

By understanding the human microbiome and its influencing factors, oncology nurses in clinical practice can educate, screen, and monitor patients with cancer who have a higher risk of gut microbiome dysbiosis. Knowledge of the gut microbiome and its impact on cancer outcomes can help oncology nurses interpret associations between the gut microbiome and treatment-related toxicities and symptoms. Oncology nurses can guide patients to build a healthy gut microbiome across the trajectory of cancer treatment and survivorship.

#### AT A GLANCE

- Chemotherapy and radiation therapy can influence the composition of the gut microbiome and lead to decreases in healthy gut microorganisms and increases in pathologic microbes.
- Decreases in the diversity and abundance of healthy microbial communities are associated with gastrointestinal symptoms and psychoneurologic toxicities.
- Oncology nurses can help patients maintain a healthy gut microbiome through following a healthy diet and lifestyle and taking appropriate prebiotics or probiotics.

#### KEYWORDS

gut microbiome; microbiome dysbiosis; psychoneurologic toxicities; cancer treatment

#### DIGITAL OBJECT IDENTIFIER

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# Human Microbiome

## Understanding the role of the gut microbiome and implications for oncology nursing care

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The human microbiome is defined as a collection of the microorganisms (e.g., bacteria, archaea, eukaryotes, viruses) and their genomes harbored in or on the human body (Marchesi & Ravel, 2015). The diversity and composition of the human microbiome varies across different body sites. For example, the gastrointestinal tract is primarily dominated by anaerobic microbes, which are critically associated with food digestion and metabolism, as well as with maintaining homeostasis of the immune system. A healthy vagina is comparatively acidic with the dominance of *Lactobacillus* species to prevent yeast infections, sexually transmitted infections, and urinary tract infections. In addition, the skin has the most variable and least stable microbiome, owing to constant exposure to various conditions, including humidity, salinity, and temperature (Kennedy & Chang, 2020).

The human microbiome is a complex entity. Figure 1 provides key definitions of terms used throughout this article. Compared to other body sites, the microbiome in the gut has been studied extensively among patients with cancer. The human gut hosts an average of 500 to 1,000 microbial species (Knight & Buhler, 2015). A dysbiotic gut microbiome (loss of keystone taxa, loss of diversity, shifts in metabolic capacity, or increase of pathogens) is associated with carcinogenesis and interference with therapeutic drug metabolism, such as chemotherapy (Roy & Trinchieri, 2017).

Dysbiotic gut microbiome has been identified as a promising biomarker of toxicities associated with cancer treatment (Bai et al., 2020; Toucheffeu et al., 2014). Specifically, a disturbed gut microbiome potentially contributes to frequent gastrointestinal symptoms (Toucheffeu et al., 2014) and psychoneurologic symptoms (Bai et al., 2020; Song & Bai, 2021).

#### Influencing Factors of the Gut Microbiome

Various factors can affect the diversity and composition of the gut microbiome. More than 20% of microbiota variability is shaped by environmental factors, such as the use of antibiotics, the living environment, and anthropometric measurements (e.g., height, weight, body mass index), whereas family factors (e.g., genetics, heredity, ethnicity, culture) explain only 2% of taxa variance (Rothschild et al., 2018). The priority effects (i.e., the order and timing of gut microbiota arrival) and microbial transmission (e.g., infant delivery and feeding modalities) can determine microbial development in early life (Sprockett et al., 2018).

Both the Human Microbiome and the American Gut projects have identified a series of individual factors that change the gut microbiome, including sociodemographic characteristics (e.g., sex, age, race), health behaviors (e.g., tobacco, alcohol, diet, physical activity) (Singh et al., 2017), and chronic conditions (e.g., diabetes, Crohn disease, obesity, autoimmune disease). In addition, the gut microbiome has been explored in various cancers