Precision Medicine in Dengue Management: Advancements and Challenges

Gupta R* and Bhandari M

Department of Computer Science and Engineering, Jamia Hamdard, India

*Corresponding author: Richa Gupta, Department of Computer Science and Engineering, Jamia Hamdard, Delhi, India, Email: richagupta@jamiahamdard.ac.in

Keywords: Dengue; Risk Assessment; Treatment; Diagnostics; Vaccine

Abbreviations: DHF: Hemorrhagic Fever; DSS: Dengue Shock Syndrome.

Opinion

Dengue, a globally impactful mosquito-borne viral infection, is explored in Dr. Richa Gupta and Mansi Bhandari's review on precision medicine. With an annual toll of 390 million infections and 22,000 deaths, primarily affecting children, dengue places immense strain on healthcare systems. The absence of specific antiviral medication makes supportive care the prevailing treatment [1-20].

Precision medicine emerges as a transformative approach, finding applications in diagnostics, risk assessment, treatment customization, and vaccine development for dengue. The primary vectors, Aedes mosquitoes, particularly Aedes aegypti, transmit the virus, leading to diverse clinical manifestations, from mild symptoms to severe conditions like dengue hemorrhagic fever (DHF) and dengue shock syndrome (DSS) [21-25].

In the context of dengue treatment, precision medicine tailors regimens based on individual characteristics to optimize efficacy and minimize adverse effects. Genetic testing and biomarker analysis play a crucial role in diagnostics, enabling early detection, risk assessment, and targeted preventive actions in high-risk areas [26-27]. The authors stress the integration of precision medicine in healthcare plans, considering individual genetic, environmental, and lifestyle factors [28-30].

The paper also highlights precision medicine's pivotal role in vaccine development, factoring in genetic variations and immune responses to enhance efficacy and reduce risks [31-33]. A visual representation of the Precision Medicine Workflow for dengue is presented, illustrating its integration in diagnostics, risk assessment, treatment optimization, and vaccine development [34].

The review delves into the clinical symptoms and epidemiology of dengue, noting its prevalence in tropical and subtropical regions influenced by climate, urbanization, and population mobility [35]. From mild flu-like manifestations to severe conditions, early detection of high-risk individuals is deemed crucial.

Synonymous with personalized medicine, precision medicine shows promise in managing infectious diseases by tailoring healthcare decisions to individual genetic, environmental, and lifestyle characteristics. Its role in enhancing diagnostic methods through genetic testing and biomarker analysis is emphasized, allowing early diagnosis, risk estimation, and identification of high-risk patients [36-38].

In the absence of specific antiviral medications, the primary therapeutic approach for dengue involves supportive care, with ongoing research exploring promising alternatives like immunomodulatory drugs, herbal remedies, and innovative approaches such as monoclonal antibodies, antiviral peptides, host-targeted therapies, and RNA interference.

Challenges such as the high cost of tailored medications and advanced diagnostics pose barriers to precision

medicine's feasibility, particularly in economically disadvantaged areas. The authors propose collaboration among stakeholders, cost-sharing programs, and investments in affordable diagnostics and treatments. Telemedicine and mobile health technology are suggested to overcome accessibility challenges in resource-limited environments.

The review concludes by outlining future research directions, emphasizing the discovery of accurate biomarkers for dengue severity and treatment response. International collaboration and advancements in nanotechnology and point-of-care devices are highlighted for their potential to increase the accessibility of personalized treatment in resource-limited settings.

- **Contributions:** The author gratefully acknowledges Dr Richa Gupta, the corresponding author, for her invaluable supervision in guiding the conceptualization, structure, and scholarly rigour of this review article.

References

1. World Health Organization (2023) Dengue and severe dengue.

2. Hasan S, Jamdar SF, Alalowi M, Al Beaiji SMAA (2016) Dengue virus: A global human threat: Review of literature. J Int Soc Prev Community Dent 6(1): 1-6.

3. Bhatt S, Gething PW, Brady OJ, Messina JP, Farlow AW, et al. (2013) The global distribution and burden of dengue. Nature 496(7446): 504-507.

4. Brady OJ, Gething PW, Bhatt S, Messina JP, Brownstein JS, et al. (2012) Refining the global spatial limits of Dengue virus transmission by evidence-based consensus. PLoS Negl Trop Dis 6(8): e1760.

5. Yuan B (2022) What Personalized Medicine Humans Need and Way to It--also on the Practical Significance and Scientific Limitations of Precision Medicine. Precision Medicine 15: 927-942.

6. Simmons CP, Farrar JJ, Nguyen VVC, Wills B (2012) Dengue. N Engl J Med 366(15): 1423-1432.

7. Pang J, Chia PY, Lye DC, Leo YS (2017) Progress and challenges towards point-of-care diagnostic development for dengue. J Clin Microbiol 55(12): 3339-3349.

8. Srikiatkhachorn A, Yoon IK (2020) The dengue vaccine: a progress review. Expert Rev Vaccines 19(2): 121-134.

9. Soundravally R, Hoti SL (2019) Personalized medicine in dengue: A need of the hour. J Family Med Prim Care 8(8): 2487-2489.

10. Dhanoa A, Hassan SS, Zainal N (2018) Personalized medicine in the genomics era: highlights from an international symposium on childhood and adult asthma held. Asian Pac J Allergy Immunol 36(1): 1-12.

