Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

CAMPYLOBACTER AND HELICOBACTER-RELATED DISEASES AND THEIR LABORATORY DIAGNOSIS

Rakhmatullaeva Maxfuza Igamberdiyevna
Senior Lecturer, Department of Professional Disciplines
Faculty of General Medicine, Angren University

Abstract

Campylobacter and Helicobacter species occupy an important place among medically significant Gram-negative, microaerophilic bacteria that cause gastrointestinal and extraintestinal diseases in humans. Campylobacter jejuni and Campylobacter coli are among the leading bacterial agents of acute gastroenteritis, while Helicobacter pylori is strongly associated with chronic gastritis, peptic ulcer disease, mucosa-associated lymphoid tissue lymphoma, and gastric cancer risk. The clinical significance of these pathogens is determined not only by their frequency, but also by diagnostic complexity, variable clinical manifestations, antimicrobial resistance, and the need for timely laboratory confirmation. This article examines the diseases caused by Campylobacter and Helicobacter species and analyzes the main approaches to their laboratory diagnosis in medical practice. Special attention is paid to bacteriological culture, microscopy, biochemical identification, immunological assays, molecular methods, and non-invasive diagnostic techniques. The study emphasizes that effective diagnosis depends on proper specimen collection, transport conditions, selection of appropriate laboratory methods, and interpretation of results in connection with clinical findings. In the context of medical education, understanding these pathogens is essential for developing professional competence in microbiology, infectious diseases, gastroenterology, and laboratory diagnostics.

Keywords: Campylobacter, Helicobacter pylori, gastrointestinal infection, gastritis, laboratory diagnosis, microbiology, bacterial pathogens, molecular diagnostics.

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

KAMPILOBAKTERIYALAR VA HELIKOBAKTERIYALAR KELTIRIB CHIQARADIGAN KASALLIKLAR HAMDA ULARNING LABORATORIYA TASHXISI

Raxmatullaeva Maxfuza Igamberdiyevna
Katta o‘qituvchi. Kasbiy fanlar kafedrasi.
Davolash ishi fakulteti Angren universiteti

Annotatsiya:
Kampilobakteriyalar va helikobakteriyalar insonlarda oshqozon-ichak hamda ayrim ichakdan tashqari kasalliklarni keltirib chiqaruvchi tibbiy ahamiyatga ega grammanfiy, mikroaerofil bakteriyalar qatoriga kiradi. Campylobacter jejuni va Campylobacter coli o‘tkir gastroenteritning muhim bakterial qo‘zg‘atuvchilari hisoblanadi, Helicobacter pylori esa surunkali gastrit, yara kasalligi, shilliq qavat bilan bog‘liq limfoid to‘qima limfomasi va oshqozon saratoni xavfi bilan uzviy bog‘liq. Ushbu mikroorganizmlarning klinik ahamiyati ularning keng tarqalganligi, tashxis qo‘yishdagi murakkabliklar, klinik belgilar xilma-xilligi, antimikrob preparatlarga chidamlilik holatlari va laborator tasdiqlash zarurati bilan belgilanadi. Mazkur maqolada kampilobakteriyalar va helikobakteriyalar keltirib chiqaradigan kasalliklar hamda ularning laboratoriya tashxisi yoritiladi. Bakteriologik ekish, mikroskopiya, biokimyoviy identifikatsiya, immunologik testlar, molekulyar usullar va noinvaziv diagnostika yondashuvlariga alohida e’tibor qaratiladi. Samarali tashxis klinik materialni to‘g‘ri olish, tashish sharoitlariga rioya qilish, mos laborator usulni tanlash va natijalarni klinik belgilar bilan bog‘lab talqin qilishga bog‘liq ekani asoslanadi.

Kalit so‘zlar. Kampilobakteriya, Helicobacter pylori, oshqozon-ichak infeksiyasi, gastrit, laboratoriya tashxisi, mikrobiologiya, bakterial patogenlar, molekulyar diagnostika.

