https://doi.org/10.33472/AFJBS.6.9.2024.4735-4755

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

NAVIGATING THE NEW NORMAL: PUBLIC HEALTH CHALLENGES IN THE AGE OF EMERGING INFECTIOUS DISEASES

Dr B.V.S Lakshmi[1], Dr Krupavaram.B[*2], Surya Prabha Matangi[3], Renukaradhya Chitti[4], Dr Sree Vennela Rao[5], Dr.S.Heamavathi.,M.D(s)[6], G Venkata Nagaraju[7]

[1]Dept. of Pharmacology, School of Allied and Health Care Sciences, Malla Reddy University, Hyderabad, Telangana,

[*2]School of Pharmacy, KPJ Healthcare University, Malaysia.

[3]Vignan's Foundation for Science, Technology and Research, Deemed to be University. Guntur, Andhra Pradesh.

[4]Assistant Professor, Department of Practice, Sri Adichunchanagiri College of Pharmacy, Adichunchanagiri University, B.G Nagar, Karnataka- 571418

[5]Dept. of Pharmacology, School of Allied and Health Care Sciences, Mallareddy University, Hyderabad, Telangana

[6]Junior Research Fellow-Peripheral Pharmacovigilance Centre, Govt.Siddha Medical College, Arumbakkam Chennai-106.

[7]Assistant Professor, Department of Pharmacy Practice, Hindu College of Pharmacy, Guntur.

***Corresponding author**

Dr Krupavaram.B

ucn.krupa@kpju.edu.my

Article Info Volume 6, Issue 9, 2024
Received: 09 Apr 2024
Accepted: 10 May 2024
doi:10.33472/AFJBS.6.9.2024.4735-4755

Abstract:
Worldwide, infectious diseases account for the majority of morbidity and mortality. The first step towards both treatment and the control and prevention of disease is an accurate and early diagnosis. The identification of diseases, appropriate treatment, and containment of epidemics among the populace all depend on efficient diagnostic methods. Some significant questions that can be addressed by assessments of these procedures in light of numerous variables are whether or whether they are useful in a particular community context and, if so, which test would be most suitable. Important aspects include the degree of the sickness, genetic variety of the pathogen, availability and accessibility of resources, and proficiency with existing techniques that could add to understanding of the virulence. Numerous approaches of diagnosing infectious diseases have been put forth and evaluated in the literature. There are three main groups into which mainstream diagnostics can be divided: 1) Conventional techniques, such as microscopy and cell culture 3) cutting-edge biotechnology techniques including molecular genotyping, DNA microarray, and nanotechnology; 2) biochemical techniques like immunoassays and colorimetric tests. Within their respective functional ranges and situations of necessity and application, each approach possesses unique benefits and drawbacks. Advanced methods are often faster and more sensitive than classical methods, which are regarded as industry standards and economical. For some microbiological infections, such as tuberculosis, traditional techniques like microscopy and culture are tried-and-true, reasonably priced approaches. Compared to pricey contemporary approaches, these methods are easily accessible in remote, difficult-to-reach areas. The gold-standard diagnostic techniques have drawbacks despite these benefits, such as time-consuming sample preparation, sluggish results, lower sensitivity, and occasionally ineffectual detection. Rapid and sensitive immunotechniques are available, such as agglutination and dipsticks, that are employed in both rural and urban regions and can confirm positivity or negativity with nearly 100% sensitivity.
***Keywords*:** Infectious diseases, biochemical methods, diagnostic techniques, disease control and prevention.

Introduction

A scientific strategy and workable fix to stop infection-related harm to patients and healthcare professionals is infection prevention and control. It is a subset of epidemiology and plays a crucial role in the social sciences, global health, and infectious illnesses. A key public health concern for patient safety and the improvement of the healthcare system is effective infection prevention and control [1].

The Spread of Infectious Disease

The successful spread of pathogenic microorganisms, such as bacteria, viruses, parasites, or fungus, is referred to as an infection.

Directly:

- From person to person
- Through respiratory droplets (for example, coughing or sneezing)
- Through body fluids
- Direct exposure to infectious agent in environment
- During childbirth from mother to foetus (transplacental/perinatal)

Epidemiological Triad [2]

When an infectious bacterium enters the body, it multiplies, causing a reaction in the body and maybe an infectious disease in people. Three factors, referred to as the epidemiological triad, are necessary for the transmission of infectious disease:

- The Agent - The microorganism that causes the infection and can be in the form of bacteria, viruses, parasites or fungi.
- The Host - The target of the disease
- The Environment - The surroundings and conditions (these are external to the host)

Infection Spread in Healthcare [3]

Because of the presence and relative ratio of susceptible individuals, healthcare facilities, whether they are hospitals or primary care clinics, are areas with a higher risk of disease transmission. Although 10% of patients contract an infection while receiving treatment, 30% or less of healthcare-associated infections can be prevented with good infection prevention and control.

Source - places where infectious agents survive (e.g. sinks hospital equipment, countertops, and medical devices).

Environment - patient care areas, sinks hospital equipment, countertops, and medical devices.

People - patients, healthcare workers, or visitors.

Susceptible Person - An individual with a weakened or compromised immune system, or a patient, healthcare worker, or visitor who is not immune to a certain infectious disease. Moreover, underlying medical disorders, drugs, and essential treatments and procedures that raise the risk of infection (such as surgery) can all make a person more susceptible.

Transmission - The way germs are moved to the susceptible person

- Touch, including via medical equipment or a susceptible person (for example, MRSA or VRE)
- Sprays or splashes (for example, Pertussis)
- Inhalation of aerosolised particles (for example, TB or Measles)
- Sharps injuries introducing blood-borne pathogens (for example, HIV, HBV, HCV)

For example, when it comes to infectious diseases, the inaccurate pathogen identification could result in the improper medication prescription. Although accurate statistics regarding the entire scope of misdiagnosis remains elusive, a meta-analysis of mortality in US intensive

care units (ICUs) provided some indication of the problem's magnitude, estimating that 40,500 adult patients in the US may pass away annually due to a misdiagnosis. In comparison, a sensitivity of 99% will result in many virus carriers receiving the incorrect diagnosis for a more common illness like HIV AIDS [4]. "As of right now, about 140 million rapid HIV tests are conducted annually; even if the error rate was only 1%—which we know it is much higher-there would be over a million false positives annually," stated Peeling. Nevertheless, the speed and ease with which HIV tests can now be performed in the field has made it possible to diagnose many patients much faster than in the past. In any case, positive tests are confirmed, and the difficulty lies in raising the sensitivity as high as possible to prevent false negative results at the outset. While bacterial and viral illnesses have benefited most from developments in molecular diagnostics, prions and other infectious agents have also been successfully detected [5]. The most recent developments are related to a method known as quaking-induced conversion (RT-Quick) seeding, which can identify minuscule quantities of the pathogenic protein in samples of olfactory mucosa or cerebrospinal fluid. Little amounts of infectious prions are added to normal protein in the RT-Quick assay to either seed or produce the misfolding observed in the disease. Subsequently, the assay is quantified by assessing the samples' successive dilutions and calculating the seeding activity loss [6].

