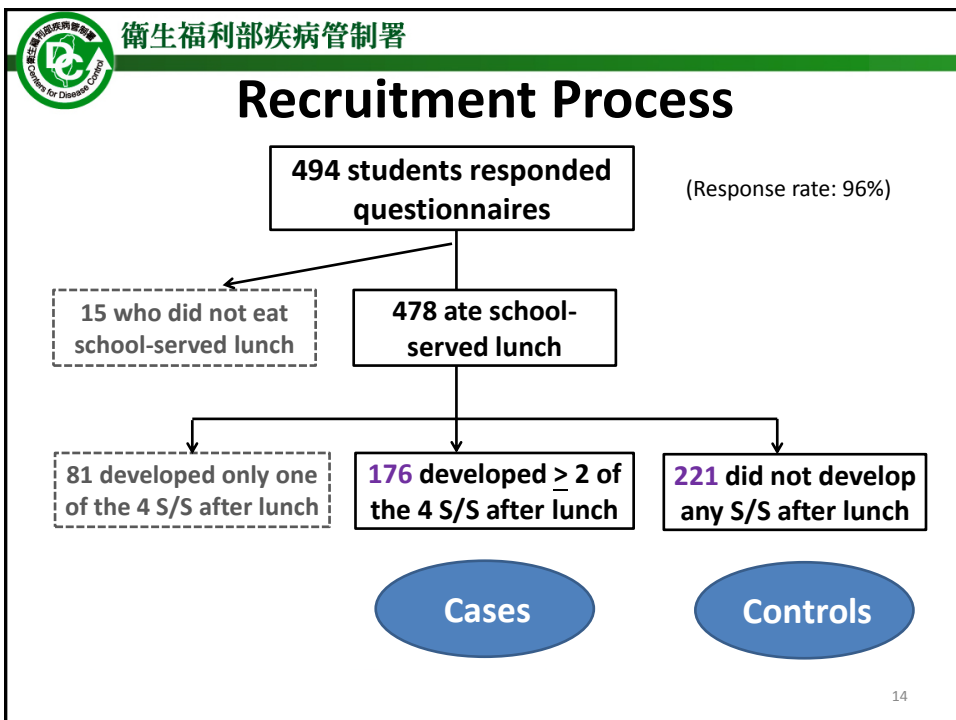
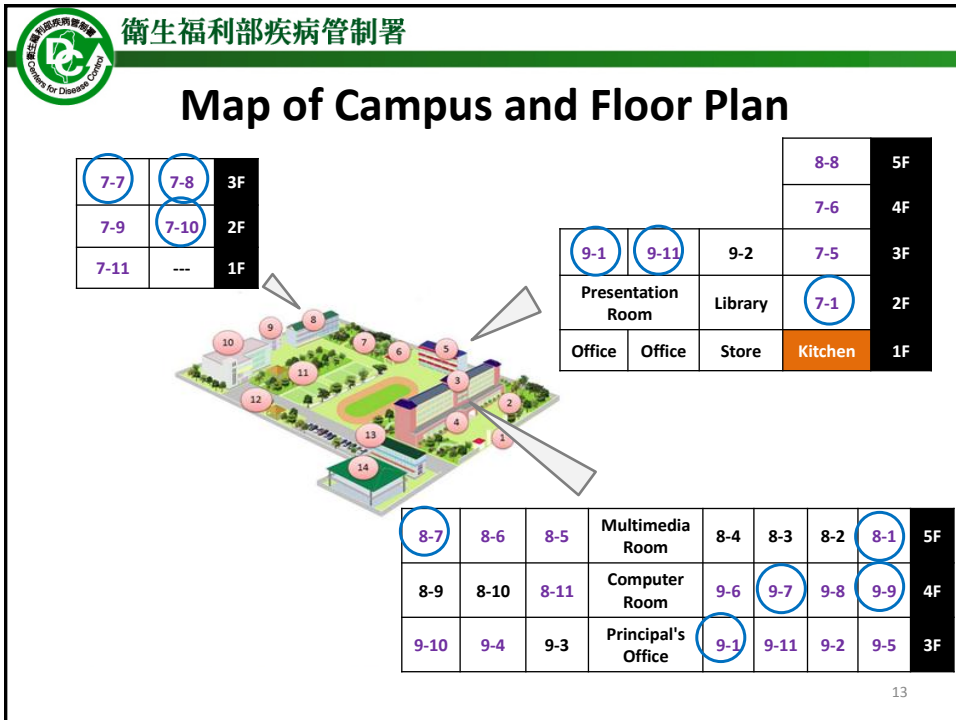
