A simple stool sample can **speak volumes** on intestinal inflammation.

Get a reliable first read on intestinal inflammation with **LACTOFERRIN TESTING**

- Non-invasive
- Sensitive
- Specific
- Cost-effective

Brought to you by the developers of the trusted **C. DIFF QUIK CHEK COMPLETE®** test.
**Lactoferrin: a highly reliable marker of intestinal inflammation**

**What is lactoferrin?**

Lactoferrin is a protein found in fecal leukocytes, also known as white blood cells. When there is inflammation in the intestines, leukocytes are shed into the stool. Numerous clinical studies over the last decade have established that fecal lactoferrin levels closely correlate with levels of intestinal inflammation. Elevated lactoferrin, therefore, is a biomarker for fecal leukocytes and a highly reliable indicator of intestinal inflammation.

**What conditions can lactoferrin help to identify?**

Many different conditions cause inflammation, but two diseases, in particular, are often associated with intestinal inflammation: **Inflammatory Bowel Disease (IBD)** and **Clostridium difficile disease/infection (CDI)**. IBD is the primary cause of noninfectious intestinal inflammation and can be difficult to distinguish from other intestinal disorders, especially **Irritable Bowel Syndrome (IBS)**. CDI is the primary cause of infectious intestinal inflammation. IBD and CDI are often found together in a single patient. Assessing fecal lactoferrin by means of a simple stool sample provides clinicians with a non-invasive yet reliable way to initially assess the inflammation status of their patients, and to determine if further testing is needed.

For disorders involving intestinal inflammation, the **treat to target** objective is mucosal healing.

**The science behind the biomarker: Lactoferrin levels parallel inflammation**

**Endoscopic Pictures (top) & Histologic Slides (bottom) of Intestines**

- **No acute inflammation** Score = 0
  - Mean lactoferrin = 22±7 μg/mL
  - Mag = 50x
  - Asymmetric crypt architecture
- **Mild inflammation** Score = 1
  - Mean lactoferrin = 62±12 μg/mL
  - Mag = 400x
  - A single crypt abscess
- **Moderate inflammation** Score = 2
  - Mean lactoferrin = 270±127 μg/mL
  - Mag = 250x
  - Frequent crypt abscesses
- **Severe inflammation** Score = 3
  - Mean lactoferrin = 739±254 μg/mL
  - Mag = 50x
  - Greater neutrophil infiltration into the lamina propria

**Correlation of Lactoferrin Levels to Endoscopy Score for Intestinal Inflammation**

- **None** Score = 0
  - Mean lactoferrin = 22±7 μg/mL
  - N = 63
  - \( R^2 = 0.85 \)
  - \( P<0.03^* \)
- **Mild** Score = 1
  - Mean lactoferrin = 62±12 μg/mL
  - \( P<0.03^* \)
- **Moderate** Score = 2
  - Mean lactoferrin = 270±127 μg/mL
  - \( P<0.13 \)
- **Severe** Score = 3
  - Mean lactoferrin = 739±254 μg/mL
  - \( P<0.05^* \)

*Statistical significance based on Student’s T-test with \( P<0.05 \)

Concentrations = mean ± standard error
Lactoferrin testing provides a first read on IBS/IBD

Detecting elevated lactoferrin levels can help to differentiate active IBD from IBS.

Intestinal inflammation distinguishes active Inflammatory Bowel Disease (IBD) from Irritable Bowel Syndrome (IBS). A positive test result for elevated fecal lactoferrin in persons who have tested negative for infectious etiologies should alert the physician to possible IBD, which warrants further testing. A negative result may signal a functional disorder like IBS, which is non-inflammatory.

Diagnosed IBD patient

Measuring lactoferrin levels can help to indicate the degree of IBD severity.

Levels of fecal lactoferrin correlate with levels of IBD activity and may be used as an indicator of mucosal healing. Lactoferrin levels can also help to predict IBD relapse and help to guide IBD treatment decisions.

Lactoferrin was the first United States FDA-cleared non-invasive biomarker to aid in the differentiation of active IBD from IBS.

Lactoferrin testing also gives insight into C. difficile

Detecting elevated lactoferrin levels can help to confirm the diagnosis of true CDI.

Toxins A and B are the primary diagnostic targets for C. difficile infection (CDI) and both toxins elicit a strong leukocyte response during infection. Elevated lactoferrin is a biomarker for fecal leukocytes and an indicator of intestinal inflammation. Knowing whether a patient has intestinal inflammation, therefore, can be useful when assessing for true C. difficile infection.

