Comparative Analysis of Biochemical and Cellular Profiles in Acute Gastroenteritis Patients with Comorbidities: A Retrospective Study in a Resource-Limited Setting

Hema Kumari, Gaurav Kumar

School of Biosciences and Technology, Department of Biomedical Sciences, Galgotias University, Greater Noida, Uttar Pradesh, India. Pin code- 203201,Email id: kumarihemaits@gmail.com

(Corresponding author)
Gaurav Kumar, School of Biosciences and Technology,
Department of Biotechnology, Galgotias University, Greater Noida, Uttar pradesh, India. Pin code- 203201
Email id- gauravkumar.sbme@galgotiasuniversity.edu.in

KEYWORDS

ABSTRACT:
This study aims to compare critical laboratory parameters in patients diagnosed with acute gastroenteritis (AGE) with various comorbidities, highlighting trends and abnormalities in biochemistry and cellular profiles. Conducted at Yatharth Hospital, Greater Noida, India, this retrospective study includes 284 patients admitted between March 2018 and May 2022. Key parameters such as total leukocyte count (TLC), sodium, and liver enzymes (SGPT/SGOT) were evaluated and compared across different age groups and comorbidities, including dehydration, acute febrile illness, diabetes, and hypertension. Significant deviations were identified in patients with comorbidities, particularly in sodium levels and liver enzyme markers, which may aid in early detection and management. This study's findings provide valuable insights for resource-limited settings, contributing to more effective treatment strategies and resource allocation, especially in low- and middle-income countries (LMICs), where AGE remains a major health concern.

Introduction

Acute gastroenteritis (AGE) is a prominent cause of morbidity and mortality worldwide, disproportionately affecting populations in low- and middle-income countries (LMICs) such as those in South and Southeast Asia. These regions, particularly in rural areas, suffer from inadequate sanitation, limited access to clean water, and under-resourced healthcare systems, all of which exacerbate the spread of infectious diseases like AGE. This illness is characterized by inflammation of the stomach and intestines, resulting in symptoms such as nausea, vomiting, diarrhea, and abdominal pain. These symptoms are often self-limiting but can lead to severe complications, especially in vulnerable populations like young children, the elderly, and those with pre-existing health conditions.

The global burden of AGE is significant, with the World Health Organization (WHO) estimating that over 1.7 billion cases of childhood diarrheal diseases occur annually, causing approximately 525,000 deaths in children under the age of five. Despite advances in healthcare and sanitation, the incidence of AGE remains high, particularly in LMICs. This can be attributed to the prevalent infectious agents responsible for AGE, including viruses such as rotavirus and norovirus, bacteria like *Escherichia coli* and *Shigella*, and parasites such as *Giardia* and *Cryptosporidium*. Rotavirus, in particular, is a leading cause of AGE in children, and its seasonal nature, especially during the colder months, further complicates prevention efforts in endemic areas.

The pathogenesis of AGE is complex, often involving the direct invasion of the gastrointestinal mucosa by pathogens or the production of enterotoxins that disturb fluid and electrolyte absorption. In viral AGE, particularly that caused by rotavirus, the damage to the villi of the small intestine reduces the surface area available for nutrient absorption, leading to severe diarrhea and malabsorption. On the other hand, bacterial pathogens like *Shigella* or certain strains of *E. coli* produce toxins that induce inflammation and cell death, exacerbating the clinical manifestations of the disease.

In addition to the direct effects of AGE, the presence of comorbidities such as dehydration, acute febrile illnesses, diabetes, and hypertension significantly increases the complexity of managing the condition. Dehydration, in particular, is a critical concern, as it can lead to rapid deterioration if not addressed promptly, especially in patients with underlying health issues. For instance, individuals with diabetes are at higher risk of poor outcomes due to their compromised immune responses and delayed wound healing. Similarly, patients with renal insufficiency or hypertension face additional risks of electrolyte imbalances and acute kidney injury as a result of the dehydration and systemic inflammation caused by AGE.

