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Your Power to Heal

Microbe of the month

Breaking The Chain of Infection

JUNE 2024 NEWSLETTER

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FEATURED THIS MONTH:

The Human MICROBIOME

4 key aspects affecting immune health and wellbeing

10-minute read + QUIZ

Hello readers!

Microbe of the Month aims to provide a concise clinical resource, to help you keep up to date about pathogens of importance, in an easy-to-read and understand format.

The concept of the human microbiome was first suggested by Joshua Lederberg in 2001, who coined this term to describe *'the ecological community of commensal, symbiotic, and pathogenic microorganisms that share our body space'*.

It is common knowledge that the human body is inhabited by at least 10 times more bacteria than the number of human cells in the body, and that the majority of those bacteria are found in the human gastrointestinal tract. Interestingly, most microbiological studies have focused on the *disease-causing organisms* found on or inside people; but fewer studies have examined the benefits of our resident bacteria also referred to as 'endogenous' or 'commensal' flora.[1]

There is a quick quiz at the end of the newsletter to test your grasp of the content – please use this newsletter as a teaching tool in your workplace and start an 'infectious dialogue' about topical issues in infection control!

What is the microbiome?

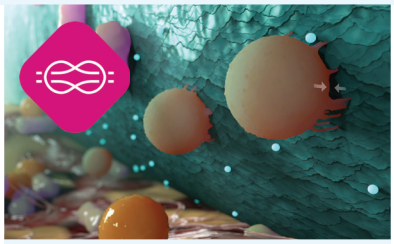
The microbiome comprises the genetic material of all the bacteria, fungi and viruses that live on and inside the human body. This genetic material is 200 times the number of genes in the human genome; and the microbiome is estimated to weigh as much as five pounds!

The gastrointestinal tract comprises the largest and most complex population of microorganisms, as well as the largest mass of lymphoid tissue – the first line of immune defence of the intestinal mucosa. The ***microbiota*** (plural) present at different body sites influence numerous biological functions important for maintaining health and immune function, while disruption of the composition and function of our gut flora (referred to as ***dysbiosis***) can contribute to disease development.[2,3]

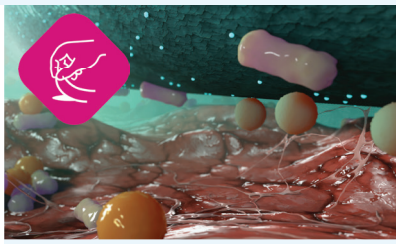
Key terms: *beneficial colonisers, microbiome, genome, microbial inheritance,microbiota dysbiosis, faecal transplantation, autoimmune and metabolic disease, obesity.*

Sorbact® Technology Mode of Action

Bind:
Bacteria naturally bind and anchor to the unique Sorbact surface.



Inhibit:
Bacteria are irreversibly bound, and growth is inhibited. Development of bacterial or fungal resistance is not expected.



Remove:
Bound bacteria, fungi and endotoxins are removed.

WHAT DOES THE MICROBIOME HAVE TO DO WITH HEALTH AND DISEASE? [2,3]

The study of the microbiome is a rapidly evolving area of interest, especially for us to understand the microbial makeup of a healthy individual. ***To date, our insights have revealed that the interaction between the types of microbes, microbial genes and their human host is far reaching.*** Researchers mapping the human microbiome are discovering previously uncharted species and genes. Genetic studies measuring the relative abundance of different species in the human microbiome have linked various combinations of microbial species to certain human health conditions.

The microbiome is essential for human development, immunity, and nutrition.

The bacteria living on and inside us are not invaders but beneficial colonizers. Autoimmune diseases such as diabetes, rheumatoid arthritis, muscular dystrophy, multiple sclerosis, and fibromyalgia are associated with dysfunction in the microbiome.

The **International Human Microbiome Consortium** (IHMC) was formed in 2005 – to investigate and better understand how microbes influence human health and disease. In 2008, the **National Human Genome Project** (part of the US National Institutes of Health) joined the IHMC global project to examine the normal microbial composition at 4 different body sites:

- **the skin**
- **the mouth**
- **the gastrointestinal tract**
- **the vagina**

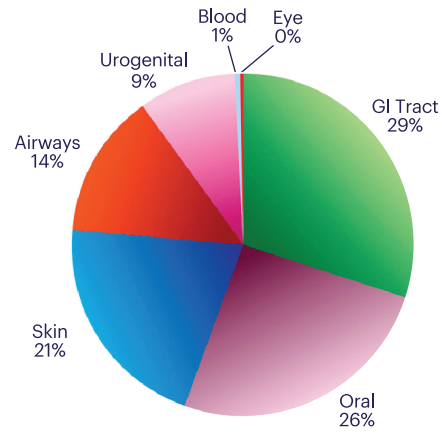


Figure 1. ***Bacterial distribution by body site.***[1]

DID YOU KNOW?

The bacteria in the gut microbiome help to digest our food, regulate our immune system, and protect against other bacteria that cause disease.

