

An outbreak of hepatitis A associated with a bakery, New York, 1994: The 1968 ‘West Branch, Michigan’ outbreak repeated

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SUMMARY

In a community hepatitis A outbreak in the Rochester, New York area, 64 of 79 (81%) people with anti-hepatitis A IgM-antibodies and onset of symptoms from 9 April–31 May 1994, recalled eating food obtained from a retail buyer's club. Eleven (65%) of 17 households with cases contained club members compared with 7 (21%) of 34 neighbourhood-matched control-households (matched odds ratio 8.5; 95% CI 1.7–41.6). Club employees who ate sugar-glazed baked goods were at fourfold increased risk for hepatitis. The source of infection was an IgM-positive baker who contaminated baked goods while applying sugar glaze. Computer-generated purchase lists implicated 11–12 March and 21–24 March as the most likely dates when contamination occurred. This investigation demonstrates the importance of food workers adhering to established hygiene practices. Computer-generated commercial datasets can be useful in epidemiologic investigations.

INTRODUCTION

About 24000 cases of hepatitis A are reported annually in the United States [1]. Mechanisms of transmission include faecal-oral spread through close household or sexual contact, unpurified water, and a variety of foods that are uncooked, undercooked, or contaminated after cooking [2–5]. Baked goods rarely have been implicated in hepatitis A outbreaks. In

1968, a community outbreak of hepatitis A in West Branch, Michigan was traced to a baker's assistant who contaminated doughnuts while applying a sugar glaze [6]. The West Branch outbreak was popularly described by Berton Roueché and later was turned into a widely used epidemiology teaching exercise [7, 8].

We report an investigation of an outbreak of hepatitis A in the Rochester, NY area. The outbreak was associated with sugar-glazed baked goods prepared and sold at a large retail buyer's club. The apparent mechanism of food contamination was the

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same as that of the West Branch outbreak 26 years earlier. A unique feature of our investigation was the use of a computer-generated list of all buyer's club customers, their purchases, and the dates of purchase. Such information, maintained by many retailers for commercial purposes, has potential epidemiologic applications.

METHODS

Background

Monroe County, located in western New York State, includes the city of Rochester (1990 Monroe County population, 713 968; Rochester population, 231 636). On 15 April 1994, a woman who had hepatitis A was reported to the Monroe County Health Department (MCHD). Three of her five children were also ill with symptoms consistent with acute hepatitis. The woman said she often shopped at a 10 000-member retail buyer's club ('Club A'), a large department store and supermarket open only to registered members. Also on 15 April, two meat department employees from Club A were reported to have hepatitis A. They told MCHD investigators that at least three other workers from the club were ill with similar symptoms. By 25 April, a total of five club workers and ten other persons who ate food from the club had been reported with hepatitis A, including four persons from surrounding counties. Initial interviews suggested the only common exposure was working at, shopping at, or eating food from Club A.

Because cases were identified in several counties, the MCHD asked the Bureau of Communicable Disease Control from the New York State Department of Health to assist in the investigation. We focused on identifying the source of the outbreak, determining whether transmission was continuing in the community, and interrupting ongoing transmission.

Identification of cases and descriptive epidemiology

Physicians and laboratories must report cases of acute hepatitis A to the MCHD. During the outbreak, local hospital and commercial laboratories were repeatedly contacted by telephone to ensure complete and timely reporting.

A case was defined as a person with a positive serologic test for anti-hepatitis A IgM who had

symptom onset from 9 April to 31 May 1994, and who worked or lived in Monroe County or any of eight neighbouring counties. A club-associated case was one who worked at or ate food from Club A. A secondary case was a person who did not work at or eat food from the club, but who had contact with a club-associated case and had onset of symptoms at least 2 weeks later than the club-associated case. All suspected cases were interviewed by health department staff, who asked about food consumption in the period 2 weeks to 2 months preceding symptom onset.