Inadequate diagnostic procedures for prompt identification was the primary issue impeding appropriate action to address morbidity and death, particularly in cases with drug-resistant tuberculosis and HIV. Diagnostic methods such as light microscopy and occasionally culture are still reliant on conventional methods in high-incidence and low-income nations [7, 8, 9].

But these microscopy methods are far less sensitive, with sensitivity ranging from 20 to 80 percent, particularly in youngsters and HIV patients whose pulmonary bacillary burden is below the microscopy's detection limits1–10. The World Health Organisation advises against using traditional light or fluorescence microscopes in favour of light emitting diode microscopy, which can produce both light and fluorescence wavelengths, in order to increase sensitivity. Cultivation became essential because the little advancement in microscopy method was still insufficient to address diagnostic issues like drug-resistant infections and those co-infected with HIV. The WHO guidelines state that patients with TB symptoms who test negative for HIV should also have their samples cultured. The two main types of multidrug-resistant tuberculosis (TB) that are commonly identified by conventional culture and drug susceptibility test (DST) are MDR-TB (primarily resistant to INH and RIF) and XDR-TB (resistant to additional antibiotics) [10, 11]. These two types of TB highlight the need for quick and efficient diagnostic techniques. The inefficiency of culture techniques in resource-poor nations can be attributed to inadequate infrastructure, inadequate biosafety protocols, and a shortage of skilled personnel capable of conducting trustworthy testing. Furthermore, DST and cultivation waste valuable time. Numerous immunological methods, such as the enzyme-linked immunosorbent assay (ELISA) and serologic test, were also tested for the diagnosis of tuberculosis (TB), but they were unsuccessful because of their poor sensitivity and cross-reactivity. One of the most common and

fatal parasite infections is malaria, which is particularly common in South East Asian and African developing nations. The most recent WHO study estimates that there were 660,000 malaria deaths (with an uncertainty range of 490,000 to 836,000) and roughly 219 million malaria cases in 2010 (with an uncertainty range of 154 million to 289 million) [12].

A new WHO worldwide programme called T3 (Test, Treat, and Track) was launched in 2012 with the goal of ensuring that everyone has access to diagnoses, treatment, and more robust surveillance. For effective treatment and to stop the spread of disease, early detection is crucial. The most well-researched and effective methods for diagnosing malaria to date are rapid diagnostic tests (RDTs) and Giemsa microscopy. In rural endemic areas, giemsa staining microscopy is still the go-to technique for fast parasite detection because of its simplicity and reduced cost. Conventional approaches, however, are inappropriate for this purpose due to low sensitivity (50–100 parasites per μl), false positive results, and emerging challenges in the diagnosis, such as dealing with 4-aminoquinolines medication resistant P. falciparum strain and low infection level. Alternative techniques for studying malaria have been developed during the past few decades. These include ELISA, Immunofluorescence assays, RDTs, and most recently, DNA-based assays [13-15].

HIV-related AIDS is the world's most serious public health concern. A recent WHO and UNAIDS report states that by the end of 2014, there were 36.9 million HIV-positive individuals worldwide, 1.2 million fatalities, and 2 million new infections. Africa's sub-Saharan area is the most afflicted, accounting for over 70% of HIV infections worldwide. HIV has no known treatment. On the other hand, prompt HIV status testing can help ensure that patients receive effective antiretroviral medication (ART), lead healthy lives, and stop the illness from spreading. These days, three common HIV diagnostic test types are available: HIV antibody and nucleic acid tests (NAT), as well as Western blot antigen/antibody combination tests like viral protein p24 and antibody tests like ELISA or fast test. Antibody tests identify proteins, not HIV itself, but antibodies the body produces in response to the virus. Tests for antigens and RNA directly identify HIV. When compared to antibody-only methods, fourth-generation approaches that concurrently detect antigen and antibodies can shorten the diagnostic window following initial infection. The nucleic acid amplification test (NAAT), which can be both qualitative and quantitative, primarily relies on PCR amplification of the nucleic acid. These days, PCR tests are more widely used because of their sensitivity and simplicity of use11–19. Tests based on the human immunodeficiency virus have significantly changed since their introduction. The latest CDC recommendations no longer include Western blot and indirect immunofluorescence assays because of false negative results [16].

Infection Control in Healthcare Facilities

HAIs are among the most frequent negative consequences on the provision of healthcare, and their prevalence and potential for epidemics pose a serious threat to public health. In addition to posing an expensive burden on society, HAIs have a substantial effect on morbidity, mortality, and quality of life. However, a significant number of HAI are avoidable, and a growing corpus of

research is shedding light on the harm that these diseases bring to the world at large, including methods for slowing their spread.

How to Boost Infection Control

To stop infections from spreading in hospital environments, the Centres for Disease Control and Prevention (CDC) recommends two levels of safety measures: The first two precautions are Standard Precautions and Transmission-Based Precautions [17].

Standard Precautions for All Patient Care [19]:

- Perform hand hygiene
- Use personal protective equipment (PPE) to prevent exposure to infection
- Follow respiratory hygiene/cough etiquette principles
- Ensure appropriate patient placement and isolation precautions
- Properly handle, clean, and disinfect patient care equipment and medical instruments
- Handle and sterilise textiles and laundry carefully
- Follow safe injection practices and proper handling of sharps/needles
- Ensure healthcare worker safety via IPC and post-exposure prophylaxis
- Prevention of intervention-related infections (catheter-associated urinary tract infections, intravascular catheter-related infections, surgical site infections)
- The implementation of the specific isolation precaution when diagnosing some syndromes
- Improving the communication between health care workers especially when referring potentially contagious patients
- In paediatric departments or ambulatory settings, there should be efforts to decrease infection from contaminated toys. Families can be encouraged to bring their own toys.

Transmission-Based Precautions [19]

- Transmission-Based Precautions used in addition to Standard Precautions for patients with infectious disease to prevent transmission:
- Contact precautions
- Droplet precautions
- Airborne precautions

Infection Control Programmes in Acute Care [20]

The CDC suggests that the assessment and management of infection control programmes and practices in acute care hospital can be divided into 4 sections:

Section 1: Facility Demographics

Section 2: Infection Control Programme and Infrastructure

Section 3: Direct Observation of Facility Practices (optional)

Section 4: Infection Control Guidelines and Other Resources

Environmental Cleaning and Disinfection [2, 20-27]

The door to the room where they were placed or isolated should stay closed for an hour, and neither cleaning nor usage is permitted. The person in charge of cleaning the room should put on disposable single-use nitrile or household gloves and, if one is available, a disposable apron.

