BMC Gastroenterology

RESEARCH

Open Access

Clinical and microbiological profile of patients with diarrhea evaluated using the gastrointestinal panel in a high-complexity center

Jorge Andrés Salazar-Arenas[1], Leidy Johanna Hurtado-Bermúdez[2,3], Edgar David Salazar-Cardona[2], Nelson Enrique Rojas-Rojas[3], Juan Felipe Cubides-Martinez[3], Juan David Toro-Palma[3], Valeria Zúñiga-Restrepo[3] and Carlos Arturo Rojas-Rodríguez[1,3*]

Abstract

Introduction Gastrointestinal infections represent a worldwide public health problem. In Colombia, the incidence reaches 21.4 cases per 1,000 inhabitants. Given the limitations of traditional diagnostic methods in terms of sensitivity and specificity, the gastrointestinal panel (GIP) has emerged as a promising tool, allowing rapid detection of 22 pathogens. This study aimed to describe the clinical and microbiological characteristics of immunosuppressed and immunocompetent adult patients with diarrhea and the influence of the gastrointestinal panel in their treatment in a high-complexity hospital in Colombia.

Materials and methods A cross-sectional observational study was carried out including 350 adult patients treated at the Fundación Valle del Lili hospital between 2021 and 2022. Demographic and clinical variables, GIP findings and treatment were analyzed by univariate and bivariate analysis. We compare immunocompromised and immunocompetent adult patients using Chi-square tests, Fisher's F test for qualitative variables, Student's t-test, and the Mann-Whitney U test for quantitative variables. A significance level of 5% was applied to demonstrate the significance of the variables in all the tests used.

Results The results showed that 52% were men, with an average age of 52 years. 72.0% presented acute diarrhea, being inflammatory in 60.1%. 39.1% of the patients were immunosuppressed, mainly transplant recipients (31.3%). 53% of the GIPs were positive, with up to 5 pathogens per sample. Bacteria were detected in 80%, viruses in 14.4%, and parasites in 5.5%. The most frequent bacteria were enteropathogenic *E. coli* (43.0%), enteroaggregative *E. coli* (18.6%), and *C. difficile* (17.4%). Norovirus was the predominant virus (67.7%) and *Cryptosporidium* the most common parasite (41.7%). A higher frequency of *Vibrio spp.* was observed in non-immunosuppressed patients ($p=0.004$) and of enterotoxigenic *E. coli* in immunosuppressed patients. 41.0% of patients received antibiotic/antiviral therapy, 83% empirically. GIP influenced the treatment of 56.7% of patients, with a 90.0% recovery rate.

*Correspondence:
Carlos Arturo Rojas-Rodríguez
carlos.rojas@fvl.org.co

Full list of author information is available at the end of the article

Conclusion This study confirms that GIP is a valuable diagnostic tool in the management of adult patients with diarrheal disease, particularly in immunocompromised patients. In our setting it is still a costly and difficult to access test, which makes it necessary to standardize the indications for its application. Future studies could evaluate its cost-effectiveness in our context.

Keywords Gastrointestinal panel, Diarrhea, Microorganisms, Gastrointestinal infections

Introduction

Gastrointestinal infections are a global public health problem, being one of the ten leading causes of mortality. Despite advances in health policies, there are an estimated 6 to 60 billion gastrointestinal infections globally [1, 2]. In the United States, 179 million episodes of diarrheal diseases are reported annually, resulting in 500,000 hospitalizations and 5,000 deaths [3]. In Colombia, the incidence is 21.4 cases per 1,000 inhabitants [4].

Diagnosis has been based on clinical history, physical examination and conventional laboratory tests, which can be slow and lack sensitivity and specificity [5]. Classical methods such as microbiological culture identify only 25% of the etiologic agents of diarrhea, are costly and difficult to access [6, 7].

In recent years, molecular biology techniques such as the gastrointestinal panel (GIP), a multiplex PCR system approved by the FDA in 2014, have been introduced. This method allows rapid detection of 22 bacterial, viral and protozoan pathogens in approximately one hour, with higher sensitivity and specificity than standard methods [8–10].

