S Afr Gen Pract. 2023;4(3):84-85
https://doi.org/10.36303/SAGP.0041

S Afr Gen Pract
ISSN 2706-9613 EISSN 2706-9621

GUEST EDITORIAL

Unravelling the complexities of the human microbiome: current trends in microbiome research for medical practitioners

Morné A Strydom

Department of Pharmacology, School of Medicine, University of Pretoria, South Africa
Corresponding author, email: *morne.strydom@up.ac.za*

Microbiome research has revolutionised our understanding of the intricate relationship between the human body and its resident microbial ecosystems. As medical doctors in clinical practice, staying informed about the current trends in microbiome research is crucial for providing evidence-based and personalised care to patients. This editorial aims to explore the recent advancements in microbiome research, including profiling techniques, the impact of microbiota dysbiosis on health and disease, therapeutic interventions, and the potential for personalised medicine. By embracing these trends, medical practitioners can enhance patient care and improve clinical outcomes.

Introduction

The human microbiome can be defined as a collection of dynamic microbial ecosystems that inhabit various internal and external parts of the body, where coevolution with its host plays a crucial role in health promotion.[1] It is currently a well-established research focus area and has become a topic of great scientific and public interest. A simple PubMed search revealed that 90% of our existing published knowledge base on the topic has emerged in the last decade, with 60% of all publications occurring in the last five years. It is apparent that the field of human microbiome research is a rapidly expanding subject of interest that should be noted. Innovations in DNA sequencing technologies and computerised analysis have led to the accurate identification of microbial populations, yielding unparalleled insights into their involvement in human health and disease. By acknowledging these developments, medical practitioners may be able to capitalise on the potential of microbiome research in providing evidence-based and personalised care to patients. Recent trends in microbiome research will be highlighted in this editorial, with a focus on its value to medical practitioners.

Profiling techniques: illuminating the microbial universe

Profiling techniques have advanced significantly in the field of microbiome research, allowing for the thorough investigation of microbial communities. High-throughput DNA sequencing and metagenomics have transformed our abilities to identify and quantify microbial taxa, revealing the composition and functional potential of the microbiome. Over 130 000 bacterial genomes have been sequenced in their entirety or nearly so, where over 20 000 metagenomic projects are publicly available.[1] Furthermore, single-cell sequencing and metabolomics have enabled the characterisation of individual bacteria and their metabolic processes. These profiling techniques may enable medical practitioners to get insights into their patients' microbial ecosystem, assisting in the knowledge of disease origin, progression, and therapeutic response.

Microbiome dysbiosis: implications for health and disease

Growing evidence indicates that microbiome dysbiosis plays a significant role in the pathogenesis of a broad spectrum of diseases, including gastrointestinal disorders, metabolic syndrome, neurodegenerative conditions, and mental health issues.[1] Dysregulation of microbial ecosystems can disturb immunological homeostasis, damage barrier functions, and affect host metabolism. Human microbiome quantity and diversity are influenced by both intrinsic and external influences. Intrinsic aspects include the nature of bodily environments, since the physiology of habitat locations encourages the growth of some bacteria.[1] Other fundamental elements that influence the composition of the microbiome include genetics, ethnicity, sex, and age. Once microbes have acclimatised to their environment, the human microbiome is generally stable and robust. In addition to intrinsic factors, extrinsic factors such as diet, life-style, medication, geographic location, climate, and seasonality, may induce changes in the microbial community over time.[1] As people get older, their capacity to digest food and absorb nutrients in the stomach changes, changing the composition of the gut microbiome. As older individuals' immunological activity declines, they become more susceptible to infections, altering the core microbiome. *Bifidobacterium* species are known to stimulate the immune system and metabolic processes, therefore a decrease in bifidobacteria may result in malnutrition and low systemic inflammatory status in older adults.[2] The role of microbiota in different body parts (digestive system, respiratory system, skin, urinary system, reproductive system) and their relationship with health and disease is well summarised by Aggarwal et al..[1] Knowledge of the associations between specific microbial taxa and disease states empowers medical practitioners to detect potential risk factors, predict disease outcomes, and adjust treatment plans accordingly. Recognising the intricate interplay between the microbiome and systemic diseases can facilitate a holistic approach to personalised and targeted patient care management.

