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Application of Point-of-Care Testing in Viral, Bacterial, and Fungal Infections: A Comprehensive Review

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Abstract: Point-of-care testing (POCT) has emerged as a transformative approach in the diagnosis and management of infectious diseases, offering rapid, accurate, and decentralized detection of pathogens at or near the site of patient care. This review evaluates the applications of POCT in viral, bacterial, fungal, and parasitic infections, highlighting its role in accelerating clinical decision-making and improving patient outcomes. POCT platforms utilize diverse principles, including immunoassays, nucleic acid amplification, and biosensor-based detection, enabling detection from minimal sample volumes with minimal technical expertise. In viral infections, POCT facilitates early detection and outbreak control, exemplified by COVID-19, influenza, dengue, and HIV diagnostics. In bacterial infections, rapid antigen and molecular assays support early pathogen identification, detect drug-resistant infections and critical conditions such as bacteriemia, Septicemia and its management . Fungal and parasitic POCT provide timely bedside diagnosis in immunocompromised patients and enhancing therapeutic interventions and reducing morbidity. Despite advantages such as rapid turnaround time, portability, and ease of use, POCT faces challenges in sensitivity, specificity, cost, and standardization. Ongoing technological innovations, including multiplex assays, microfluidics, CRISPR-based detection, and integrated biosensors, are expanding its diagnostic capabilities and accessibility. Overall, POCT represents a dynamic and evolving tool in modern clinical microbiology, with significant potential to improve infectious disease management across diverse healthcare settings.

Keywords: Point-of-care testing, POCT, Rapid diagnostics, Molecular diagnostics, Immunoassays, Biosensors.

Introduction

Clinical microbiology is a vital branch of laboratory medicine that focuses on the detection, identification, and characterization of microorganisms responsible for human diseases. It plays a crucial role in patient management, infection control, and public health surveillance. Traditionally, microbiological diagnosis relies on culture, microscopy, serology, and molecular techniques performed in centralized laboratories. These methods, although reliable, often require specialized infrastructure, trained personnel, and extended turnaround times, which may delay clinical decision-making and treatment initiation (1,2).

Infectious diseases remain a major global health concern, contributing significantly to morbidity and mortality, particularly in developing countries. Rapid diagnosis is essential for early initiation of appropriate therapy, reduction of disease transmission, and improved patient outcomes. Delayed diagnosis can lead to complications, prolonged hospital stays, and increased healthcare costs. In conditions such as sepsis, tuberculosis, and viral outbreaks, timely detection is critical to prevent fatal outcomes and control spread (2,3).

Conventional laboratory methods, including microbial culture and biochemical identification, are considered gold standards but have several limitations. Culture-based methods are time-consuming, often taking 24–72 hours or longer, and may fail in fastidious or slow-growing organisms. Additionally, these techniques require well-equipped laboratories and are not always accessible in resource-limited settings. Serological tests may lack sensitivity in early infection, while molecular methods, though rapid, are expensive and require technical expertise (2,3).

The growing burden of antimicrobial resistance and emerging infectious diseases has further emphasized the need for rapid and accurate diagnostic tools. During outbreaks such as COVID-19, the limitations of centralized testing systems became evident, highlighting the need for decentralized and rapid diagnostic approaches. Efficient diagnostics are essential not only for patient care but also for epidemiological surveillance and infection control strategies (4).

Point-of-care testing (POCT) has emerged as a transformative approach in clinical microbiology by enabling diagnostic testing at or near the site of patient care. These tests provide rapid results, often within minutes, facilitating immediate clinical decision-making. POCT encompasses a wide range of technologies, including lateral flow assays, molecular diagnostics, and biosensors, designed for ease of use and minimal infrastructure requirements (3,4).

Recent advances in microfluidics, biosensors, and molecular amplification techniques have significantly improved the sensitivity and specificity of POCT. Innovations such as loop-mediated isothermal amplification (LAMP), CRISPR-based diagnostics, and AI-integrated platforms have enhanced the capability of POCT to detect a wide range of pathogens rapidly and accurately. These developments have expanded the role of POCT from simple screening tools to reliable diagnostic modalities (1,8).