Introduction

Campylobacter and Helicobacter species are clinically important microorganisms that occupy a significant place in modern medical microbiology, infectious diseases, gastroenterology, epidemiology, and laboratory diagnostics. These

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

bacteria are Gram-negative, spiral or curved rods, capable of surviving under microaerophilic conditions, and they demonstrate specific biological features that distinguish them from many other enteric pathogens. Their medical relevance is associated with their ability to colonize the gastrointestinal tract, damage mucosal surfaces, provoke inflammatory responses, and contribute to both acute and chronic pathological processes. In medical university education, the study of these pathogens is essential because they connect fundamental microbiology with real clinical practice, including patient examination, differential diagnosis, laboratory confirmation, treatment selection, and prevention of complications.

Campylobacter species, especially Campylobacter jejuni and Campylobacter coli, are among the most frequent bacterial causes of acute gastroenteritis worldwide. Infection is commonly associated with consumption of contaminated poultry meat, unpasteurized milk, unsafe water, and contact with infected animals. The disease usually manifests with diarrhea, abdominal pain, fever, nausea, and general weakness. In some cases, stools may contain mucus or blood, which can make the clinical picture similar to other invasive intestinal infections caused by Salmonella, Shigella, enterohemorrhagic Escherichia coli, or Yersinia. Although many cases are self-limited, Campylobacter infection may lead to serious post-infectious complications such as Guillain–Barré syndrome, reactive arthritis, irritable bowel syndrome, and, in immunocompromised patients, bacteremia. Therefore, laboratory diagnosis is important not only for confirming the etiological agent but also for epidemiological control and rational antimicrobial therapy.

Helicobacter pylori has a different but equally important clinical profile. It is adapted to colonize the gastric mucosa despite the acidic environment of the stomach. This ability is largely connected with urease activity, motility, adhesion factors, and virulence determinants that enable the bacterium to persist for years. Helicobacter pylori infection is closely associated with chronic active gastritis, gastric and duodenal ulcers, gastric mucosa-associated lymphoid tissue lymphoma, and increased risk of gastric adenocarcinoma. The infection may remain asymptomatic for a long period, but in many patients it contributes to dyspepsia, epigastric pain, nausea, bloating, and recurrent ulceration. Because of

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

its chronic course and potential complications, accurate detection of Helicobacter pylori is a major task in gastroenterological practice.

The laboratory diagnosis of Campylobacter and Helicobacter infections requires careful methodological selection. Campylobacter diagnosis often depends on stool culture using selective media, microaerophilic incubation, microscopy, antigen detection, polymerase chain reaction, and antimicrobial susceptibility testing when needed. Helicobacter pylori can be detected by invasive methods such as biopsy-based rapid urease test, histological examination, culture, and molecular testing, as well as non-invasive methods including urea breath test, stool antigen test, and serological assays. Each method has advantages and limitations related to sensitivity, specificity, cost, availability, patient condition, previous antibiotic use, and laboratory capacity.

In Uzbekistan, as in many regions with developing healthcare infrastructure, improvement of laboratory diagnostics remains an important factor in strengthening infectious disease control and gastroenterological care. Proper training of medical students in the diagnosis of Campylobacter and Helicobacter-related diseases helps form practical competence in specimen collection, biosafety, interpretation of microbiological results, and evidence-based clinical decision-making. Thus, the topic is relevant not only from a theoretical point of view, but also for public health, clinical medicine, and professional medical education.

Methods

This study was prepared on the basis of a theoretical, analytical, and comparative approach to the medical and microbiological literature related to Campylobacter and Helicobacter infections. The methodological framework focused on the clinical significance of these microorganisms, the diseases associated with them, and the diagnostic procedures used for their identification in laboratory practice. Since the topic is closely connected with medical microbiology and infectious disease diagnostics, the analysis included information from textbooks of microbiology, clinical laboratory diagnostics, gastroenterology, infectious diseases, epidemiology, and international methodological recommendations

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

concerning bacterial gastrointestinal infections and Helicobacter pylori-associated pathology.

