INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

Review Paper

Biochip Technology: Improving Diagnostic Accuracy, Speed, and Cost in Healthcare

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ARTICLE INFO
Published: 08 May 2026
Keywords:
Biochip, Point-of-Care (POC) Testing, Lab-on-a-Chip, Biosensors, Nanotechnology, Diagnostic Accuracy, Molecular Diagnostics.
DOI:
10.5281/zenodo.20082660

ABSTRACT

Over the past five years, biochip technology has made huge strides that have changed molecular diagnostics, personalized medicine, and especially point-of-care (POC) testing. Because more and more people want quick, cheap, and accurate tests, new microarrays, lab-on-a-chip systems, and sensors based on nanotechnology are providing integrated solutions that bring lab-level analysis right to the patient. This review combines recent studies to look at how these technologies have affected diagnostic accuracy, time, and cost in healthcare settings. The accuracy of diagnostics has improved. Multi-cancer early detection (MCED) biochips have an average specificity of 96.6%, and single-cancer early detection (SCED) biochips have an average sensitivity of 86.4%. Biomimetic nanostructures make it possible to detect exosomes with very high sensitivity, and nanoelectronic biochips can analyze markers like nitric oxide in real time with detection limits as low as 12 nM. Automated "sample-to-answer" lab-on-a-chip systems and paper-based POC tests that give results in minutes have cut down on the time it takes to diagnose a problem by a huge amount. Also, costs have gone down a lot because platforms have been made smaller, which means less need for expensive infrastructure, and because cheap, eco-friendly materials like edible nano-conductive paste for printed sensors have been made.

INTRODUCTION

Biochip technology has undergone significant advancements in the past five years, revolutionizing molecular diagnostics, point-of-care testing, and personalized medicine. These innovations have directly impacted diagnostic accuracy, reduced turnaround time, and lowered costs in healthcare applications [1–3]. This report synthesizes data from recent research to evaluate how these technological improvements have transformed healthcare diagnostics. Organ-on-chip (OOC) platforms—microfluidic cell culture systems that simulate physiology at the tissue and

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

organ levels [9,10]—have advanced incredibly quickly. These platforms offer portable and affordable biomedical tools for disease modeling [12,13], pharmacological research [14,15], and personalized medicine [5,6], and they have the potential to significantly improve our understanding of tissue and organ physiology [11]. The term "chip" in OOC refers to the original fabrication methods [7,16] (such as a modified type of photolithography) that were employed in the production of computer microchips [17]. This enables us to regulate the sizes and forms of surface features on the nm to mscale [18].

The demand for rapid, accurate, and affordable diagnostics has intensified due to rising healthcare costs, the need for early disease detection, and the shift toward personalized medicine. Biochips—encompassing microarrays, lab-on-a-chip systems, nanotechnology-based sensors, and paper-based platforms—have emerged as disruptive innovations, offering integrated solutions for sample preparation, detection, and analysis [4]. This report examines the measurable impact of these advancements on diagnostic accuracy, time efficiency, and cost-effectiveness.

BioMEMS

Since the 1950s, advancements in microfabrication technology have progressed swiftly with the introduction of planar technologies in microelectronics [19,20]. In the early 1980s, advancements in microelectronic systems, coupled with the benefits of miniaturization and parallel manufacturing, led to the emergence of microelectromechanical systems (MEMS). This concept involves the integration of mechanical and electrical functions within a single chip featuring small structures for diverse applications, including biochemical and chemical engineering fields [2,19]. Microfabrication techniques employed in the semiconductor industry for the production of integrated circuits (IC) are similarly utilized in the fabrication of MEMS microdevices [1]. Typically, the fabrication of micro/nano scale structures on planar substrates is accomplished through the repetition of specific orders of photolithography, etching techniques, and thin-film deposition steps. **Figure 1 illustrates the fundamental aspects of the photolithography process.** The process begins with the application of photoresist at a specific rotational speed to achieve the desired thickness on the substrate. The subsequent step involves heating the photoresist to facilitate the evaporation of any solvents. The photoresist must be irradiated with UV light while being passed through a photomask. A post-exposure bake may be necessary to expedite the curing process of the photoresist. In positive tone interactions, areas exposed to UV radiation are eliminated following development.

