

Original Article

## Physician perspectives on vaccination and diagnostic testing in children with gastroenteritis: A primary care physician survey

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### Abstract

**Objectives:** Gastroenteritis remains a common paediatric illness. Little is known about physician knowledge of enteric pathogen diagnostic tests. At the time of study conduct, Alberta lacked a publicly funded rotavirus vaccination program and knowledge of primary care physician perspectives was lacking. We sought to ascertain diagnostic testing methods and to understand knowledge and perceptions regarding enteric pathogen vaccination.

**Methods:** A 30-item electronic survey was distributed across Alberta's five health care zones. The survey was developed by virology, microbiology, paediatrics, family medicine and public health experts. Participants were members of Alberta's Primary Care Networks, the TARRANT network and The Society of General Pediatricians of Greater Edmonton. Study outcomes included: (1) physician knowledge of available diagnostic tests, (2) perspectives regarding stool sample collection and (3) support for an enteric vaccine program.

**Results:** Stool culture was reported as the test to identify parasites (47%), viruses (74%) and *Clostridium difficile* (67%). Although electron microscopy and enzyme immunoassay were used to identify viruses in Alberta during the study period, only 20% and 48% of respondents respectively identified them as tests employed for such purposes. Stool testing was viewed as being inconvenient (62%; 55/89), whereas rectal swabs were thought to have the potential to significantly improve specimen collection rates (82%; 72/88). Seventy-three per cent (66/90) of the respondent physicians support the adoption of future enteric pathogen vaccines.

**Conclusions:** Simplification of diagnostic testing and stool sample collection could contribute to improved pathogen identification rates. Implementation of an enteric vaccine into the routine paediatric vaccination schedule is supported by the majority of respondents.

**Keywords:** *Diagnostic testing; Gastroenteritis; Primary care; Vaccination.*

Acute gastroenteritis remains a common cause of childhood mortality worldwide, claiming approximately 578,000 lives annually (1). Although mortality is very low in Canada, morbidity is significant with an estimated 240,000 children seeking emergency department (ED) care annually on account of gastroenteritis (2). Societal costs are enormous as each ED visit costs ~\$800 and a hospitalized child costs ~\$2700 (3).

Implementation of rotavirus vaccination programs has successfully resulted in a reduction in the incidence of rotavirus-related ED visits, hospitalizations and health care costs (4–7). However, a universal rotavirus vaccination program had not been included in Alberta's publicly funded health care system at the time of this study, despite endorsement by Canada's National Advisory Committee on Immunization in 2010 (8) (note: a vaccination program was implemented June 1, 2015). The delayed implementation of a program in Alberta could have been due to a lack of knowledge of the local pathogen-specific gastroenteritis epidemiology and disease burden (9).

Identifying the pathogens responsible for gastroenteritis symptoms has traditionally been challenging. The majority of affected patients do not seek medical care, stool samples are not always requested from those who seek care, and compliance with specimen collection is suboptimal (10). Diagnostic capabilities of routine laboratory testing and physician understanding of these test results, is limited. These issues contribute to under-reporting and a misrepresentation of disease burden.

Our objective was to ascertain physician understanding of the diagnostic tests used to identify various enteric pathogens and the ease of sample collection methods. Such knowledge is needed to drive changes in the diagnostic approach to gastroenteritis. Additionally, we sought to measure physician support for the implementation of an enteric pathogen vaccination program.

## METHODS

### Survey development

Physicians and researchers with clinical and academic expertise from the areas of paediatrics (S.B.F., B.L.), family medicine (J.A.D.), emergency medicine (S.B.F.) and microbiology/virology/infectious disease (M.L., L.C., X-L.P., B.L.), collaborated to develop survey content. The survey was designed to capture clinician knowledge and awareness of existing diagnostic tests used in Alberta and also knowledge of 'optimal' testing options available. Additionally, the survey aimed to obtain perspectives on the integration of an enteric vaccine into the existing local vaccine schedule. The final version of the survey was restricted to 30 questions and was designed for completion in 5 to 7 minutes. Before distribution, the survey was tested among 10 Alberta Provincial Pediatric Enteric Infection Team (APPETITE) members for face validity, content, relevance and time required for completion. Based on the feedback provided, the survey was revised accordingly. A limited number of survey results were included in a prior publication describing the rationale for the development of the APPETITE team (9).

### Survey setting and population

The province of Alberta has a population of 3.8 million and is divided into five health care zones with two-thirds of the population residing in two urban zones (Calgary and Edmonton). The survey was administered to physicians across all five health care zones (<http://www.albertahealthservices.ca/ahs-map-ahs-zones.pdf>) who were members of Alberta's Primary Care Networks (PCN), The Alberta Recording and Research Network (TARRANT) and The Society of General Pediatricians of Greater Edmonton. These groups were selected as they represent discrete target end-user physician groups who directly treat children with gastroenteritis. They were also felt to potentially have higher response rates than from unselected populations. Eligible participants had an email address and were members of one of the aforementioned networks.

