

OUTBREAK INVESTIGATION

Investigation of salmonellosis outbreak following a hospital endoscopy: A public health case study

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ABSTRACT

Background: The results of a public health investigation are presented. During 2014, a local public health unit in Ontario became aware that three cases of *S. enteritidis* may be related. One common factor was identified: all three had received endoscopy at the local community hospital prior to their diagnosis.

Methods: Infection prevention and control assessment of the procedures used in the operation of the endoscopy suite as well as reprocessing methods used for the equipment was completed. In addition, microbiological testing of the endoscope and epidemiological investigation techniques were used to try to confirm the hypothesis that the procedure was the most likely source of transmission for the three patients.

Results: No significant infection prevention and control lapses were identified at the endoscopy suite. Reprocessing methods and verification, including documentation, were found to be adequate. However, the epidemiological investigation implicated the endoscope as being the likely source of transmission of *S. enteritidis* for the three patients.

Conclusions: The question is proposed for future examination in the IPAC field: are current reprocessing guidelines for endoscopy equipment adequate to protect patients from exogenous infection? And, for public health investigations: should recent endoscopic procedures be included as a potential acquisition exposure question when interviewing lab-confirmed cases of salmonella?

KEY WORDS

Salmonella, endoscopy

BACKGROUND

Salmonellosis is caused by the bacterium salmonella, a Gram-negative non-spore forming bacillus that has more than 2,000 serotypes. This infection occurs worldwide and salmonellosis is the second most common enteric infection in Ontario, with an average of almost 2,500 cases occurring per year. *S. Typhimurium* and *S. Enteritidis* are the leading causes of salmonellosis in Ontario (1). The health unit jurisdiction where the investigation occurred averages 18 cases of Salmonella per year (2).

The majority of infections with salmonella are associated with the ingestion of contaminated food or contact with infected animals (3). Investigations of sporadic cases and outbreaks of salmonellosis focus on the ingestion of the organism in food, travel history or contact with animals. Once acquired, the established incubation period for salmonella ranges from 6 to 72 hours, although longer incubation periods have been reported. The period of communicability lasts throughout the course of infection, varying from several days to several weeks (4).

Infection prevention and control issues related to endoscopy procedure are well documented in the literature. Since the introduction of standardized guidelines for reprocessing of endoscopes in the early 1990s, the incidence of associated infections have dropped dramatically and disease transmission has been mainly associated with lapses in IPAC practices or

non-endoscopic procedure issues such as the contamination/improper use or care of intravenous lines and administration of anesthesia or other medications (5).

This paper describes a public health investigation of a small cluster of salmonella cases which appear to have been associated with endoscopy procedures at one hospital.

METHODS

Initial Investigation

The Infectious Disease Prevention and Control (IDPC) team at an Ontario public health unit received a telephone call late in the day on Thursday April 17, 2014 from Case A who had been diagnosed with salmonellosis on April 11, 2014 and who was concerned that, while hospitalized at Hospital A with symptoms of salmonellosis from April 7 to April 16 2014, she had met another patient, Case B, who was also diagnosed with salmonella on April 11 and hospitalized with symptoms from April 9 to April 25. Case A and Case B shared a hospital room at Hospital A (a community hospital with 102 beds) while they were both hospitalized with symptoms of salmonellosis. During a conversation, they discovered that they had both received endoscope procedures at the outpatient department of Hospital A in the same week, approximately three weeks prior to their in-patient stay. The complaint was reviewed and it was decided that further investigation was warranted.

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On Tuesday April 22, 2014 existing public health salmonella report investigation records of Case A and Case B were reviewed. It was noted that both patients had lab confirmation of *S. enteritidis*. A line list was reviewed of all *S. enteritidis* received by the health unit in 2014. Seven cases were identified. Three cases had a travel history during their incubation periods, and were, therefore, removed from the investigation. This left four remaining cases with no travel history, including Case A and Case B. Case C had a note written in the paper file that she had undergone an endoscope procedure at Hospital A prior to onset of symptoms. Infection Control at the hospital was notified. The infection control practitioner (ICP) checked hospital records and confirmed that three of the four cases of *S. enteritidis* identified with no travel history had colonoscopy procedures at the hospital and provided the dates of their procedures.

All four cases were re-interviewed by the IDPC team to confirm that they had no travel history, the onset date of their illness, and whether or not they had a recent colonoscopy procedure. Onset dates were confirmed for Case B and Case C. Case A remained unclear of an onset date, as there was a long history of diarrhea and gastro-intestinal upset, although did state that symptoms seemed to worsen about a week prior to hospitalization. Although these cases had been previously interviewed about possible sources of infection, this part of the interview was repeated for validation purposes. Public health inquires routinely about food, sources of water, animal contact and attendance at special events up to three days prior to the onset of salmonellosis symptoms. Three cases were confirmed as having a recent colonoscopy procedure and no travel history. The fourth case had no travel history and no recent colonoscopy procedure.