Microbiome-based therapeutics: from theory to practice

The emergence of microbiome-based therapeutics presents exciting prospects for disease management. Faecal microbiota transplantation (FMT) is a procedure involving the transfer of faecal material from a healthy donor to a recipient by colonoscopy, enema or nasogastric tube.[3] It has demonstrated remarkable efficacy in recurrent *Clostridioides difficile* infection with a resolution rate of 85–90% and is highly recommended for both mild and severe cases.[4] FMT is also being explored for other conditions such as inflammatory bowel disease, metabolic diseases, obesity, cancer, malnutrition and autism spectrum diseases.[5] Various challenges of FMT must be explored and researched before it can be widely used in therapeutic settings. One of the most important aspects of FMT success is the identification of an acceptable donor. Although autologous FMT is expected to produce better compatibility, it is not always possible, necessitating the use of a stool donor. To ensure procedural safety, the donor's gut microbiota must be meticulously screened for potentially pathogenic species before FMT. The discovery of the SARS-CoV-2 virus in individual faecal samples has made this extremely relevant in the COVID-19 pandemic.[6] Additionally, targeted antimicrobial strategies, prebiotics, probiotics, postbiotics, and microbial-derived metabolites offer potential avenues for modulating the microbiome and promoting health. Medical practitioners should remain updated on these evolving therapeutic modalities and their applications in primary care settings. Collaboration with specialists in microbiome research can facilitate an integrative and multidisciplinary approach to patient care, such as the proposed biobank working group for South Africa.[7]

Personalised medicine: unleashing the potential of the microbiome

The concept of personalised medicine, tailoring treatments to an individual's unique characteristics, has gained a lot of attention in health care. The microbiome represents a vital component of personalised medicine, given its substantial interpersonal variation. Integrating microbiome profiling into routine clinical practice may enable medical practitioners to identify microbial signatures associated with treatment response, disease susceptibility, and adverse drug reactions. A holistic understanding of the microbiome as a highly modulable "fingerprint" allows for the development of rational, context-specific, and data-driven interventions such as personalised nutrition, precision probiotics, metabolite supplementation ("postbiotic" therapy), and directed pathobiont suppression modalities.[8] This information can guide therapeutic decisions, optimise treatment outcomes, and minimise potential harm. However, challenges such as standardisation, reproducibility, and data interpretation need to be addressed to effectively incorporate the microbiome into personalised medicine. Collaborative efforts among researchers, clinicians, and policy-makers are crucial in overcoming these challenges.

Conclusion

Microbiome research has transformed our understanding of the human body and its symbiotic relationship with microbial ecosystems. Medical practitioners, as frontline healthcare providers, should embrace the current trends in microbiome research to optimise patient care. Profiling techniques offer unique opportunities to explore the microbial universe, while the recognition of microbiome dysbiosis provides insights into disease pathogenesis. Microbiome-based therapeutics hold promise for disease management, and the integration of the microbiome into personalised medicine opens avenues for targeted treatments. By incorporating microbiome research into clinical practice, medical practitioners can enhance patient outcomes, contribute to scientific advancements, and pave the way for a new era of personalised health care.

ORCID

MA Strydom https://orcid.org/0000-0001-8144-4970

References

1. Aggarwal N, Kitano S, Puah GRY, et al. Microbiome and human health: current understanding, engineering, and enabling technologies. Chem Rev. 2023;123(1):31-72. https://doi.org/10.1021/acs.chemrev.2c00431.
2. Guigoz Y, Dore J, Schiffrin EJ. The inflammatory status of old age can be nurtured from the intestinal environment. Curr Opin Clin Nutr Metab Care. 2008;11:13-20. https://doi.org/10.1097/MCO.0b013e3282f2bfdf.
3. Goldenberg SD, Batra R, Beales I, et al. Comparison of different strategies for providing fecal microbiota transplantation to treat patients with recurrent *Clostridium difficile* infection in two English hospitals: a review. Infect Dis Ther. 2018;7(1):71-86. https://doi.org/10.1007/s40121-018-0189-y.
4. Cammarota G, Ianiro G, Tilg H, et al. European consensus conference on faecal microbiota transplantation in clinical practice. Gut. 2017;66:569. https://doi.org/10.1136/gutjnl-2016-313017.
5. Millan B, Laffin M, Madsen K. Fecal microbiota transplantation: beyond *Clostridium difficile*. Curr Infect Dis Rep. 2017;19(9):31. https://doi.org/10.1007/s11908-017-0586-5.
6. Park S-K, Lee C-W, Park D-I, et al. Detection of Sars-Cov-2 in fecal samples from patients with asymptomatic and mild Covid-19 in Korea. Clin Gastroenterol Hepatol. 2021;19:1387-94. https://doi.org/10.1016/j.cgh.2020.06.005.
7. Fredericks E, Hoosien E, Brink A. The case for stool banks in South Africa. S Afr Med J. 2019;109(8):546-7. https://doi.org/10.7196/SAMJ.2019.v109i8.14169.
8. Federici S, Kredo-Russo S, Valdes-Mas R, et al. Targeted suppression of human IBD-associated gut microbiota commensals by phage consortia for treatment of intestinal inflammation. Cell. 2022;185(16):2879-98.e24. https://doi.org/10.1016/j.cell.2022.07.003.