Studies in the United States, Italy, and Chile have demonstrated clinical benefits of GIP, including a reduction in the time to initiation of targeted antibiotic therapy and hospital stay [2, 10–12]. However, in Colombia, the evidence on its application and usefulness is limited, especially in immunosuppressed adult populations.

This study aimed to describe the clinical and microbiological characteristics of immunosuppressed and immunocompetent adult patients with diarrhea and the influence of the gastrointestinal panel in their treatment in a high-complexity hospital in southwestern Colombia.

Materials and methods

Study design and selection criteria

This is an observational cross-sectional study. Patients of both sexes, adults over 18 years of age, treated at the Fundación Valle del Lili hospital between 2021 and 2022 in whom GIP was performed in fecal samples due to diarrhea were included, regardless of admission diagnosis, age, sex or comorbidities. No patients were excluded.

Variables

Demographic, clinical, GIP findings and treatment variables were considered, including gender, age, immunosuppression, type of diarrhea, and antibiotic/antiviral administration before and after the test, change or suspension of treatment. In this study, inflammatory diarrhea is diarrhea that clinically presents with blood or mucous discharge. The immunosuppressed patient is the one with a disease or medications that compromise their immune status. About the diarrhea's classification, it was made according to its chronology, understanding that acute diarrhea is the one that lasts less than 7 days, persistent diarrhea lasts from 7 to 30 days and chronic diarrhea lasts more than 4 weeks.

All clinical data and microbiological results were obtained directly from institutional reports and/or the patient's clinical history, which were entered into electronic software maintained by the institution's clinical research center.

Sample size and statistical analysis

Sample size was calculated considering that GIP detects at least one pathogen in 50% of the cases, an estimated error of 5% and a significance level of 5%. A total of 350 patients were included. The descriptive statistical analysis summarized the information of the quantitative variables with mean and standard deviation or median with interquartile range according to their distribution. The Kolmogorov Smirnov test was used to evaluate the normality of the variables. Qualitative variables are presented with absolute and relative frequencies. Bivariate analysis included observing the relationship between patients under immunosuppression and those not under immunosuppression. Chi-square or Fisher's F tests were performed for qualitative variables and t-test (under normal distribution) or Mann Whitney test (when normal could not be assumed) for quantitative variables. P-values < 0.05 were considered significant. The relationship between the different microorganisms detected and the demographic and clinical characteristics of the patients was also observed. The statistical analysis described above was performed in the Stata package version 16.0.

Results

Demographically, 52% were male and 48% were female. The average age was 52 years. Regarding clinical presentation, acute diarrhea was present in 72% of the patients, while persistent and chronic diarrhea were present in 14% of the patients, respectively. Inflammatory diarrhea was present in 60.1%. 90% of the tests were performed in the hospital setting (Table 1).

Table 1 Demographic and clinical characteristics of patients with diarrhea disease at the hospital Universitario Fundación Valle Del Lili between 2021 and 2022

Features	General	Immunosuppression Status		*p*-value
	n = 350	Yes, *n* = 211	No, *n* = 139	
		Demographics		
Gender				
Male	182 (52.0)	114 (54.0)	68 (48.9)	0.349†
Female	168 (48.0)	71 (51.1)	97 (45.9)	
Age in years**	52.5 (30.0)	53 (28.0)	52 (33.0)	> 0.9&
		Classification of diarrhea		
Type of diarrhea				
Acute	252 (72.0)	152 (72.0)	100 (71.9)	
Persistent	49 (14.0)	29 (13.8)	20 (14.4)	> 0.9†
Chronic	49 (14.0)	30 (14.2)	19 (13.7)	
Inflammatory diarrhea				
Yes	172 (60.1)	105 (63.6)	67 (55.4)	0.158†
No	114 (39.9)	60 (36.4)	54 (44.6)	
Test site				
Hospitalization	250 (71.8)	148 (70.8)	102 (73.4)	
ICU	63 (18.1)	41 (19.6)	22 (15.8)	0.65†
Ambulatory	35 (10.1)	20 (9.6)	15 (10.8)	

**Median (interquartile range). *Mean (standard deviation) & Mann Whitney † Chi squared Test ^ Fisher Test

90.6% presented with a comorbidity or an associated health condition, with malignancy being the most frequent (28.4%), followed by transplant recipient status (24.3%). Other gastrointestinal comorbidities such as Inflammatory Bowel Disease and colitis/proctitis were found in 10.4% of the patients. (Additional file 1). 39.1% of all the patients had some type of immunosuppression, most commonly after transplant reception (31.3%), followed by hematologic neoplasia (21.3%), and HIV infection (18.5%) (Additional file 2).