They also produce vitamins B12, thiamine and riboflavin, and vitamin K, which is needed for blood clotting. [2,3]

These are some of the questions the Human Genome Project researchers are investigating: [2]

- How is a specific microbiome established in an individual?
- How do antibiotics affect the microbiome?
- How does the microbiome influence immunity and contribute to disease?
- Can the microbiome be altered to improve health?

1 DO BABIES BORN BY CAESAREAN SECTION STILL RECEIVE ESSENTIAL MICROBES FROM THEIR MOTHER? [4]

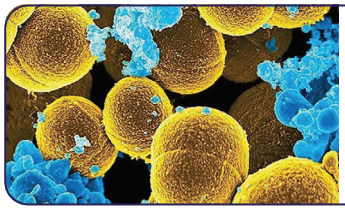
The establishment of gut microbiota has been proven to be impacted by several factors during pregnancy, delivery, and neonatal periods. For a long time, caesarean section birth has been associated with certain health-related outcomes - for example, obesity, Type-1 diabetes, and allergies.

It is now known that maternal 'microbial inheritance' is quite different in babies born vaginally than by caesarean section (LSCS), so do LSCS babies miss out on this vertical mother-to-infant transmission of microbes?

A recent study has investigated early life microbiota development over the first 30 days of life, to assess how the infant microbiome develops in distinct parts of their bodies and how this is influenced by factors such as birth mode, antibiotic use, and lack of breast feeding. Babies are considered to be sterile before birth, so bacterial samples were collected from 6 maternal sites (skin, nasopharynx, saliva, breastmilk, vagina, and faeces) and 4 infant sites (skin, nasopharynx, saliva, and faeces).

A total of **2453** samples from **120** mother-infant pairs was collected and analysed. The investigators determined that approximately 60% of an infant's microbiome is acquired from the mother, irrespective of the birth route - however different maternal sites contributed to differences in the infants' microbiomes (i.e., LSCS babies received fewer microbes from their mother's vaginal and faecal flora, but this was later compensated for by receiving more microbes via breastmilk).

Therefore, breastfeeding appears to be even more important for children born by LSCS, who do not receive vaginal and gut flora from their mother. [4]



2 PROBIOTIC THERAPY MAY PREVENT COLONISATION WITH *Staphylococcus aureus*

Antibiotic-resistant bacteria are a major public health threat - one of the most common and devastating being *Staphylococcus aureus* which is associated with potentially fatal blood stream, lung, bone, and skin/ wound infections. However, *S. aureus* is also a harmless commensal (resident) organism in the nose, oropharynx, on the skin, or in the gut of approximately 30% of the human population; and most *S. aureus* infections begin as symptom-free colonization. **Decolonization** (eliminating certain colonisers) **could prevent the development of *S. aureus* infections.**

Commonly used decolonization strategies include topical antibiotics (Mupirocin) or antiseptics (chlorhexidine gluconate) to get rid of *S. aureus* from the nose or skin; however, these have had limited success, because they don't affect *S. aureus* in the gut. Decolonizing the gut would require oral antibiotics - but this would harm beneficial gut microbes and increase the risk of antibiotic resistance. A recent clinical trial [5] screened more than 600 people and found that 115 were colonised with *S. aureus* in their gut, nose, or both sites. Study participants were assigned at random to take either a ***Bacillus subtilis* probiotic** or placebo (orally) daily for four weeks.

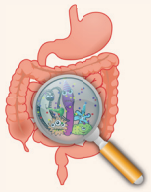
After four weeks of probiotic treatment, *S. aureus* in the stool declined by 97% and in the nose by 65% - and importantly, no other changes in microbiome composition were observed. In those receiving the placebo treatment, *S. aureus* numbers did not change in either the gut or nose. [5]

Note: the probiotic used did not 'kill' *S. aureus*, but its presence diminished the capacity of *S. aureus* to colonize the individuals. **Such a strategy could help lower healthcare associated infection (HAI) rates in high-risk settings such as hospitals and long-term care nursing homes.** [5]

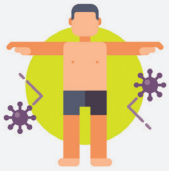
3 THE EFFECTS OF ANTIBIOTICS ON THE GUT MICROBIOME

The human microbiome is overly exposed to antibiotics given their use in everyday medicine, but also in crop and livestock farming. The composition of the human microbiome is rapidly altered by exposure to antibiotics, with potentially immediate effects on health - for example, through **the selection of resistant opportunistic pathogens** - which increases the risk of secondary infections, whilst the gut provides a significant reservoir for antibiotic resistance.
Broad spectrum antibiotic therapy can affect 30% of the gut community, causing a rapid and significant drop in species diversity.