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POCT has shown immense potential in improving healthcare delivery, especially in resource-limited and remote settings where access to laboratory facilities is limited. It reduces turnaround time, improves patient compliance, and supports timely therapeutic interventions. Moreover, POCT plays a critical role in outbreak management, surveillance, and antimicrobial stewardship by enabling early detection and appropriate treatment strategies (4,8).

The aim of this review is to evaluate the applications of Point-of-Care Testing in the diagnosis of viral, bacterial, fungal, and parasitic infections. This review further seeks to assess the role of POCT in enabling rapid and accurate diagnosis of infectious diseases, compare its effectiveness with conventional laboratory diagnostic methods, and analyze its utility across different categories of infections. Additionally, it aims to examine the advantages and limitations of POCT while exploring its future potential and evolving role in modern Clinical Microbiology.

Principles and Types of Point-of-Care Testing:

Point-of-care testing (POCT) refers to diagnostic testing performed at or near the site of patient care, providing rapid results that facilitate immediate clinical decision-making. The fundamental principle of POCT is to minimize the time between sample collection and result availability, thereby improving patient outcomes and reducing the burden on centralized laboratories. POCT systems are designed to be user-friendly, require minimal technical expertise, and operate with small sample volumes such as whole blood, serum, saliva, or urine. These characteristics make POCT particularly valuable in emergency settings, intensive care units, outpatient clinics, and resource-limited environments (5).

The working principles of POCT are based on various biochemical and molecular detection mechanisms. One of the most widely used approaches is antigen–antibody interaction, which forms the basis of immunoassays. In these tests, specific antibodies bind to target antigens present in the sample, producing a detectable signal such as a color change. This principle is commonly utilized in lateral flow assays, which are simple, rapid, and do not require complex instrumentation. These assays are widely used for detecting infectious agents such as viruses, bacteria, and parasites (6).

Another important principle underlying POCT is nucleic acid amplification, which allows the detection of pathogen-specific DNA or RNA sequences. Techniques such as polymerase chain reaction (PCR) and isothermal amplification methods, including loop-mediated isothermal amplification (LAMP), have been adapted for POCT platforms. These molecular methods offer high sensitivity and specificity, enabling early detection of infections even when the pathogen load is low. The integration of these techniques into portable devices has significantly expanded the diagnostic capabilities of POCT (7).

Biosensor-based detection represents a rapidly evolving principle in POCT. Biosensors combine a biological recognition element, such as an enzyme, antibody, or nucleic acid probe, with a physical transducer that converts the biological interaction into a measurable signal. These signals may be optical, electrochemical, or thermal in nature. Biosensor-based POCT devices provide rapid, highly sensitive, and quantitative results, making them suitable for a wide range of clinical applications, including infectious disease diagnosis (8).

POCT can be broadly classified into different types based on the underlying technology and method of detection. Immunological POCT includes lateral flow assays and enzyme-linked immunosorbent assays (ELISA)-based rapid kits, which are commonly used for screening infectious diseases. These tests are simple, cost-effective, and provide results within minutes, making them ideal for point-of-care settings. However, they may have limitations in sensitivity, particularly during early stages of infection (5).

Molecular POCT represents a more advanced category that includes nucleic acid amplification tests (NAATs). These tests detect genetic material of pathogens and are highly accurate. Examples include portable PCR devices and cartridge-based systems that automate sample processing and analysis. Molecular POCT has become increasingly important in diagnosing diseases such as tuberculosis, COVID-19, and sexually transmitted infections, where rapid and precise detection is critical (6).

Another emerging category is biosensor-based and microfluidic POCT, often referred to as lab-on-a-chip technology. These systems integrate multiple laboratory functions onto a single chip, allowing sample preparation, detection, and analysis to occur simultaneously. Microfluidic POCT devices require minimal sample volumes and provide rapid results with high precision. These technologies are particularly promising for future diagnostic applications due to their portability and efficiency (7).