They should then physically clean the surroundings and furniture with a household detergent solution, followed by a disinfectant, or a combination of the two, like a bleach solution with hypochlorite. Products meeting this requirements come in a variety of formats, such as wipes.
Walls and floors don't need to be cleaned especially. Pay close attention to any surfaces that the afflicted individual has touched, including door handles, backs of chairs and couches, and flat surfaces that are often handled. Put garbage in a healthcare risk trash bag (yellow) along with used tissues and disposable cleaning cloths. Take off the gloves and the disposable plastic apron (if applicable), then place them in a healthcare risk waste bag. Put the garbage in a small domestic waste bag and tie it securely if there isn't a healthcare risk waste bag available. Avoid packing too much. After that, tuck the bag firmly into a second household trash bag. Keep stored in a secure area. You can dispose of the rubbish normally if the case is not confirmed. Following confirmation of the case, public health will advise you on what to deal with the garbage. After this procedure is finished and every surface has dried, the room can be used once more.

Infection Control in Disaster and Conflict Settings [28]

In emergency situations, it is still crucial to follow IPC guidelines to safeguard both you and your patients. This is especially crucial because of the unhygienic circumstances that arise after a disaster and the unrest that often occurs in camps. These factors can create an ideal environment for the spread of infectious diseases and wound infections. Rehab professionals face significant challenges in many disaster and conflict settings due to a high incidence of complex, open traumatic injuries requiring surgery performed in sub-optimal surgical environments. This increases the risk of wound infection, which is further exacerbated by limited access to resources like clear (potable) water and medical consumables. Additional IPC procedures will be in place while working in an area where infectious illnesses, such as cholera, diphtheria, Ebola, and Middle East Respiratory Syndrome (MERS), are listed as a risk. Verify that you have received the necessary supplementary PPE and that you have received specialised training [29].

Improving Social Determinants

Addressing and enhancing the social determinants of health in societies is a crucial component of the control of infectious illnesses. A person's surroundings and their health are directly related. Three "common interventions" have been recognised by WHO as effective for enhancing global health conditions:

Education: There is a direct correlation between education and health. Social Protection: A community's health and behaviours can also be influenced by having access to reasonably priced healthcare and a social security system.

Urban Development: The layout of our towns, cities, and villages can have a significant effect on disease transmission and public health. Infectious diseases can spread more quickly in crowded housing, damp housing, or housing with inadequate services and sanitary conditions. Since reverse transcriptase (RT)-PCR and polymerase chain reaction (PCR) are recognised as trustworthy techniques for virus identification with high sensitivity and specificity, they are frequently used to identify SARS-CoV-2 (Li et al., 2020a). Despite the availability of multiple

very accurate RT-PCR-based test kits for SARS-CoV-2 detection, this application is still limited in a number of ways. These restrictions include the need for adequate genetic material to be sampled, the high expense of the reagents and equipment, and the lengthy turnaround time for results (Shoaib et al., 2021). Despite the widespread recommendation for nucleic acid amplification tests in the diagnosis of COVID-19, erroneous negative or false positive results might lead to a false diagnosis and other hazardous implications that should not be disregarded (Li et al., 2020a). It was found which characteristics of 60%–70% of COVID-19 patients were identical on chest radiography (CT) scan images. testing using nucleic acids Accepted as significant nucleic acid-based diagnostics that rely on the identification of a particular gene are PCR and RT-PCR. Since these techniques are recognised as trustworthy approaches with high sensitivity and specificity for pathogenic virus identification, they are frequently employed to determine SARS-CoV-2.

It is better advised to utilise RNA-template RT-PCR rather than DNA-template PCR. Many RT-PCR-based test kits for SARSCoV-2 detection have been produced, and they have a 95% accuracy rate28–30. According to some reports, the novel ultra-sensitive isothermal nucleic acid amplification-based approach called loop mediated isothermal amplification (LAMP) addresses the time-consuming and costly aspects of RT-PCR. Nevertheless, the implementation of this approach is limited by the need for a high temperature (mostly 65 °C) and optimisation issues with primers and reaction conditions. The LAMP method is used with the Cas13 enzyme in the "specific high-sensitivity enzymatic reporter unlocking" approach, a CRISPR (clustered regularly interspaced short palindromic repeats) based nucleic acid detection technology. For the portable, quick, and extremely sensitive detection of SARS-CoV-2, there are a few at-home assays based on the CRISPR-Cas13 technique that have received FDA approval (FDA emergency use authorization). radiological assessment In clinical practice, computed tomography (CT) of the chest is recognised as a valid technique for Covid-19 diagnosis. About 60% to 77% of COVID-19 cases had CT scan pictures that show the same characteristics, such as bilateral ground-glass opacity and multifocal lung lesions. The highest lung involvement is documented in CT findings, even though more than half of the patients have normal CT findings during the first infection stage (0–2 days), which is roughly 10 days following the onset of symptoms.

This technique's drawbacks include the imaging system's expensive cost, the need for a technical expert, and the technique's poor 25% specificity for COVID-19 diagnosis. serological examinations While direct diagnostic techniques, such as those based on specific antigens or nucleic acids, are favoured for COVID-19 diagnosis, indirect detection techniques are also frequently employed in clinical settings and research. These techniques are predicated on the analysis of antibodies that the patient produces in response to an infection.

The accuracy and specificity of these approaches are, however, inferior to direct diagnostic techniques. IgM and IgG serum levels, which are antibodies the body produces following an infection, can be utilised as markers for SARS-CoV-2 infection. IgG antibody

levels fluctuate throughout the middle or late stages of the illness, whereas IgM antibody levels can be utilised in the early stages. One point-of-care method being explored for COVID-19 diagnosis is lateral flow IgM and IgG detection for SARS-CoV-2. For IgM, lateral flow has a clinical sensitivity of 57%, specificity of 100%, and accuracy of 69%; for IgG, these figures are 81%, 100%, and 86%, respectively. The interferon (IFN)-gamma release from T cells in response to the COVID-19 antigens is measured by the enzyme-linked immunospot assay (ELISpot), often referred to as an interferon gamma release assay (IGRA). This assay is used to detect SARS-CoV-2. According to a study by Schwarzkopf et al. (2021), the interferon-γ ELISpot assay was able to detect 78% of PCR-positive individuals who had undetectable IgG antibodies [30].

Nevertheless, in a different recent investigation, the COVID-19 ELISpot test results showed a robust T-cell response in 44% of healthy, unexposed individuals who were IgG-RBD seronegative. Other serological markers, such as interleukins (IL-6, IL-10, and IL-2R), erythrocyte sedimentation rate (ESR), complete blood count (CBC), prothrombin time (PT), and related enzymes of liver, kidney, and heart tissues, are also used to track the severity of the infection and the progression of the disease in COVID-19 patients. promising new methods for diagnosis In diagnostic clinics and hospitals, serological and nucleic acid-based techniques are the most often used. Enzyme-linked immunosorbent test (ELISA) and RT-qPCR techniques are frequently employed for these objectives. These techniques are expensive, time-consuming, and not always precise. Additionally, because there aren't enough testing facilities, the samples must be transported to centres that are available, which raises the cost and lengthens the time it takes to receive the results. To identify coronavirus 2 [SARS-CoV-2] infections, a quick, affordable, sensitive, and operator-independent diagnostic method is desperately needed [31–35].

