Contribution ID: **172** Type: **Poster**

The Role of Long Non-Coding RNAs (lncRNAs) in Host-Pathogen Interactions.

Long non-coding RNAs (lncRNAs) have emerged as pivotal regulators in the intricate molecular dialogue between hosts and pathogens. Once dismissed as transcriptional noise, lncRNAs—transcripts longer than 200 nucleotides that do not encode proteins—are now recognized for their diverse roles in gene regulation, chromatin remodeling, and cellular signaling. In the context of host-pathogen interactions, lncRNAs orchestrate a wide array of immune responses, modulating both innate and adaptive immunity. They act as molecular scaffolds, decoys, guides, and sponges, influencing the expression of cytokines, chemokines, and other immune effectors. Recent research has illuminated how lncRNAs can either bolster host defenses or be co-opted by pathogens to facilitate their own survival and replication. Specific lncRNAs, such as NEAT1, lincRNA-Cox2, and Lethe, have been shown to regulate inflammatory pathways, cell survival, and the balance between immune activation and tolerance. The dynamic expression of lncRNAs during infection not only shapes the outcome of disease but also offers promising avenues for therapeutic intervention and biomarker discovery. Advances in high-throughput sequencing and single-cell technologies have accelerated our understanding of lncRNA functions, revealing their potential as both diagnostic tools and targets for novel antimicrobial therapies. This review synthesizes current knowledge on the fundamental biology of lncRNAs, their mechanisms of action in host-pathogen interactions, and the emerging therapeutic strategies targeting these versatile molecules. By unraveling the complex roles of lncRNAs, we gain deeper insights into the molecular arms race between hosts and pathogens, paving the way for innovative approaches to combat infectious diseases.

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Track Classification: Biological Sciences