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## Bacteria in HIV-AIDS

**Marjan Alibakhshi**  
Islamic Azad University, Iran

The bacteria that can be grown in the laboratory are only a small fraction of the total diversity that exists in nature. At all levels of bacterial phylogeny, uncultured clades that do not grow on standard media are playing critical roles in cycling carbon, nitrogen, and other elements, synthesizing novel natural products, and impacting the surrounding organisms and environment. While molecular techniques, such as metagenomics sequencing, can provide some information independent of our ability to culture these organisms, it is essentially impossible to learn new gene and pathway functions from pure sequence data. A true understanding of the physiology of these bacteria and their

roles in ecology, host health, and natural product production requires their cultivation in the laboratory. Recent advances in growing these species include coculture with other bacteria, recreating the environment in the laboratory, and combining these approaches with micro cultivation technology to increase throughput and access rare species. These studies are unravelling the molecular mechanisms of unculturability and are identifying growth factors that promote the growth of previously uncultivable organisms. This review summarizes the recent discoveries in this area and discusses the potential future of the field.

dorfamceo@gmail.com