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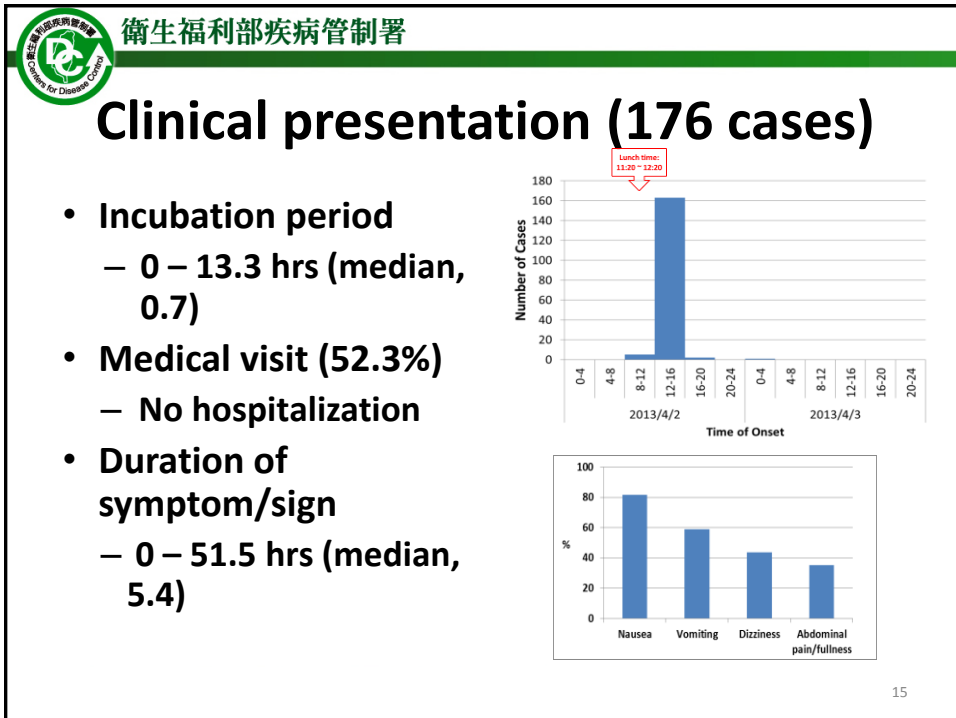