The research method was based on a systematic review of scientific and educational sources describing the biological characteristics of Campylobacter and Helicobacter species. Particular attention was paid to their morphology, staining properties, growth requirements, biochemical activity, virulence factors, epidemiological distribution, routes of transmission, and clinical manifestations. Campylobacter species were analyzed mainly in relation to acute intestinal infections, especially gastroenteritis caused by Campylobacter jejuni and Campylobacter coli. Helicobacter species were examined primarily through the example of Helicobacter pylori, which is the most clinically significant representative of this genus and is strongly associated with chronic gastritis and peptic ulcer disease.

The diagnostic component of the study was structured according to the type of clinical material and the laboratory method used. For Campylobacter infections, stool samples were considered the main diagnostic material, while blood, rectal swabs, and other biological materials may be used in severe or systemic cases. The analysis included bacteriological culture on selective media, incubation under microaerophilic conditions, direct microscopy, Gram staining, phase-contrast microscopy, biochemical tests, antigen detection assays, molecular identification, and antimicrobial susceptibility testing. Special attention was given to the importance of specimen transport because Campylobacter organisms are sensitive to drying, oxygen exposure, and improper temperature conditions.

For Helicobacter pylori infection, diagnostic methods were divided into invasive and non-invasive approaches. Invasive methods include endoscopic biopsy followed by rapid urease testing, histological examination, culture, polymerase chain reaction, and, when necessary, antimicrobial susceptibility testing. Non-invasive methods include the urea breath test, stool antigen test, and serological detection of specific antibodies. The study compared these methods according to their diagnostic value, practical availability, sensitivity, specificity, limitations, and suitability for primary diagnosis or post-treatment control. The interpretation

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

of results was considered in relation to patient history, clinical symptoms, medication use, and previous eradication therapy.

A comparative analytical method was used to identify similarities and differences between the laboratory diagnosis of Campylobacter and Helicobacter-related diseases. Campylobacter diagnosis is usually connected with acute infection and epidemiological investigation, whereas Helicobacter pylori diagnosis is more often associated with chronic gastrointestinal pathology and long-term clinical management. The study also considered the educational importance of these diagnostic approaches for medical university students, especially in the formation of practical skills in microbiological reasoning, biosafety, sample handling, and interpretation of laboratory findings. This methodological design made it possible to present the topic as an integrated medical problem combining pathogen biology, clinical presentation, diagnostic technology, and public health relevance.

Results

The analysis of Campylobacter and Helicobacter-related diseases shows that these microorganisms differ in their epidemiology, clinical course, diagnostic strategy, and medical consequences, although both are important gastrointestinal pathogens. Campylobacter infections are most often associated with acute intestinal disease, while Helicobacter pylori infection is mainly connected with chronic inflammatory and ulcerative processes of the stomach and duodenum. This distinction determines the choice of laboratory material, diagnostic timing, and interpretation of laboratory findings. In Campylobacter infection, rapid confirmation is important during the acute phase of diarrhea, whereas in Helicobacter pylori infection, diagnostic evaluation is commonly related to persistent dyspeptic symptoms, ulcer recurrence, or monitoring of eradication therapy.

The most clinically relevant Campylobacter species are Campylobacter jejuni and Campylobacter coli. Their detection is usually based on stool examination, because the pathogen actively multiplies in the intestinal tract during the acute stage of disease. The typical clinical picture includes abdominal cramps, fever, diarrhea, nausea, and general weakness. In more severe cases, inflammatory

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

diarrhea with blood and mucus may occur, which makes laboratory differentiation necessary. The results of microbiological assessment indicate that clinical symptoms alone are insufficient for accurate etiological diagnosis, since similar manifestations may be observed in salmonellosis, shigellosis, yersiniosis, and infections caused by pathogenic Escherichia coli strains. Therefore, laboratory confirmation plays a decisive role in identifying the causative agent and selecting appropriate epidemiological and therapeutic measures.

Bacteriological culture remains an important diagnostic method for Campylobacter, especially when antimicrobial susceptibility testing is required. However, successful isolation depends on proper collection and transportation of stool samples, the use of selective media, and incubation in a microaerophilic atmosphere. Campylobacter organisms are sensitive to environmental oxygen and drying, so delays in transportation or incorrect storage may reduce diagnostic accuracy. Microscopy may reveal curved or spiral Gram-negative rods with characteristic motility, but it is usually not sufficient as an independent diagnostic method. Antigen detection tests and molecular methods increase diagnostic speed and sensitivity, especially in laboratories where culture conditions are limited or when rapid clinical decisions are needed.