Of the 350 gastrointestinal panels performed, 188 (53%) were positive, with a maximum of five pathogens identified in a single sample. A total of 215 microorganisms were detected, distributed as follows: 80% bacteria ($n = 172$), 14.41% viruses ($n = 31$) and 5.58% parasites ($n = 12$). Of the studies, 64.4% identified a single microorganism, 21.8% two pathogens, and 13.8% three or more infectious agents.

Among bacteria, the three most frequent were enteropathogenic *Escherichia coli* (43.0%), enteroaggregative *E. coli* (18.6%), and *Clostridioides difficile* (17.4%). In viral infections, norovirus was predominant (67.7%), with a maximum of two viruses per patient. As for parasites, *Cryptosporidium* was the most common (41.7%), with a maximum of one parasite detected per patient (Table 2).

When comparing the groups of immunosuppressed and non-immunosuppressed patients, it was observed that *Vibrio spp.* was ne times more frequent in the non-immunosuppressed group (10.1% vs. 2.8%), this difference being statistically significant ($p = 0.004$), while enterotoxigenic *E. coli (*ETEC*)* was more prevalent in immunosuppressed patients (4.7% vs. 1.4%; $P = 0.097$) however, this difference was not statistically significant (Table 2).

When comparing the microorganisms identified with demographic and clinical characteristics, a higher frequency of EPEC, norovirus, and rotavirus was observed in men compared to women ($p < 0.05$). By age, it was evidenced that norovirus affected individuals with an average age of 40 years, while rotavirus manifested in older individuals, with an average age of 67 years, this difference being statistically significant ($p < 0.05$). Although no differences were observed by type of immunosuppression, it is noteworthy that more parasites were detected in transplant patients, viruses in patients with solid neoplasms, and more bacteria in patients with HIV (Table 3).

When observing whether there was any difference between demographic characteristics and having a positive or negative test result, statistically significant differences were found only by sex, while 61.2% of men had a positive test result, in women it was only 38.8% ($p < 0.05$) (Additional file 3).

Regarding treatment, 41% of patients received antibiotic/antiviral management, of which 83% ($n = 117$) initially had empirical management. The results of the panel had an impact on 56.7% ($n = 195$) of the patients, as follows: 45.6% continued without antibiotic/antiviral management, 19.5% continued with the antibiotic indicated empirically, 13.3% required a change of antibiotic, 12.3% were started on antibiotics and 9.2% had their treatment suspended (Table 4). It was found that the initiation of initial treatment was more frequent in immunosuppressed patients (44.7% vs. 35.3%; $p = 0.082$), however,

Table 2 Microorganisms identified in the PGI in fecal material in patients with diarrheal disease at the hospital Universitario Fundación Valle Del Lili between 2021 and 2022

