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Short Communication

On-Chip TB Diagnostics: A Promising Solution for Rapid and Accurate Diagnosis

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DESCRIPTION

Tuberculosis (TB) is a highly infectious disease caused by the bacteria *Mycobacterium tuberculosis*. TB is a major global health issue, with an estimated 10 million people falling ill with the disease each year and 1.4 million dying from it. Early diagnosis and treatment of TB are critical to controlling the spread of the disease and reducing mortality rates. However, traditional diagnostic methods for TB, such as sputum microscopy and culture, are time-consuming and require specialized laboratory equipment and trained personnel [1]. On-chip TB diagnostics are emerging as a promising solution to these challenges. On-chip TB diagnostics use microfluidic chips that contain miniaturized laboratory systems to process and analyze samples of bodily fluids, such as sputum or blood, for the presence of TB bacteria. These chips integrate multiple functions, such as sample preparation, nucleic acid amplification, and detection, onto a single platform, reducing the time and complexity of the diagnostic process [2].

One of the main advantages of on-chip TB diagnostics is their speed. Traditional diagnostic methods for TB can take several weeks to produce results, but on-chip diagnostics can provide results within hours or even minutes [3]. This is critical for patients in low-resource settings, where delays in diagnosis and treatment can lead to the spread of the disease and higher mortality rates. Another advantage of on-chip TB diagnostics is their portability. Microfluidic chips are small and can be easily transported to remote or underserved areas, where access to laboratory facilities may be limited [4]. This makes on-chip diagnostics an ideal solution for addressing the global burden of TB, which disproportionately affects low- and middle-income countries. Several on-chip TB diagnostic platforms have been developed and tested in recent years. One example is the GeneXpert system, developed by Cepheid, which uses a disposable cartridge to process sputum samples for TB bacteria. The system integrates sample preparation, nucleic acid amplification, and detection on a single chip, producing results within two hours [5]. The GeneXpert system has been shown to be highly accurate and is now widely used in many countries [6].

Another example is the Lab-on-a-Chip for TB platform, developed by researchers at the Indian Institute of Science. The platform uses a microfluidic chip to isolate and concentrate TB bacteria from sputum samples, followed by nucleic acid amplification and detection. The platform produces results within 90 minutes and has shown high sensitivity and specificity in clinical trials [7]. Despite the promise of on-chip TB diagnostics, there are still challenges to their widespread adoption. One challenge is the cost of the technology. While the cost of on-chip TB diagnostics has decreased in recent years, it is still higher than traditional diagnostic methods in many low- and middle-income countries. Efforts to reduce the cost of the technology, such as through bulk purchasing and manufacturing, are underway [8].

Another challenge is the need for trained personnel to operate the technology. While on-chip TB diagnostics are simpler and faster than traditional methods, they still require some technical expertise to operate and interpret the results [9]. Training programs for healthcare workers and laboratory technicians are essential to ensure the successful adoption of on-chip TB diagnostics [10].

In conclusion, on-chip TB diagnostics offer a promising solution to the challenges of diagnosing and treating TB. Their speed, portability, and accuracy make them an ideal solution for addressing the global burden of TB, particularly in low- and middle-income countries. While there are still challenges to their widespread adoption, efforts to reduce costs and increase access to training programs are underway, paving the way for a future where on-chip TB diagnostics are a routine part of TB diagnosis and treatment.

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