The results concerning Helicobacter pylori demonstrate that this bacterium has a specific relationship with chronic gastric pathology. Its urease activity allows it to survive in the acidic environment of the stomach, while motility and adhesion mechanisms support long-term colonization of the gastric mucosa. The infection is frequently associated with chronic gastritis, peptic ulcer disease, gastric mucosal atrophy, and increased risk of malignant transformation. Laboratory diagnosis therefore has both clinical and preventive significance. Invasive methods based on endoscopic biopsy provide direct information about mucosal condition and bacterial presence. Rapid urease testing is convenient and widely used, while histological examination allows simultaneous assessment of inflammation, epithelial damage, atrophy, and bacterial colonization. Culture is technically more demanding but valuable for antibiotic susceptibility testing in cases of treatment failure.

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

Non-invasive diagnostic methods for Helicobacter pylori are especially important in outpatient practice and post-treatment monitoring. The urea breath test and stool antigen test are useful for detecting active infection, while serological methods may be less suitable for confirming eradication because antibodies can remain detectable after bacterial elimination. The comparative analysis indicates that no single diagnostic method is universal for all clinical situations. The most reliable approach is achieved when laboratory results are evaluated together with clinical symptoms, endoscopic findings, patient history, and previous use of antibiotics, proton pump inhibitors, or bismuth preparations. Thus, accurate diagnosis of Campylobacter and Helicobacter-related diseases requires not only technical laboratory capacity, but also competent clinical interpretation.

Discussion

The findings of the analysis indicate that Campylobacter and Helicobacter infections require different diagnostic strategies because their biological behavior, disease mechanisms, and clinical significance are not the same. Campylobacter infection is usually acute, foodborne, and epidemiologically connected with contaminated poultry products, water, milk, and animal contact. Helicobacter pylori infection, on the other hand, is typically chronic, persistent, and closely related to long-term inflammatory changes in the gastric mucosa. This difference is important for medical students and clinical specialists because it shows that laboratory diagnosis cannot be based on a single universal model. The diagnostic algorithm must correspond to the pathogen, the stage of disease, the type of clinical material, and the purpose of testing.

In Campylobacter-related diseases, the main diagnostic problem is the need to detect the pathogen during a limited period of active intestinal infection. Since many patients present with diarrhea, abdominal pain, fever, and dehydration, the clinical picture may resemble other bacterial and viral gastroenteritis. In such cases, empirical diagnosis may lead to inaccurate treatment, unnecessary antibiotic use, or delayed recognition of outbreaks. Laboratory confirmation helps differentiate Campylobacter infection from salmonellosis, shigellosis, pathogenic Escherichia coli infection, and other intestinal diseases. Culture remains valuable

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

because it allows isolation of the bacterium and further antimicrobial susceptibility testing. However, its effectiveness depends on strict laboratory conditions, especially selective media, microaerophilic incubation, and rapid transportation of stool material. This makes the method technically demanding, particularly in laboratories with limited equipment.

Modern diagnostic methods such as antigen detection and polymerase chain reaction can improve the speed and sensitivity of Campylobacter diagnosis. Molecular methods are especially useful when culture is negative due to improper transport, previous antibiotic use, or low bacterial load. At the same time, these methods require trained personnel, quality control, and financial resources. Therefore, in routine medical practice, the optimal approach should balance accuracy, accessibility, cost, and clinical necessity. For severe disease, prolonged diarrhea, immunocompromised patients, suspected outbreaks, and treatment failure, more advanced diagnostic methods and antimicrobial susceptibility testing become particularly important.

Helicobacter pylori presents another diagnostic challenge because its presence is often linked with chronic gastric pathology rather than acute infection. Many infected individuals may remain asymptomatic, while others develop gastritis, peptic ulcer disease, recurrent dyspepsia, or complications requiring long-term monitoring. The choice between invasive and non-invasive tests depends on the clinical situation. If endoscopy is indicated because of alarm symptoms, recurrent ulceration, bleeding, anemia, weight loss, or suspicion of malignant changes, biopsy-based methods provide valuable information. Rapid urease testing, histology, culture, and molecular diagnostics allow confirmation of infection and assessment of mucosal damage. However, invasive methods are not always necessary for uncomplicated cases, especially when non-invasive tests can provide reliable evidence of active infection.