Methods of vibrational spectroscopy The basis of spectroscopic techniques is the way electromagnetic radiation interacts with matter. Infrared and Raman spectroscopy are the two primary types of vibrational spectroscopy. Infrared light interacts with matter in infrared spectroscopy. While the transition between the vibration energy levels is identified as a low probability event, Raman spectroscopy uses the radiation corresponding to the electronic energy levels. When combined with chemometric techniques, these vibrational methods provide an excellent way to identify viruses, including the COVID-19 corona virus. Without the use of stains or dyes, vibrational spectroscopy and imaging provide essential molecular information quickly and easily, simplifying and expediting the required tests for detection. Additional benefits of the methods include the need for a smaller sample size, operator independence, and accuracy without the need for highly specialised human knowledge to transfer vibrational techniques from a bench to a bed site. Spectroscopy in the infrared when combined with multivariate analysis techniques, Fourier-transform infrared (FTIR) spectroscopy-particularly attenuated total reflection fourier-transform infrared (ATR-FTIR) spectroscopy-is a strong contender for illness diagnosis, even in samples contaminated with viruses.

When using the ATR mode, a very little sample-for instance, one drop of bio fluids-is placed directly on top of the crystal, and noise-free spectrum data are quickly acquired thanks to the improved infrared spectrometers. Imaging and spectroscopy with Raman Raman and microspectroscopy are vibrational spectroscopic methods that show promise in illness detection and screening, much as infrared spectroscopy. Numerous studies pertaining to their usage in conjunction with various multivariant analysis techniques on various human disorders utilising bodily fluids, tissues, and cells have been reported. Microspectroscopy and Raman spectroscopy are two more powerful tools for studying the COVID-19 virus. Technologies for omics based on mass spectrometry (MS) Proteomics, glycomics, lipidomics, and metabolomics are examples of mass spectrometry (MS)-based omics technologies that have been utilised to identify and detect microbial agents like SARS-CoV-2. MS technologies give a real-time image of host alterations caused by pathogens. Using MS-based omics technologies, the pathophysiology and infections of SARS-CoV-2 have been investigated in the materials and cellular model systems of COVID-19 patients. In clinical specimens, PCR-MS has directly identified every known pathogen and found the gene sequences of unknown pathogens. The most sophisticated technique for diagnosing COVID-19 is matrix-assisted laser desorption/ionization coupled with mass spectrometry (MALDI-MS), which requires few specimens, a small number of reagents, an easy-to-follow protocol, and a quick data acquisition system. However, MALDI-MS is currently an expensive instrument for many laboratories worldwide.

More research is being done to create many more unique and inventive optical detection techniques for the detection of respiratory viruses, such as SARS-CoV-2, using absorbance, surface plasmon resonance, localised surface plasmon resonance, fluorescence, and colorimetric techniques in micro fluidic devices [36].

These methods have several benefits, including small sample volumes, quick test turnaround times, affordability, portability, and accuracy. These techniques are currently being developed, so they cannot be utilised to diagnose COVID-19 directly. Present-day therapeutic approaches UV-based methods of disinfection For many years, hospitals and medical equipment have been extensively disinfected using ultraviolet (UV) technologies. UV light has the power to destroy bacteria and render viruses, such as SARS-CoV-2, inactive on any surface. SARS-CoV-2 can endure up to nine days on surfaces. UV-C dose, irradiation time, UV-C absorbance, culture medium, and SARS-CoV-2 concentration all affect how SARS-CoV-2 responds to UV germicidal irradiation (UVGI, UV-C irradiation at 254 nm) (Biasin et al., 2021). In addition, UV-C exposure can result in cataracts and skin cancer in people. In light of the safety of UV devices, UVGI methods for the inactivation of SARS-CoV-2 and the disinfection of discarded personal protective equipment must be developed. Conversely, SARS-CoV-2 on surfaces can be rendered inactive by UV-B radiation for up to 20 minutes. Additionally, UV-B promotes vitamin D synthesis, which boosts immunity and has preventive effects against COVID-19 patients [37].

Antiviral medication therapy

For the treatment of viral illnesses, such as HIV, Ebola, influenza A and B, hepatitis A and C, herpes simplex, and human papillomavirus, more than 80 antiviral medications are licenced.

Numerous sources state that various antiviral medications have been utilised to treat the COVID-19 pandemic since its onset. This topic has already been the subject of numerous reviews, some of which have been examined again; in this section, the conclusions of these reviews, together with original reports, have been discussed.

Darunavir is a nonpeptidyl HIV-1 protease inhibitor that works by specifically blocking the cleavage of the Gag-Pol polyprotein to cure HIV infections (Tarighi et al., 2021). Early predictive research was conducted on a number of commercially available studies, with darunavir being mentioned as a possible contender. Oseltamivir, a neuraminidase inhibitor, is used to treat influenza A and B viruses. It works by preventing neuraminidase, an enzyme that is necessary for both viral release from infected cells and viral entry into host cells. Innovative and potential COVID-19 treatment approaches

The novel and promising treatments under review here have not yet received FDA authorization or approval. According to national or international criteria, patients with COVID-19 should prioritise receiving accepted treatment techniques [38].

Using a photosensitizer that has been activated in the presence of visible or near-infrared light and molecular oxygen, photodynamic therapy (PDT) produces reactive oxygen species (ROS) that eventually target cell death through apoptosis, autophagy, or necrosis with little to no damage to surrounding tissues. ROS include singlet oxygen (1O2) and/or superoxide anion, hydroxyl radicals, and hydrogen peroxide. PDT is authorised for the treatment of a number of non-cancerous conditions as well as precancerous diseases. surveillance for infectious diseases

One of the best methods for limiting newly developing pathogens and managing infectious disease outbreaks is surveillance. Strong epidemiological surveillance systems make it possible to track the spread of pathogens among humans, non-human animals, and animals interacting with humans. This monitoring aids in the early identification of new diseases that have the potential to spread like epidemics or pandemics. Furthermore, the method that enables the identification of abrupt rises in a certain disease's case count is epidemiological surveillance. Genome-based technologies are currently used for infection surveillance and fast, extremely accurate diagnosis. Additionally, these technologies make it possible to precisely and practicallymonitor pandemics, epidemics, and outbreaks in real time36–38. The populations that are most vulnerable to infectious diseases must be the focus of traditional or genome-based surveillance methods. The dangers associated with emerging infections must also be taken seriously, with a focus on those that have a high public health significance (high mortality, high transmissibility among people, etc.).

