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Pediatric Astrovirus Gastroenteritis: One-Year Prospective Irish Study

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Astrovirus (AsV) was first detected in 1975 after a diarrheal upsurge in humans[1] and is a significant cause of gastroenteritis (GE) in young children globally.[2] Their name refers to the Greek word "astron" meaning star. They are non-enveloped RNA viruses with cubic capsids, about 28-35 nm in diameter.[3]

The chief manifestations are diarrhea, but nausea, vomiting, fever, malaise, and abdominal pain may occur, following an incubation period of about 3-4 days. Diagnosis can be made by electron microscopy, enzyme-linked immunosorbent assay (ELISA), immunofluorescence, polymerase chain reaction (PCR),[4] and real-time reverse transcription (RT)-PCR.[5]

Astrovirus causes endemic childhood diarrhea; worldwide, it is responsible for 3-9% of diarrheal illness.[6,7] Transmission is primarily person to person via the fecal–oral route and also via contaminated food and water.[7,8] In temperate regions, there is a peak in infection during winter months; in tropical regions, infection occurs most frequently during rainy seasons.[9,10]

Astrovirus is responsible for 4-7% of diarrheal illness in childcare centers and in the community[11] and has been associated with nosocomial disease in up to 16% of cases.[12]

In this study, data were analyzed monthly regarding AsV GE in children ≤3 years old, predicated on the result of viral testing performed in the National Virus Reference Laboratory (NVRL) in Dublin, Ireland. Data were analyzed regarding age, gender, AsV season, AsV disease virulence, and its dual infection with other viruses.

We recruited, prospectively from November 18, 2016, to November 18, 2017, all children ≤3 years old who presented to the emergency department or were hospitalized with vomiting and diarrhea, all hospitalized children developing diarrhea 3 days (72 hours) following hospitalization, probable nosocomial infection, and all children ≤3 years old re-hospitalized within 48 hours after recent discharge, possible nosocomial infection.

We excluded parents declining participation, children with chronic diarrhea owing to other conditions, for example, immunodeficiency or inflammatory bowel disease, and children with similar presentation within a 48-hour period.

The following definitions were used:

The median (M) of positive stool samples for AsV: the total number of AsV-positive stool samples in 2 successive weeks divided by 2. The median percentage of AsV-positive stool samples: the median of positive stool samples for AsV in 2 successive weeks divided by the total number of stool samples analyzed for AsV during the same period.

Peak of AsV season: any 2 successive weeks in any month with the highest value of the median percentage of AsV-positive stool samples.

End of AsV season: any 2 successive weeks in any month with the median percentage of AsV-positive stool samples less than 10%.

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Table 1. Astrovirus Season—Total Request and Short Episode of Infection

Month	Week (W)	Total AsV (R)	AsV Positive	Median AsV Positive	Median Positive AsV %	Notes	Duration of Season or (EOI) (WK)
November 18-30	W3-4	2	0	0	0		
	W4-5	1	0	0	0		
November/December	W5/W1	4	1	0.5	12.5	First EOI	2
December	W1-2	9	1	0.5	5.6		
	W2-3	8	0	0	0		
	W3-4	9	0	0	0		
	W4-5	6	0	0	0		
December/January	W5/W1	0	0	0	0		
January	W1-2	2	0	0	0		
	W2-3	7	0	0	0		
	W3-4	7	0	0	0		
	W4-5	5	1	0.5	10	Onset S1	4
January/February	W5/W1	6	2	1	16.7	Peak S1	
February	W1-2	4	1	0.5	12.5	S1	
	W2-3	3	0	0	0	End S1	
	W3-4	6	0	0	0		
	W4-5	6	1	0.5	8.3		
February/March	W5/W1	5	1	0.5	10	Second EOI	2
March	W1-2	8	0	0	0		
	W2-3	9	0	0	0		
	W3-4	6	0	0	0		
	W4-5	4	0	0	0		
March/April	W5/W1	3	0	0	0		
April	W1-2	7	0	0	0		
	W2-3	9	0	0	0		
	W3-4	6	0	0	0		
	W4-5	7	0	0	0		
April/May	W5/W1	10	0	0	0		
May	W1-2	11	1	0.5	4.5		
	W2-3	9	2	1	11	Third EOI	2
	W3-4	8	1	0.5	6.3		
	W4-5	5	0	0	0		
May/June	W5/W1	2	0	0	0		
June	W1-2	5	1	0.5	10	Fourth EOI	2
	W2-3	9	1	0.5	5.6		
	W3-4	11	0	0	0		
	W4-5	6	0	0	0		
June/July	W5/W1	0	0	0	0		
July	W1-2	3	0	0	0		
	W2-3	7	0	0	0		
	W3-4	8	0	0	0		
	W4-5	6	0	0	0		
July/August	W5/W1	7	0	0	0		
August	W1-2	9	0	0	0		
	W2-3	4	0	0	0		
	W3-4	1	0	0	0		
	W4-5	2	0	0	0		
August/September	W5/W1	2	0	0	0		
September	W1-2	3	0	0	0		
	W2-3	3	0	0	0		
	W3-4	2	0	0	0		
	W4-5	1	0	0	0		
September/October	W5/W1	2	0	0	0		