Features	General	Immunosuppression Status		*p*-value
	n = 350	Yes, *n* = 211	No, *n* = 139	
		PGI Findings		
Test result				
Positive	188 (53.7)	110 (521)	78 (56.1)	0.465†
Negative	162 (46.3)	101 (47.9)	61 (43.9)	
Number of pathogens identified	188 (53.7)			
One (1)	121 (64.4)	70 (63.6)	51 (65.4)	0.063^
Two (2)	41 (21.8)	25 (22.7)	16 (20.5)	
Three (3)	18 (9.6)	8 (7.3)	10 (12.8)	
Four (4)	7 (3.7)	7 (6.4)	0 (0)	
Five (5)	1 (0.5)	0 (0)	1 (1.3)	
		Bacteria		
Number of bacteria identified	172 (49.1)			
EPEC	74 (43.0)	48 (22.7)	26 (18.7)	0.365†
EAEC	32 (18.6)	22 (10.4)	10 (7.2)	0.305†
C. difficile	30 (17.4)	16 (7.6)	14 (10.1)	0.416†
Campylobacter spp	28 (16.3)	14 (10.1)	14 (6.6)	0.246†
Vibrio spp	20 (11.6)	6 (2.8)	14 (10.1)	**0.004**†
Shigella spp/EIEC	20 (11.6)	13 (6.2)	7 (5.0)	0.657^
Salmonella spp	13 (7.6)	8 (3.8)	5 (3.6)	> 0.9^
ETEC	12 (7.0)	10 (4.7)	2 (1.4)	0.097^
STEC	9 (5.2)	4 (1.9)	5 (3.6)	0.325^
P. shigelloides	6 (3.5)	2 (1.0)	4 (2.9)	0.174^
Y. enterocolitica	2 (1.2)	1 (0.5)	1 (0.5)	> 0.90^
		Virus		
Number of identified viruses	31 (8.9)			
Norovirus	21 (67.7)	15 (7.1)	6 (4.3)	0.282^
Rotavirus	5 (16.1)	3 (1.4)	2 (1.4)	> 0.9^
Astrovirus	3 (9.6)	1 (0.5)	2 (1.4)	0.566^
Sapovirus	3 (9.6)	3 (1.4)	0 (0.0)	0.28^
		Parasite		
Number of parasites identified	12 (3.4)			
Cryptosporidium spp	5 (41.7)	3 (1.4)	2 (1.4)	> 0.9^
E. histolytica	3 (25.0)	2 (0.9)	1 (0.7)	> 0.9^
C. cayetanensis	2 (16.6)	1 (0.7)	1 (0.7)	> 0.9^
G. lamblia	2 (16.6)	0 (0.0)	2 (1.4)	0.157^

**Median (interquartile range). *Mean (standard deviation) † Chi squared Test ^ Fisher Test

EPEC, enteropathogenic *Escherichia coli;* EAEC, enteroaggregative *Escherichia coli;* EIEC, enteroinvasive *Escherichia coli;* ETEC, enterotoxigenic *Escherichia coli;* STEC, Shiga-like toxin-producing *Escherichia coli*

this difference was not statistically significant (Additional file 4).

In relation to the outcomes, 90% of the patients recovered. In 10% ($n = 33$) of the patients in whom diarrhea persisted, EAEC and vibrio were found to be the most frequent pathogens (Additional file 5).

Discussion

In this study, most of the population corresponded to the male sex with an average age of 52 years, findings consistent with similar studies where the population is composed more by men in the fifth decade of life [11, 13–16]. Of the population studied, 40% presented some condition of immunosuppression, being more frequent in transplant recipients, hematologic neoplasms and HIV infection. In contrast, Morales et al. describe similar comorbidities in their population, but in lower proportion: 13.8% of transplant patients, 16.4% with neoplasia and 5.5% with HIV infection [16].

Most of the cases were categorized as acute and inflammatory diarrhea, this agrees with the literature, which indicates that more than 70% of the cases of diarrheal diseases correspond to acute cases [11, 16, 17]. In addition, it was found that there was a higher prevalence of

Table 3 Relationship between most frequent pathogens and demographic and clinical characteristics of the patients at the hospital Universitario Fundación Valle Del Lili between 2021 and 2022