Additionally, a sufficient surveillance system needs to place a high priority on collaborations between public health organisations and research institutions, with an emphasis on long-term investments, technical personnel training, diagnostic capabilities, and quick responses to outbreaks carried out in a coordinated, systemic, and long-lasting manner. When doing research in an outbreak scenario, experts need to be dedicated to creating (or enhancing) reliable surveillance, healthcare, and diagnostic infrastructure at the outbreak site. National boundaries, political boundaries, and cultural barriers are all irrelevant to pathogens and

epidemics. Outbreaks of infectious diseases may turn into international emergencies due to flaws in the surveillance systems. Therefore, measures aimed at containing infectious diseases necessitate health diplomacy and adherence to local and international ethical standards, both of which rely on strong international alliances and collaboration among world leaders. Controlling human agglomeration and sufficient urbanisation is known as urban planning. Epidemics have historically occurred in human societies ever since the first cities were established. Put another way, epidemics date back to the earliest settlements and towns in human history. Human agglomeration is a crucial component in the spread of infectious diseases from person to person. Epidemics and outbreaks of non-vector carried illnesses are sustained by this type of transmission. In summary, a city's population density creates the perfect environment for diseases spread by direct touch.

The emergence and spread of infectious diseases are facilitated by human agglomeration, unplanned urbanisation, and de-urbanization (neglected/abandoned urban areas), as these factors are linked to persistent human-to-human transmission of pathogens, poor sanitation, close contact with wildlife, garbage accumulation, and the growth of disease vectors. Therefore, as it establishes the conditions required for a healthy urban lifestyle and prevents human settlement in areas without sufficient sanitary standards, urban planning that places a high priority on population access to health infrastructure is a meaningful strategy to control infectious diseases. In order to accomplish this goal, it is essential that environmental and sanitary engineers, urban planners, and architects actively engage in conversations about how urban factors contribute to the spread of infectious illnesses and offer solutions to address these issues.

Social measures to encourage a slowdown in population increase there are currently more people living in cities than in rural areas, with the global population approaching 8 billion.
The growing number of people on the planet raises a number of social, health, and environmental issues. Poverty and limited access to formal education are linked to high birth rates in families facing social and economic vulnerabilities, resulting in a vicious cycle of societal issues. In addition, environmental degradation brought on by the increasing demand for natural resources to suit human consumption needs results in the collapse of ecosystems and a decline in biodiversity. Many factors work together to promote the spread of novel infections among human populations, including overcrowding, poverty, the strong demand for food and consumer goods, large-scale agricultural practices and industrial production, and environmental degradation. In areas with high population density, known infectious diseases can also spread more easily.

Encouragement of good hygiene Louis Pasteur proved that germs were the source of infectious diseases in 1878. Following the acceptance of the "Germ Theory of Diseases," it became clear that family and personal hygiene habits might effectively lower the risk of infection. Robust and numerous pieces of evidence have supported the link between hygiene behaviours (e.g., hand cleanliness, soap use, proper waste disposal, and hygiene education) and reduced human mortality and infection rates. Even though high-income countries have long

recognised the importance of personal hygiene practices as a disease prevention strategy, many low-income countries still do not live up to this expectation due to a lack of infrastructure or knowledge regarding the distribution of treated water, sewage collection, and proper kitchen and bathroom facilities. Governments must provide enough housing for the populace with hygienic fixtures in order to lower the number of diseases linked to poor personal cleanliness. They also must fund public health education programmes to raise public awareness of these issues. Common sense hygiene precautions, including washing your hands after handling objects or adjusting structures for public usage, should be promoted in high-income nations. These easy steps are critical to stopping the spread of viral infections, particularly during the months when seasonal viruses are most active. Food security, availability, and appropriate diet, the susceptibility and development of viral diseases are greatly influenced by dietary status in multiple ways. Protein deficiencies and malnourishment, for instance, heighten an individual's vulnerability to infections and expedite the development of illnesses such as HIV infection, malaria, and tuberculosis.

A healthy diet, environmental concerns, food security, and agricultural methods are interconnected and have significant long- and short-term effects on the environment, public health, and the management and prevention of infectious diseases. Consequently, it is the duty of governments to ensure that their constituents have these essential rights. decrease in social disparities, One of the primary causes of the bad health of the people is social inequality. People who don't have enough money to invest in education and professional training, maintain a healthy diet, or engage in enough leisure activities to maintain their physical well-being and lower their stress levels are more likely to suffer from a variety of illnesses. It is noteworthy that the diagnosis, treatment, and prevention of diseases depend on having access to health services39-40. Host genetics' impact on infectious illnesses It is now known to researchers that not everyone exposed to pathogens will become infected (having a decreased susceptibility or resistance to infection), while some people will become infected (having a normal or higher sensitivity to infection). Inter-individual phenotypic heterogeneity is another noteworthy aspect of most infectious diseases, with infected individuals displaying clinical characteristics ranging from asymptomatic infection to lethal outcome during clinical course. This clinical diversity in many diseases is dependent on immunological responses against infections, which are impacted by genetic variables specific to the host. measures aimed at reducing diseases and outbreaks Given the threat that outbreaks, epidemics, and pandemics pose to public health, it is critical that nations work together to take action to slow the spread of infections and lessen the impact of disease. Containment strategies include tactics including travel bans, immunisation drives, case reporting, and surveillance. It's crucial to concentrate on actions that support disease mitigation when epidemic or pandemic events are developed and preventative and control methods are not followed. The involvement of numerous stakeholders at various levels, including governments, institutions, communities, and individuals, is necessary for such initiatives to be successful. Furthermore, for communication to reach all societal levels and increase community knowledge and participation, it must be clear and effective [39].

Medication and Vaccines

The history of medicine in human culture is perhaps as old as illness itself. However, amid the changing dynamic between microorganisms and their human hosts, biochemical methods to disease prevention and treatment have gained significant attention since the emergence of the modern pharmaceutical industry. Immunisations, a biological preparation known as a vaccination works to increase immunity to a certain disease. A vaccination is usually composed of weakened or destroyed versions of the disease-causing bacterium or its toxins and contains an agent that mimics the bacteria that causes the disease. In order to make it easier for the immune system to identify and eliminate any of these bacteria that it comes into contact with in the future, the agent encourages the body's immune system to recognise it as foreign, destroy it, and "remember" it. Despite the fact that vaccines themselves cannot spread illness, the body's immune system reacts to them as though they do contain a virus.

Many once-common diseases, including polio, measles, diphtheria, whooping cough, mumps, tetanus, and some types of meningitis, are either rare or under strict control in the United States thanks to the widespread use of immunisations. Those who have received vaccinations develop antibodies that destroy bacteria or viruses that cause disease. They have a far lower chance of contracting the infection and spreading the germs to other people. Because the vaccinated individuals around them are not contracting the illness or spreading it to others, even those who have not received vaccinations may benefit from the immunity of the "herd." Greater herd immunity results from a community's higher vaccination rate since it reduces the possibility that a susceptible person may come into touch with an infectious person. Antivirals and Antibiotics Strong medications called antibiotics are used to treat bacterial infections. They either eradicate germs or prevent them from proliferating, enabling the body's defence mechanisms to get rid of the infections. Antibiotics can save lives when used correctly. However, rising antibiotic resistance is reducing these medications' efficacy. Curing an infection and stopping the growth of resistant germs require using an antibiotic as prescribed, even after symptoms go away. Colds and the flu are examples of viral diseases that are resistant to antibiotics. In some situations, antiviral medications are used to treat the infection. These medications work by preventing the virus from replicating or by enhancing the body's immunological response to the illness. The antiviral family of medications includes multiple classes, each of which is used to treat a particular type of viral illness. Antiviral pharmaceuticals are used to treat a limited range of organisms than antibacterial therapies, which may cover a wider spectrum of infections.) Antiviral drugs are now available to treat a number of viruses, including hepatitis B, herpes, influenza, and HIV. Like bacteria, viruses change over time and become resistant to medications meant to treat them. Novel Therapies Novel antibiotics and antivirals are needed in modern medicine to treat infections that are resistant to drugs. Yet the supply of novel medications is running out. For instance, the two newest molecular families of antibiotics-fluoroquinolones were introduced about 40 years apart. Because antibiotics are less profitable than medications that treat chronic illnesses and lifestyle-related disorders like high