Epidemiological analysis of existing case information

Through the re-interviewing of Cases A, B and C it was established that no common food or other exposure could be identified in the usual incubation period for salmonella. While the usual incubation period of 6 to 72 hours did not support a point-source common cause for these three cases, re-interview exposure questions extended beyond 72 hours to include the previous month because salmonella has been known to have longer incubation periods. It is also possible that the same source of contamination was ingested by the cases on different days, such as when a contaminated food like poultry or produce is widely distributed in a community. Only one significant commonality was found among Cases A and C – Case C attended an event at a restaurant bar on March 28 and Case A worked at this same restaurant bar with the last

day worked being March 23. Case C denied eating food at the restaurant but consumed beverages. Case B was asked directly about this restaurant but denied ever going there.

Dates of colonoscopy were confirmed with the cases and matched the information provided by the hospital. This information in Table 1. The date of hospitalization minus seven days was used as the onset date for Case A, who could not clearly define the date of symptom onset.

It was hypothesized that these three cases may have had the same source of infection based on their common exposure of a colonoscopy at the hospital. However, the procedure date did not fit into the established incubation period for salmonella (6 to 72 hours, usually about 12 to 36 hours). Instead the incubation period, using the theory that the colonoscopy was the source, ranged from 4 to 8 days.

Public Health Ontario (PHO), the provincial agency responsible for providing scientific and technical advice and support to public health and health care including laboratory services, was contacted to inquire about phage typing results of the three isolates. One phage type was available (PT 8), while the other two were pending.

Feasibility and risk

On Wednesday April 23, the IDPC team requested that the PHO library services conduct a literature search on the transmission of salmonella during colonoscopy. The search was limited to articles published after 1980.

Reports of transmission of salmonella species' during colonoscopy have not been reported since endoscope reprocessing guidelines from the Association for Professionals in Infection Control and Epidemiology (APIC) were put into place in 1989 (6). Prior to 1989, Dwyer et al. (7) reported an outbreak of *S. Newport* transmitted by fiberoptic colonoscopy. This was the first outbreak reported where transmission followed a route that was not fecal-oral, but rather was hypothesized to have been transmitted via a contaminated colonoscope directly to a patient's lower gastrointestinal tract. Moreover, incubation periods in the Dwyer et al. outbreak were found to be longer than expected for two of the cases. One developed acute gastroenteritis on the seventh day after the procedure and one on the ninth day after the procedure. This suggested two new pieces of information about salmonella:

1) transmission of salmonella during colonoscopy directly to the lower gastrointestinal tract is possible and 2) this mode of transmission may result in a longer incubation period than the usual ingestion route.

TABLE 1: Summary of dates used for establishing acquisition risk timelines

	Onset Date	Lab Test Date	Usual Incubation Period to Identify Acquisition Source	Date of Colonoscopy	Attendance at Restaurant/Bar
Case A	April 1	April 7	March 29 to April 1	March 24 2014	March 23
Case B	April 6 2014	April 10	April 3 to April 6	March 31 2014	Did not attend
Case C	March 29 2014	March 31	March 26 to March 29	March 25 2014	March 28

Hospital investigation

On Thursday April 24, the public health unit shared its findings with the hospital. Automated machines for disinfection are used after the scopes are manually brushed, cleaned and tested for leaks. While the “dirty” and “clean” areas are in the same room, a barrier exists between them (a counter) and policies and procedures are in place to attempt to keep the areas separate. It was noted that there is limited storage for clean endoscopes (they were short one hook for hanging), therefore, one randomly chosen, processed endoscope is always stored in the automated machine (with the lid open).

To identify any other potential sources of enteric bacteria to patients other than the endoscope itself, a discussion was held regarding process flow of patients undergoing an endoscope procedure and all actions and equipment that occur before, during and after a procedure. Patients receive the same instructions for preparation; however, specific preparation products varied and were obtained through different community pharmacies, ruling out preparation products as a source of infection. No other items or procedures were identified at that time as a potential source of enteric bacteria.

The hospital performed 15 to 20 colonoscopies per weekday and had 10 endoscopes used for colonoscopies. Each scope is stored with a printout from the disinfectant machine confirming the process was completed and when the scope is used. A copy of the printout is subsequently attached to the appropriate patient’s chart.

The hospital agreed to review patient records of Cases A, B and C to identify if any commonalities with staff or equipment were present and to confirm the quality control verification check of the scope cleaning.

