Probiotics: Making a comeback
A.K. Sharma, P. Mohan, B.B. Nayak

ABSTRACT
Probiotics are nonpathogenic microbes used to confer health benefits to the recipient. The derangement of normal body flora has been held responsible for causation of various disorders. Probiotics have been tried in a number of infective and noninfective disorders and found useful, primarily because of their ability to supplement the normal body flora. Their use offers various advantages over-existing antimicrobial agents in being relatively cheap and safe. However, there are few reports of systemic fungemia associated with their use especially, in immunocompromised and severely debilitated patients. They also carry a risk of transferring resistance to other microbes including pathogens. In conclusion, more studies are required to establish their definite place in therapeutics.

KEY WORDS: Bifidobacterium, Lactobacilli, microflora, Saccharomyces.

Introduction
Introduction of antibiotics brought revolution in the treatment of infectious diseases. The dramatic results of chemotherapy lead to an enhanced interest and funding in this field and its rapid development.

However, the use of antimicrobial therapy is associated with the risk of increased incidence of drug resistance and opportunistic infections,[1] which can be avoided if the use of the antimicrobial agents can be minimized. One of the contributory factors for acquiring the infections is the decrease in the normal microflora at various sites in the body.

The nonpathogenic, micro-organisms or microbial mixtures may be used to improve microbial balance and to confer health benefits to the recipient. The microbes used for this purpose are called probiotics. (The term ‘probiotic’ in Greek means ‘for life’.)

History
Benefits of using fermented milk products and poultices of mould breads have been known since long. However, nobel laureate Elie Metchnikoff gave the first account of practice of probiotic therapy via fermented milk products in 1907.[2] Application of this therapy to urogenital infections dates back at least to 1915.[3]

However, due to increased interest in antibiotics, only few studies were done on probiotics in the intertwining period of 7-8 decades, and this field was labelled as ‘alternative medicine’.

There is a recent resurgence of interest in probiotics due to consumer demand for better therapies and problems like drug resistance and opportunistic infections.

Prerequisites of probiotic
A microbe may be used as a probiotic if it has been scientifically demonstrated to be having beneficial physiological effects and safety. It should preferably be nonpathogenic, of human origin, stable in acid and bile and be able to adhere to human mucosa[4] also should retain viability during storage and use.[5]

Probiotics as therapeutic tools
Probiotics are under study for a variety of pathophysiological states. Their status in various conditions, where they have the potential to establish their place more firmly, are discussed below.

Urogenital infections
Incidence of nonsexually transmitted urogenital infections, including urinary tract infections (UTI), bacterial vaginosis (BV) and vaginal candidiasis, is estimated to be quite high (around 1 billion per year) around the world.[6] The ready availability and efficacy of antimicrobials has limited the attention paid to probiotics for UTI and BV. However, probiotics have been found to have a definitive role in the management of these diseases especially in recurrent and chronic cases.

Prevention of UTI
A number of clinical studies with Lactobacilli have shown encouraging results in preventing the recurrence of UTI.

Intra-vaginal insertion and perineal implantation of Lactobacilli GR1 strain twice weekly in patients suffering from recurrent UTI have been shown to result in infection free periods ranging from 4 weeks to 6 months.[7]
In another randomized double blind study conducted in 55 women taking *Lactobacillus* GR-1 and B-54 strains weekly/twice weekly by vaginal insertion, the mean incidence of UTI was reduced by 79%.[11]

Reid and Bruce also demonstrated that the administration of *Lactobacilli* as vaginal suppositories after treatment with antimicrobial agents reduced the recurrence rate to 21% as compared to 47% seen in control group.[8]

The above reports confirm the usefulness of probiotics in UTI but the number of studies is limited and more work needs to be done to establish their role.

**Prevention of bacterial vaginosis and candidal vaginal infections**

Majority of women, especially in the first part of their menstrual cycle, have transient abnormal pattern of vaginal flora resembling in some cases to bacterial vaginosis. In most of these cases, vaginal flora reverts back to normal pattern,[9] but if a probiotic may also be a natural means of correcting this abnormality and maintaining urogenital health.

