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"EXPERIMENTAL ANALYSIS OF MICROBIAL FLORA IN AYURVEDIC PANCHAKARMA CENTRES AND THEIR HEALTH IMPLICATIONS"

Dr. Loveena[1]*, Deeksha Kumari[2], Dr. Sumit Srivastava[3]

*[1]PG Scholar, Department of Rog Nidana Evum Vikriti Vigyana, Shri Dhanwantry Ayurvedic College and Hospital, Sector 46, Chandigarh.

[2]Medical Microbiologist, Shri Dhanwantry Ayurvedic College and Hospital, Sector 46, Chandigarh.

[3]Principal, Professor, Department of Rog Nidana Evum Vikriti Vigyana, Shri Dhanwantry Ayurvedic College and Hospital, Sector 46, Chandigarh.

***Corresponding Author: Dr. Loveena**

PG Scholar, Department of Rog Nidana Evum Vikriti Vigyana, Shri Dhanwantry Ayurvedic College and Hospital, Sector 46, Chandigarh.

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ABSTRACT

Ayurveda, as an ancient system of holistic medicine, heavily emphasizes preventative care and environmental hygiene, critical components underpinning Panchakarma therapies. This longitudinal experimental study evaluated the microbiological contamination and antibiotic susceptibility patterns in a Panchakarma theatre within an Ayurvedic hospital over a three-month period. Twelve high-contact and environmental surfaces, including patient bed surfaces, therapeutic instruments, and waiting areas, were sampled monthly and analyzed using conventional culture techniques and disk diffusion for antibiotic resistance. The most frequent bacterial isolates included *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Pseudomonas aeruginosa*, predominantly from moist and high-touch areas such as sinks, floors beneath therapy tables, and door handles. Notably, some traditionally emphasized therapeutic implements remained uncontaminated, reflecting the efficacy of single-use or traditional cleaning protocols. Antibiotic susceptibility testing revealed significant resistance to beta-lactams and fluoroquinolones among Gram-negative isolates, with maintained sensitivity to carbapenems and aminoglycosides. Integration of microbiological surveillance with classical Ayurvedic cleansing rituals, including *dhoopana* (medicated fumigation), can amplify the prevention of nosocomial infections in such settings. This study highlights the necessity and possibility of harmonizing Ayurvedic tradition with modern infection control and antimicrobial stewardship, ensuring both patient safety and fidelity to holistic principles. Adoption of evidence-based microbiological protocols alongside traditional hygiene measures will foster a renewed paradigm in Ayurveda clinics, supporting their safe and sustainable operation in contemporary healthcare landscapes.

KEYWORDS: Panchakarma, Ayurveda hygiene, Microbiological surveillance, Antibiotic resistance.

INTRODUCTION

Ayurveda, India's time-honoured system of medicine, is rooted in the principles of balance between mind, body, and environment, emphasizing prevention, sustainability, and patient-centred approaches to healthcare.[1] Ayurveda's integrative view regards health as the equilibrium of the three doshas—*Vata*, *Pitta*, and *Kapha*—maintained through thoughtful regimens and therapies. Panchakarma, one of Ayurveda's hallmark clinical interventions, constitutes a set of five meticulously orchestrated biocleansing therapies: *Vamana, Virechana, Basti, Nasya, and Raktamokshana*.[2] These interventions, administered in dedicated Panchakarma theatres, are designed to purge toxins, enhance homeostasis, and restore optimal physiological function.