(*Continued*)

Month	Week (W)	Total AsV (R)	AsV Positive	Median AsV Positive	Median Positive AsV %	Notes	Duration of Season or (EOI) (WK)
October	W1-2	3	0	0	0		
	W2-3	1	0	0	0		
	W3-4	2	0	0	0		
	W4-5	2	0	0	0		
October/November	W5/W1	0	0	0	0		
November 1-18	W1-W2	1	0	0	0		
	W2-W3	3	0	0	0		

AsV, astrovirus; S, season; R, request; EOI, episode of infection.

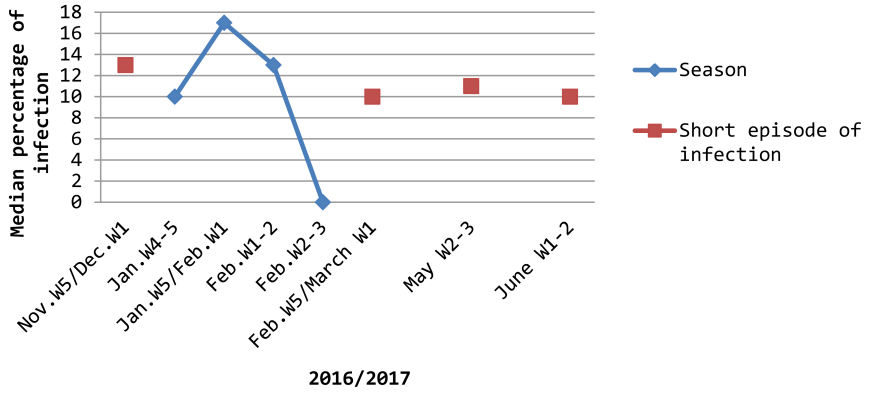

Figure 1. 2016-2017 Astrovirus season and short episode of infection—Onset, peak, end, and median % of infection.

A short episode of AsV infection (EOI): no "peak" of AsV infection, duration is shorter than 3 weeks with a quick onset and a quick end, and the median percentage of AsV-positive infection is less than 10% in the 2 successive weeks following AsV onset of infection.

Consent was granted from carers of participating children who were provided with information leaflets (Supplementary Material 1), showing the objectives of the study.

In the NVRL in Dublin, stool samples were checked for AsV and other viruses (rotavirus (RV), norovirus (NoV), and sapovirus) by RT-PCR of viral RNA genome and PCR of DNA genome of adenovirus F.

Vesikari Scoring System (Supplementary Material 2) evaluated disease severity.

Among a total number of 150 samples analyzed for AsV and other viruses, 7 stool samples tested positive for AsV (5%), 4 were females (57%), 4/7 were infants. No week peak of AsV GE infection was detected. The majority of cases were with moderate GE (57%), 29% severe, and 14% mild. No nosocomial infections were detected. Dual infection was confirmed in 2 patients of AsV GE, 2 were infants, 1 male, both due to co-infection with NoV GI & NoV GII (1 strain in each case).