Reid G et al demonstrated that daily oral administration of *L. rhamnosus* GR-1 and *L. fermentum* RC-14 improved vaginal flora and lowered yeast and coliform count.[10] On oral ingestion, these microbes pass through the gut and ascend from rectum to vagina and colonize there.[11]

In another comparative study, prophylaxis of recurrent candidal vaginitis and recurrent BV was studied between groups taking yogurt enriched with *H₂O₂* producing *Lactobacilli* and pasteurized yogurt. After one month of study, 25% women in enriched group had an episode of BV as compared to 50% in pasteurized yogurt group (p=0.04). However, reduction in percentage of women with candida positive cultures in both groups was same, indicating that perhaps nonviable yogurt cultures also have an anticondial effect.[12]

Hilton et al administered *Lactobacilli* for a longer period and studied the incidence of candidal vaginal infections. One group of patients consumed *H₂O₂* producing *Lactobacilli* and another group consumed no yogurt for 6 months and then both groups mutually crossed over. The number of candidal vaginal infections per patient was 0.36 in yogurt group and 2.54 during no yogurt period (p=0.001).[13]

Since only few strains of *Lactobacilli* have been shown to be effective in bacterial vaginosis and vaginal candidiasis, more studies are warranted before such an approach can be recommended for routine use.

**Treatment of bacterial vaginosis**

Bacterial vaginosis is effectively treated with metronidazole and clindamycin, but it is associated with adverse effects and frequent recurrences. A number of studies have shown that probiotics if taken with antimicrobials can reduce the risk of vulvo-vaginal perturbations.

Hillier et al. found that the incidence of vaginal infection in pregnant women was inversely related to the intravaginal presence of *H₂O₂* producing *Lactobacilli*.[14]

Neri et al. (1993) also demonstrated higher success rate of 28/32 in pregnant bacterial vaginosis patients taking *Lactobacilli* acidophilus yogurt two doses for 7 days as compared to 12/32 in placebo group.[13]

In spite of probiotics being useful in treating and preventing urogenital infections,[10] the lack of knowledge about them amongst physicians limits their use in day-to-day practice and retards their growth.[17]

**Diarrhea**

Diarrhea is a common gastrointestinal problem, especially in the developing world. It can result from multiple aetiologies. Probiotics have been shown to prevent and assist the recovery from many types of diarrheas.

**Infectious diarrheas**

In developing countries, incidence of infectious diarrhoea is very high due to poor sanitation and nutrition. The problem is best addressed by improving sanitation and nutrition but an inexpensive and effective probiotic also has a value.

Probiotics have been shown to reduce the incidence of diarrheal episodes and facilitate the recovery when used as an adjunct to oral rehydration therapy for acute diarrheas.

*Lactobacilli* GG, *Bifidobacterium* and *Streptococcus thermophilus* have been shown to reduce the incidence of diarrhea as compared to control groups.[18] [19] The use of *Bifidobacterium* and *Streptococcus thermophilus* also reduced rotavirus shedding.[19]

The recovery (in terms of reduction in duration of diarrhea) from acute diarrheas has been shown to be facilitated by *Lactobacilli* GG, *L. reuteri*, *L. casei* and *S. boulardii*. [20][23]

In AIDS-associated diarrhea, *S. boulardii* has been found to help resolution in 10 of 18 patients as opposed to 1 of 11 in placebo when administered for 1 week.[21] In another study, patients with HIV-related chronic diarrhea, Elmer et al. found it to be useful in 7 of 11 patients but in 2–4 weeks.[22]

The role of *E. faecium* SP68 in acute diarrhea cannot be ignored. It has been found to be effective in reducing diarrhea in adults after 1 week of treatment (0.6% in treatment group and 8.7% in placebo group, P=0.01).[24] however, it was not found to be useful in patients infected with V. cholerae /ETEC after 3 days treatment.[27]

**Antimicrobial agent associated diarrhea**

Diarrhea is one of the most common adverse effects of antibiotic therapy. The precise mechanism is not known; however, perturbation of normal intestinal flora leading to the following events seems to be responsible.

1. Decrease in short chain fatty acid produced by normal flora. These fatty acids are important for the nutrition of the enterocyte and for the absorption of water and electrolytes.[22][29]
2. Loss of carbohydrate digesting gut bacteria leading to osmotic diarrhea.[30]
3. Direct stimulation of gut motility: For instance, erythromycin acts as motilin agonist to produce diarrhea.[31]

The re-establishment of gut flora and cure of antimicrobial agent associated diarrhea (AMAAD) has been an area of interest since long. Anecdotal evidence indicates that consumption of commercial unpasteurized yogurt is helpful in AMAAD.

*Saccharomyces boulardii* has reduced the incidence of diarrhea in patients taking tetracyclines or β-lactam antibiotics to 4.5% as compared to 17.5% with placebo.[32]

*L. rhamnosus* GG taken as yogurt has been shown to have a beneficial effect in volunteers on erythromycin.