Diagnosed C. difficile patient

Measuring lactoferrin levels can help to indicate the degree of CDI severity.

C. difficile disease presents with a range of severity levels, ranging from mild to severe. Treatment usually includes metronidazole, for mild cases, and vancomycin, fidaxomicin and fecal microbiome transplant (FMT) for more severe cases. Stratifying patients for disease severity can be difficult in elderly patients who have comorbid disease. Studies have shown that more severe disease includes higher WBC counts, low serum albumin, and higher lactoferrin levels. Lactoferrin levels can help determine severity of disease for targeting and optimizing treatment.
Lactoferrin in pediatric IBD care

Approximately 20% of IBD patients are diagnosed in childhood, yet many methods of monitoring IBD activity are difficult for both the parents and the child. Parents may be reluctant for their child to undergo repeated colonoscopy given the perceived risk of the procedure. Routine laboratory measurement of serum biomarkers requires phlebotomy which is invasive and often provokes severe anxiety. Several clinical indices are dependent on the patient being able to describe their symptoms. Patients less than five years of age may not be able to communicate symptoms such as abdominal discomfort. **Lactoferrin testing is a non-invasive approach that causes less stress for parents and children and offers a sensitive and specific indicator of active disease.**

Lactoferrin in obstetric IBD care

IBD is most often diagnosed in the second through fourth decades of life—a period that coincides with likely childbearing years for female patients. Twenty-five percent of patients conceive for the first time after their diagnosis. Pregnancy with IBD, however, can be challenging. Research indicates that women with IBD are at higher risk for developing gestational diabetes, delivering preterm, and requiring cesarean section. The majority of patients with active disease will continue to have it throughout pregnancy, yet some IBD medications are contraindicated during gestation, making treatment more difficult. To ensure a successful pregnancy, close monitoring and management of IBD during the conception period and pregnancy is therefore essential. **Lactoferrin testing can help to non-invasively monitor disease activity and guide treatment decisions for women during this time.**
A comprehensive algorithm for C. difficile testing

Introducing a comprehensive algorithm for C. difficile testing

C. DIFF QUIK CHEK COMPLETE® plus lactoferrin testing is a winning combination for more effective CDI treatment.

Clostridium difficile infection involves a range of clinical presentations—from mild, self-limiting diarrhea to life-threatening pseudomembranous colitis and megacolon. Moderate to severe CDI cases require early identification for better outcomes and decreased mortality, especially among the elderly.

To achieve this, studies support the routine determination of both the presence of stool toxin and the degree of intestinal inflammation as an indicator of disease severity in CDI patients. Adding lactoferrin testing for intestinal inflammation to C. DIFF QUIK CHEK COMPLETE® testing for stool toxin provides a comprehensive algorithm for assessing CDI. Together, these tests quickly, easily, and non-invasively confirm true CDI and reveal the severity of infection, enabling clinicians to better manage their most vulnerable CDI patients.
Lactoferrin testing provides 
a number of clinical benefits

**Lactoferrin testing is reliable.**
Elevated levels of lactoferrin have been proven to correlate with endoscopic and histologic patterns of intestinal inflammation. Lactoferrin is stable in feces for up to 2 weeks at room temperature and for much longer periods at ≤-20°C. It is the most stable fecal biomarker available for intestinal inflammation, and is more reliable than microscopy for detecting fecal leukocytes since it does not rely on intact leukocytes (which degrade in stool within hours).

**Lactoferrin testing is non-invasive.**
Lactoferrin testing relies only on a fecal sample and thus reduces patient anxiety about having to submit to more invasive procedures. It provides a patient-friendly first read on inflammation and helps to rapidly identify those relatively few patients who will warrant further investigation. Avoiding unnecessary endoscopy in pediatric patients, who usually require deep sedation or anesthesia for the procedure, is particularly beneficial. Lactoferrin testing is also very well-suited to pregnant women seeking non-invasive methods.

**Lactoferrin testing is sensitive and specific.**
Lactoferrin testing has a sensitivity of 81.5 and a specificity of 96.5. Unlike, white blood cell count, it is specific to intestinal inflammation.

**Lactoferrin testing is cost-effective.**
By ruling out active IBD, lactoferrin testing helps to prevent unnecessary endoscopy, resulting in significant cost savings for both the patient and the health system. It also prevents unnecessary or mistargeted antibiotic use for suspected *C. difficile* patients.