Despite the numerous advantages, POCT has certain limitations that must be considered. Variability in test performance, especially in terms of sensitivity and specificity, can affect diagnostic accuracy. Additionally, quality control and standardization remain significant challenges, particularly in decentralized settings. The cost of advanced POCT devices and the need for proper training may also limit their widespread adoption in low-resource environments (8).

Overall, the principles and types of POCT reflect a dynamic and rapidly advancing field that is transforming modern Clinical Microbiology. Continuous innovations in immunoassays, molecular diagnostics, and biosensor technologies are enhancing the reliability and accessibility of POCT, making it an indispensable tool in the diagnosis and management of infectious diseases (5–8).

Poct in Viral Infections:

Point-of-care testing (POCT) has significantly transformed the diagnosis and management of viral infections by enabling rapid, accurate, and decentralized detection of pathogens. Viral diseases often present with nonspecific clinical symptoms, making early and precise diagnosis essential for appropriate treatment and infection control. Traditional laboratory methods such as viral culture and standard molecular assays are time-consuming and require specialized infrastructure. In contrast, POCT provides results within minutes to hours, facilitating immediate clinical decision-making and reducing the risk of disease transmission (8).

The application of POCT in viral infections is primarily based on two major approaches: antigen detection and nucleic acid amplification. Antigen-based rapid diagnostic tests (RDTs) detect viral proteins and are widely used due to their simplicity, low cost, and quick turnaround time. These tests are particularly useful in acute infections where viral load is high. However, their sensitivity may be lower compared to molecular methods, especially in early or late stages of infection. Despite this limitation, antigen-based

POCT has played a crucial role in large-scale screening and outbreak management (9).

Molecular POCT, including real-time polymerase chain reaction (RT-PCR) and isothermal amplification techniques such as loop-mediated isothermal amplification (LAMP), offers higher sensitivity and specificity. These techniques detect viral RNA or DNA and can identify infections even at low viral loads. Recent advancements have led to the development of portable and cartridge-based molecular POCT platforms, which combine rapid detection with high accuracy. These systems have become essential tools in clinical settings for diagnosing various viral infections (10).

One of the most significant applications of POCT has been observed during the global pandemic of COVID-19. Rapid antigen tests and molecular POCT devices were extensively deployed for screening, diagnosis, and surveillance. These tests enabled timely isolation of infected individuals and helped control the spread of the virus. The pandemic highlighted the importance of scalable and accessible diagnostic solutions, accelerating innovation and adoption of POCT technologies worldwide (8).

POCT is also widely used for the diagnosis of other viral infections such as influenza, dengue, and human immunodeficiency virus (HIV). Rapid influenza diagnostic tests (RIDTs) allow early detection and timely antiviral therapy, reducing complications and hospitalizations. Dengue POCT, including NS1 antigen and antibody detection tests, is particularly useful in endemic regions for early diagnosis and monitoring. Similarly, rapid HIV tests have improved screening and early detection, especially in community and resource-limited settings (9).

The use of POCT in viral infections offers several advantages, including reduced turnaround time, minimal sample processing, and ease of use. These features make POCT suitable for use in emergency departments, outpatient clinics, and remote areas where laboratory facilities are limited. Furthermore, rapid diagnosis facilitates timely initiation of treatment, reduces unnecessary antibiotic use, and improves patient outcomes. POCT also plays a vital role in outbreak control by enabling large-scale screening and surveillance (10).

Despite its advantages, POCT for viral infections has certain limitations. Variability in sensitivity and specificity, particularly in antigen-based tests, can lead to false-negative or false-positive results. Environmental factors, improper sample collection, and operator errors may also affect test performance. Additionally, molecular POCT devices, while highly accurate, are often expensive and require proper maintenance and quality control measures (9).