Matched case-control study

To test the hypothesis that Club A was associated with the hepatitis A outbreak, two neighbourhood-matched control-households were selected for each available case-household by single-digit addition to and subtraction from the end of case-household telephone numbers. Interviewers spoke to the head of the household or another responsible person over the age of 18 years. Respondents were asked whether anyone in the household was a member of Club A, shopped at the club, or ate food from the club in March 1994, and whether anyone in the household had been ill with jaundice or acute gastrointestinal symptoms. Control households were excluded if any member exhibited these symptoms in March 1994.

The household was considered the unit of analysis because in many instances a household reported more than one case. If at least one person in a case- or control-household had a particular characteristic, the entire household was categorized as having that characteristic. Club A employees were categorized as club members and shoppers. Data were analysed by using the Mantel-Haenszel procedure for matched data, and the 95 percent confidence intervals for matched odds ratios were calculated [9, 10].

Cohort study of club employees

To determine what factors might be associated with hepatitis at Club A, we asked all employees to complete a written questionnaire about their health and what foods they had eaten at the club in March 1994. Employees were also asked to provide a serum specimen to be tested for anti-hepatitis A IgM and total antibodies. For categorical data, risk ratios and 95% confidence intervals, or *P* values, were calculated

[11]. Continuous data were analysed by using Student's *t* test. Statistical significance was assessed at $P \leq 0.05$.

Investigation of food preparation at the club

A sanitarian from the MCHD and inspectors from the New York State Department of Agriculture and Markets inspected Club A's facilities and observed their food-preparation procedures.

Analysis of computer-generated data on club purchases

Only persons who are issued a special discount card can shop at the club. At the time of purchase, the club records the member's identification number and the specific items purchased. A 'day pass' can also be obtained by persons who wish to shop on a trial basis; information on shoppers with day passes is limited. These computerized data are retained by the club for commercial purposes. During the outbreak investigation, we obtained printouts of all persons who shopped at the club between 5–31 March 1994, including their names, addresses, telephone numbers, and specific items and dates they were purchased. During the outbreak, we used this information to verify patrons' recall of purchases from the club and to identify the most likely dates of food contamination.

RESULTS

Identification of cases and descriptive epidemiology

Between 9 April and 31 May 1994, 79 cases of acute hepatitis A were reported from nine counties in western New York State (Fig. 1). By comparison, these nine counties reported 29 cases of hepatitis A in all of 1993. Nine (11%) of the 79 cases were club employees, 55 (70%) were non-employees who had eaten club baked goods, and 2 (3%) were secondary cases (non-employees who did not eat club food but had contact with a club-associated case) (Table 1). At least four case-patients were hospitalized. Despite repeated interviews, we could not clearly link to the outbreak the patients with onsets in March and early April (excepting Baker A). The patients with onsets from 18–21 May ate implicated food on multiple

occasions, and we could not determine if illness was due to leftover contaminated baked goods or a long incubation period. No alternative sources of hepatitis A, other than eating Club A food or related secondary transmission, were identified for any cases during the study period.

Matched case-control study

At the time the case-control study was conducted (30 April–1 May 1994) we had identified 17 case-households representing 26 patients. Eleven (65%) of these 17 households contained club members compared with 7 (21%) of 34 control-households (matched odds ratio [MOR] 8.5; 95 percent confidence interval [CI] 1.7–41.6) (Table 2). Eleven (65%) case-households contained persons who shopped at the club in March 1994 compared with two (6%) control-households (MOR undefined; 95% CI 4.3^{-∞}). Eleven (65%) case-households contained persons who had eaten club baked goods in March compared with no control-households (MOR undefined; 95% CI 5.0^{-∞}).

Cohort study

Of 108 club employees, both questionnaires and sera were obtained from 76 (70%). Questionnaires but not sera were available from an additional 24 (22%) employees, none of whom reported symptoms of hepatitis; including these in the analysis, assuming that they were antibody negative, did not much alter our findings. Five (5%) other employees provided sera but not questionnaires, and all five were negative for anti-hepatitis A antibodies. Only 3 (3%) employees did not provide questionnaires or blood samples. Of the 76 employees with both sera and questionnaires, eight (11%), who had anti-hepatitis A IgM-negative sera but elevated anti-hepatitis A total antibodies, were considered to be immune and were excluded from further analysis. Of the remaining 68 employees, ten (15%) had IgM-positive sera. Baker A, who had mild symptoms in mid-March 1994 and was IgM-positive, was assumed to be the source case and was excluded from the cohort analysis; the other 9 IgM-positive employees had symptom onset in April. In the cohort of 9 IgM-positive employees and 58 IgM-negative employees, acute hepatitis A was significantly associated with fulltime male employees (Table 3) and eating sugar-glazed Danish pastry