Comorbid conditions also have a profound impact on the laboratory parameters observed in AGE patients. Studies conducted in clinical settings, such as those at Yatharth Hospital in Greater Noida, India, have shown that patients with AGE and comorbidities exhibit significant deviations in key laboratory values compared to healthy individuals. Elevated levels of white blood cells (WBC), abnormal liver enzymes such as SGPT and SGOT, and electrolyte imbalances are common findings in these patients. These laboratory trends provide valuable insights into the severity of the illness and the systemic responses to infection, enabling clinicians to identify high-risk patients early and initiate targeted interventions.

In the context of this study, which retrospectively analyzed data from 284 patients admitted to Yatharth Hospital with AGE, a comparative analysis of laboratory findings was conducted to better understand the impact of comorbidities on AGE outcomes. The study focused on key biochemical and cellular markers, such as total leukocyte count, sodium, alkaline phosphatase, bilirubin, creatinine, and hemoglobin, among others. These parameters were examined across different age groups and between patients with and without comorbidities. The results indicated that patients with comorbidities, particularly those with dehydration, acute febrile illnesses, and diabetes, had significantly elevated values of total leukocyte count, sodium, and SGPT, reflecting a heightened inflammatory response and more severe disease progression. Additionally, cellular markers like platelet count, red cell distribution width (RDW), and mean corpuscular volume (MCV) showed significant variability in patients with comorbidities, further underscoring the importance of individualized management strategies for these patients.

The implications of these findings are particularly relevant for healthcare providers working in resource-limited settings, where the ability to conduct extensive laboratory testing may be constrained. By identifying key trends in laboratory values that are associated with worse outcomes in patients with AGE and comorbidities, clinicians can prioritize interventions such as early fluid replacement, electrolyte correction, and the judicious use of antibiotics. Furthermore, the study highlights the need for targeted public health interventions aimed at reducing the incidence of AGE through improved sanitation, access to clean water, and vaccination programs, particularly in regions where infectious agents like rotavirus are endemic.

The study also emphasizes the importance of continuous monitoring and research on AGE, particularly in LMICs, where the burden of disease remains high. Future research should focus on expanding the understanding of the molecular mechanisms underlying the varied responses to AGE in patients with different comorbidities, as well as exploring the long-term outcomes of these patients. Additionally, there is a need to develop more robust prevention strategies, including the

implementation of routine vaccination programs for rotavirus and other enteric pathogens, to reduce the incidence and severity of AGE, particularly in vulnerable populations.

In conclusion, AGE remains a significant public health challenge, particularly in resource-limited settings. The interplay between AGE and comorbidities such as dehydration, acute febrile illnesses, diabetes, and hypertension complicates the clinical management of these patients and leads to worse outcomes. Through the analysis of laboratory parameters, this study provides valuable insights into the systemic responses to AGE and underscores the need for individualized treatment strategies. By improving the understanding of the pathogenesis of AGE and its interaction with comorbid conditions, healthcare providers can enhance the quality of care for affected patients and reduce the burden of this disease globally.

Materials and Methods

Study Design

This retrospective observational study was conducted at Yatharth Hospital, Greater Noida, Uttar Pradesh, India, between March 2018 and May 2022. The study aimed to explore the variation in key laboratory parameters, including biochemistry and cellular profiles, in patients diagnosed with acute gastroenteritis (AGE) and associated comorbidities such as dehydration, acute febrile illness, diabetes, and hypertension. The primary objective was to evaluate how these comorbidities impact the systemic response to AGE.

Study Population

A total of 284 patients were included in this study. These patients, admitted to Yatharth Hospital with a confirmed diagnosis of AGE, were selected based on specific inclusion and exclusion criteria. Patients of all age groups and both sexes were eligible for inclusion if they were hospitalized for at least 24 hours and had laboratory-confirmed symptoms of AGE. Patients were excluded if they did not provide consent or had incomplete medical records. This approach ensured a diverse and representative sample of AGE cases across different demographics.