blood pressure or high cholesterol, major pharmaceutical companies are reluctant to invest significant resources in the antibiotics business. Additionally costly, dangerous, and time-consuming is the research and development of antibiotics. Given that antibiotic resistance gradually reduces the effectiveness of the drug over time, the return on that investment may not always be expected [8, 15, 40].

There's a shortage of new antiviral medications as well. Since antivirals can harm host cells where the viruses live, developing these medications has proven to be far more challenging than developing antibacterial ones. HIV is now more treatable as a chronic illness than any other viral disease thanks to the availability of antiviral medications, which earlier made the infection fatal. However, new medications are required to fight other viral epidemics including influenza and hepatitis B and C. Numerous initiatives have been created to support the investigation and creation of novel medications and vaccines. The Biomedical Advanced Research and Development Authority, which was recently established by the U.S. Department of Health and Human Services, offers an integrated, methodical approach to the creation and acquisition of the vaccines, medications, treatments, and diagnostic equipment required for public health medical emergencies. The Patient Protection and Affordable Care Act's Cures Acceleration Network provision, which President Obama signed into law in March 2010, aims to advance research discoveries towards safe and effective therapies by providing grants to biotech companies, academic institutions, and patient advocacy groups through the National Institutes of Health. Additionally, philanthropists, medical research foundations, business executives, and other significant stakeholders are joining forces with charitable organisations committed to expediting the discovery and clinical development of innovative treatments to treat infectious diseases inorder to create productive partnerships. Awareness of Microbes Some of the best protection against infectious diseases comes from routine behaviours. Amongthe prudent things you can doare: Update your immunisation records. Hands-wash frequently. The best defense against the spread of disease is thought to be frequent washing with soap and water, thorough drying, and rinsing. Regular consumer use of antibacterial products that leave residues, including those that include triclosan, has not been shown to improve health and may even increase the development of antibiotic resistance. Carefully prepare and manage food. Only take antibiotics for bacterial infections. Antibiotics cannot be used to treat viral infections. Governmental Directives Programmes that monitor public health must be efficient and well-coordinated in order to prevent disease outbreaks and safeguard our country. What are some of the most important initiatives being implemented in the US?.

Capacity for Public Health Ensuring and enhancing the general health of the population is the aim of public health. Consequently, having a strong public health system is necessary to effectively respond to dangers posed by infectious diseases. Numerous organisations in the US carry out public health surveillance for infectious illnesses. In accordance with municipal and state health rules, health care professionals and others notify state health authorities about cases of infectious diseases that are notifiable. In turn, state health department representatives confirm disease reports, track the occurrence of diseases, spot potential outbreaks, and send their results

to the CDC. The Food and Drug Administration, the CDC, and other federal organisations in the U.S. Department of Agriculture, and the U.S. Department of Defence, conduct independent data collection and analysis for disease surveillance41–42. Dietary safety most food borne illnesses may be avoided, but doing so necessitates careful consideration at every stage, from the farm to the table. Efficient farming and production methods can minimise the transfer of microorganisms between animals and shield food from contamination. Hazards can be identified and control points where contamination can be avoided, reduced, or removed can be identified by monitoring the whole food manufacturing process. The Hazard Analysis Critical Control Point system, or HACCP (pronounced "has-sip") system, is a formal technique for assessing risk control. HACCP safety standards were initially created by NASA to guarantee that astronauts would consume safe food, but they are now being used for a growing number of foods, such as beef, poultry, seafood, fruit juices, and other items. Global Collaboration. The hazards posed by infectious diseases are negligibly hindered by national borders. In today's highly interconnected and easily navigable global village, a problem in one country quickly affects all nations. As a result, in order to truly make an impact, many of the above-mentioned methods need to be put into practice globally as well as nationally [41].

Worldwide Monitoring Global monitoring is essential to combating infectious disease response globally, just as national surveillance is essential to managing outbreaks within a country. The WHO's 2007 revision of the International Health Regulations is one of the best tools for boosting global infectious disease surveillance. These mandate that WHO member nations bolster their capabilities for public health surveillance, diagnosis, and response, as well as report to the WHO specific diseases and outbreaks that may constitute public health crises of global concern. Moreover, the CDC's Division of Global Migration and Quarantine strives to prevent, identify, and contain infectious illnesses in nations of origin and at U.S. ports of entry through an integrated and comprehensive partnership of local, national, and international health authorities.

Developing Country Public Health Due in great part to the prevalence of infectious diseases, the differences in life expectancy between the richest and poorest nations now surpass forty years. In underdeveloped countries, there is an immediate need for clean water supplies, sewage treatment and disposal, enhanced food safety, and immunisation programmes. An important obstacle to realising these gains is the fundamental fragility of public health systems in low-resource nations, such as a lack of medical personnel that impedes efforts to treat, immunise, and track patients' status. Developing countries also lack modern laboratories and disease surveillance systems, which are critical to the search, diagnosis, and containment of infectious diseases. Medicine Distribution [42].

Worldwide, access to life-saving immunisations and drugs is not guaranteed. The majority of HIV/AIDS patients who require medication treatment do not get it. Merely 2% of patients suffering from multidrug-resistant tuberculosis are prescribed appropriate drugs. Furthermore, children in developing nations often suffer more than 2,000 deaths from pneumonia for every child that passes away from the disease in developed nations. This is in contrast to

children in wealthy nations, where children are regularly immunised against childhood pneumonia and diarrhoea. Many factors affect the availability of high-quality, reasonably priced medications in developing countries [43,44]. Because they do not represent a sizable market, the requirements of people in developing nations are not typically taken into account in drug research and development. As a result, issues impacting a tiny portion of the global population receive a disproportionate amount of funding allocated to health care research globally. Other elements that affect the distribution of drugs are social and political issues. Foundations, pharmaceutical corporations, and other organisations are working to address these issues by contributing money for research, medicine donations, and other resources. The tragedy of infectious diseases worldwide is not only the large number of lives lost or injured, but also the large number of infections that may be successfully treated or prevented with inexpensive medications [45].