11. Guzman MG, Harris E (2015) Dengue. Lancet 385(9966): 453-465.

12. Watanabe S, Chan KR, Ong EZ, Tan HC, Ng WC, et al. (2016) Dengue virus infection: Epidemiology, pathogenesis, and surveillance. Jpn J Infect Dis 69(1): 1-10.

13. Nguyen TL, Nguyen TH, Tieu NT (2014) The impact of biomarkers in understanding dengue virus pathogenesis and dengue vaccine efficacy. J Vaccines Immun 2(1): 4-10.

14. Chaudhary S, Garg A, Singh H, Tomar S (2019) Bioinformatics approaches for host-pathogen interaction studies. Curr Bioinform 14(2): 89-98.

15. Hunsperger EA, Yoksan S, Buchy P, Nguyen VC, Sekaran SD, et al. (2014) Evaluation of commercially available diagnostic tests for the detection of dengue virus NS1 antigen and anti-dengue virus IgM antibody. PLoS Negl Trop Dis 8(10): e3171.

16. Guha Sapir D, Schimmer B (2005) Dengue fever: new paradigms for a changing epidemiology. Emerg Themes Epidemiol 2:1.

17. Soo KM, Khalid B, Ching SM, Chee HY (2016) Meta-analysis of dengue severity during infection by different dengue virus serotypes in primary and secondary infections. PLoS One 11(5): e0154760.

18. Tricou V, Minh NN, Van TP, Lee SJ, Farrar J, et al. (2010) A randomized controlled trial of chloroquine for the treatment of dengue in Vietnamese adults. PLoS Negl Trop Dis 4(8): e785.

19. Lee IK, Liu JW, Yang KD (2008) Clinical and laboratory characteristics and risk factors for fatality in elderly patients with dengue hemorrhagic fever. Am J Trop Med Hyg 79(2): 149-153.

20. Malavige GN, Ogg GS (2017) Pathogenesis of vascular leak in dengue virus infection. Immunology 151(3): 261-269.

21. Thein TL, Leo YS, Fisher DA, Low JG, Gan VC, et al. (2013) Risk factors for fatality among confirmed adult dengue inpatients in Singapore: a matched case-control study. PLoS One 8(11): e81060.

Gupta R and Bhandari M. Precision Medicine in Dengue Management: Advancements and Challenges. Clin Pathol 2024, 8(1): 000182.

Copyright© Gupta R and Bhandari M.

22. Hussein HA, Abdelaziz MO, Zourob M (2020) Recent advances in antiviral peptide-based strategies for dengue virus. Front Microbiol 11: 280.

23. Lucchini MA, Lopes NP, Kohn LK (2020) Host-targeted therapies for dengue: current progress and prospects. Infect Drug Resist 13: 2977-2992.

24. Pinto AK, Richner JM, Diamond MS (2018) Development of effective therapeutics against dengue virus infections. Expert Rev Mol Med 20: e5.

25. Nayak MK, Agrawal AS, Bose S (2014) Antiviral activity of pantothenol against dengue virus. Antiviral Res 106: 83-92.

26. Sabchareon A, Wallace D, Sirivichayakul C, Limkittikul K, Lang J, et al. (2012) Protective efficacy of the recombinant, live-attenuated, CYD tetravalent dengue vaccine in Thai schoolchildren: a randomised, controlled phase 2b trial. Lancet 380(9853): 1559-1567.

27. Kirkpatrick BD, Whitehead SS, Pierce KK, Tibery CM, Grier PL, et al. (2016) The live attenuated dengue vaccine TV003 elicits complete protection against dengue in a human challenge model. Sci Transl Med 8(330): 330ra36.

28. Low JG, Sung C, Wijaya L, Wei Y, Rathore APS, et al. (2014) Efficacy and safety of celgosivir in patients with dengue fever (CELADEN): a phase 1b, randomised, double-blind, placebo-controlled, proof-of-concept trial. Lancet Infect Dis 14(8): 706-715.

29. Nguyen NM, Tran CNB, Phung LK, Duong KTH, Farrar J, et al. (2013) A randomized, double-blind placebo-controlled trial of balapiravir, a polymerase inhibitor, in adult dengue patients. J Infect Dis 207(9): 1442-1450.

30. de Melo KC (2019) Personalized Medicine for Dengue: Unraveling the Variables That Interact to Develop an Effective Treatment. Frontiers in Immunology.

31. World Health Organization (2009) Dengue Guidelines for Diagnosis, Treatment, Prevention, and Control.

32. Shah J (2017) Personalized Medicine in Developing Countries: Possibilities and Challenges. Journal of Pharmacogenomics & Pharmacoproteomics.

33. Puhan MA (2020) Supporting Health Decision Makers with Innovative Knowledge Translation Tools: A Needs Assessment of Canadian Health Systems. Journal of Biomedical Informatics.

34. Thierfelder C (2021) Dengue Fever: The Battle to Bring Down the Mosquito that Spreads it. BBC News.

35. Batra P (2018) Telemedicine and Its Applications in the Management of Dengue Fever: A Systematic Review. Tropical Medicine & International Health.

36. Malavige GN (2018) Biomarkers for Dengue Severity and Management. Journal of Clinical Virology.

37. Garg N (2021) Global Collaborative Efforts to Combat Dengue: Current Status and Future Directions. The Indian Journal of Medical Research.

38. Wang S (2020) Nanotechnology for Enhanced Diagnosis and Treatment of Infectious Diseases. European Journal of Nanomedicine.