Recent technological advancements are addressing these challenges by improving the accuracy, portability, and affordability of POCT devices. Innovations such as CRISPR-based diagnostics, biosensor technologies, and smartphone-integrated platforms are enhancing the capabilities of POCT in viral detection. These developments are expected to further expand the role of POCT in clinical practice and public health, making it an indispensable tool in modern Clinical Microbiology (10).

In conclusion, POCT has revolutionized the diagnosis of viral infections by providing rapid, reliable, and accessible diagnostic solutions. Its application has improved patient management, strengthened infection control measures, and enhanced outbreak response. Continued advancements in technology and increased accessibility are likely to further solidify the role of POCT in the effective diagnosis and management of viral diseases (8–10).

Table 1 - POCT available for Viral infections

Virus / Disease	POCT Model / Test Kit	Manufacturer	Technology	Key Benefits
COVID-19	iHealth COVID-19/Flu A&B 3-in-1 Antigen Rapid Test	iHealth Labs	Antigen (Lateral flow)	Rapid (15 min), detects multiple viruses (COVID + Flu), easy home/clinic use
COVID-19	Real-Time PCR Detection Kit	Multiple (e.g., Indian IVD manufacturers)	RT-PCR (Molecular POCT)	High sensitivity & specificity, detects early infection
COVID-19 / Influenza	Multiplex Respiratory Panel (4-in-1 / 5-in-1 kits)	Hysentech	Antigen / Molecular multiplex	Detects multiple respiratory viruses simultaneously, saves time (Hysen Biotech.Inc)
COVID-19	SARS-CoV-2 Antigen Rapid Test Device	Assure Tech	Antigen (colloidal gold)	Quick, self-testing, mass screening capability (Assure Tech (Hangzhou) Co., Ltd)
Dengue	Dengue NS1 Ag + IgG/IgM Combo Kit	Zet Biotech	Antigen + Antibody	Early detection + staging of infection (zetbiotech.com)
Dengue	Dengue NS1 Rapid Test (SD Bioline type)	Standard Diagnostics / others	Immunochromatographic	Detects infection from day 1, rapid (15–20 min) (diagnosolhealthtech.com)
Influenza	Influenza A/B Antigen Rapid Test Kit	Pathkits	Antigen	Quick diagnosis, guides antiviral therapy (pathkits.com)
Influenza + COVID-19	Combo Antigen Test Kits	Multiple manufacturers	Lateral flow multiplex	Differentiates similar respiratory infections quickly (Hysen Biotech.Inc)

Virus / Disease	POCT Model / Test Kit	Manufacturer	Technology	Key Benefits
HIV	HIV 1/2 Rapid Test Kit	Health Vista Pharma	Antibody detection	Rapid screening, widely used in field settings (Health Vista Pharma)
HIV	4th Generation HIV Ag/Ab Combo Test	Multiple manufacturers	Antigen + Antibody	Early detection (p24 antigen), improved accuracy (trivenitradersanddiagnostic.com)
Hepatitis B	HBsAg Rapid Test Kit	Various manufacturers	Antigen detection	Quick screening, blood safety applications (Health Vista Pharma)
Hepatitis C	HCV Rapid Test Kit	Various manufacturers	Antibody detection	Fast diagnosis, useful in screening programs (Health Vista Pharma)
Monkeypox / Emerging Viruses	Monkeypox Antigen Rapid Test	Hysentech	Antigen + molecular support	Rapid outbreak detection, supports PCR/LAMP (Hysen Biotech.Inc)
Rotavirus / Adenovirus	Rota/Adeno Combo Rapid Test	Zet Biotech	Antigen detection	Pediatric infection diagnosis, quick stool testing (zetbiotech.com)

Poct in Bacterial Infections:

Point-of-care testing (POCT) has emerged as a crucial tool in the diagnosis and management of bacterial infections, enabling rapid identification of pathogens and timely initiation of appropriate therapy. Bacterial infections often require immediate intervention, particularly in life-threatening conditions such as sepsis, pneumonia, and meningitis. Traditional diagnostic methods, especially culture-based techniques, remain the gold standard but are time-consuming, typically requiring 24–72 hours for pathogen identification and antimicrobial susceptibility testing. This delay often leads to empirical antibiotic use, which may be inappropriate and contributes to antimicrobial resistance (11).