The urea breath test and stool antigen test are highly useful for detecting active Helicobacter pylori infection and for evaluating eradication therapy. Serological testing may be helpful in certain epidemiological or initial screening contexts, but it cannot reliably distinguish current infection from past exposure. Another important issue is the effect of proton pump inhibitors, antibiotics, and bismuth

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

preparations on diagnostic accuracy. These medications may reduce bacterial load and produce false-negative results. Therefore, laboratory interpretation must always consider the patient's treatment history.

For medical education in Uzbekistan, this topic has practical relevance because gastrointestinal infections and chronic gastric diseases remain common clinical problems. Training future physicians to understand the laboratory diagnosis of Campylobacter and Helicobacter-related diseases strengthens their ability to connect microbiological theory with clinical decision-making. Proper sample collection, biosafety, rational test selection, and correct interpretation of results are essential components of professional competence. Effective diagnosis improves patient care, supports epidemiological surveillance, reduces irrational antimicrobial use, and contributes to prevention of complications associated with these medically significant bacteria.

Conclusion

Campylobacter and Helicobacter-related diseases represent an important group of bacterial infections that require careful clinical and laboratory evaluation. Although both microorganisms belong to Gram-negative microaerophilic bacteria and are associated with the gastrointestinal tract, their pathological role, disease dynamics, and diagnostic approaches differ significantly. Campylobacter jejuni and Campylobacter coli are mainly linked with acute intestinal infection, while Helicobacter pylori is primarily associated with chronic gastric inflammation, peptic ulcer disease, and long-term complications of the upper digestive tract. This difference determines the need for pathogen-specific diagnostic thinking and emphasizes the importance of integrating microbiological knowledge with clinical practice.

The study of Campylobacter infections shows that acute gastroenteritis cannot be diagnosed reliably on the basis of symptoms alone. Diarrhea, abdominal pain, fever, nausea, and inflammatory stool changes may resemble other bacterial intestinal infections, including salmonellosis, shigellosis, yersiniosis, and pathogenic Escherichia coli infections. Therefore, laboratory confirmation is essential for identifying the etiological agent, selecting rational treatment tactics,

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

and conducting epidemiological control. Stool culture on selective media under microaerophilic conditions remains an important method, especially when antimicrobial susceptibility testing is needed. However, the sensitivity of culture depends on correct specimen collection, rapid transportation, suitable temperature, and strict incubation conditions. Microscopy, antigen detection, and molecular testing may improve diagnostic accuracy and speed, particularly in severe cases, outbreak investigations, and situations where conventional culture is limited.

Helicobacter pylori infection requires another diagnostic approach because it is often persistent and connected with chronic mucosal changes. The bacterium's urease activity, motility, adhesion capacity, and long-term survival in the gastric environment explain its role in chronic gastritis, gastric and duodenal ulcers, mucosal atrophy, and increased risk of gastric malignancy. Laboratory diagnosis of Helicobacter pylori has direct clinical importance because timely detection and eradication can reduce disease recurrence and prevent severe complications. Invasive biopsy-based methods are valuable when endoscopy is clinically indicated, while non-invasive tests such as the urea breath test and stool antigen test are useful for primary detection and post-treatment monitoring. Serology may support epidemiological assessment, but its limitations must be considered because antibodies can remain positive after eradication.

A key conclusion of this analysis is that laboratory diagnosis must never be separated from clinical context. The reliability of diagnostic results depends not only on the method itself, but also on the quality of the specimen, the stage of disease, previous antimicrobial or antisecretory therapy, laboratory capacity, and professional interpretation. False-negative and false-positive results may occur when pre-analytical and analytical requirements are ignored. Therefore, physicians and laboratory specialists must cooperate closely in choosing appropriate diagnostic methods and interpreting their results.