	Bacteria			**Virus**		**Parasite**
Characteristic / Pathogen	EPEC *n* = 74	EAEC *n* = 32	*C. difficilen* = 30	Norovirus *n* = 21	Rotavirus *n* = 5	*Cryptosporidium sppn* = 5
Sex						
Man	**46(62.2)&**	14 (43.7)	15 (50.0)	**16(76.2)** &	**5(100)**&	2 (40.0)
Woman	28 (378)	18 (56.3)	15 (50.0)	5 (23.8)	0 (0)	3 (60.0)
Age**	49.5(29.0)	53.5(32.5)	54 (29.0)	**40(170)**&	**67(6.0)**&	49 (20.0)
Test site						
Hospitalization	58 (78.4)	24 (77.4)	23 (76.7)	15 (75.0)	4 (80)	5 (100)
ICU	10 (13.5)	5 (16.1)	6 (20.0)	4 (20.0)	1 (20.0)	0 (0)
Ambulatory	6 (8.1)	2 (6.5)	1 (3.3)	1 (5.0)	0(0)	0 (0)
Type of diarrhea						
Acute	50 (67.6)	25 (78.1)	24 (0.8)	11 (52.4)	5 (100)	4 (80.0)
Subacute	12 (16.2)	4 (12.5)	6 (0.2)	6 (28.6)	0 (0)	1 (20.0)
Chronic	12 (16.2)	3 (9.4)	0 (0)	4 (19.0)	0 (0)	0 (0)
Type of immunosupression						
Trasplant	17 (35.4)	4 (18.2)	3 (18.7)	3 (20.0)	1 (33.3)	2 (66.7)
Hematologic neoplasia	9 (18.7)	2 (9.1)	5 (31.2)	3 (20.0)	1 (33.3)	1 (33.3)
HIV	8 (16.7)	8 (36.4)	5 (31.2)	2 (13.3)	0 (0.0)	0 (0.0)
Solid neoplasia	7 (14.16)	3 (13.6)	1 (6.2)	4 (26.7)	0 (0.0)	0 (0.0)
Autoimmune disease	4 (8.3)	3 (13.6)	1 (6.2)	3 (20.0)	1 (33.3)	0 (0.0)
Inflammatory bowel disease	3 (6.2)	2 (9.1)	1 (6.2)	0 (0.0)	0 (0.0)	0 (0.0)

**Median (interquartile range). *Mean (standard deviation) & Significant at $P < 0.05$

EPEC, enteropathogenic Escherichia coli; EAEC, Enteroaggregative Escherichia coli

Table 4 Patient's treatment at the hospital Universitario Fundación Valle Del Lili between 2021 and 2022

Features	***N* (%)**
Treatment	
Yes	141 (41.0)
No	203 (59.0)
Impact after the gastrointestinal panel result	195 (56.7)
Continued without antibiotic	89 (45.6)
Continuous empirical antibiotic	38 (19.4)
Change of antibiotic	26 (13.3)
Initiation of antibiotic	24 (12.3)
Suspension of antibiotic	18 (9.2)

acute diarrhea in immunosuppressed patients, although without statistical significance.

Most of the patients were hospitalized at the time of GIP, coinciding with what is described in the literature, where between 60 and 70% of the patients to whom the test is indicated are in an inpatient setting [10, 11, 17].

Previous studies have reported that the gastrointestinal panel has a positive result in approximately 50% of the samples analyzed [11, 15, 18], identifying one germ in 70–80% and two or more agents in 20–30% [15–17]. Our findings are consistent with these data, where about half of the panels were positive and, in most cases, only one germ was isolated, with a maximum of five potential pathogens detected in a sample. The most frequently identified bacteria were EPEC, EAEC and *Clostridioides difficile*, the viruses norovirus and rotavirus, and the parasites *Cryptosporidium spp*. This distribution agrees with the literature, which indicates the predominance of bacterial etiology in cases of acute diarrhea in adults, followed by viruses and parasites [11, 12, 16, 17]. When analyzing patients according to their immunosuppression status, parasites were more frequent in transplant patients, viruses in patients with solid neoplasms and bacteria were more common in patients with HIV, with no statistically significant differences.

Regarding treatment, most patients initially received empirical antibiotic management. An impact was observed in more than 50% of the management after the PGI result given by continuing without antibiotic treatment, maintaining the initial empirical regimen or changing the treatment. These results are consistent with previous studies, where empirical treatment was prescribed in up to 70% of the adult diarrhea population [12, 15, 19]. In addition, other studies evaluating the impact

of the gastrointestinal panel on treatment describe that in approximately 50% of patients, the result of the panel allows for treatment tailoring [12, 15].

GIP is emerging as a useful tool in the personalized management of gastrointestinal infections; however, it should be considered as a diagnostic support element in decision making, encompassing other clinical parameters of the patient that can be considered in additional studies.