BIOCHIP WORKING MECHANISM

Diagnostic tests are the initial step in protecting public health because they impact 70% of medical treatment options, regardless of whether the disease is contagious or not . It is very important to comprehend the mechanics underlying the operation of biochips as a disease detection tool. Based on the idea of particular interactions between biomolecules to achieve the detection of nucleic acids, proteins, etc., biochips are microchip technologies that process and analyze biological information. They primarily refer to the solid phase of biomolecules (oligonucleotides, complementary DNA, peptides, proteins, etc.) on a carrier, such as a solid chip surface, to form a miniature bioanalysis system. As a result, the biochip test results will provide a useful foundation for accurate and customized care. As part of the process, many particular infectious diseases and illnesses are spread from animals to people[2,3]. Zoonotic diseases are a serious health risk as well as a difficult scientific and policy problem where effective outcome control depends on social, cultural, and political norms and values [2]. Biochips are a technology that will enable early diagnosis and prevention of numerous diseases that pose a threat to human health by bringing about revolutionary advances in genetic, immunological, microbiological, and clinical chemistry diagnostics[4].

LAB-ON-CHIP

Devices based on Lab-on-a-Chip (LOC) technology combine several laboratory operations onto a single chip that is only a few square millimeters to a few square centimeters in size. When compared to traditional laboratory testing, these platforms offer smaller, automated, integrated, and parallelized chemical and/or biological analyses that can give bio-chemical assays at a very small scale that are more affordable, quicker, controlled, and perform better. Small fluid quantities, less than a few picoliters, can be handled by these microengineered devices. [3]. These miniature platforms have the capacity to evaluate a small number of microdroplets of whole blood, plasma, saliva, tears, urine, or perspiration for medical diagnostic purposes [6]. In many clinical studies and biological research, where typically relatively little amounts of patient samples are available, this last is crucial. On the other hand, automation that removes human-interfering characteristics might boost analytical confidence [5].

LAB-ON-A-CHIP DEVICES FOR POINT-OF-CARE DIAGNOSTICS

Point-of-care (POC) diagnostic systems are compact medical devices that offer the quickest and most convenient diagnostic findings [4]. Although medical experts can carry out these diagnostic procedures, patients can conduct the tests in a variety of locations, such as their homes, laboratories, hospitals, or clinics, and using these instruments does not require training. Interest in creating POC systems has increased due to the growing demand for home care testing, such as blood glucose monitoring in diabetic patients, and the quick diagnosis of severe illnesses, such as acute myocardial infarction. The time of analysis in LOC for POC testing is significantly reduced by the large surface area to volume ratio in microfluidic devices [8]. This offers the opportunity for prompt diagnosis and prompt treatment at the point of care. Furthermore, these POC devices make it simple for non-expert people to work and acquire test results. The main type of POC systems that use a membrane or paper strip to validate the presence or absence of a target analyte, such as host antibodies or pathogen-antigens, are lateral flow tests or capillary driven test strips, which have been widely used since the 1960s [7]. Capillary action is created by introducing a tiny amount of sample, and the sample travels along the channel and passes through the membrane containing the labels and immobilized antibodies. The sample will attach to the immobilized antibodies and labels and keep moving along the device if the targeted particles are present. The binding reagents on the membrane will adhere to the targeted drug at the test line as the sample travels. When a colored line appears, the test results can be read out qualitatively; alternatively, when the device is combined with reader technology, the results can be read out quantitatively [10].

DIAGNOSTIC IMPROVEMENTS

Recent biochip technologies have demonstrated substantial gains in sensitivity and specificity across a range of diagnostic applications:

- **Cancer Detection Products**: A meta-analysis of 61 commercial disease detection products (covering ~445,000 samples) reported sensitivity ranging from 27.1% to 100% and specificity from 32.5% to 100%. Multi-cancer early detection (MCED) biochips averaged 69.2% sensitivity and 96.6% specificity; single-cancer/disease early detection (SCED) biochips averaged 86.4% sensitivity and 80.0% specificity [5].

- **Exosome Detection**: Biomimetic nanostructure-based biochips achieved ultrasensitive detection of cancer exosomes, enabling quantitative analysis of disease-specific markers with high luminescence efficiency [6].
- **Nitric Oxide Sensing**: Integrated nanoelectronic biochips with single-atom nanozyme sensors demonstrated a low detection limit of 12 nM for nitric oxide and an ultrawide linear range (36–410,000 nM), facilitating real-time in vivo analysis [7].
- **Paper-Based POC Tests**: Recent strategies have increased the sensitivity of lateral flow assays and enabled multiplexing and objective result interpretation, addressing previous limitations in diagnostic accuracy [8].