The group taking erythromycin and *L. rhamnosus* GG had diarrhea for 2 days instead of 8 days as seen in control group taking erythromycin and sterilized yogurt.[33]
Bifidobacterium longum in the form of fermented yogurt has also been found to be useful in reducing stool frequency and abdominal discomfort in a crossover study involving 10 volunteers receiving erythromycin. However, in volunteers taking clindamycin, B. longum in combination with Lactobacillus acidophilus was more effective than when given alone and in comparison to placebo and produced least derangement of intestinal microflora and lower incidence of gastrointestinal discomfort.

*E. faecium* is another strain having a beneficial role in AMAAD. Wunderlich et al. (1989) found *E. faecium* SF68 to reduce the incidence of antibiotic associated diarrhea from 27.2% in placebo group to 8.7% in treatment group.

**Cl. difficile associated diarrhea and colitis**

Cl. difficile associated disease (CDD) is almost always initiated by antimicrobial therapy. It consists of simple diarrhea that may progress to colitis, pseudomembranous colitis and toxic megacolon. Probiotics in various clinical studies have been found to have beneficial role in the management of CDD.

**Prevention of CDD**

In patients receiving antibiotic therapy, consumption of probiotic containing both *Lactobacilli* and *Bifidobacterium* has been associated with lower incidence of positivity for *Cl. difficile* associated toxins in stools.

**Treatment of CDD**

Metronidazole (first choice) and vancomycin (second choice, for cases resistant or not tolerating metronidazole or in whom it is contraindicated) are adequate treatment for the first episode of CDD. However, antibiotic treatment has a recurrence rate of about 20% in whom multiple recurrences are the rule. For prevention of recurrences, no simple treatment is uniformly effective, so probiotics are being tried to break the cycle of recurrence.

Saccharomyces boulardii when administered as 1 g/day for 4 weeks along with standard course of metronidazole or vancomycin in the treatment of CDD resulted in lower relative risk (RR) of recurrence than placebo group (RR 0.43; 95% confidence interval 0.20–0.97). The efficacy of *S. boulardii* was significant (recurrence rate 34.6%, compared with 64.7% on placebo; p=0.04) in patients with recurrent CDD, but not in patients with initial CDD (recurrence rate 19.3% compared with 24.2% on placebo; p=0.86).

In another study, to further refine a standard regimen of *S. boulardii* and vancomycin; a group of patients received vancomycin (2 g/day) for 10 days and then additional *S. boulardii* (1 g/day) for 28 days or placebo. A decrease in recurrence rate was observed in patients treated with vancomycin and *S. boulardii* (16.7%) compared with those who received vancomycin and placebo (50%; p=0.05).

*L. plantarum* 299v has also been found to reduce the recurrence of CDD but the number of patients studied is small.

Probiotics, at present, in spite of their documented beneficial effects in CDD, are not recommended for routine prophylactic use for want of larger studies.

**Traveler's diarrhea**

In contrast to AMAAD and CDD, traveler's diarrhea is caused by the introduction of pathogenic bacteria through food or water that overwhelm the protective effects of normal intestinal flora.

In a study conducted on 225 Americans, the group taking *L. rhamnosus* GG had a lower rate of diarrhea per day as compared to the placebo group (3.9% vs. 7.4%, respectively, p=0.05). Similar larger study conducted in travelers from Austria revealed that the group given lyophilized *S. boulardii* 1 g/day had diarrheal rate of 28.7% as compared to 39.1% in placebo group (p=0.02).

Study conducted in travelers from Turkey also demonstrated that *Lactobacilli* GG use reduced the incidence of diarrhea to 41% as compared to 46.5% in placebo group with overall protection rate of 11.8%.

**Lactose malabsorption associated diarrhea**

Enterocyte lactase activity declines throughout childhood, hence 90% of Africans, Asians and South American adults are totally lactase deficient. Consumption of dairy products in such individuals leads to signs and symptoms of lactose intolerance such as flatulence, bloating, loose motions and at times constipation.

The use of *S. thermophilus* and *Lactobacilli delbrueckii* as starter culture in yogurt has shown improvement in lactose digestion. The benefit is due to the presence of microbial β-galactosidase (lactase) in the bacteria.

In a number of studies, better lactose digestion and absorption and reduction in gastrointestinal symptoms have been demonstrated in subjects who consumed fresh yogurt (with live yogurt cultures) as compared to pasteurized product with heat killed bacteria.