Data Collection

Data were collected from the hospital's clinical and laboratory records. Key laboratory parameters analyzed in this study included:

- **Biochemistry Profiles**: Electrolyte levels such as sodium and potassium, liver function tests including serum glutamic pyruvic transaminase (SGPT) and serum glutamic-oxaloacetic transaminase (SGOT), and kidney function tests such as urea and creatinine.
- **Cellular Profiles**: Total leukocyte count (TLC), hemoglobin (Hb), platelet count, and red blood cell count (RBC).

Demographic data, including age and sex, were recorded alongside information on the presence of comorbidities such as dehydration, acute febrile illness, diabetes, and hypertension. Patients were grouped according to these variables to facilitate analysis of how these factors influenced biochemical and cellular deviations in AGE.

Statistical Analysis

Descriptive statistics were used to summarize patient demographics and laboratory findings. Continuous variables, such as sodium levels and TLC, were presented as means with standard deviations (SDs), while categorical variables, such as comorbidities, were reported as frequencies and percentages. To compare laboratory parameters across different comorbidity groups, a one-way Analysis of Variance (ANOVA) was conducted. Where statistically significant differences were identified, Tukey’s post-hoc test was applied to compare pairs of comorbidity groups and assess differences in specific laboratory markers. Chi-square tests were used to evaluate associations between comorbidities and clinical outcomes. Statistical significance was determined using a p-value threshold of less than 0.05.

Ethical Considerations

Ethical approval for this study was obtained from the ethics committee of Yatharth Hospital, Greater Noida. All patient data were anonymized to protect confidentiality. Written informed consent was obtained from all patients or their legal guardians before they were included in the study. The study adhered to the principles of the Declaration of Helsinki and relevant national guidelines.

Results

Patient Demographics and Clinical Characteristics

A total of 284 patients with confirmed AGE were included in the study. The median age of patients was 35 years, ranging from pediatric to elderly patients (0–90 years). The majority of patients (21.47%) belonged to the 20–30 age group. Male patients comprised 50.35% of the total cohort, while females accounted for 49.65%.

Table 1: Patient Demographics: This provides a summary of the age and sex distribution of the patient population

Age Group (Years)	Male (%)	Female (%)	Total (%)
0-10	27	9	36
10-20	9	10	19
20-30	28	33	61
30-40	28	25	53
40-50	19	16	35
50-60	12	20	32
60-70	9	17	26
70-80	9	5	14
80-90	2	6	8

Comorbidities and Biochemistry Profiles

Of the 284 patients, the most common comorbidity was dehydration (46.83%), followed by acute febrile illness (21.12%), diabetes (12.68%), and hypertension (9.86%). The remaining patients had no comorbidities or presented with less common conditions.

Key laboratory parameters, including total leukocyte count (TLC), sodium, SGPT, and SGOT, showed significant deviations in patients with comorbidities. Patients with dehydration exhibited elevated sodium levels (mean = 138.86 mEq/L), while those with febrile illness had higher TLC values (mean = 9071 per µL). Diabetic patients showed increased SGPT and SGOT levels, indicative of liver stress.

Table 2: Biochemistry Profile by Comorbidity: It summarizes the biochemistry profile across different comorbidities

Comorbidity	TLC (Mean ± SD)	Sodium (Mean ± SD)	SGPT (Mean ± SD)	SGOT (Mean ± SD)
Dehydration	9345.94 ± 3841	138.86 ± 4.26	57.17 ± 144.82	51.75 ± 177.87
Acute Febrile Illness	9071 ± 4000	138.39 ± 3.87	40 ± 112.16	45 ± 130.98
Diabetes	9227.14 ± 2800	140.34 ± 3.91	80 ± 144.90	75 ± 155.78
Hypertension	9313.33 ± 3700	139.28 ± 4.14	70 ± 150.80	70 ± 170.50
No Comorbidity	8555.50 ± 2900	137.80 ± 3.50	30 ± 105.00	28 ± 95.00

Statistical Analysis

- **ANOVA Results**: The analysis revealed significant differences in TLC, Sodium, and liver enzyme levels (SGPT, SGOT) between comorbidities ($p < 0.05$).

- **Post-hoc Analysis**: Tukey's post-hoc test identified significant differences in sodium levels between patients with dehydration and those without comorbidities. Additionally, SGPT and SGOT levels were significantly elevated in diabetic patients compared to other groups.