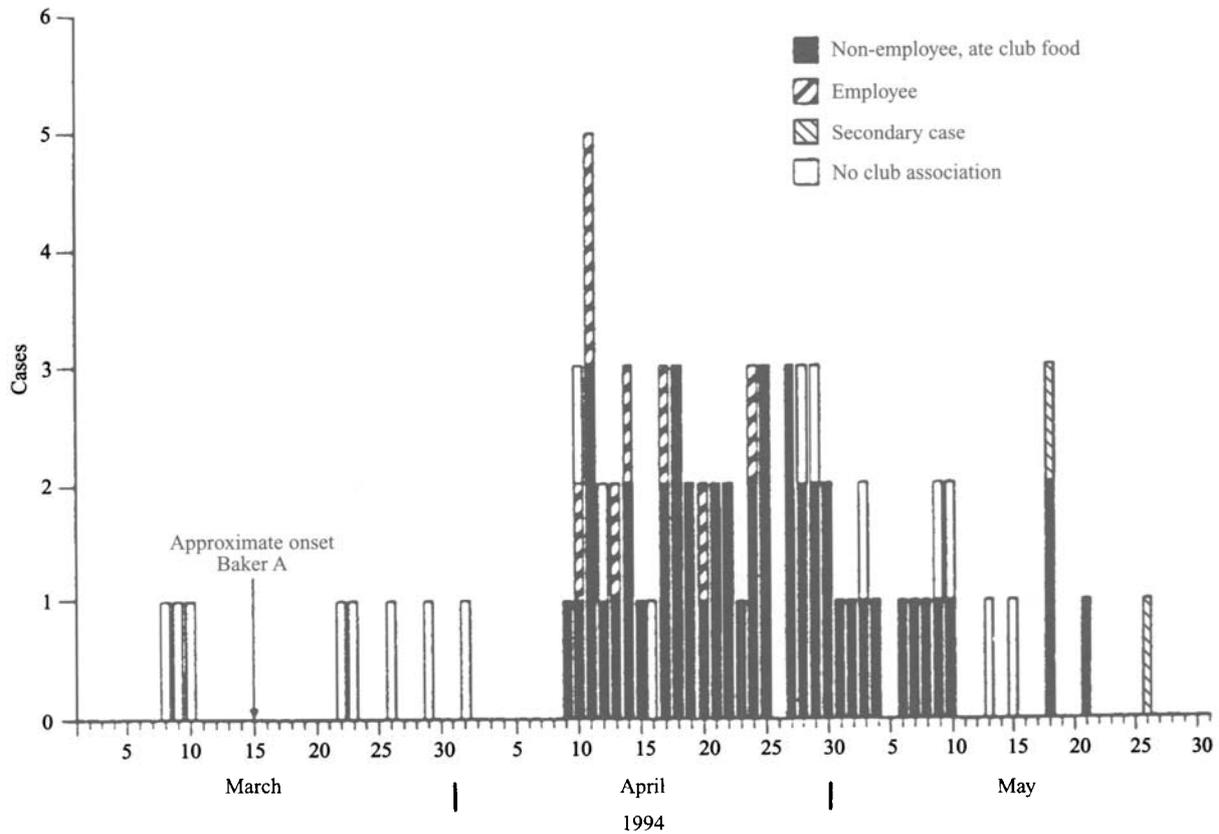


Fig. 1. Dates of symptom onset for persons with laboratory-confirmed acute hepatitis A, Greater Rochester, NY Area, 1 March–31 May 1994. (Specific dates of symptom onset could not be elicited for eight persons, including one employee and five other persons who were associated with Club A.)