Strengths and limitations

This retrospective study on the identification of microorganisms by GIP presents significant strengths, such as the evaluation of an advanced diagnostic technique in a real clinical context. However, an important limitation was that the results were not communicated in a timely manner to the treating physicians, which probably reduced their impact on the clinical management of patients. This limitation underscores the need for prospective studies that evaluate the real impact of this diagnostic tool when effectively integrated into clinical practice. Future studies should focus on measuring the impact of timely use of GIP on variables such as length of hospital stay, days of antibiotic treatment, need for abdominal imaging studies, and associated costs per patient. This would allow a more complete evaluation of the clinical and economic utility of this technology in the management of gastrointestinal infections.

Conclusion

This study confirms that GIP is a valuable diagnostic tool in the management of adult patients with diarrheal disease, particularly in immunocompromised patients. In our setting it is still a costly and difficult to access test, which makes it necessary to standardize the indications for its application. Future studies could evaluate its cost-effectiveness in our context.

Abbreviations

GIP	Gastrointestinal Panel
EPEC	Enteropathogenic Escherichia coli
EAEC	Enteroaggregative Escherichia coli
EIEC	Entero-invasive Escherichia coli
ETEC	Enterotoxigenic Escherichia coli
STEC	Shiga-like toxin-producing Escherichia coli

Supplementary information

The online version contains supplementary material available at https://doi.org/10.1186/s12876-025-03693-6.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4

Supplementary Material 5

Acknowledgements

The authors would like to thank Dr. Juan Camilo Ramírez-Marquéz and Dr. Juan Pablo Díaz-Solórzano for providing language editing to improve the quality of the final version of the manuscript.

Author contributions

All authors contributed to the conception and design of the study. ES, JC and JT made the first draft of the manuscript. JS, CR and LH performed critical revision and analysis important for the final version to be published. LH performed the statistical analysis of the data. All authors commented on previous versions of the manuscript and read and approved the final version to be published. Also, agreement to be accountable for all aspects of the work and to ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Funding

This research did not receive any specific grants from public, commercial, or nonprofit sector funding agencies.

Data availability

All data generated or analyzed during this study are included in this published article (and its supplementary information files).

Declarations

Ethics approval and consent to participate

This research was conducted in accordance with the Declaration of Helsinki and the international agreements on biomedical research of the CIOMS. It was approved by Biomedical Research Ethics Committee of Fundación Valle del Lili Hospital under protocol number 2081 (Approval Act 25–December 7-2022) authorizing the exemption of informed consent as the study is classified as "no risk", due to its observational and retrospective nature in accordance with Colombian law (Resolution 8430 of 1993).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Departamento de Medicina Interna, Servicio de Gastroenterología, Fundación Valle del Lili, Cra 98 No. 18 - 49, Cali 760032, Colombia
[2]Centro de Investigaciones Clínicas, Fundación Valle del Lili, Cra 98 No. 18 - 49, Cali 760032, Colombia
[3]Facultad de Ciencias de la Salud, Universidad Icesi, Calle 18 No. 122 -135, Cali, Colombia

Received: 1 October 2024 / Accepted: 13 February 2025
Published online: 06 March 2025

References

1. GBD 2016 Diarrhoeal Disease Collaborators. Estimates of the global, regional, and national morbidity, mortality, and aetiologies of diarrhoea in 195 countries: a systematic analysis for the global burden of Disease Study 2016. Lancet Infect Dis. 2018;18(11):1211–28.
2. American Academy of Microbiology. Resolving the Global Burden of Gastrointestinal Illness: A Call to Action. Washington (DC): American Society for Microbiology; 2002 [cited 2023 Sep 20]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK561281/https://doi.org/10.1128/AAMCol.15Feb.2002
3. Torres-Miranda D, Akselrod H, Karsner R, Secco A, Silva-Cantillo D, Siegel MO, et al. Use of BioFire FilmArray gastrointestinal PCR panel associated with reductions in antibiotic use, time to optimal antibiotics, and length of stay. BMC Gastroenterol. 2020;20(1):246.
4. Bonilla Molano SL, Walteros Acero DM. Informe de Evento Primer Semestre Morbilidad por Enfermedad Diarreica Aguda, 2023. Bogotá: Instituto Nacional de Salud; 2023 [cited 2023 Sep 20]. Available from: https://www.ins.gov.co/buscador-eventos/informesdeevento/morbilidad%20por%20eda%20informe%20primer%20semestre%202023.pdf