Lactoferrin testing can make the diagnosis and treatment of IBS, IBD, and CDI much **quicker and easier for you and your patient**.
Lactoferrin testing is available in two formats to fit your needs

1 QUALITATIVE TESTING

Qualitative lactoferrin testing provides a positive or negative result for elevated levels of fecal lactoferrin. It can rapidly and non-invasively:
- Distinguish between patients with IBS and active IBD.
- Identify IBD patients with active inflammation.
- Provide convenient results for smaller clinics with appropriately-licensed in-house labs.

HOW QUALITATIVE TESTING WORKS

1 Fecal sample is tested in laboratory.
2 Lactoferrin presence is analyzed.
3 Physician learns whether inflammation is present to help diagnose/treat.

HOW QUANTITATIVE TESTING WORKS

1 Fecal sample is tested in laboratory.
2 Lactoferrin levels are analyzed.
3 Physician receives lactoferrin numerical concentration to help diagnose/treat.

2 QUANTITATIVE TESTING

Quantitative lactoferrin testing provides a quantitative measurement of fecal lactoferrin. It helps to quickly and non-invasively:
- Distinguish between patients with IBS and active IBD.
- Assess inflammation levels during IBD treatment to help direct treatment and to aid in predicting relapse.

Qualitative and quantitative lactoferrin testing is covered by most insurance plans.

HOW TO ORDER LACTOFERRIN TESTING

Both qualitative and quantitative lactoferrin testing can be easily ordered through most laboratories.

QUALITATIVE TESTING
CPT CODE 83630

QUANTITATIVE TESTING
CPT CODE 83631
Lactoferrin and CDI

L. Archbald-Pannone, J. Sevilleja, R. Guerrant.
Diarrhea, *Clostridium difficile*, and intestinal inflammation in residents of a long-term care facility.

J. Boone, L. Archibald-Pannone, K. Wickham, R. Carman, R. Guerrant, C. Franck, D. Lyerly.
Ribotype 027 *Clostridium difficile* infections with measurable stool toxin have increased lactoferrin and are associated with a higher mortality.

Elevated lactoferrin is associated with moderate to severe *Clostridium difficile* disease, stool toxin, and 027 infections.

P. LaSala, T. Eckhmimi, A. Hill, I. Farooqi, P. Perrotta.
Quantitative fecal lactoferrin in toxin-positive and toxin-negative *Clostridium difficile* specimens.

Laboratory diagnosis of *Clostridium difficile* infection. An evaluation of tests for faecal toxin, glutamate dehydrogenase, lactoferrin and toxigenic culture in the diagnostics laboratory.

Elevated levels of intestinal inflammation in *Clostridium difficile* infection associated with fluoroquinolone-resistant *C. difficile*.

Markers of intestinal inflammation, not bacterial burden, correlate with clinical outcomes in *Clostridium difficile* infection.

Lactoferrin and IBS/IBD

Diagnostic utility of faecal biomarkers in patients with irritable bowel syndrome.

R. Sidhu, P. Wilson, A. Wright, C. Yau, F. D’Cruz, L. Foye, S. Morley, A. Lobo, M. Mcalindon, D. Sanders.
Faecal lactoferrin—a novel test to differentiate between the irritable and inflamed bowel?

Fecal lactoferrin is a sensitive and specific marker of disease activity in children and young adults with inflammatory bowel disease.

Fecal lactoferrin for diagnosis of symptomatic patients with ileal pouch-anal anastomosis.

Fecal lactoferrin is a sensitive and specific marker in identifying intestinal inflammation.

G. Van Assch, S. Hanauer.
Fecal biomarkers for the diagnosis and management of inflammatory bowel disease.

B. Abraham, S. Kane.
Fecal markers: calprotectin and lactoferrin.

See more evidence-based literature at lactoferrintesting.com
Care to know more? It's easy to learn about lactoferrin testing online or by phone.

- Visit us online at lactoferrintesting.com.
- See current research and clinical data on lactoferrin testing at techlab.com/poster-gallery.
- Visit the TECHLAB Inc YouTube channel for product demonstration videos.
- Call our tech support team at 1-800-TECHLAB (in US) or +1-540-953-1664 (outside US) Monday-Friday from 8:30am-5:00pm ET.
- Or e-mail us at lactoferrin@techlab.com.

ABOUT TECHLAB®

For over 25 years, physicians have trusted TECHLAB, Inc. to provide high quality, non-invasive, in vitro diagnostics for gastrointestinal disorders. TECHLAB is the manufacturer of the FDA-cleared qualitative and quantitative fecal lactoferrin diagnostics for intestinal inflammation. Lactoferrin is a stable and reliable biomarker that can aid in the differentiation of active IBD from IBS, as well as an indicator of severity of other infectious disease states.