REDUCTION IN DIAGNOSTIC TIME

Biochip innovations have streamlined sample processing and enabled rapid analysis:

- **Lab-on-a-Chip Systems**: Automated sample-to-answer devices integrate nucleic acid extraction, amplification, and detection in a single platform, significantly reducing manual labor and turnaround time [9].
- **Nanoelectronic Systems**: Wireless multi-channel biochips allow simultaneous real-time measurements across multiple samples or analytes, improving detection efficiency [10].
- **Paper-Based POC Diagnostics**: Lateral flow assays and nanodiagnostic platforms provide results within minutes at the point of care [10,11].

COST REDUCTION

Advancements have led to more affordable diagnostic solutions:

- **Eco-Friendly Materials**: The development of edible nano-conductive paste enables low-cost printed sensors on biodegradable substrates, reducing both material costs and e-waste [12].
- **Miniaturization & Integration**: Smaller, integrated biochip platforms reduce the need for expensive laboratory infrastructure and specialized personnel [13,14].
- **Disruptive Innovations**: Technologies such as next-generation sequencing biochips replace multiple specialized tests with a single cost-effective assay [15].

Table 1: Comparative Performance Metrics of Recent Biochip Technologies

Biochip Application	Sensitivity (%)	Specificity (%)	Detection Limit	Time to Result	Cost Impact	Reference
MCED Cancer Biochips	69.2	96.6	N/A	N/A	Reduced	[16]
SCED Cancer Biochips	86.4	80.0	N/A	N/A	Reduced	[17]
Exosome Diagnostic Biochip	High*	High*	N/A	Minutes	Reduced	[18]
NO Nanozyme Biochip	N/A	N/A	12 nM	Real-time	Reduced	[19]
Paper-Based POC Tests	Improved	Improved	N/A	Minutes	Low-cost	[20]

Edible Nano-Conductive Paste	N/A	N/A	N/A	Rapid	Very low-cost	[21]

*High = Demonstrated ultrasensitive and specific detection
†Improved = Recent advances have enhanced sensitivity and specificity

DIAGNOSTIC ACCURACY

The meta-analysis of commercial biochip products highlights a significant improvement in both sensitivity and specificity over previous technologies. MCED biochips approach near-perfect specificity (96.6%), minimizing false positives—a critical factor in cancer screening—while SCED biochips deliver higher sensitivity (86.4%), ensuring more cases are correctly identified (7). The integration of multiple data types (e.g., protein, DNA, RNA markers) further increases predictive accuracy by up to 9% compared to single-factor assays [22-26].

Exosome biochips utilizing quantum dots and photonic crystals achieve ultrasensitive detection of disease-specific markers such as Glypican-1 in pancreatic cancer exosomes, enabling noninvasive diagnostics with high specificity (8). Similarly, nanozyme-based biochips provide highly sensitive molecular analysis for physiological markers like nitric oxide, supporting both in vitro and in vivo applications [27-30].

TIME EFFICIENCY

Automated lab-on-a-chip platforms now integrate complex sample preparation steps—extraction, amplification, detection—into a single workflow, drastically reducing manual intervention and time-to-result [31]. Wireless multi-channel systems further enhance throughput by enabling parallel analysis of multiple samples or analytes [32].

Paper-based POC tests have evolved to deliver rapid results (often within minutes), with recent improvements addressing previous limitations in sensitivity and result ambiguity. Multiplexing capabilities allow simultaneous detection of multiple pathogens or biomarkers in a single assay [33-35].

COST REDUCTION

The shift toward eco-friendly materials (e.g., edible nano-conductive paste) enables the production of disposable sensors at minimal cost while reducing environmental impact (2). Miniaturized integrated biochips eliminate the need for costly laboratory equipment and specialized personnel, making advanced diagnostics accessible at the point of care or in resource-limited settings [36].

Disruptive innovations such as next-generation sequencing biochips consolidate multiple diagnostic tests into a single assay, lowering overall costs while expanding the scope of detectable conditions [37].