Mode of action in urogenital infections and diarrheas

The beneficial effects of probiotics in UG infections and diarrheas have been ascribed to the manipulation of local flora composition. These changes can be achieved by the following mechanisms.

**Production of inhibitory substances:** Inhibitory substances such as organic acids, H₂O₂ and bacteriocins are produced which are harmful to pathogens. *L. rhamnosus* GG and *L. reuteri* have been found to produce inhibitory substances like microcin and reuterin, respectively. Vaginal flora prevents vaginal infections by creating unfavourable vaginal conditions for pathogens by producing H₂O₂ and fermenting glycoprotein to produce lactic acid and an acidic pH.

**Inhibition of pathogen attachment:** Competitive inhibition of bacterial attachment sites on epithelial surfaces is another mechanism. *L. acidophilus* has been shown to inhibit the attachment of *E. coli* to mucosal cells in pig ileum. There is no effect if *L. acidophilus* if given after attachment has already taken place.

**Competition for nutrients:** Probiotics also deplete nutrients, which are essential for the proliferation of pathogens. An example is the depletion of monosaccharides, which is essential for *Cl. difficile*.

**Stimulation of IgA:** *S. boulardii* has been found to stimulate secretory IgA in small intestine in rats. *L. rhamnosus* GG has been found to cause stimulation of local IgA secretion in human intestine in rotavirus infection.

**Trophic effects on intestinal mucosa:** *Bifidobacterium* and other probiotics have been shown to produce substances like...
butyrate, which stimulate the proliferation of normal epithelium and play role in maintaining mucosal barrier defences.\[31\]

Inhibition of action of microbial toxin: S. boulardii destroys Cl. difficile toxin A receptor in isolated rat ileum.\[53\]

**Helicobacter pylori infections**

Helicobacter pylori, which colonizes the stomach, is implicated in the aetiology of gastric ulcers and gastric cancer. Various preclinical studies shown that antibacterial substances produced by some Lactobacilli inhibit the growth, colonization and survival of this pathogen.\[56\]

Preliminary results in humans shown that milk fermented with Lactobacilli johnsonii strain can help to control H. pylori gastric infections, but cannot eradicate H. pylori.\[96\]

In some studies conducted on subjects positive for H. pylori, the incidence of side effects associated with anti-Helicobacter antibiotic therapy was less when administered with Lactobacilli GG\[57\] or Bacillus clausii \[58\] but one study failed to demonstrate any beneficial effect of probiotic use as a supplement to the classical triple therapy with antibiotics.\[59\] In lieu of above reports, more number of studies are required to clearly define the role of probiotics.

**Inflammatory bowel disease**

Inflammatory bowel disease (IBD) is a collective term used for ulcerative colitis (UC) and Crohn’s disease (CD). Traditional medication used in IBD includes 5-aminosalicylic acid (5-ASA) and corticosteroids. Corticosteroids are very effective in inducing remission in both UC and CD, but have no role in maintaining remission and are fraught with many unwanted effects.\[60,61\]

There is enough evidence that IBD is caused by an abnormal immune response to a luminal antigen and it appears that the antigens are probably commensal bacteria.\[61 - 64\] In experimental studies, it has been proved that different bacteria elicits different types of cytokine response. In Crohn’s disease, commensal E. coli strain stimulate the release of tumour necrosis factor-α (TNF-α) and interleukin-8 (IL-8) by inflamed mucosa. However, some lactobacilli strains including L. casei down regulate the spontaneous release of TNF-α by the inflamed tissue and also the inflammatory response induced by E. coli.\[62,63,66\] Therefore, it makes sense to either eliminate some bacteria with antibiotics or to alter the gut flora, in favour of more beneficial bacteria, by the use of probiotics and prebiotics. (Prebiotics are dietary substances usually nondigested carbohydrates that stimulate the growth and metabolism of protective commensal enteric bacteria.)

Clinical trials suggest that some probiotics can be beneficial in preventing the relapse of IBD. In ulcerative colitis, oral administration of viable E. coli strain Nissle 1917 has been found to be as effective as mesalazine (the standard therapy for the maintenance of remission) in maintaining remission.\[67,68\] The same probiotic also lowered the relapse rate (33% in test group vs 63% in placebo group) in cases of Crohn’s disease.\[69,70\]

Another probiotic, S. boulardii, when administered in patients with quiescent Crohn’s disease as adjuvant therapy with mesalazine, produced lower clinical relapse rate as compared to mesalazine alone.\[70\]

Although these initial studies show promising prospects in IBD patients, further research on mechanism of action is desired so as to optimize their use.