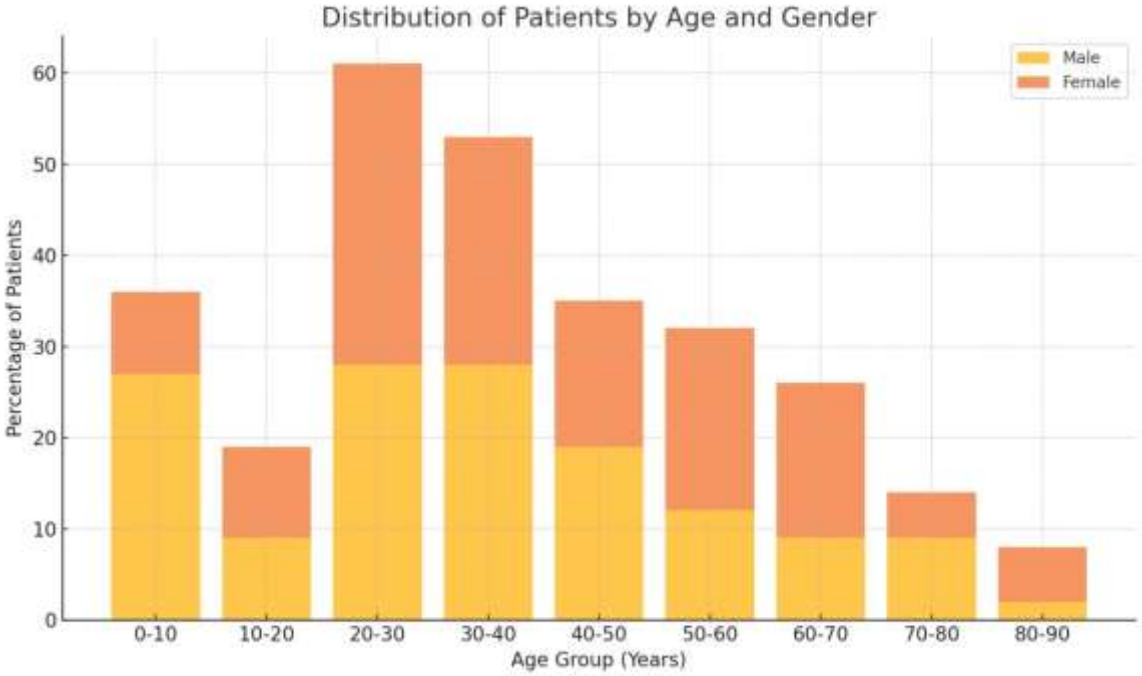

Figure 1: Distribution of patients by age and gender.