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Results

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Factors associated with the presence of illness among students who consuming school-served lunch on 2 April, 2013

	Case N = 176	Control N = 221	Odds ratio (95% confidence interval)	p value
Age (year), mean \pm SD	13.6 \pm 0.9	13.7 \pm 1.0	--	0.455
Gender, male*, n (%)	76 (43.2)	142 (64.3)	0.4 (0.3 – 0.6)	< 0.001
Food items, n (%)				
Noodles*	175 (99.4)	206 (93.2)	12.7 (1.7 – 97.4)	0.002
Vegetable soup	71 (40.3)	81 (36.7)	1.2 (0.8 – 1.8)	0.452
Bean paste	119 (67.6)	137 (62.0)	1.3 (0.8 – 1.9)	0.245
Milk	142 (80.7)	173 (78.3)	1.2 (0.7 – 1.9)	0.557

* Multiple logistic regression analysis revealed eating noodles (adjusted odds ratio [95% confidence interval], 12.8 [1.7 - 99]; $p = 0.015$) independently associated with the development of illness after adjusting for gender.

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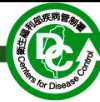


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Laboratory result

- **Hydrogen peroxide:**
 - Positive in two noodle samples (leftover & reserved sample: 528 & 531 ppm)
- **Microbiological tests:**
 - all negative (for both food samples and human specimens)
- **Concentrations of other food additives in food samples:**
 - Less than the maximum allowable concentration

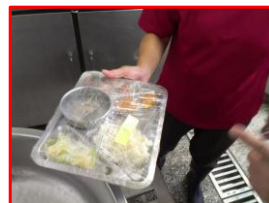
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School Kitchen


- **Environment- clean and tidy**
- **Process of food preparation- following a standard operating procedure**
- **Health status of the kitchen staff- free from any gastrointestinal symptoms**




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Noodle Factory



Noodle boiling and cooling machines



A bucket of unknown material



A container with 30-kg H₂O₂ (50%)

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Processes of noodle supply chain and preparation

Noodle

- 13 no an

Who

- Ar co
- Pr temperature
- 5:00 – 9:00, April 2: distributing to retailers or customers

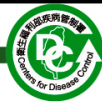
A proposed mechanism of the outbreak:

- Noodles contaminated with H₂O₂ at the factory
- No boiling process during food preparation → unable to remove residual H₂O₂

April 2: noodles in stirring well-cooked ble

0, April 2: delivering meal to each classroom

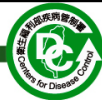
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Summary

- Short incubation period, symptom/signs and limited duration of symptoms -- compatible with hydrogen peroxide-related intoxication
- Eating noodles as an independent factor associated with acute gastrointestinal illness
- Noodles (both meal sample and leftover): positive test result for hydrogen peroxide
- Buckets of hydrogen peroxide at the noodle factory

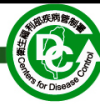
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Strengths and Limitations

- ☺ Timely report of the event
- ☺ Good cooperation between different public health sectors
- ☹ Unable to identify the mechanism of contamination

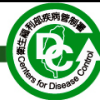
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Discussion

- Similar reports of acute GI upset caused by H_2O_2 -contaminated noodles (udon) in Japan
- Prevalence of H_2O_2 -associated foodborne outbreaks in Taiwan:
 - 1-2 events per year
 - Food vehicles: udon, noodles, and mesona jelly
 - H_2O_2 residues, 500 - 1600 ppm
- A survey of H_2O_2 residues in noodle samples from traditional markets in two cities (*Su, et al., 2001*)
 - Rates of detection- 3.3% & 26.7%

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Conclusions

- Cause of outbreak: hydrogen peroxide
- Vehicle/food item: noodles
- Proposed mechanism: ready-to-eat noodle products contaminated by H_2O_2 at the noodle factory

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Recommendations

- **Food manufacturer:**
 - Enhancing good management of food manufacturing environment
 - Ensuring the compliance with relevant food standards and regulations
- **Public health sector:**
 - Implementing tight control of food additives and frequent audits of H₂O₂ residue in noodle products

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Acknowledgements

- **Students and staff who participated in this investigation**
- **Pintung County Health Department, Kaohsiung City Health Department, Taiwan Food and Drug Administration**

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Laboratory investigation

Leftover and food samples	
Bacteria culture	<i>Staphylococcus aureus</i> , pathogenic <i>E. coli</i> , <i>Vibrio parahaemolyticus</i> , <i>Salmonella</i> species, <i>Bacillus cereus</i>
Bacterial toxin	Enterotoxin of <i>Staphylococcus aureus</i>
Chemicals	Hydrogen peroxide, and other food additives
Human specimen*	
Bacteria culture	Toxicogenic <i>Staphylococcus aureus</i> , <i>Bacillus cereus</i> , <i>Vibrio</i> species, <i>Salmonella</i> species, <i>Shigella</i> species
Virus	Norovirus

* Specimens from students with illness and all staff working at the school kitchen

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Environmental investigation

- **School:**
 - Inspecting kitchen: sanitation, food-handling and meal-serving process
 - Evaluating health of kitchen staff
- **Food providers**
 - Inspecting the environment of food manufacturing
 - Assessing the process of food supply chain

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Multiple logistic regression model: independent factors associated with the presence of illness after lunch

Variables	Odds ratio (95% confidence Interval)	<i>p</i> value
Gender, male	0.4 (0.3 – 0.6)	< 0.001
Eating noodles	12.8 (1.7 – 99)	0.002

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Discussion

- **More female students developed symptoms after eating noodles (99/173, 57% versus 76/208, 37%)**
 - Gender difference in vulnerability?
 - Different exposed dose?
 - Mass hysteria?

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