**Allergy**

Infants with atopic eczema or cow’s milk allergy have shown that probiotics can be a useful tool in the treatment of food allergy. In infants receiving extensively hydrolyzed whey formula with Lactobacilli GG or Bb12, there is significant improvement in the clinical score of atopic dermatitis and reduction in the markers of inflammation compared with placebo groups.\[71,72\]

Rosenfeldt et al. also confirmed that administration of L. rhamnosus and L. reuteri for 6 weeks in atopic children up to 13 years of age resulted in higher improvement rate of eczema (56% compared to 15% in placebo group).\[73\]

The antiallergic effects of probiotics are suggested to be mediated through the induction of regulatory T cells and counter regulation of Th1 cells,\[74\] reduced immunogenicity of potential allergens through modification of their structures\[75\] strengthening of mucus defenses (production of IgA), stabilization of gut mucosal barrier and down regulation of inflammatory responses.\[76\]

**Hypertension**

A large population in the world is estimated to have hypertension. Evidence exists to suggest that some decrease in blood pressure (BP) may result from consumption of certain Lactobacilli, or milk fermented with Lactobacilli.

Studies with human subjects are limited. However, in one placebo controlled trial, milk fermented with Lactobacilli helveticus and Saccharomyces cerevisiae, reduced systolic BP by 9.4 mmHg and 14.1 mmHg after 4 and 8 weeks, respectively, and diastolic BP by 6.9 mmHg after 8 weeks of consumption in known hypertensives.\[77\]

Attempts to identify the antihypertensive mechanism suggest that it may be due to a bacterial cell wall component or angiotensin-converting enzyme inhibiting peptides generated by probiotics.\[78\]

**Hypercholesterolemia**

Cholesterol is a component of cell membranes and nerve cells. It also acts as a precursor to certain hormones and vitamins. However, elevated levels of total blood cholesterol or other blood lipids are considered risk factors for developing coronary heart disease.

Although humans synthesize cholesterol, diet also plays a role in determining serum cholesterol levels. Probiotic have been evaluated for their effect on serum cholesterol levels. Consumption of yogurt containing E. faecium is effective in lowering LDL and total cholesterol.\[78,79\] In another study, probiotic consumption was also found to increase HDL and reduce the ratio of LDL to HDL from 3.24 to 2.48.\[80\]

Precise mechanism of this effect is not known. However, assimilation of cholesterol by bacterial cells, deconjugation of bile acids by bacterial acid hydrolases and inhibition of hepatic cholesterol synthesis are some of the proposed mechanisms.\[81\]
Kidney stones

High level of oxalate in the urine is a risk factor for the development of kidney stones. An intestinal microbe called *Oxalobacter formigenes* can degrade oxalate through the enzyme oxalyl-CoA decarboxylase and thus limits its absorption.

Patients with calcium oxalate stone have been shown to have lower rate of colonization with *Oxalobacter formigenes*. Among stone formers, absence of intestinal *Oxalobacter* correlates with higher oxalate concentration and increased risk of hyperoxaluria.[82]

In another study, *Bifidobacterium* breve was found to possess oxalate-degrading capabilities and hence has a potential to be used as a probiotic in oxalate stone diseases for prophylaxis against new stone formation.[83]

Cancer

Chemical exposure is a potential cause for high risk of cancer. Chemicals causing cancer (carcinogens) can be ingested or generated by the metabolic activity of microbes that harbor in the gastrointestinal system.

It has been hypothesized that probiotic might decrease the exposure to chemical carcinogens by (i) detoxifying ingested carcinogens, (ii) decreasing the population or metabolic activity of bacteria that may generate carcinogenic compounds, (iii) producing compounds that inhibit the growth of tumor cells, (iv) stimulating the immune system to defend against cancer cell proliferation or (v) producing metabolic products (e.g., butyrate) which improve programmed cell death (apoptosis).[56]

It has been demonstrated in various animal studies that supplementation with specific strains of *Lactobacilli* can prevent establishment, growth and metastasis of transplantable and chemically induced tumours.[84]

In humans also, the consumption of fermented dairy products containing *Lactobacilli* or *Bifidobacterium* has been found to have inverse relationship with incidence of breast and colon cancer.[85, 86]

As direct evidence in humans, the consumption of *L. casei* fermented milk has been shown to significantly reduce the recurrence of superficial bladder cancer.[87]