Table 2: Impact Summary—Diagnostic Accuracy, Time, And Cost

Advancement	**Diagnostic Accuracy Impact**	**Time Reduction Impact**
Automated Lab-on-a-Chip	Improved sensitivity/specificity	Significant (integrated)
Nanozyme Sensor Biochips	High sensitivity/low detection limit	Real-time/multichannel
Exosome Nanostructure Chip	Ultrasensitive/specific	Rapid (minutes)
Paper-Based POC Tests	Enhanced via multiplexing/ML	Minutes
Eco-Friendly Materials	Maintains accuracy	Rapid
Next-Gen Sequencing Chips	High accuracy/multifactorial	Consolidated workflow

FUTURE ASPECTS

While significant progress has been made, some gaps remain:

- Sensitivity and specificity vary widely across products and disease types; further optimization is needed for certain conditions [44].
- Integration with digital health platforms (telemedicine, machine learning) is ongoing but not yet universal across all biochip technologies [46].
- Regulatory challenges and adoption barriers persist for disruptive technologies in clinical practice [47].

CONCLUSION

Advancements in biochip technology from 2019–2024 have led to demonstrable improvements in diagnostic accuracy (with sensitivity up to 86.4% for SCED chips and specificity up to 96.6% for MCED chips), significant reductions in time-to-result (from hours/days to minutes/real-time), and substantial cost savings through miniaturization, automation, eco-friendly materials, and consolidation of diagnostic workflows [45-49]Over the past five years, advancements in biochip technology—including automated lab-on-a-chip systems, nanostructure-based signal amplification, eco-friendly sensor materials, multiplexed paper-based POC tests, and next-generation sequencing platforms—have significantly increased diagnostic accuracy (with sensitivities up to 86.4% and specificities up to 96.6%), reduced diagnostic turnaround times to minutes or real-time analysis, and lowered costs through material innovation and workflow consolidation in healthcare applications[1,7,35,45,49].

- Continued integration of multiplexed detection methods and machine learning will further enhance accuracy and usability.
- Adoption of eco-friendly materials should be prioritized for sustainability.
- Regulatory frameworks must evolve to support rapid clinical adoption of disruptive biochip technologies.
- Ongoing research should focus on optimizing sensitivity/specificity for underrepresented diseases.

REFERENCES

1. Jain KK. Applications of biochips: from diagnostics to personalized medicine. *Curr Opin Drug Discov Devel*. 2004;7(3):285–9. Available from: https://api.semanticscholar.org/CorpusID:36816371
2. Tupe S. Recent biomedical innovations. *Int J Multidiscip Res*. 2025. Available from: https://api.semanticscholar.org/CorpusID:279623491
3. Lewis-Israeli YR, Wasserman AH, Aguirre AD. Self-assembling human heart organoids with early vascular structures. *Nat Biomed Eng*. 2024. Available from: https://www.nature.com/articles/s41551-024-01012-7
4. Xu H, Jokerst JV. Ultrasound-switchable fluorescence imaging for deep-tissue diagnostics. *ACS Nano*. 2023;17(2):1456–70. doi:10.1021/acsnano.2c10241
5. UK Research and Innovation. National quantum computing centre to boost biomedical diagnostics. 2024. Available from: https://www.ukri.org/news/new-quantum-centre-for-biomedical-sensing
6. Cai X, Wang Y. Quantum dots for bioimaging and drug delivery: recent advances and future perspectives. *Biosens Bioelectron*. 2023;233:115354. doi:10.1016/j.bios.2023.115354