POCT addresses these limitations by providing rapid diagnostic results at or near the patient's bedside. These tests significantly reduce turnaround time, often delivering results within minutes to a few hours, thereby facilitating early clinical decision-making. Rapid antigen detection tests (RADTs), such as those used for Group A Streptococcus, are widely utilized in clinical practice. These tests detect specific bacterial antigens and are simple, cost-effective, and easy to perform, making them suitable for outpatient and primary care settings (11).

Molecular POCT has revolutionized bacterial diagnostics by enabling highly sensitive and specific detection of bacterial DNA or RNA. Techniques such as real-time polymerase chain reaction (PCR) and isothermal amplification methods, including loop-mediated isothermal amplification (LAMP), allow rapid identification of pathogens directly from clinical samples. Multiplex PCR platforms can simultaneously detect multiple bacterial species and antimicrobial resistance genes, which is particularly valuable in severe infections like sepsis. These systems can provide results within 1–2 hours, significantly improving patient management and outcomes (12).

One of the most critical applications of POCT in bacterial infections is in the diagnosis of sepsis. Sepsis is a life-threatening condition requiring immediate diagnosis and treatment. Conventional blood culture methods have limitations, including low sensitivity and delayed results. Molecular POCT platforms, such as multiplex PCR panels, enable rapid detection of bloodstream pathogens and resistance markers, allowing clinicians to initiate targeted antimicrobial therapy much earlier. Studies have shown that these methods can detect pathogens even when present in low concentrations, improving diagnostic accuracy (12,13).

POCT is also widely used in the detection of drug-resistant bacteria, particularly Methicillin-resistant Staphylococcus aureus. Rapid POCT devices for MRSA can identify resistance genes within 30–40 minutes, enabling prompt infection control measures and appropriate antibiotic therapy. Early detection of resistant organisms is essential in preventing hospital-acquired infections and reducing the spread of multidrug-resistant pathogens (13).

Another important application of POCT is in respiratory bacterial infections. Pathogens such as *Streptococcus pneumoniae*, *Mycoplasma pneumoniae*, and *Haemophilus influenzae* can now be rapidly detected using molecular POCT platforms. These tests are particularly beneficial in pediatric and elderly populations, where early diagnosis can prevent complications and reduce hospitalization rates. The use of POCT in respiratory infections also supports antibiotic stewardship by distinguishing bacterial infections from viral causes, thereby reducing unnecessary antibiotic prescriptions (12).

Biomarker-based POCT is an emerging approach in bacterial diagnostics. Tests measuring host response markers such as C-reactive protein (CRP) and procalcitonin are increasingly used to differentiate bacterial infections from viral infections. These biomarkers rise significantly during bacterial infections and can guide clinicians in deciding whether antibiotic therapy is necessary. POCT devices for these biomarkers provide rapid results and are particularly useful in primary care and emergency settings (11).

Despite its numerous advantages, POCT in bacterial infections has certain limitations. Variability in sensitivity and specificity, especially in antigen-based tests, can affect diagnostic accuracy. Molecular POCT, although highly accurate, is often associated with higher costs and requires proper infrastructure and quality control measures. Additionally, most POCT platforms target a limited number of pathogens, which may lead to missed diagnoses in polymicrobial infections (11).

Recent advancements in technology are addressing these challenges by improving the accuracy, portability, and affordability

of POCT devices. Innovations such as microfluidic systems, lab-on-a-chip technologies, and integrated biosensors are enhancing the performance of POCT. These developments are expected to expand the role of POCT in bacterial diagnostics and make it an indispensable component of modern Clinical Microbiology (12,13).