Forty-six PCNs were listed on the Primary Care Initiative website when it was accessed in October 2013. Seven of the PCNs were listed as 'under development' or did not provide contact information online and were excluded from this study. Therefore, 39 PCNs representing 2492 physicians were invited to participate. Of these 39 PCNs, 18 PCNs representing 1106 physicians agreed to participate and confirmed sending out the survey to their physicians. Twenty-one PCNs declined participation or did not confirm sending out the surveys. Four of the PCNs that declined participation suggested that we contact their encompassing medical clinics directly, which resulted in 35 physicians from 9 clinics being sent the survey link. Thus, 1141 physicians, or 45.8% of the eligible PCN physician members, were contacted by these methods.

TARRANT is a province-wide influenza illness surveillance program and is composed of approximately 50 voluntary participating primary care physicians. The Society of General Pediatricians of Greater Edmonton is comprised of approximately 60 paediatricians.

### Survey distribution

A study team member called each PCN and explained the purpose of the survey to administrative personnel. PCNs that agreed to participate distributed the survey to their physicians with an initial email containing the survey link, followed by three reminder emails spaced ~1 week apart. PCN administrative staff were subsequently contacted to ensure that survey links were distributed. Two participating PCNs distributed the link within their newsletter. In keeping with the administrative infrastructure required by these PCNs, survey distribution was performed by an administrator within each network, thereby prohibiting our group's ability to track emails and reminders sent.

The head of the TARRANT network (J.A.D.) is a member of our research group and agreed to distribute the survey link and three reminder emails to all members. The chair of The Society of General Pediatricians of Greater Edmonton is affiliated with a member of our research group (B.L.), and agreed to distribute the survey link and three reminder emails to all members. Again, survey distribution was performed by an administrator within each network, thereby prohibiting our group's ability to track emails and reminders sent.

The final 30-question survey was administered between October 2013 and January 2014 using REDCap™ (Research Electronic Data Capture).

### Data analysis

Qualitative analysis of the data was performed. The results presented include respondent demographics and perspectives on three domains: knowledge needs surrounding diagnostic tests to detect pathogens, stool sample collection methods and implementation of enteric virus vaccination programs. Responses are summarized as frequencies. Likert scale responses (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree) were offered to collect respondents' perspectives. While the raw data is presented in tabular format, manuscript text grouped together 'strongly agree' with 'agree', and 'strongly disagree' with 'disagree' to facilitate and clarify the interpretation of the responses received.

## RESULTS

### Demographics

Of the 1251 physicians who were provided the survey link, 92 (7.4%) completed the survey, including 78 family physicians, 9 paediatricians, 3 physicians who indicated their field of training as 'other' and 2 physicians who abstained from answering this question. Surveys were collected from 18 physicians (19.6%) from the North zone, 9 (9.8%) from the Edmonton zone, 5 (5.4%) from the Central zone, 52 (56.5%) from the Calgary zone and 8 (8.7%) from the South zone. Fifty-eight per cent (53/91) of the respondents described their practice as 'all urban' or 'mostly urban'.

## Knowledge needs

To identify self-perceived gaps related to diagnostic testing modalities, respondents evaluated their comfort with ordering tests to identify bacteria, viruses and parasites in stool (Table 1). Ninety-one per cent (81/89) of the respondents claimed that they are aware of the tests available to identify bacterial and parasitic pathogens. Fifty-one per cent (44/87) reported that they possess sufficient knowledge to order tests to identify viruses. Seventy-six per cent (68/90) of the respondents believe that enhancing their knowledge of viral pathogens would enable them to provide better care and guidance.

Respondent physicians were asked to identify diagnostic tests that (a) are currently used and (b) are optimal, to identify stool pathogens (Table 2). Although EM and EIA were used to evaluate viruses in stool samples in Alberta during the study period (11), only 20% and 48% of respondents identified EM and EIA respectively as tests they could request for these purposes. Culture was correctly identified by 99% of the respondents as the available test to identify bacterial stool pathogens, however, culture was also incorrectly chosen as a modality to diagnose viruses (74%), parasites (47%) and *C. difficile* (67%) in stool. Additionally, PCR is the diagnostic modality with the greatest ability to identify all discussed stool pathogens, but was only selected as the best modality to identify bacteria, viruses, parasites and *C. difficile* by 22%, 40%, 8% and 29% of the respondents, respectively.

## Stool sample collection

Though 77% (69/90) of the respondents agreed that children with diarrhea and vomiting can be seen on the same day in their practice, 62% (55/89) believe that current methods of stool sample collection for diagnostic testing are inconvenient and 82% (72/88) indicated that specimen submission rates would improve if rectal swab samples could be submitted for testing. Furthermore, 40% (36/90) of the physicians agreed that current stool sample testing methods lack sensitivity and do not provide results in a timely manner (Table 3).