Conclusion

The prevention and management of infections is a worldwide concern, and numerous recommendations and protocols exist to reduce the transmission of infections among individuals, within a population, and across borders. A pertinent strategy to safeguard these susceptible populations can also be guided by identifying at-risk groups, such as youngsters, the elderly, and those with chronic illnesses. The gold-standard procedures used today to diagnose bacterial and viral illnesses can take hours or days to produce correct results, which could delay the initiation of appropriate treatment by healthcare providers and increase the risk of side effects. What's more concerning is that managing infectious diseases becomes more challenging even with a correct diagnosis due to the prevalence of infections resistant to traditional therapies and complex pathogens without a gold-standard or efficient treatment in the clinical pipeline. In order to integrate novel ways of prevention, diagnosis, and treatment into the clinical pipeline and potentially slow the spread of infectious disease cases in society, it is imperative that these approaches be developed.

Classical methods such as microscopy, advanced biotechnological techniques like genotyping, and immunoassays like ELISA and colorimetric assays were assessed for the diagnoses in the population. In both rural and urban areas, ELISA and colorimetric methods are frequently used to detect bacterial illnesses such as tuberculosis, with a sensitivity of 80% to 90%. Despite being widely used, microscopy and culturing have low sensitivity, and the latter requires special media and time. Due to its sophistication and ability to be 100% sensitive as well as helpful in studying drug-resistant strains, genotyping and SNP analysis are primarily carried out in metropolitan labs. Malaria, a parasitic disease, exhibits a similar pattern in its diagnostic methods. Rapid diagnostic tests (RDTs) based on immunoassay are widely used in both urban and rural populations, yielding fast results and approximately 90% sensitivity. Although they are important for analysing newly emerging and resistant strains, high throughput genotyping technologies are now restricted to metropolitan labs. Due to the urgent need to intervene in rural STD epidemics, HIV and other STD diseases exhibit slightly different patterns in terms of diagnostic development. These days, both rural and urban settings can use quick and sensitive

immunotechniques, such agglutination and dipsticks, that can assess positivity or negativity with nearly 100% sensitivity. Additional testing, such as protein Western, is carried out for confirmation. The more advanced and complex RNA NAAT test utilised in urban labs is more advanced and sophisticated for both early infection identification and infection load determination.

Funding
Self Funding

Author Contribution
All authors are contributed equally

Ethical Consideration
Not applicable

Acknowledgement
Not Declared

Conflict of Interest
Authors are declared that no Conflict of Interest.

References

1. Klouche M and Schröder U (2008) Rapid Methods for Diagnosis of Bloodstream, Infections. Clinical Chemistry and Laboratory Medicine, 46, 888–908.
2. Wongsrichanalai C, Barcus MJ, Muth S, Sutamihardja A and Wernsdorfer WH (2007) A Review of Malaria Diagnostic Tools: Microscopy and Rapid Diagnostic Test (RDT). The American Journal of Tropical Medicine and Hygiene, 77, 119–127.
3. Fleischer B (2004) Editorial: 100 Years Ago: Giemsa's Solution for Staining of Plasmodia. Tropical Medicine and International Health, 9, 755–756.
4. Spencer HC, Skinner JC, Chin W and Collins WE (1979) The Enzyme-Linked Immunosorbent Assay (Elisa) for Malaria. The American Journal of Tropical Medicine and Hygiene, 28, 927–932.
5. Sulzer AJ, Hall EC and Wilson M (1969) Indirect Fluorescent-Antibody Tests for Parasitic Diseases. The American Journal of Tropical Medicine and Hygiene, 18, 199–205. 10.4269/ajtmh.1969.18.199.
6. Shiff CJ, Minjas J and Premji Z (1994) The ParaSightR-F Test: A Simple Rapid Manual Dipstick Test to Detect Plasmodium falciparum Infection. Parasitology Today, 10, 494–495. 10.1016/0169-4758(94)90164-3.

7. Moody AH and Chiodini PL (2002) Non-Microscopic Method for Malaria Diagnosis Using OptiMAL IT, a Second-Generation Dipstick for Malaria pLDH Antigen Detection. British Journal of Biomedical Science, 59, 228–231.
8. Johnston SP, Pieniazek NJ, Xayavong MV, Slemenda SB, Wilkins PP and da Silva AJ (2006) PCR as a Confirmatory Technique for Laboratory Diagnosis of Malaria. Journal of Clinical Microbiology, 44, 1087–1089.
9. Khairnar K, Martin D, Lau R, Ralevski F and Pillai DR (2009) Multiplex Real-Time Quantitative PCR, Microscopy and Rapid Diagnostic Immuno-Chromatographic Tests for the Detection of Plasmodium SPP: Performance, Limit of Detection Analysis and Quality Assurance. Malaria Journal, 8, 284 10.1186/1475-2875-8-284.
10. Poon LLM (2005) Sensitive and Inexpensive Molecular Test for Falciparum Malaria: Detecting Plasmodium falciparum DNA Directly from Heat-Treated Blood by Loop-Mediated Isothermal Amplification. Clinical Chemistry, 52, 303–306.
11. Paris DH, Imwong M, Faiz AM, Hasan M, Yunus EB, Silamut K et al. (2007) Loop-Mediated Isothermal PCR (LAMP) for the Diagnosis of Falciparum Malaria. The American Journal of Tropical Medicine and Hygiene, 77, 972–976.
12. Van Binsbergen J, De Rijk D, Peels H, Dries C, Scherders J, Koolen M, et al. (1996) Evaluation of a New Third Generation Anti-HIV-1/Anti-HIV-2 Assay with Increased Sensitivity for HIV-1 Group O. Journal of Virological Methods, 60, 131–137.
13. Weber B, Thorstensson R, Tanprasert S, Schmitt U and Melchior W (2003) Reduction of the Diagnostic Window in Three Cases of Human Immunodeficiency-1 Subtype E Primary Infection with Fourth-Generation HIV Screening Assays. Vox Sanguinis, 85, 73–79.
14. Gürtler L, Mühlbacher A, Michl U, Hofmann H, Giancarlo Paggi G, Bossi V, et al. (1998) Reduction of the Diagnostic Window with a New Combined p24 Antigen and Human Immunodeficiency Virus Antibody Screening Assay. Journal of Virological Methods, 75, 27–38.
15. Speers D, Phillips P and Dyer J (2005) Combination Assay Detecting both Human Immunodeficiency Virus (HIV) p24 Antigen and Anti-HIV Antibodies Opens a Second Diagnostic Window. Journal of Clinical Microbiology, 43, 5397–5399.
16. Bremer JW, Lew JF, Cooper E, Hillyer GV, Pitt J, Handelsman E, et al. (1996) Diagnosis of Infection with Human Immunodeficiency Virus Type 1 by a DNA Polymerase Chain Reaction Assay among Infants Enrolled in the Women and Infants' Transmission Study. The Journal of Pediatrics, 129, 198–207.
17. Fischer A, Lejczak C, Lambert C, Servais J, Makombe N, Rusine J, et al. (2004) Simple DNA Extraction Method for Dried Blood Spots and Comparison of Two PCR Assays for Diagnosis of Vertical Human Immunodeficiency Virus Type 1 Transmission in Rwanda. Journal of Clinical Microbiology, 42, 16–20.