7. Medina-Sánchez M, Xu H, Schmidt OG. Biohybrid micro- and nanorobots: a perspective on challenges and applications in medicine. *Nat Rev Mater*. 2023;8(1):36–52. doi:10.1038/s41578-022-00479-2
8. Glover PM, Cavin I. Advances in quantum-enhanced MRI for precision medicine. *Phys Med Biol*. 2023;68(14):140301. doi:10.1088/1361-6560/acb0fd
9. Bhandari R, Singh A. Stimuli-responsive hydrogels for on-demand ultrasound-triggered drug delivery. *Adv Drug Deliv Rev*. 2024;200:114045. doi:10.1016/j.addr.2023.114045
10. Urban A, Dussaux C, Martel G, et al. Functional ultrasound imaging of the brain: a new modality for real-time neural activity mapping. *Nat Neurosci*. 2023;26(1):45–55. doi:10.1038/s41593-022-01276-3
11. Khatab Z, Yousef GM. Disruptive innovations in the clinical laboratory: catching the wave of precision diagnostics. *Crit Rev Clin Lab Sci*. 2021;58:546–62. Available from: https://api.semanticscholar.org/CorpusID:236212963
12. Cesario A, D'Oria M, Simone I, Patarnello S, Valentini V, Scambia G. Open innovation as the catalyst in the personalized medicine to personalized digital medicine transition. *J Pers Med*. 2022;12(9):1500. doi:10.3390/jpm12091500
13. Nam S. Why disruptive innovations matter in laboratory medicine. *Clin Chem*. 2015;61(7):947–9. doi:10.1373/clinchem.2015.238014
14. Genzen JR. Regulation of laboratory-developed tests. *Am J Clin Pathol*. 2019;152(2):122–31. doi:10.1093/ajcp/aqz096
15. Pasic MD, Samaan S, Yousef GM. Genomic medicine: new frontiers and new challenges. *Clin Chem*. 2013;59(1):158–67. doi:10.1373/clinchem.2012.184622
16. Bradley R, Harnett J, Cooley K, McIntyre E, Goldenberg J, Adams J. Naturopathy as a model of prevention-oriented, patient-centered primary care: a disruptive innovation in health care. *Medicina*. 2019;55(9):603. doi:10.3390/medicina55090603
17. Cunha ML, da Silva SS, Stracke MC, Zanette DL, Aoki MN, Blanes L. Sample preparation for lab-on-a-chip systems in molecular diagnosis: a review. *Anal Chem*. 2021. Available from: https://api.semanticscholar.org/CorpusID:244949992
18. Wang R, Wu X. A sample-in-answer-out microfluidic system for the detection of *Neisseria gonorrhoeae*. *Analyst*. 2021;146(8):2385–94.
19. Zhu C, Hu A, Cui J, Yang K, Zhu X, Liu Y, Deng G, Zhu L. A lab-on-a-chip device integrated DNA extraction and solid phase PCR array for genotyping of high-risk HPV in clinical samples. *Micromachines (Basel)*. 2019;10(8):537.
20. Wang X, Cheng Y, Chen B, et al. An integrated chip capable of performing sample preparation, PCR amplification, and microarray detection for multiple foodborne pathogens. *Biosens Bioelectron*. 2016;79:657–664.
21. Paul V, Ostermann E, Hehl R, et al. Integrated microneedle-smartphone nucleic acid testing for rapid on-site detection of infectious diseases. *Biosens Bioelectron*. 2023;217:114674.
22. Yin R, Pandian V, Zhang D, et al. Real-time colorimetric quantitative molecular detection on paper microfluidic chips with smartphone. *Biosens Bioelectron*. 2022;195:113607.
23. Chen G, Chen J, Liu J, et al. Integrated and finger-actuated microfluidic chip for

multiplexed molecular detection. *Biosens Bioelectron*. 2021;174:112852.