Growth and well-being

In an Indian study, involving 100 malnourished children, the use of 50 ml of fermented curd for 6 months produced higher weight gain (1.3 kg vs. 0.81 kg in controls), greater height (3.2 cm vs. 1.7 cm in placebo group), lower incidence of diarrhea (21 vs. 35 episodes in controls) and fever (30 vs. 44 episodes in placebo).[88]

In another study, administration of milk formulae supplemented with *Bifidobacterium lactis* and *Streptococcus thermophillus* reduced the incidence of colic and irritability in infants as compared to control group.[89]

These beneficial effects of probiotics may be attributed to their ability to prevent various pathological states common in children especially gastrointestinal infections and milk allergy.

Problems associated with probiotic use

Viability of probiotics

An important problem with the use of probiotics is the maintenance of their viability to produce beneficial effects to the consumer. The probiotics need to survive in several environments including processing treatments, storage conditions and human body conditions (especially gastric acidity and action of bile salts).

The ability to live through the stressful acidic conditions and bile solutions in human body vary among the strains of probiotic bacteria. Only those strains, which tolerate these adverse conditions better, should be preferred.

The viability of probiotics may also be improved by using a medium, nutrient and temperature, which supports their survival.

Viability of *Lactobacilli* has been enhanced by encapsulation in artificial sesame oil for storage and in simulated high gastric or bile salt condition as compared to free cells.[89]

Storage at 4°C temperature is reported to be a most important factor in keeping probiotic *Bifidobacterium* viable during 4-week storage time.[91]

The use of prebiotics like isomalto-oligosaccharides has been found to be associated with higher levels of probiotics like *Lactobaillus* and *Bifidobacterium* after 1 month storage.[92]

The issue of viability of probiotics from the stage of processing till it is used by the consumer to produce benefits still remains a fertile field for more research.[93]

Safety and tolerance

Fermented dairy products and cereals have been an integral part of food for centuries. The available probiotic microorganisms are also considered nonpathogenic, but these can be infective in a severely debilitated or immunosuppressed patient. To date, there have been only isolated reports linking probiotics with adverse effects. Some cases of liver abscess.[90] *Lactobacillilia* and *S. boulardii* fungemia[91-93] have been reported in such patients. On the other hand, *S. boulardii* has been used without complications to treat chronic diarrhea in AIDS patients.[24, 25]

Another reason of concern is the risk of transfer of resistance via probiotic agents as these agents have to be resistant to the antibiotics because they are to be used alongside. In fact, a study has demonstrated transfer of plasmid pAMβ1, from *L. reuteri* to *E. faecium* and from *E. faecium* to *E. faecalis* in mouse intestinal tract.[94]

In a long-term study, undertaken in children for 1 year, consumption of 10^8–10^9 CFU of *Lactobacilli* and *Bifidobacteria* daily did not only result in any adverse effect but also showed that probiotics taken over a long time improve gastrointestinal function and reduce the incidence of diaper rash.[95]

Conclusion

Probiotics are likely to emerge as alternative to conventional antimicrobial therapy, as they are relatively cheap and may have lower risk of resistance due to multifaceted mechanisms of action.
Studies have shown their beneficial effects in urogenital infections, diarrheal diseases, hypertension, oxalate renal stones, allergic disorders, cancer and in children as growth promoters. However, further studies are required to establish their place in the management of these conditions.

Some major limitations in establishing their role in the therapeutics may be lack of adequate knowledge about them among prescribers, and probably the preparations available over the counter contain nonviable organisms or strains that possess no antipathogenic activity.

In general, the published reports suggest that the risk of therapy with the available probiotics is small. However, the risk of transmission of resistance and apprehension about their use in immuno compromised patients remain as some of the issues that need further clarification.

References


41. Hilton E, Kolakowski P, Singer C, Smith M. Efficacy of Lactobacilli GG as a

---

GenXPharm

The newest e-group for the next generation pharmacologists

Have a problem with your study design?
Looking for particular references?
Need a special chemical?
Want to know which statistical test to use?
Whatever your problem may be - you are not alone
Come share your thoughts, views and ideas with young pharmacologists all over India
Get help, information and support from your peers

Join GenXPharm - the e-group with pizzaz

This forum is for postgraduate students and research scholars only

For further information please contact:

Dr. S. Manikandan
Department of Pharmacology, JIPMER, Pondicherry-605 006.
E-mail: manikandan001@yahoo.com