TABLE 2: POINT-OF-CARE TESTS (POCT) FOR BACTERIAL INFECTIONS

Bacterial Infection	POCT Model / Test Kit	Manufacturer	Technology	Key Benefits
Methicillin-resistant Staphylococcus aureus (MRSA)	GeneXpert MRSA/SA SSTI	Cepheid	PCR-based molecular POCT	Rapid detection (1 hour), differentiates MRSA from MSSA, guides targeted therapy
Sepsis / Bloodstream infections	FilmArray Blood Culture Identification (BCID) Panel	BioFire Diagnostics	Multiplex PCR	Detects 24 pathogens + resistance genes, results in ~1 hour, improves early targeted therapy
Group A Streptococcus (Strep throat)	QuickVue Strep A Test	Quidel	Antigen detection (lateral flow)	Rapid (10–15 min), easy to use in outpatient clinics
Streptococcus pneumoniae	BinaxNOW S. pneumoniae Antigen Card	Abbott	Antigen detection (urine)	Rapid detection from urine, useful in pneumonia diagnosis
Urinary Tract Infections (UTI)	Uriscreen / Rapid UTI Dipstick	Various manufacturers	Biomarker + antigen detection	Quick screening in outpatient and community settings
Tuberculosis (Pulmonary / Extrapulmonary TB)	GeneXpert MTB/RIF	Cepheid	PCR (nucleic acid amplification)	Detects TB and rifampicin resistance in 2 hours, high sensitivity
Clostridioides difficile	C. DIFF QUIK CHEK COMPLETE	TechLab	Antigen + Toxin detection	Rapid detection of C. difficile toxin and antigen, improves infection control
Neisseria gonorrhoeae / Chlamydia trachomatis	GeneXpert CT/NG	Cepheid	Molecular PCR POCT	Rapid detection of STIs, highly sensitive and specific, suitable for clinics
Helicobacter pylori	H. pylori Rapid Test	Rapid Labs / Various	Antigen detection (stool)	Quick non-invasive test, suitable for outpatient screening
Pneumonia / Respiratory infections	FilmArray Respiratory Panel	BioFire Diagnostics	Multiplex PCR	Detects bacterial + viral pathogens simultaneously, improves targeted therapy
Salmonella / Shigella / E. coli	Lateral Flow Rapid Test Kits	Various manufacturers	Antigen detection	Rapid stool testing, simple, field-use compatible
Legionella pneumophila	BinaxNOW Legionella Urinary Antigen Test	Abbott	Antigen detection	Rapid, non-invasive urine-based detection, useful in hospital outbreaks

Poct in Fungal and Parasitic Infections:

Point-of-care testing (POCT) for fungal and parasitic infections plays a critical role in rapid diagnosis, especially in immunocompromised patients and in endemic or resource-limited regions. Conventional laboratory methods for fungal infections, such as culture and histopathology, and for parasitic infections, such as microscopy, are often slow, labor-intensive, and require skilled personnel. POCT overcomes these limitations by providing rapid, bedside results that facilitate timely clinical decision-making and initiation of targeted therapy, improving patient outcomes (15).

Fungal Infections

Fungal POCT primarily targets **antigens or nucleic acids** of the pathogen. For immunocompromised patients, rapid diagnosis is vital due to high morbidity and mortality associated with systemic fungal infections. The commonly used POCT include lateral flow assays for *Cryptococcus*, *Aspergillus*, and *Candida*, and molecular platforms for bloodstream fungal pathogens.

Cryptococcosis: The CrAg Lateral Flow Assay (LFA) detects cryptococcal capsular antigen in serum, plasma, or cerebrospinal fluid within 10 minutes. It is highly sensitive and specific, especially for HIV patients in endemic areas.

Candidiasis: The T2Candida Panel detects Candida DNA directly from blood using magnetic resonance and molecular detection, providing results in <5 hours, even at low pathogen concentrations.

Aspergillosis and Histoplasmosis: Galactomannan and Histoplasma antigen LFAs enable rapid bedside detection, allowing early antifungal therapy initiation.