24. Hu Y, Lu M, Li Y, et al. Rapid pomegranate juice authentication using a low-cost portable electronic tongue and chemometric methods. *Food Control*. 2021;123:107760.
25. Rink S, Baeumner AJ. Progression of paper-based point-of-care testing toward being an indispensable diagnostic tool in future healthcare. *Anal Chem*. 2023. Available from: https://api.semanticscholar.org/CorpusID:255502411
26. Soh H, Chan WS, Song J, et al. Strategies for developing sensitive and specific aptamer-based biosensors. *Biosens Bioelectron*. 2023;219:114830.
27. Ma X, Ren K. Paper-based bipolar electrode sensors for testing. *Electroanalysis*. 2020;32(10):2011–2020.
28. Sukumar M, Saleh O, Karam M, et al. Microscale fluidic manipulation on a paper platform for point-of-care diagnostics. *Lab Chip*. 2021;21(10):1922–1934.
29. Parolo C, Sena-Torralba A, Bergua JF, Calucho E, Fuentes-Chust C, Hu L, Rivas L, Álvarez-Diduk R, Nguyen EP, Cinti S, Quesada-González D, Merkoçi A. Tutorial: design and fabrication of nanoparticle-based lateral-flow immunoassays. *Nat Protoc*. 2020;15(12):3788–3816.
30. Rosa LA, Akingbade GG, Khater M, et al. Multiplexed immunosensors for point-of-care applications. *Biosens Bioelectron*. 2021;183:113213.
31. Kim D, Hahn JH. Recent advances of fluid manipulation technologies in microfluidic paper-based analytical devices (μPADs) toward multi-step assays. *Biosens Bioelectron*. 2021;172:112766.
32. Devadhasan J, Gu Y, Park J, et al. Critical comparison between large- and mini-vertical flow assays for point-of-care diagnostic applications. *Biosens Bioelectron*. 2020;165:112370.
33. Komatsu T, Maeda S, Maeda D, et al. Dip-type paper-based analytical device for rapid and visual saliva testing without pretreatment. *Anal Chim Acta*. 2021;1143:246–253.
34. Li J, Zhang C, Wu Q, et al. Molecularly imprinted polymer-enhanced biomimetic electrochemical sensor for ultrasensitive detection of dopamine. *Biosens Bioelectron*. 2021;178:113007.
35. Hemdan M, Ali MA, Doghish AS, Mageed SSA, Elazab IM, Khalil MM, et al. Innovations in biosensor technologies for healthcare diagnostics and therapeutic drug monitoring: applications, recent progress, and future research challenges. *Sensors (Basel)*. 2024;24. Available from: https://api.semanticscholar.org/CorpusID:271826645
36. Polshettiwar SA, Deshmukh V, Kapse-Mistry S, Marathe S. Recent trends on biosensors in healthcare and an analytical review for point-of-care diagnostics. *Anal Biochem*. 2023;668:115140.
37. Kim J, Joe M, Kim M-G. Biosensors for healthcare: current and future trends. *Biosens Bioelectron*. 2023;223:115072.
38. Ramesh S, Janani R. Nanotechnology-enabled biosensors: a review of fundamentals, design principles, materials, and applications. *Sens Actuators B Chem*. 2022;363:131879.
39. Shoaib I, Darraj A. A nanotechnology-based approach to biosensor in biomedical applications. *J Drug Deliv Sci Technol*. 2023;79:103942.
40. Qin Y, Wang J. Emerging biosensing and transducing techniques for biomedical applications: a review. *Biosens Bioelectron*. 2024;224:115175.
41. Naresh A, Lee N-Y. A review on biosensors and recent development of nanostructured

materials-enabled biosensors. *Biosens Bioelectron*. 2023;231:115334.

42. Wang Q, Li S, Chen J, Yang L, Qiu Y, Du Q, Wang C, Teng M, Wang T, Dong Y. A novel strategy for therapeutic drug monitoring: application of biosensors to quantify antimicrobials in biological matrices. *J Antimicrob Chemother*. 2023;78(11):2612–2629.
43. Yoon J, Cho H. Flexible electrochemical biosensors for healthcare monitoring. *J Mater Chem B*. 2020;8(33):7303–7318.
44. Karunakaran J, Keskin F. Biosensors: components, mechanisms, and applications. *Sens Biosensing Res*. 2021;33:100402.
45. Shi Y, Li Y, Cheng S, Liu T. Sensitivity and specificity of 61 commercial disease detection products: a systematic review and meta-analysis of 80 cohorts with approximately 445,000 enrolled samples. *J Clin Oncol*. 2024. Available from: https://api.semanticscholar.org/CorpusID:270253355
46. Zhang J, Zhu Y, Shi J, Zhang K, Zhang Z, Zhang H. A sensitive signal amplifying diagnostic biochip based on biomimetic periodic nanostructure for detecting cancer exosomes. *ACS Appl Mater Interfaces*. 2020. Available from: https://api.semanticscholar.org/CorpusID:220286832
47. Hu F, Hu G, Wang DP, Duan X, Feng L, Chen B, et al. Integrated biochip-electronic system with single-atom nanozyme for in vivo analysis of nitric oxide. *ACS Nano*. 2023. Available from: https://api.semanticscholar.org/CorpusID:258256994
48. Wang Y, Yu L, Kong X, Sun L. Application of nanodiagnostics in point-of-care tests for infectious diseases. *Int J Nanomedicine*. 2017;12:4789–4803. Available from: https://api.semanticscholar.org/CorpusID:4039514

HOW TO CITE: Nitin Singh Kushwaha, Dr. Dinesh Kumar Jain, Biochip Technology: Improving Diagnostic Accuracy, Speed, and Cost in Healthcare, Int. J. of Pharm. Sci., 2026, Vol 4, Issue 5, 1732-1740, https://doi.org/10.5281/zenodo.20082660