Table 1. Characteristics of people with laboratory-confirmed acute hepatitis A, Greater Rochester, NY Area, 9 April–31 May 1994

Characteristic	n (%)
Male	46 (58)
Age in years	
Median	32.5
Range	4–74
Associated with Club A	66 (84)
Club employee	9 (11)*
Non-employee, ate club food	55 (70)
Secondary case	2 (3)
Not associated with Club A	13 (17)
Total	79 (100)*

* Excludes the source case, Baker A, who had symptom onset in March 1994.

(Table 4) (risk ratio [RR] 4.4; 95% CI 1.2–15.9) or any sugar-glazed baked item (RR 4.1; 95% CI 1.1–14.8) (Table 3). No other food items were significantly associated with hepatitis.

Three IgM-positive employees reported not eating sugar-glazed baked goods. However, two of these employees ate food demonstration samples that occasionally included sugar-glazed baked goods, and all three attended weekly staff meetings where sugar-glazed baked goods were served. The nine case-employees were all male, full-time employees. Similar numbers of male and female employees reported eating Danish pastry (10 male, 11 female).

Investigation of food preparation at the club

Club A primarily sells commercially prepared food items delivered pre-packaged to the club, including most baked goods. In addition, an on-site bakery ‘proofs’ (allows dough to rise to ready for baking) some commercially frozen items such as Danish pastry, cinnamon rolls, and breads, then bakes them at 175 °C (350 °F) for 15 min. After cooling, Danish pastry and cinnamon rolls are glazed by hand by using a commercially prepared sugar mixture. Sugar-glazed baked goods remain on store shelves for no more than

Table 2. Characteristics of 17 case-households and 34 neighbourhood-matched control-households, Greater Rochester, NY Area, 30 April–1 May 1994

Characteristic	Case-households <i>n</i> (%)	Control-households <i>n</i> (%)	Matched odds ratio	95% Confidence interval
Club A member	11 (65)	7 (21)	8.5	(1.7–41.6)
Shopped at Club A in March	11 (65)	2 (6)	Undefined	(4.3 ^{-∞})
Ate Club A baked goods in March	11 (65)	0 (0)	Undefined	(5.0 ^{-∞})
Total	17 (100)	34 (100)		

Table 3. Characteristics of 67 Buyer's Club employees with questionnaires and sera available*

Characteristic	Number at risk	Number of cases	Attack rate (%)	Risk ratio	<i>P</i> -value
Female	32	0	0	Reference	—
Male	35	9	26	Undefined	0.002
Part-time employees	27	0	0	Reference	—
Full-time employees	40	9	23	Undefined	0.006

* With questionnaires and sera both obtained, of 108 employees in the club. Excludes eight employees with anti-hepatitis A IgM-negative sera but elevated anti-hepatitis A total antibodies (i.e. previously immune), and the source case, Baker A.

Table 4. Club foods eaten in March, 1994 by 67 Buyer's Club employees with questionnaires and sera available*

Club A food†	Case/ate food (%)	Case/not eat food (%)	Risk ratio	95% Confidence interval or <i>P</i>
Glazed Danish	6/21 (29)	3/46 (7)	4.4	(1.2–15.9)
Any sugar-glazed baked item	6/22 (27)	3/45 (7)	4.1	(1.1–14.8)
Cake	4/18 (22)	5/49 (10)	2.2	(0.7–7.2)
Muffins	3/17 (18)	6/50 (12)	1.5	(0.4–5.3)
Breads	4/27 (15)	5/40 (13)	1.2	(0.4–4.0)
Cookies	2/14 (14)	7/53 (13)	1.1	(0.3–4.6)
Meats	2/13 (15)	7/54 (13)	1.2	(0.3–5.0)
Fruits	0/11 (0)	9/56 (16)	0	<i>P</i> = 0.37

* With questionnaires and sera both obtained, of 108 employees in the club. Excludes eight employees with anti-hepatitis A IgM-negative sera but elevated anti-hepatitis A total antibodies (i.e., previously immune), and the source case, Baker A.

† Does not include commercially prepared pre-packaged items.

3 days, although most are sold on the day they are baked. Outdated baked goods are sometimes donated to local charities.