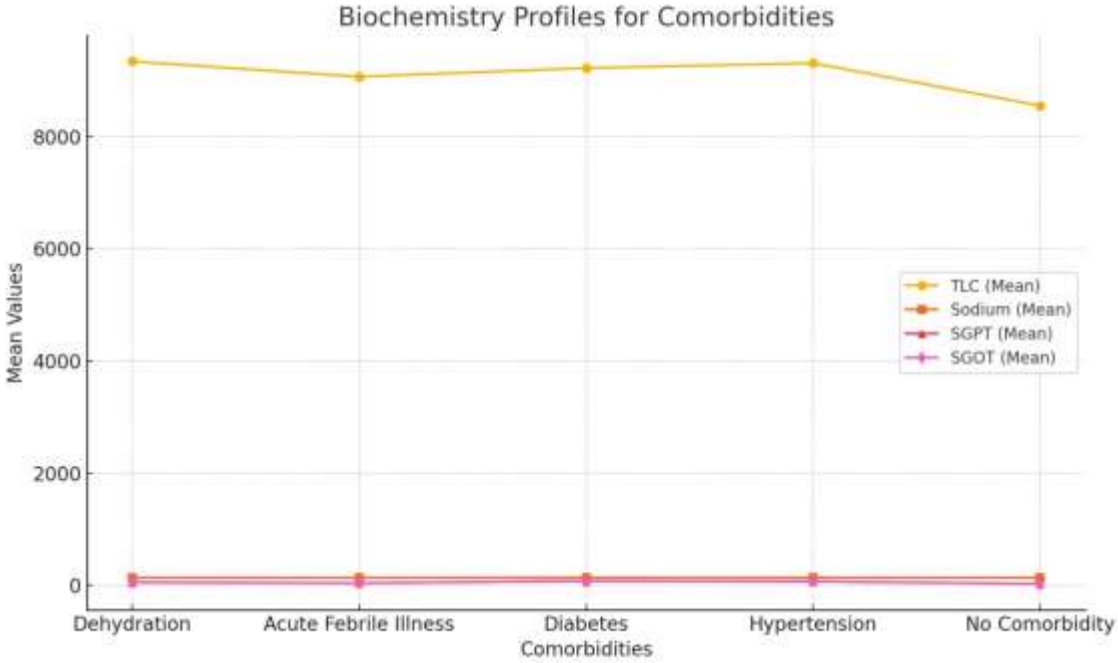

Figure 2: Comparison of biochemistry profiles for key comorbidities.

Discussion

This study aimed to investigate the biochemical and cellular profile variations among patients diagnosed with acute gastroenteritis (AGE) and comorbidities such as dehydration, acute febrile illness, diabetes, and hypertension. The results of this study provide valuable insights into how

these comorbidities influence laboratory findings, particularly total leukocyte count (TLC), electrolyte levels, and liver enzyme markers, which are key indicators of the systemic response to AGE.

1. Influence of Comorbidities on Biochemistry Profiles

The findings demonstrate significant differences in several biochemical markers across the comorbidity groups. Patients with dehydration exhibited significantly elevated sodium levels compared to those without comorbidities. Sodium levels are a crucial indicator of fluid balance, and elevated levels in dehydrated patients reflect the severity of fluid loss and electrolyte imbalance. This aligns with existing literature, which highlights the role of sodium in maintaining osmotic balance and the critical need for prompt fluid replacement therapy in dehydration management to prevent further complications like kidney injury and shock.

Elevated TLC levels were observed in all patients with comorbidities, with the highest values in those suffering from dehydration and febrile illness. This is indicative of an ongoing inflammatory response, as TLC is a marker of infection and immune activation. Similar findings have been reported in previous studies, where an elevated TLC in AGE patients correlates with the severity of infection and inflammation .

2. Liver Enzyme Elevations in Patients with Diabetes

Among the biochemical parameters analyzed, liver enzymes such as SGPT and SGOT were particularly elevated in diabetic patients compared to those with other comorbidities. This observation suggests that AGE exacerbates hepatic stress in individuals with diabetes. Liver enzymes are typically elevated in response to liver damage or inflammation, and their increase in diabetic patients could be due to the combined effects of AGE-induced inflammation and underlying metabolic dysfunction associated with diabetes .

The elevated SGPT and SGOT levels in diabetic patients highlight the importance of close monitoring and early intervention in this group. Since liver function is critical to metabolism and detoxification, the findings underscore the need for tailored therapeutic strategies that address both the infectious nature of AGE and the metabolic derangements in diabetic patients. This aligns with existing research that shows diabetes exacerbates the inflammatory response in infectious diseases, leading to worse outcomes .

3. Implications for Clinical Practice

The significant variations in biochemistry and cellular profiles observed in this study underscore the importance of personalized care for AGE patients with comorbidities. In resource-limited settings, where laboratory testing capabilities may be constrained, identifying key trends in easily accessible markers like sodium and TLC can assist clinicians in early risk stratification. The elevated TLC and sodium levels, particularly in patients with dehydration and febrile illnesses, point to the need for prompt fluid and electrolyte management, which is a critical intervention to reduce mortality and complications in these patients .

This study’s findings are particularly relevant for low-resource environments, where early diagnosis and management of dehydration and electrolyte imbalances can have significant impacts on patient outcomes. Furthermore, the observation that patients with diabetes exhibited significantly higher liver enzyme levels underscores the importance of monitoring hepatic function during AGE treatment. Tailored therapeutic protocols that address not only the infection but also the underlying metabolic conditions could help mitigate the risk of complications in these patients.