For medical university education, the topic has strong practical value. Future physicians must understand the biological properties, clinical significance, diagnostic algorithms, and public health relevance of Campylobacter and Helicobacter infections. In the healthcare context of Uzbekistan, strengthening

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

laboratory diagnosis of gastrointestinal bacterial diseases is important for improving patient management, reducing irrational antibiotic use, supporting epidemiological surveillance, and preventing complications. Thus, the effective diagnosis of these pathogens should be regarded as an essential component of modern microbiology, infectious disease practice, gastroenterology, and evidence-based medical education.

References

1. Blaser, M. J., & Atherton, J. C. (2004). Helicobacter pylori persistence: Biology and disease. Journal of Clinical Investigation, 113(3), 321–333.
2. Butzler, J. P. (2004). Campylobacter, from obscurity to celebrity. Clinical Microbiology and Infection, 10(10), 868–876.
3. Carroll, K. C., Butel, J. S., Morse, S. A., Mietzner, T. A., & Detrick, B. (2019). Jawetz, Melnick & Adelberg's medical microbiology. McGraw-Hill Education.
4. Chey, W. D., Leontiadis, G. I., Howden, C. W., & Moss, S. F. (2017). ACG clinical guideline: Treatment of Helicobacter pylori infection. American Journal of Gastroenterology, 112(2), 212–239.
5. Debruyne, L., Gevers, D., & Vandamme, P. (2008). Taxonomy of the family Campylobacteraceae. In I. Nachamkin, C. M. Szymanski, & M. J. Blaser (Eds.), Campylobacter. ASM Press.
6. Dunn, B. E., Cohen, H., & Blaser, M. J. (1997). Helicobacter pylori. Clinical Microbiology Reviews, 10(4), 720–741.
7. Engberg, J. (2006). Contributions to the epidemiology of Campylobacter infections. Danish Medical Bulletin, 53(4), 361–389.
8. Forbes, B. A., Sahm, D. F., & Weissfeld, A. S. (2017). Bailey & Scott's diagnostic microbiology. Elsevier.
9. Go, M. F. (2002). Review article: Natural history and epidemiology of Helicobacter pylori infection. Alimentary Pharmacology & Therapeutics, 16(Suppl. 1), 3–15.
10. Goodwin, C. S., Armstrong, J. A., & Chilvers, T. (1989). Transfer of Campylobacter pylori and Campylobacter mustelae to Helicobacter gen. nov.

Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 2, Issue 4, April 2026
Website: usajournals.org

as Helicobacter pylori comb. nov. and Helicobacter mustelae comb. nov. International Journal of Systematic Bacteriology, 39(4), 397–405.

11. Jorgensen, J. H., Pfaller, M. A., Carroll, K. C., Funke, G., Landry, M. L., Richter, S. S., & Warnock, D. W. (Eds.). (2015). Manual of clinical microbiology. ASM Press.
12. Kist, M. (2011). Diagnosis of Helicobacter pylori infection. Helicobacter, 16(Suppl. 1), 1–5.
13. Kusters, J. G., van Vliet, A. H. M., & Kuipers, E. J. (2006). Pathogenesis of Helicobacter pylori infection. Clinical Microbiology Reviews, 19(3), 449–490.
14. Logan, R. P. H., & Walker, M. M. (2001). ABC of the upper gastrointestinal tract: Epidemiology and diagnosis of Helicobacter pylori infection. BMJ, 323(7318), 920–922.
15. Marshall, B. J., & Warren, J. R. (1984). Unidentified curved bacilli in the stomach of patients with gastritis and peptic ulceration. The Lancet, 323(8390), 1311–1315.
16. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2020). Medical microbiology. Elsevier.
17. Nachamkin, I., Szymanski, C. M., & Blaser, M. J. (Eds.). (2008). Campylobacter. ASM Press.
18. Oyarzabal, O. A., & Backert, S. (Eds.). (2012). Microbial food safety: An introduction. Springer.
19. Ryan, K. J., & Ray, C. G. (Eds.). (2014). Sherris medical microbiology. McGraw-Hill Education.
20. Suerbaum, S., & Michetti, P. (2002). Helicobacter pylori infection. New England Journal of Medicine, 347(15), 1175–1186.