Occasionally, food (including sugar-glazed baked goods from the on-site bakery) is placed on trays as free 'demonstration samples'. A snack bar on the premises sells hot and cold items for patrons to eat in the store or to take out, including hot dogs on Club A baked rolls, but no sugar-glazed baked goods. The club sells fresh fruits, some of which (e.g. strawberries)

are repackaged by hand. The club also has a meat department that cuts, grinds, and packages meat.

Review of the club's food-preparation procedures after the outbreak was recognized found no major violations of New York State Department of Agriculture and Markets regulations. In particular, investigators observed bakery employees washing their hands. However, a handwashing sink in the bakery had faucet handles that were difficult to use (foot pedals mounted at waist level), and the water took

Table 5. Relationship of dates Baker A worked and dates of purchase of sugar-glazed baked goods by club-associated case-patients with data available, 5–31 March, 1994.

Case Number	March, 1994																														
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31				
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Dates that Baker A are shown in bold type along the top row. The body of the table indicates dates of purchase for sugar-glazed baked goods which were later consumed by cases. Shaded columns indicate most likely dates of food contamination. Not all case-patients associated with the club could be linked to a specific purchase date.

several minutes to become hot. Bakery employees were observed wearing gloves when applying the sugar glaze, although some workers said that gloves were not worn consistently. The use of gloves or some other barrier is required by New York State to

prevent bare-hand contact with foods that are not subsequently cooked.

Three bakers worked at the club. Because the epidemiologic data implicated the bakery as the likely source of contaminated food, attention focused on the

only baker with IgM-positive serum, Baker A. This person denied having diarrhoea, jaundice, or other symptoms consistent with hepatitis. However, the MCHD received information that Baker A had mild diarrhoea in the middle of March 1994, about 30 days before the peak in the epidemic curve (Fig. 1).

The US Food and Drug Administration (FDA) contacted the manufacturer of the sugar glaze. Neither the FDA nor the manufacturer received other reports of hepatitis A associated with consumption of the sugar glaze. We attempted to locate leftover pastries in patrons' refrigerators or leftover sugar glaze at the club to test for hepatitis A virus particles, but none were available.

Analysis of computer-generated data on club purchases

To identify more precisely the probable days of food contamination, we studied the computer-generated lists of club patrons and their purchases that were provided by Club A. Comparing the dates that Baker A worked with the dates that case-households purchased sugar-glazed baked goods, we found the most likely days of food contamination to be 11–12 and 21–24 March (Table 5). Because many patrons bought baked items on more than one day in March we could not exclude food contamination on other days. For the same reason, we could not clearly define the risk of acquiring hepatitis A from items baked on any particular day.

The patron list also showed that the owners of at least two small restaurants purchased Club A baked goods for resale in their restaurants. The owners were listed as private individuals, but the relatively large amounts of food purchased prompted further investigation. We can attribute only one case of hepatitis A (in a waitress at one of the restaurants) to consumption of baked goods intended for resale, but other cases might have occurred.

Outbreak control measures

Frequent contact between the MCHD and the local news media allowed us to publicise basic precautions (such as handwashing). When the investigation implicated club baked goods prepared in March as the likely vehicle of transmission, Club A patrons were encouraged through the media to destroy goods baked in March, or to bring them back to the club for a refund.

The bakery was closed on 28 April 1994. Symptomatic club employees were excluded from food-worker duties, and all employees who prepared or served food were tested for anti-hepatitis A antibodies and required to receive intramuscular injections of immune globulin before resuming food-worker duties. Sanitary practices, including handwashing and glove use, were emphasized to club management and employees. The bakery was allowed to reopen on 24 May 1994.

Special 'immune globulin clinics' were held for members of the public who, within the preceding 2 weeks, had close contact with a case-patient or ate Club A baked goods prepared in March (this last category included club patrons who froze sugar-glazed baked items at home for later consumption). At least 650 persons received immune globulin, not including those who received immune globulin from their private physicians.