## Vaccination perceptions

Seventy-three per cent (66/90) of the physicians support an enteric vaccine program however, 82% (71/87) stated that a requirement for the addition of such a vaccine into the provincial vaccination schedule should include evidence of cost-effectiveness (Table 4).

## DISCUSSION

The survey indicated that there is room for improvement in the understanding of available and optimal diagnostic test options to detect enteric pathogens. Although the vast majority of the respondents claim that they possess adequate

knowledge of the tests available to identify bacterial and parasitic pathogens, only one-half claim that they are aware of tests to identify viruses. This disparity uncovers a need for increased knowledge of viral pathogens and the methods by which they can be diagnosed. Limited testing and identification of fecal viral pathogens in Alberta may be connected to knowledge gaps we identified regarding diagnostic tests.

Diagnostic testing based on stool collection impedes pathogen identification in community practice. Our survey identified that physicians believe that rectal swab use would increase convenience and sample collection rates. Such an approach has been used to identify enteric pathogens and it may be as sensitive as stool (12). Rectal swab use could therefore improve our understanding of the pathogen-specific burden of disease.

Another target for improvement relates to microbiology requisitions which often require physicians to select tests from a list. Such a process does not directly ask what organism physicians are seeking or what the clinical context is—such approaches could better link clinical needs and microbiologic tests. Given that most clinicians have limited knowledge of likely pathogens and recent advances in microbiologic testing procedures, a gap is created between clinical needs and the tests requested. This challenge has been identified (13) and an alternative to changing the approach to test ordering may be the use of assays that test for a broad range of the most common disease causing pathogens. One such example is the The Luminex Gastrointestinal Pathogen Panel (xTAG<sup>®</sup> GPP) that detects in one assay adenovirus 40/41, norovirus genogroup I/II, rotavirus A, *Clostridium difficile* toxin A/B, *Campylobacter* sp., *Escherichia coli* O157, Enterotoxigenic *E. coli* heat-labile enterotoxin/heat-stable enterotoxin, *Salmonella* sp., Shiga-toxin producing *E. coli*, Shiga-like toxin (Stx)1/2, *Shigella* sp., *Vibrio cholerae*, *Yersinia enterocolitica*, *Cryptosporidium* sp., *Entamoeba histolytica* and *Giardia* sp. However, such approaches also present challenges for clinicians with respect to interpretation.

We found that 73% of the respondent physicians support the addition of a gastroenteritis vaccine into Alberta's vaccination schedule. Our survey adds to the existing literature which reported that only 53% of the Canadian paediatricians recommend the administration of a rotavirus vaccine and 59% endorse the implementation of a publicly funded vaccination program (14). A recent study reported that Canadian physician endorsement of rotavirus vaccination is the lowest of the seven vaccines evaluated (15). Our findings demonstrate that physician endorsement of a gastroenteritis vaccine is far from universal. This knowledge is important since physician opinion plays a major role in vaccine uptake (16). One possible explanation for the low endorsement rate may relate to the limited ability to identify a pathogen and hence a lack of direct connection between episodes of rotavirus and severe gastroenteritis symptoms. Additionally in Canada, rotavirus infections are associated with very low mortality rates compared to elsewhere in the world.

**Table 1.** Perceived knowledge needs

	Strongly agree; n (%)	Agree; n (%)	Neither agree or disagree; n (%)	Disagree; n (%)	Strongly disagree; n (%)
My knowledge of the epidemiology of childhood gastroenteritis is adequate to enable me to properly investigate and treat affected children.	4 (4.4%)	67 (74.4%)	13 (14.4%)	5 (5.6%)	1 (1.1%)
Increasing my knowledge of childhood gastroenteritis viral pathogens and their roles in childhood gastroenteritis would enable me to provide better care and guidance to patients and their families.	26 (28.9%)	42 (46.7%)	20 (22.2%)	1 (1.1%)	1 (1.1%)
I am aware of the test(s) that I can request to identify bacterial and parasitic pathogens in the stool.	22 (24.7%)	59 (66.3%)	3 (3.4%)	4 (4.5%)	1 (1.1%)
I am aware of the test(s) that I can request to identify gastroenteritis viruses.	6 (6.9%)	38 (43.7%)	23 (26.4%)	18 (20.7%)	2 (2.3%)

Respondents were asked the following questions and were allowed to select only one option.