Only 1 season and 4 brief episodes of AsV infections (EOI) were determined in 2016-2017 (Table 1, Figure 1).

Astrovirus GE occurs primarily in children younger than 4 years; AsV GE usually occurs in the winter months.[13,14] Astrovirus GE season started in late January and early February with a peak of 16.7%. The duration of AsV season was brief (4 weeks). Short episodes of AsV infections were determined during the year (March, May, and June), and each of these episodes persisted for 2 weeks. Our study demonstrated that AsV is rare, confirmed in 7 cases (5%) of all cases of GE, nearly similar to other studies including the Irish data acquired from the NVRL in Ireland (July 2014-June 2015).[6,7,15] Viral dual infection may occur, mostly with NoV or RV,[13] and may not be necessarily associated with severe GE, similar to our study. Unlike reports of nosocomial infection with AsV in other studies,[12] no nosocomial infections were detected in our study. The low proportion of nosocomial viral infection may be owing to a few subjects from only 1 geographic site during 1 year of analysis and probably owing to strict adherence to hygienic guidelines in our hospital.

We declare that a small number of samples in 1 center only can affect the reliability of our results. The amount of our positive samples is also not sufficient to interpret the results using formal statistical methods, and we also acknowledge this limitation.

However, our study was the first to look into AsV regionally in Ireland, assessing its seasonal trends and frequency, disease virulence, and dual infection with other viruses. We recommend future research in wider areas for proper analysis of seasonal trends of AsV. We hope that our study may guide future research in our country.

Ethical Committee Approval: Ethics committee approval was received for this study from Mayo University Hospital (TOM/DP).

Informed Consent: Informed consent was obtained from all individual participants included in the study.

Peer Review: Externally peer-reviewed.

Author Contributions: Concept, Design, Literature Search, Writing - Z.B.

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SUPPLEMENTARY MATERIAL 1 INFORMATION LEAFLET & CONSENT FORM

Dear Parents,

Rotavirus (RV) is the commonest cause for diarrhoea (loose stool) in childhood. RV can lead to excessive water loss and weakness of your child. RV commonly affects children younger than three years of age. There is a significant financial burden associated with RV infection both to you and the state.

RV vaccine has been introduced as part of Irish childhood immunisation programme to protect your child from RV disease.

This study will look at the frequency of rotavirus and other viruses that can cause diarrhoeal disease in children in our community. The study will look at how the vaccine will work. A stool sample is part of routine clinical care of all children presenting with loose stool. There will be no other extra tests and no blood testing will be required. For the study to be conducted, I need to collect a stool sample from your child to be tested for rotavirus and other viruses.

Once results are available, I will notify you if you wish.

All information about your child will be kept confidential.

You can choose to opt out of this research at any time.

Thank you for your co-operation.

Primary investigator

Are you willing to participate in this study and allow us to obtain a stool sample from your child for rotavirus and other virus testing?

Please circle your answer.

Please print your name, date and sign.

1-Yes **2-No**

Name: _____
_____

Signature: _____
_____

Date: _____
__/_____/_____

Supplementary Material 2. Vesikari Clinical Severity Scoring System

Parameter	**Score**		
	1	**2**	**3**
Diarrhea			
Maximum number of stools/day	1–3	4–5	6 or more
Diarrhea duration (days)	1–4	5	6 or more
Vomiting			
Maximum number vomiting episodes/day	1	2–4	5 or more
Vomiting duration (days)	1	2	3
Temperature	37.1–38.4	38.5–38.9	39 or more
Dehydration	N/A	1–5%	6% or more
Treatment	ORT therapy	Hospitalization or IV hydration	N/A
Total score			
Severity category	Mild	Moderate	Severe
	<7	7–10	11 or more
Severity score			

IV, intravenous ORT, oral rehydration therapy.