At 5:45 p.m. that same day, the health unit received an email from the hospital that their record review revealed the same endoscope was used on Case A, Case B and Case C. No other commonality was found between cases, including no common staff among all three cases. The public health unit and the hospital agreed to remove this endoscope, identified as endoscope #17, from use until an investigation was complete.

Public health investigation

At the request of the public health, the hospital generated a list of patients who received a colonoscopy at the hospital within a defined time period. The suspect case definition used to generate this list included patients who had a colonoscopy procedure at the hospital with endoscope # 17 between March 17 and April 3, 2014. The time period used in this case definition was informed by the longer than expected incubation period reported by Dwyer et al (1987) (8) for transmission through colonoscopy. This produced a list of 24 people, not including the three people identified as cases.

Results of the health unit and hospital investigation were shared with PHO. PHO provided a procedure from the Public Health Agency of Canada (PHAC) (9) for sampling an endoscope to test for bacterial contamination. Several limitations were identified in the methodology; however, public health and the hospital agreed to proceed with this testing.

On Tuesday April 29, confirmation was received from PHO lab that all three cases were of the same genotype (phage type 8) and that the PFGE patterns were identical. Based on this information, the public health unit moved forward with active case finding and officially declared a suspect outbreak. Initial calls were to be made to patients who were scoped the same day and on all the days in between the cases with endoscope #17. If interviews yielded suspect cases, then the calling would widen to include the original range of dates found within the case definition. The rationale for this was to lessen the number of patients who may become worried or anxious until additional information was discovered which would necessitate contacting all patients exposed during the period of concern. An initial list of 14 patients was identified to be contacted.

RESULTS

The endoscope was sampled on May 1. Public health and the hospital performed the sampling. Sample results were received on May 7. No salmonella species was detected.

The patients were contacted and asked if they experienced symptoms of gastrointestinal upset before or after their procedure. It was anticipated that some patients would have been experiencing gastrointestinal symptoms before the procedure and these symptoms were the reason for the procedure. Since patients were required to do a pre-procedure colonic cleansing, the questions were also carefully worded to ask about any changes in the type or intensity of symptoms after the procedure. Patients were also asked if they would be willing to submit a stool sample for salmonella testing.

Of the 14 patients contacted, eight submitted a stool sample. All submitted samples were negative for salmonella.

None of the patients experienced fever after the procedure, which is a common symptom of salmonella infection. Of those that experienced abdominal pain and diarrhea, which are other common symptoms of salmonella infection, it was neither severe nor different from what they were experiencing before the procedure.

Based on these results, no further patients were contacted.

DISCUSSION

This outbreak supports the suggestions of Dwyer et al that transmission of salmonella can occur during colonoscopy with contamination occurring directly to the lower gastrointestinal tract and that when this occurs, the incubation period may be longer than with the usual ingestion route.

No further evidence of symptomatic or non-symptomatic salmonella infection was found among colonoscopy patients from the hospital who had a procedure performed with endoscope #17 during the time frame of the affected individuals. In addition, eight patients were lab tested for salmonella, all with negative results. While lab testing of patients was performed some weeks after they would have been expected to have salmonella if infected, carriers can shed the bacteria for years and 5 % of patients recovering from non-typhoidal salmonellosis can shed the bacteria for 20 weeks (10).

While culture results from endoscope #17 were negative for salmonella, the scope would have been cleaned and disinfected many times between the time period of suspect transmission and sampling.

The following recommendations were made to the hospital regarding infection prevention and control:

1. If a renovation opportunity arises, have separate rooms for clean and dirty endoscopes.
2. Purchase an additional hanger so that one endoscope does not need to be stored inside the automated disinfection machine.
3. Do not put endoscope #17 back into service until the supplier/manufacturer is notified of the occurrence of three identical salmonella infections in patients that occurred after receiving a colonoscopy with endoscope #17. The hospital is to follow the direction of the supplier/manufacturer.
4. Infection control staff should consider complete infection prevention and control audit of the endoscopy area as soon as possible.

CONCLUSION

While a definitive explanation was not found, it is clear that the occurrence of three cases of identical isolates of *Salmonella* enteritidis in three patients who all had a colonoscopy using the same endoscope within a period of eight days in the same hospital did not occur by chance. While Public Health Ontario laboratory data as of April 23, 2014 confirmed that PT8 was the most common PT seen in the year-to-date *Salmonella* enteritidis isolates, consisting of 32% of the 356 cases with PT results known, the availability of PFGE results which showed the isolates to be indistinguishable supports the conclusion that the similarity did not occur by chance alone.

Public health authorities investigating salmonella infections and infection prevention and control practitioners need to be vigilant for occurrences of salmonella infections following colonoscopy procedures so that the cause of these rare transmissions can be discovered and endoscope design and/or processing practices can be adjusted to prevent transmission of salmonella in the endoscope suite.

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