5. Fernández-Bañares F, Accarino A, Balboa A, Domènech E, Esteve M, Garcia-Planella E, et al. Chronic diarrhoea: definition, classification and diagnosis. Gastroenterol Hepatol. 2016;39(8):535–59.
6. Riddle MS, DuPont HL, Connor BA. ACG Clinical Guideline: diagnosis, treatment, and Prevention of Acute Diarrheal infections in adults. Am J Gastroenterol. 2016;111(5):602–22.
7. Machiels JD, Cremers A, van Bergen-Verkuyten M, Paardekoper-Strijbosch S, Frijns K, Wertheim H, et al. Impact of the BioFire FilmArray gastrointestinal panel on patient care and infection control. PLoS ONE. 2020;15(2):e0228596.
8. Yang S, Rothman RE. PCR-based diagnostics for infectious diseases: uses, limitations, and future applications in acute-care settings. Lancet Infect Dis. 2004;4(6):337–48.
9. Huang RS, Johnson CL, Pritchard L, Hepler R, Ton TT, Dunn JJ. Performance of the Verigene® enteric pathogens test, Biofire FilmArray™ gastrointestinal panel and Luminex xTAG® gastrointestinal pathogen panel for detection of common enteric pathogens. Diagn Microbiol Infect Dis. 2016;86(4):336–9.
10. Food and Drug Administration. 510(k) Summary: k140407 - XYZ Medical Device. U.S. Department of Health and Human Services; 2014 [cited 2024 Sep 20]. Available from: https://www.accessdata.fda.gov/cdrh_docs/reviews/k140407.pdf
11. Piralla A, Lunghi G, Ardissino G, Girello A, Premoli M, Bava E, et al. FilmArray™ GI panel performance for the diagnosis of acute gastroenteritis or hemorragic diarrhea. BMC Microbiol. 2017;17(1):111.
12. Buss SN, Leber A, Chapin K, Fey PD, Bankowski MJ, Jones MK, et al. Multicenter evaluation of the BioFire Film Array gastrointestinal panel for etiologic diagnosis of infectious gastroenteritis. J Clin Microbiol. 2015;53(3):915–25.
13. Farfan M, Piemonte P, Labra Y, Henríquez J, Candia E, Torres JP. Filmarray GI TM panel for detection of enteric pathogens in stool samples: preliminary experience. Rev Chil Infectol. 2016;33(1):89–91.
14. Alejo-Cancho I, Fernández Avilés F, Capón A, Rodríguez C, Barrachina J, Salvador P, et al. Evaluation of a multiplex panel for the diagnosis of acute infectious diarrhea in immunocompromised hematologic patients. PLoS ONE. 2017;12(11):e0187458.
15. Valenzuela C, Legarraga P, Peña A, Arenas A, Berkowitz L, Ramírez G, et al. Etiologic and clinical characterization of community acquired gastroenteritis in adult patients in a Chilean emergency room by the FilmArray GI panel. PLoS ONE. 2018;13(11):e0207850.
16. Morales-Cruz X, Rojas-Kozhakin D, Durán-Torres F, Durán-Torres M, Barragán AM, Barrera E. Utilidad del panel gastrointestinal en adultos con diarrea en un hospital de alta complejidad. Acta Med Colomb. 2023;48(4):7–12.
17. Ena J, Afonso-Carrillo RG, Bou-Collado M, Galian-Nicolas V, Reyes-Jara MD, Martínez-Peinado C, et al. Epidemiology of severe Acute Diarrhea in patients requiring Hospital Admission. J Emerg Med. 2019;57(3):290–8.
18. Leli C, Di Matteo L, Gotta F, Vay D, Cavallo V, Mazzeo R, et al. Evaluation of a multiplex gastrointestinal PCR panel for the aetiological diagnosis of infectious diarrhoea. Infect Dis (Lond). 2020;52(2):114–20.
19. Spina A, Kerr KG, Cormican M, Barbut F, Eigentler A, Zerva L, et al. Spectrum of enteropathogens detected by the FilmArray GI Panel in a multicentre study of community-acquired gastroenteritis. Clin Microbiol Infect. 2015;21(8):719–28.

Publisher's note