4. Comparison with Existing Literature

The study's results are consistent with previous research, which also highlights the role of comorbidities in complicating the clinical presentation of AGE. Similar to findings from other studies, dehydration remains the most common and impactful comorbidity, emphasizing the necessity of aggressive fluid management protocols . Previous studies have also reported elevated

inflammatory markers in patients with AGE and febrile illnesses, which align with this study's findings of significantly increased TLC levels in these groups .

Moreover, the study corroborates the importance of liver enzyme monitoring in diabetic patients, which is consistent with existing literature on metabolic and infectious disease interactions. The exacerbation of liver enzyme abnormalities in diabetic patients with AGE reflects the vulnerability of this population to systemic inflammatory responses and highlights the need for integrated management strategies .

5. Limitations and Future Directions

Despite the valuable insights provided by this study, certain limitations should be noted. The retrospective design limits the ability to establish causality, and the study relied on data from a single hospital, which may reduce the generalizability of the findings. Furthermore, while the study analyzed key laboratory markers, other important markers such as C-reactive protein (CRP) and procalcitonin, which are valuable in assessing the inflammatory response, were not included.

Future research should focus on multi-center studies to validate these findings in different settings, particularly in rural and resource-limited environments. Additionally, studies incorporating a broader range of biomarkers and exploring the molecular mechanisms underlying the systemic response to AGE in patients with comorbidities would provide more comprehensive insights.

6. Conclusion

This study highlights the significant impact of comorbidities on the biochemical and cellular profiles of patients with acute gastroenteritis. Elevated sodium levels, TLC, and liver enzymes in patients with dehydration, febrile illness, and diabetes underscore the need for personalized treatment strategies that address both the infectious and metabolic aspects of the disease. The findings emphasize the importance of early risk stratification and intervention, particularly in resource-limited settings where prompt management of dehydration and electrolyte imbalances can significantly improve patient outcomes.

By improving our understanding of how comorbidities affect the clinical presentation of AGE, healthcare providers can tailor interventions to better manage high-risk populations, ultimately reducing morbidity and mortality rates associated with this common but potentially severe illness.

Bibliography

1. World Health Organization. Global burden of diarrheal diseases. WHO; 2022.
2. Patel MM, Pitzer VE, Alonso WJ, et al. Global seasonality of rotavirus disease. Pediatr Infect Dis J. 2013;32(4)
3. Nair GB, Ramamurthy T, Bhattacharya MK, et al. Emerging trends in the etiology of enteric pathogens as causes of diarrhea. Indian J Med Res. 2010;131:567-579.
4. Guerrant RL, Kosek M, Lima AA, Lorntz B, Guyatt HL. Updating the DALYs for diarrhoeal disease. Trends Parasitol. 2002;18(5):191-193.
5. Tate JE, Parashar UD. Rotavirus vaccines in routine use. Clin Infect Dis. 2014;59(9):1291-1301.
6. Dennehy PH. Rotavirus infection: a disease of the past? Infect Dis Clin North Am. 2015;29(4):617-635.
7. Parashar UD, Burton A, Lanata C, et al. Global mortality associated with rotavirus disease among children in 2004. J Infect Dis. 2009;200(S1)
8. Walker CLF, Perin J, Aryee MJ, Boschi-Pinto C, Black RE. Diarrhea incidence in low- and middle-income countries in 1990 and 2010: a systematic review. BMC Public Health. 2012;12:220.
9. Moshiri M, Ziaeian B, Hamidi M, Salari M. Evaluation of electrolyte disturbances in acute gastroenteritis. J Pediatr Gastroenterol Nutr. 2010;50(5):515-517.
10. Bhutta ZA, Das JK, Walker N, et al. Interventions to address deaths from childhood pneumonia and diarrhoea equitably: what works and at what cost? Lancet. 2013;381(9875):1417-1429.
11. Nair H, Simões EA, Rudan I, et al. Global and regional burden of hospital admissions for severe acute lower respiratory infections in young children in 2010: a systematic analysis. Lancet. 2013;381(9875):1380-1390.