Once antibiotic treatment has stopped, the microbiota may demonstrate a degree of resilience and microbiome regrowth; however, **antibiotic-induced dysbiosis can persist for prolonged periods, spanning months or even years.** [6,7]



Faecal microbiota transplantation (FMT) is a clinical procedure that replaces and restores healthy bacteria to the colon by introducing stool via enema or colonoscopy from a healthy human donor.
FMT provides a therapeutic benefit in patients with recurrent *Clostridioides difficile* (aka 'C. diff'.) infection, inflammatory bowel disease (IBD) and irritable bowel syndrome (IBS). [2,3,8,9]



4 THE IMPACT OF ANTIBIOTICS ON METABOLIC HEALTH AND AUTOIMMUNE DISEASES

Intestinal microbes consume non-digestible carbohydrates to produce short-chain-fatty-acids (SCFAs) which are used by the protective epithelial cells of the colon or transported across the gut epithelium into the bloodstream. SCFA's are major players in the maintenance of gut physiology and integrity, promote immune and metabolic homeostasis and have important anti-inflammatory and anti-tumour effects.

Alterations to the microbiota caused by antibiotics - beyond Increasing the immediate risk of infection – has far-reaching and long-term repercussions. Atopic, inflammatory, and autoimmune diseases (e.g., eczema, Crohn's disease, ulcerative colitis, systemic lupus erythematosus (SLE), rheumatoid arthritis, and inflammatory bowel disease) have been linked to gut microbiota dysbiosis, and significant associations have also been established between these diseases and the intake of antibiotics in early infancy and childhood. [1,2]

The diabetes and obesity connection: bacteria living in the digestive tract have been linked to obesity and inflammation – both contributors to type 2 diabetes mellitus. Antibiotics have also recently been implicated in increasing the risk for type 1 diabetes, an autoimmune disease whose incidence has been increasing steadily in industrialized countries. **Abnormal sugar metabolism has been seen in patients treated with β-lactam antibiotics** (e.g., penicillin derivatives, cephalosporins, monobactams, and carbapenems), **macrolides** (e.g., erythromycin) **and quinolones** (e.g., ciprofloxacin) **similar to that observed in obese individuals.** [6,8,9]

DID YOU KNOW?

The gut microbiome is different between obese and lean twins!
It has been found that obese twins have a **lower diversity of gut bacteria**, and higher levels of digestive enzymes – which seems to indicate that obese twins are more efficient at digesting food and harvesting calories. Obesity has also been associated with a specific combination of microbes in the gut. [2]

THE BOTTOM LINE...[2,3,5,6,7]

- The microbiome is essential for normal human development, immunity, and nutrition.
- The resident bacteria living on and inside us are not invaders but beneficial colonizers.
- The composition of the human microbiome is rapidly altered by exposure to antibiotics, with potentially disastrous effects on health - for example, through the selection of resistant opportunistic pathogens and providing a reservoir for antibiotic resistance.
- Autoimmune diseases such as diabetes, rheumatoid arthritis, muscular dystrophy, multiple sclerosis, and fibromyalgia are associated with dysbiosis of the microbiome.
- A more complete understanding of the diversity of microbes in the human microbiome could lead to new therapies.

Supply the correct answer!

1. The microbiome is essential for normal human development, nutrition and_____.
2. Obesity and some autoimmune diseases are associated with _____ from antibiotic exposure in infancy.
3. Differences in the microbiota of babies delivered by caesarean section compared with those delivered vaginally is compensated for by _____.
4. Faecal transplants provide a therapeutic benefit for patients with recurrent _____ infection by replacing and restoring healthy bacteria to the colon.
5. Broad spectrum antibiotic therapy can cause a rapid and significant drop in species diversity and increase the risk of the gut providing a _____ for drug resistant pathogens.

ANSWERS: **1.** *Immunity* **2.** *Dysbiosis* **3.** *Breastfeeding* **4.** *Clostridioides difficile (C. diff)* **5.** *Reservoir*

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- Up to 57% cost reduction of SSI when treating caesarean sections, using NHS cost model[2]
- Effective reduction of the bacterial burden in critically colonised or locally infected wounds[3]

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Effectively prevents and treats wound infection[1,2]

- Sorbact® technology dressings reduce the bioburden in wounds.[3]
- Effective against the Top 5 WHO (World Health Organisation) pathogens, as shown in vitro.[4]
- Can be used during the entire wound healing process.[2]

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Sorbact® Technology dressings can form a valuable part of your Antimicrobial Stewardship strategy[1]

Antimicrobial resistance is a heavy burden and optimal wound management is key in fighting it. Dedicated to improving wellbeing through leading hygiene and health solutions, Essity supports the Antimicrobial Stewardship initiative.

- **Sorbact® Technology dressings reduce the bioburden in wounds[2]**
- **Effective against the WHO's top 5 pathogens, as shown in-vitro[3]**
- **Using Cutimed® Sorbact® for acute and hard-to-heal wounds supports Antimicrobial Stewardship (AMS)[1] as part of a multi-modal approach, in line with the Best Practice Statement for AMS Strategies[4]**

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