18. Meier T, Knoll E, Henkes M, Enders G and Braun R (2001) Evidence for a Diagnostic Window in Fourth Generation Assays for HIV. Journal of Clinical Virology, 23, 113–116.
19. Sun G, Xu Y, Zheng Q and Xi S (2011) Arsenicosis History and Research Progress in Mainland China. The Kaohsiung Journal of Medical Sciences, 27, 377–381.
20. Zaaijer HL, Exel-Oehlers PV, Kraaijeveld T, Altena E and Lelie PN (1992) Early Detection of Antibodies to HIV-1 by Third-Generation Assays. The Lancet, 340, 770–772.
21. Stekler JD, Swenson PD, Coombs RW, Dragavon J, Thomas KK, Brennan CA, et al. (2009) HIV Testing in a High-Incidence Population: Is Antibody Testing Alone Good Enough? Clinical Infectious Diseases, 49, 444–453.
22. Albert H, Nakiyingi L, Sempa J, Mbabazi O, Mukkada S, Nyesiga B, et al. (2013) Operational Implementation of LED Fluorescence Microscopy in Screening Tuberculosis Suspects in an Urban HIV Clinic in Uganda. PLoS ONE, 8, e72556.
23. Chang EW, Page A-L and Bonnet M (2015) Light-Emitting Diode Fluorescence Microscopy for Tuberculosis Diagnosis: A Meta-Analysis. European Respiratory Journal, 47, 929–937.
24. Kudoh S and Kudoh T (1974) A Simple Technique for Culturing Tubercle Bacilli. Bulletin of the World Health Organization, 51, 71–82.
25. Bielecka MK, Tezera LB, Zmijan R, Drobniewski F, Zhang X, Jayasinghe S, et al. (2017) A Bioengineered Three-Dimensional Cell Culture Platform Integrated with Microfluidics to Address Antimicrobial Resistance in Tuberculosis. mBio, 8, e02073–16.
26. Pottumarthy S, Wells VC and Morris AJ (2000) A Comparison of Seven Tests for Serological Diagnosis of Tuberculosis. Journal of Clinical Microbiology, 38, 2227–2231.
27. Heym B, Honoré N, Schurra C, Cole ST, Heym B, Truffot-Pernot C, et al. (1994) Implications of Multidrug Resistance for the Future of Short-Course Chemotherapy of Tuberculosis: A Molecular Study. The Lancet, 344, 293–298.
28. Lawn SD and Nicol MP (2011) Xpert®MTB/RIF Assay: Development, Evaluation and Implementation of a New Rapid Molecular Diagnostic for Tuberculosis and Rifampicin Resistance. Future Microbiology, 6, 1067–1082.
29. Jayakumar A, Savic RM, Everett CK, Benator D, Alland D, Heilig CM, et al. (2016) Xpert MTB/RIF Assay Shows Faster Clearance of Mycobacterium tuberculosis DNA with Higher Levels of Rifapentine Exposure. Journal of Clinical Microbiology, 54, 3028–3033.
30. Kozycki CT, Umulisa N, Rulisa S, Mwikarago EI, Musabyimana JP, Habimana JP, et al. (2017) False-Negative Malaria Rapid Diagnostic Tests in Rwanda: Impact of Plasmodium falciparum Isolates Lacking hrp2 and Declining Malaria Transmission. Malaria Journal, 16, 123

31. Noedl H, Yingyuen K, Laoboonchai A, Fukuda M, Sirichaisinthop J and Miller RS (2006) Sensitivity and Specificity of an Antigen Detection ELISA for Malaria Diagnosis. The American Journal of Tropical Medicine and Hygiene, 75, 1205–1208.
32. Pang T and Peeling RW (2007) Diagnostic Tests for Infectious Diseases in the Developing World: Two Sides of the Coin. Transactions of the Royal Society of Tropical Medicine and Hygiene, 101, 856–857.
33. Peeling RW and Mabey D (2010) Point-of-Care Tests for Diagnosing Infections in the Developing World. Clinical Microbiology and Infection, 16, 1062–1069.
34. Laszlo A (1996) Tuberculosis Bacteriology Laboratory Services and Incremental Protocols for Developing Countries. Clinics in Laboratory Medicine, 16, 697–716.
35. Grandjean L and Moore DA (2008) Tuberculosis in the Developing World: Recent Advances in Diagnosis with Special Consideration of Extensively Drug-Resistant Tuberculosis. Current Opinion in Infectious Diseases, 21, 454–461.
36. Steingart KR, Flores LL, Dendukuri N, Schiller I, Laal S, Ramsay A, et al. (2011) Commercial Serological Tests for the Diagnosis of Active Pulmonary and Extrapulmonary Tuberculosis: An Updated Systematic Review and Meta-Analysis. PLoS Medicine, 8, e1001062.
37. Nuti DE, Crump RB, Dwi Handayani F, Chantratita N, Peacock SJ, Bowen R, et al. (2011) Identification of Circulating Bacterial Antigens by In Vivo Microbial Antigen Discovery. mBio, 2, e00136–11.-e-11.
38. Abate G, Aseffa A, Selassie A, Goshu S, Fekade B, WoldeMeskal D, et al. (2004) Direct Colorimetric Assay for Rapid Detection of Rifampin-Resistant Mycobacterium tuberculosis. Journal of Clinical Microbiology, 42, 871–873.
39. Keiser J, Utzinger J, Premji Z, Yamagata Y and Singer BH (2002) Acridine Orange for Malaria Diagnosis: Its Diagnostic Performance, Its Promotion and Implementation in Tanzania, and the Implications for Malaria Control. Annals of Tropical Medicine & Parasitology, 96, 643–654.
40. Krafft AE and Kulesh DA (2001) Applying Molecular Biological Techniques to Detecting Biological Agents. Clinics in Laboratory Medicine, 21, 631–660.
41. Versalovic J and Lupski JR (2002) Molecular Detection and Genotyping of Pathogens: More Accurate and Rapid Answers. Trends in Microbiology, 10, s15–s21.
42. Vanbelkum A (2003) Molecular Diagnostics in Medical Microbiology: Yesterday, Today and Tomorrow. Current Opinion in Pharmacology, 3, 497–501.
43. Getahun H, Harrington M, O'Brien R and Nunn P (2007) Diagnosis of Smear-Negative Pulmonary Tuberculosis in People with HIV Infection or AIDS in Resource-Constrained Settings: Informing Urgent Policy Changes. *The Lancet*, 369, 2042–2049.
44. Procop GW (2007) Molecular Diagnostics for the Detection and Characterization of Microbial Pathogens. Clinical Infectious Diseases, 45, S99–S111.
45. Mikhailovich V, Gryadunov D, Kolchinsky A, Makarov AA and Zasedatelev A (2008) DNA Microarrays in the Clinic: Infectious Diseases. BioEssays, 30, 673–682.