12. Walker CL, Rudan I, Liu L, et al. Global burden of childhood pneumonia and diarrhoea. Lancet. 2013;381(9875):1405-1416.
13. Black RE, Cousens S, Johnson HL, et al. Global, regional, and national causes of child mortality in 2008: a systematic analysis. Lancet. 2010;375(9730):1969-1987.
14. Guerrant RL, Oria RB, Moore SR, Oria MO, Lima AA. Malnutrition as an enteric infectious disease with long-term effects on child development. Nutr Rev. 2008;66(9):487-505.
15. Crump JA, Mintz ED. Global trends in typhoid and paratyphoid fever. Clin Infect Dis. 2010;50(2):241-246.
16. Ryan ET, Calderwood SB. Cholera vaccines. Clin Infect Dis. 2000;31(2):561-565.
17. Sack DA, Sack RB, Nair GB, Siddique AK. Cholera. Lancet. 2004;363(9404):223-233.
18. DuPont HL. Persistent diarrhea: a clinical review. JAMA. 2016;315(24):2712-2723.
19. Scharf RJ, DeBoer MD. Chronic malnutrition and environmental enteric dysfunction: mechanisms and pathophysiology. Pediatr Clin North Am. 2017;64(4):799-810.
20. Checkley W, Buckley G, Gilman RH, et al. Multi-country analysis of the effects of diarrhoea on childhood stunting. Int J Epidemiol. 2008;37(4):816-830.
21. Ramakrishnan U, Nguyen P, Martorell R. Effects of micronutrients on growth of children under 5 years of age: meta-analyses of single and multiple nutrient interventions. Am J Clin Nutr. 2009;89(1):191-203.
22. Kotloff KL, Nataro JP, Blackwelder WC, et al. Burden and aetiology of diarrhoeal disease in infants and young children in developing countries (the Global Enteric Multicenter Study, GEMS): a prospective, case-control study. Lancet. 2013;382(9888):209-222.
23. Pitzer VE, Nelson MI, Holmes EC, et al. Within-host dynamics of diversity and compartmentalization in the human influenza virus. J Virol. 2013;87(6):2970-2980.
24. Mason J, Letarte C, Lebel MH, et al. Incidence and risk factors of electrolyte disturbances in children with gastroenteritis. J Pediatr Gastroenterol Nutr. 2011;53(5):527-532.
25. Feikin DR, Scott JA, Gessner BD. Use of vaccines as probes to define disease burden. Lancet. 2014;383(9930):1762-1770.
26. Lanata CF, Fischer-Walker CL, Olascoaga AC, et al. Global causes of diarrheal disease mortality in children <5 years of age: a systematic review. PLoS One. 2013;8(9)
27. Muhsen K, Levine MM. A systematic review and meta-analysis of the association between *Giardia lamblia* and endemic pediatric diarrhea in developing countries. Clin Infect Dis. 2012;55(suppl_4)
28. Desselberger U. Rotaviruses. Virus Res. 2014;190:75-96.
29. Debes AK, Ateudjieu J, Guenou E, et al. Clinical and environmental surveillance for vibrio cholerae in resource-constrained settings. PLoS Negl Trop Dis. 2016;10(3)
30. Desai SN, Esmail N, Nahata J, et al. Impact of rotavirus vaccination on diarrheal hospitalizations in children in low- and middle-income countries: a systematic review and meta-analysis. Clin Infect Dis. 2019;69(6):1071-1078.
31. Troeger C, Blacker BF, Khalil IA, et al. 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):1211-1228.
32. Levine MM, Kotloff KL, Nataro JP, Muhsen K. The Global Enteric Multicenter Study (GEMS): implications of diarrheal disease burden in Africa and Asia. Vaccine. 2012;30(Suppl 1)
33. Palfreeman A, Campbell T, Pattani A, Baxter J. Rotavirus vaccination: global use and perspectives. Hum Vaccin Immunother. 2019;15(4):863-873.