**Table 2.** Understanding the laboratory diagnostic tests available to detect gastroenteritis pathogens

	Electron microscopy	Enzyme immunoassay	Polymerase chain reaction	Culture	Direct Examination
<sup>†</sup> Which of the following tests can be requested by primary care providers in Alberta to identify gastroenteritis viruses in stool samples?	<b>19.8%</b>	<b>47.7%</b>	48.8%	74.4%	24.4%
Which of the following test options has the greatest ability to identify norovirus infection in stool samples?	5.9%	28.2%	<b>40%</b>	25.9%	0%
<sup>†</sup> Which of the following tests can be requested by primary care providers in Alberta to identify bacterial pathogens in stool samples?	5.7%	17%	17%	<b>98.9%</b>	29.5%
Which of the following test options has the greatest ability to identify bacterial pathogens in stool samples?	3.5%	10.5%	<b>22.1%</b>	60.5%	3.5%
<sup>†</sup> Which of the following tests can be requested by primary care providers in Alberta to identify parasitic pathogens in stool samples?	7%	<b>14%</b>	5.8%	46.5%	<b>87.2%</b>
Which of the following test options has the greatest ability to identify parasitic pathogens in stool samples?	9.5%	14.3%	<b>8.3%</b>	21.4%	46.4%
<sup>†,*</sup> Which of the following tests can be requested by primary care providers in Alberta to identify <i>Clostridium difficile</i> in stool samples?	0%	<b>42.7%</b>	<b>30.5%</b>	67.1%	4.9%
<sup>*</sup> Which of the following test options has the greatest ability to identify <i>C. difficile</i> in stool samples?	3.6%	<b>35.7%</b>	<b>28.6%</b>	32.1%	0%

Correct answers are bolded.

<sup>†</sup>Respondents were asked the following questions and were allowed to select as many responses as they deemed appropriate. For all other questions, respondents were only able to select one option. <sup>\*</sup>Both enzyme immunoassay and polymerase chain reaction are acceptable answers as they are currently performed as part of a bundled test sequence that starts with enzyme immunoassay which, if positive, is followed by polymerase chain reaction. It should also be noted that certain laboratories will sometimes use culture to identify *C. difficile* pathogens in samples for typing purposes.

**Table 3.** Stool sample collection

	Strongly agree; n (%)	Agree; n (%)	Neither agree or disagree; n (%)	Disagree; n (%)	Strongly disagree; n (%)
Current methods of stool sample collection are easy and convenient for caregivers.	0 (0%)	8 (9%)	25 (28.1%)	48 (53.9%)	7 (7.9%)
Convenience (for caregivers) and the rate of specimen submission would be improved if rectal swab samples (performed by health care provider) could be submitted for testing.	31 (35.2%)	41 (46.6%)	12 (13.6%)	2 (2.3%)	2 (2.3%)
Current stool sample testing methods are sensitive and provide results in a timely manner to impact on clinical care.	3 (3.3%)	15 (16.7%)	36 (40%)	31 (34.4%)	5 (5.6%)
Children with new onset vomiting or diarrhea can be seen the same day.	20 (22.2%)	49 (54.4%)	13 (14.4%)	7 (7.8%)	1 (1.1%)

Respondents were asked the following questions and were allowed to select only one option.

Limitations of this study include a very low response rate, which may have resulted in respondent bias. Although physicians across all of Alberta's five health care zones participated, selection bias must always be considered as physicians with strong opinions might have been more likely to participate. Family physicians and paediatricians were invited to participate in the survey in an attempt to promote the generalizability, however this approach also introduced heterogeneity. In Alberta, these two groups of physicians along with emergency room physicians directly treat children with gastroenteritis, and

therefore combining the groups is appropriate. Lastly, subanalyses by group were planned, but due to the low response rate they were not practical.

## CONCLUSIONS

Challenges with stool collection and test ordering could minimize the perception of the pathogen-specific burden of disease and may contribute to limited vaccine support. Our data support the notion that simplified stool testing and

**Table 4.** Vaccination perceptions

	Strongly agree; n (%)	Agree; n (%)	Neither agree or disagree; n (%)	Disagree; n (%)	Strongly disagree; n (%)
I would be interested in employing a vaccine against the most common virus(es) causing gastroenteritis in AB (i.e., adding it to the routine vaccine schedule).	27 (30%)	39 (43.3%)	21 (23.3%)	1 (1.1%)	2 (2.2%)
Parents/guardians of my paediatric patients would be interested in adding a gastroenteritis vaccine to the routine schedule.	12 (13.5%)	36 (40.4%)	37 (41.6%)	1 (1.1%)	2 (2.2%)
I believe that a requirement for the addition of a gastroenteritis vaccine into the provincial vaccination schedule should include evidence of cost-effectiveness (i.e., result in cost-savings to the government)	42 (48.3%)	29 (33.3%)	13 (14.9%)	2 (2.3%)	1 (1.1%)

Respondents were asked the following questions and were allowed to select only one option.

collection procedures may improve our knowledge and understanding of the value of immunization, while enhancing the ability to identify enteric infections in children.

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