DISCUSSION

Our investigation found an association between eating sugar-glazed baked goods from a retail buyer's club and developing hepatitis A. The epidemic curve and data developed from computer-generated purchase lists indicate that food contamination occurred in March 1994. The data support the hypothesis that a Club A baker contaminated food while applying a sugar glaze to pastries after baking. During the outbreak period at least 79 persons became ill with hepatitis A, and immune globulin was administered to at least 650 people.

We could not demonstrate with certainty the mechanism of food contamination. We believe that contamination occurred through inadequate handwashing by Baker A and subsequent bare-hand contact with food in the bakery. Other limitations to our study include a lack of serologic data on all employees. We also could not identify all cases of hepatitis A in the community, particularly among children (who are more likely to be anicteric).

No female or part-time Club A employees became ill. We did not ask employees about how frequently they ate Club A food. If male or full-time employees were more likely to eat sugar-glazed baked goods on a regular basis, their true risk of exposure to contaminated food would be higher than our data suggest. We cannot exclude indirect transmission between employees through fomites such as faucet handles in the shared bathroom at the club, but this

seems unlikely and would not explain the observed association with eating baked goods.

Outbreak investigations often rely on people's recall to identify and quantify exposure. Because hepatitis A has a mean incubation period of 30 days, poor recall and recall bias can be a substantial problem in investigations. Recall bias can be particularly important when the outbreak and its possible cause are widely publicized in the community, as occurred in this outbreak. In our investigation, we used computer-generated lists that specified the dates and items purchased by every Club A member, thereby substantially reducing this problem.

We used the commercial dataset in several ways. In many cases we were able to confirm, while the outbreak was in progress, people's reported purchases at Club A. This information was particularly helpful for confirming purchases made by club patrons who shopped at the bakery on multiple occasions. We also used this information to identify specific days when contamination most likely occurred. We identified two separate intervals that were consistent with the known incubation period of hepatitis A, the suspected date of onset of Baker A's hepatitis, the dates Baker A worked, the usual shelf-life of the sugar-glazed baked goods, and the dates of purchases by case-patients. Previous experimental data suggest that infectious hepatitis A virus can survive for extended periods in dried faeces and in a variety of uncooked foods, including creme-filled cookies [12–15]. Establishing that Baker A remained infectious for at least 14 days is consistent with previous epidemiologic and experimental reports demonstrating the shedding of hepatitis A virus for up to 2 weeks [16, 17].

Computerized inventories have become standard features of modern supermarkets [18]. Stores can track in detail when and what items have been sold. A particular feature of buyer's clubs such as Club A is that all purchases can be linked to an individual customer [19]. These data have obvious applications to marketing and advertising [20, 21] but might also be of potential use during outbreak investigations. In urgent situations such as food contamination by botulism toxin, recalls of contaminated products *might in part be targeted to the specific purchasers*. In other situations, investigators might use such information to calculate daily attack rates or to generate hypotheses. Unfortunately, computer-generated lists cannot identify all consumers of suspect foods. For example, Club A patrons sometimes shared baked goods with other people, ate demonstration items at

the club, or used another person's membership card. Restaurant owners purchased 'retail' baked goods and then resold them. Also, food consumption by Club A employees was not recorded.

Beginning in 1992, New York State required food workers to wear gloves or use utensils or other barriers (e.g. 'deli paper') to prevent bare-hand contact with foods that are not subsequently cooked [22]. The impact of this legal requirement on the frequency of foodborne illness in New York State is unknown. Our outbreak investigation demonstrates that such requirements cannot prevent all foodborne illness outbreaks, due to inconsistent adherence by food workers.

What has been learned since 1968, when 76 people became ill with hepatitis in West Branch, Michigan [6]? In that outbreak, as in this one, a baker with acute hepatitis A applied sugar glaze to baked goods after they had been baked and allowed to cool. We are reminded that baked goods are in effect an uncooked food if they are glazed after baking. The basic precautions of thorough hand-washing with soap and hot water and excluding food workers with gastrointestinal illness from food-worker duties remain essential in preventing foodborne outbreaks. Food workers should be encouraged to abstain from food preparation and serving, without penalty, when they have gastrointestinal illness. Food workers should be prohibited from bare-hand contact with foods that are not subsequently cooked.

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