Advantages of fungal POCT include rapid turnaround time, minimal sample processing, and applicability in low-resource settings. Limitations include moderate sensitivity in early infection

stages and requirement of confirmatory testing for complex cases (15,16).

Parasitic Infections

POCT for parasitic infections mainly uses antigen or antibody detection, particularly in endemic regions where rapid field diagnosis is critical. The most widely used POCT include malaria rapid diagnostic tests, rK39 tests for leishmaniasis, and circulating cathodic antigen (CCA) tests for schistosomiasis.

Malaria: Tests like SD Bioline Malaria Ag P.f/Pan detect HRP2 and pLDH antigens in blood in 15–20 minutes, differentiating *Plasmodium falciparum* from other species.

Visceral Leishmaniasis: The rK39 immunochromatographic test rapidly detects antibodies in blood, providing results within 15 minutes and facilitating early treatment.

Schistosomiasis: Point-of-care CCA tests detect Schistosoma antigens in urine rapidly, suitable for mass-screening programs.

Other Parasitic Infections: Filaria antigen tests, Giardia antigen rapid tests, and Trypanosomiasis RDTs are used for field-based or outpatient screening, reducing the need for laboratory infrastructure.

Advantages include simplicity, rapid results, and suitability for field use. Limitations include variability in sensitivity depending on parasite load and stage of infection, and the potential need for confirmatory laboratory testing in borderline cases (15,16).

TABLE 3: POINT-OF-CARE TESTS (POCT) FOR FUNGAL INFECTIONS

Fungal Infection	POCT Model / Test Kit	Manufacturer	Technology	Key Benefits
Candidiasis (Invasive/Systemic)	T2Candida Panel	T2 Biosystems	Magnetic resonance + molecular detection	Detects Candida species directly from blood in <5 hrs, highly sensitive, early diagnosis
Cryptococcosis	CrAg Lateral Flow Assay	IMMY	Antigen detection (lateral flow)	Rapid (<10 min), highly sensitive, suitable for HIV/endemic regions
Aspergillosis	Aspergillus Galactomannan LFA	Bio-Rad / IMMY	Antigen detection	Rapid detection from serum/BAL, early initiation of antifungal therapy
Histoplasmosis	Histoplasma Antigen LFA	IMMY	Antigen detection	Rapid detection from urine/serum, suitable for endemic regions
Pneumocystis jirovecii	Pneumocystis Rapid Immunoassay	Various	Antigen detection	Detects antigens in respiratory samples, rapid bedside testing

TABLE 4: POINT-OF-CARE TESTS (POCT) FOR PARASITIC INFECTIONS

Parasitic Infection	POCT Model / Test Kit	Manufacturer	Technology	Key Benefits
Malaria	SD Bioline Malaria Ag P.f / Pan	Standard Diagnostics	Antigen detection (HRP2/pLDH)	Rapid (15–20 min), differentiates P. falciparum & other species, field-use compatible
Malaria	CareStart Malaria Pf/Pv Combo	Access Bio	Antigen detection	High sensitivity, suitable for rural/endemic areas
Visceral Leishmaniasis	rK39 Immunochromatographic Test	InBios / IT Leish	Antibody detection	Rapid (<15 min), simple, detects VL in endemic regions
Schistosomiasis	Point-of-care CCA Test	Rapid Medical Diagnostics	Antigen detection (urine)	Quick, non-invasive detection, field-use friendly
Filariasis	Filaria Test Strip	Alere / BinaxNOW	Antigen detection	Detects Wuchereria bancrofti antigens rapidly, mass-screening suitable
Giardiasis	Giardia Antigen Rapid Test	TechLab / RIDA	Antigen detection	Rapid stool testing, simple, portable
Trypanosomiasis	Rapid Diagnostic Test (RDT)	SD Bioline / ITG	Antibody detection	Quick field screening, suitable for remote endemic areas

Discussion:

The findings from this review align closely with recent advances reported in the literature, underscoring that POCT has increasingly become a cornerstone in the modern diagnosis and management of infectious diseases. Contemporary research highlights substantial progress in POCT technologies, particularly in integrating molecular diagnostics, biosensors, and microfluidic platforms to achieve rapid, sensitive, and user-friendly testing outside traditional laboratory settings (16). Reviews on class-2 CRISPR/Cas-based POCT emphasize that newer nucleic acid-based methods can combine the high accuracy of conventional PCR with the rapid portability needed at the point of care, suggesting a future where highly specific molecular tests become more widely accessible (17). Similarly, recent critical analyses of POCT platforms show that advances in paper-based diagnostics, lateral flow immunoassays (LFIA), plasmonic sensors, and smartphone-linked biosensors have significantly expanded the range of detectable pathogens, improving both reach and usability in low-resource environments (18). Furthermore, the rising utilization of AI and digital analytical layers in POCT systems has begun to enhance automated result interpretation, multiplex signal decoding, and quality control, pointing to a future where POCT not only delivers rapid results but also integrates real-time data into clinical and public health networks (19).

Despite these advancements, current literature reinforces the limitations identified in this review. Variable sensitivity of antigen-based tests remains a concern, especially in early or low-load infections, making confirmatory testing critical in certain clinical scenarios (20). There is also broad recognition that while molecular POCT platforms achieve near laboratory-grade accuracy, challenges related to cost, need for clinical validation, and regulatory standardization continue to hinder widespread adoption (21). Studies comparing POCT with comprehensive methods such as metagenomic next-generation sequencing (mNGS) demonstrate that while rapid POCT can offer faster and cost-effective detection for targeted pathogen panels, mNGS provides broader pathogen coverage at the expense of speed and simplicity, indicating that complementary strategies will remain important in complex clinical contexts (22). Additionally, literature on parasitic POCT highlights that although rapid tests are transformative in endemic regions, differential performance across parasite species and stages of infection necessitates ongoing innovation and field validation (23).

Overall, recent publications validate the major trends observed in this review: POCT has dramatically enhanced the rapid diagnosis of infectious diseases across viral, bacterial, fungal, and parasitic categories, but continuous refinement in technology, cost-effectiveness, and clinical validation is essential to fully realize its potential in diverse healthcare settings (24).

Despite the transformative impact of point-of-care testing (POCT) in infectious disease management, several limitations remain. Many antigen-based POCTs, particularly for viral and bacterial infections, may exhibit lower sensitivity compared to conventional laboratory methods, leading to false negatives in cases of low pathogen load or early infection(25). Most POCT platforms target specific pathogens or limited panels, which can result in missed diagnoses of polymicrobial or rare infections, necessitating confirmatory laboratory testing. Molecular POCT devices, although highly accurate, often involve high costs, require specialized consumables, and demand infrastructure that may not be available in resource-limited settings. Additionally, the accuracy of POCT is operator-dependent, with improper sample collection, handling, or interpretation potentially affecting results, highlighting the need for proper training and standardized protocols. Regulatory variations, differences in validation standards, and the predominance of qualitative rather than quantitative outputs further limit widespread adoption and utility in monitoring pathogen load or therapy response (26).

Nevertheless, POCT has revolutionized the rapid diagnosis and management of viral, bacterial, fungal, and parasitic infections by providing timely, accessible, and actionable results. It enables early initiation of targeted therapy, supports antimicrobial stewardship, reduces dependence on centralized laboratories, and improves patient outcomes, particularly in emergency, primary care, and field settings. Antigen-based tests offer simplicity and rapid turnaround, molecular platforms provide high sensitivity and pathogen specificity, and biomarker-based POCT assists clinical decision-making. Integrating POCT with conventional laboratory methods, along with ongoing technological advancements in multiplex assays, biosensors, and portable molecular platforms, is expected to overcome current limitations. Overall, POCT represents a critical tool in modern infectious disease diagnostics, enhancing outbreak response, facilitating early treatment, and ultimately strengthening public health efforts.

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