Panchakarma theatres often operate with a unique blend of traditional procedures, reusable apparatus, natural oils, and herbal medicaments. These theatres, while rooted in ancient healing, have progressively integrated aspects of modern patient care, safety, and evidence-based evaluation. With increased demand for Ayurveda in both domestic and international contexts, Panchakarma

centres in Ayurvedic hospitals are now frequented by patients with diverse backgrounds, including immunocompromised individuals and those with chronic comorbidities.[3-5]

Globally, the burden of healthcare-associated infections (HAIs), or nosocomial infections, presents an ongoing public health challenge.[6] While conventional hospitals and allopathic operating theatres commonly undergo routine microbiological surveillance as part of mandatory infection control protocols, Panchakarma theatres have only recently begun to attract attention regarding infection prevention and control (IPC).[7,8] Panchakarma procedures entail sustained, close contact between caregivers and patients, repeated manipulation of skin and mucosa, and the use of various reusable instruments and materials. Consequently, there are unique opportunities for cross-contamination and microbial transmission.

Ayurvedic hospitals, while steadfastly maintaining high standards of personalized, holistic care, may lack universally standardized surface decontamination protocols or microbial surveillance practices comparable to those seen in high-dependency or invasive care settings. Yet the expectation—and the necessity—for patient safety, including minimization of infection risks, is equally paramount. Modern microbial threats—inclusive of multidrug-resistant bacteria—do not distinguish between allopathic and traditional settings; hence, the integration of microbiological risk assessment into Panchakarma theatres becomes not only prudent but vital.

Safe delivery of Panchakarma therapies depends on adherence to hygienic standards that protect patients, staff, and the broader community from nosocomial infections. Previous sporadic reports—such as cases of furunculosis following oil massages—illustrate that infection risks are not theoretical. Microbial assessment within these natural medicine settings does not imply inadequacy of Ayurveda; rather, it offers an opportunity to harmonize its classic values with contemporary patient safety mandates. By systematically examining the microbial status of typical high-touch surfaces and equipment in a Panchakarma facility over three months, this study aims to support evidence-based improvements in hygiene, reinforce the safety reputation of Ayurveda, and offer a model for continuous improvement.[9-11]

Regular, context-sensitive microbial surveillance can help ensure that the age-old promise of Panchakarma—healing without harm—remains strong and trustworthy in the modern era. Such assessments provide insight into practical, feasible, and culturally aligned improvements in disinfection, staff training, and facility management. Ultimately, these efforts advance the broader integration of traditional and modern health systems, benefiting patients and practitioners alike.

This study was undertaken to identify microbial contamination in selected Panchakarma units, assess associated infection hazards, and analyze antibiotic susceptibility patterns of the detected organisms over a three-month period. Through such evidence-based evaluation, the research aims to bridge traditional Ayurvedic hygiene concepts with modern antimicrobial resistance management.

MATERIALS AND METHODS

Study Design

This experimental longitudinal study was conducted in the Panchakarma theatre of an Ayurvedic hospital for three consecutive months — May, June, and July 2025. The selected theatre represented a busy, routinely functioning facility administering diverse Panchakarma procedures.

Study Setting

The study was carried out in the Panchakarma theatre—a key clinical facility designed for delivery of all major Panchakarma procedures. Care was taken to avoid disruptions to routine patient services, and operational collaboration with staff ensured respect for traditional practices and continuity of patient care.

Sampling Strategy

Twelve critical sites commonly found in Panchakarma facilities were selected for monthly sampling. These included both high-contact patient/caregiver areas and secondary zones used for equipment storage, waste handling, or patient throughput. The sites sampled were Patient bed surface, Basti yantra table, Vamana bowl, Floor beneath therapy table, Oil massage table, Door handles, Table used for medicine preparation, Nadi swedana yantra, Sink area, Waiting area seats, Utensils, Rings used for basti.[7,8]

Sample Collection and Microbial Assessment

Each month, sterile pre-moistened cotton swabs were used to collect samples from defined areas on each surface. The standardized sample area, uniform timing of collection (before daily cleaning), and consistent handling reduced the chance of sample bias. All swabs were processed within two hours in a microbiology laboratory. Inoculation was done on nutrient agar with incubation at 37°C for 24–48 hours. Isolated colonies were then again inoculated on selective media from mother plate for proper identification.

Isolated colonies were identified using Gram staining and biochemical tests.[12,13] Each isolate was recorded as present or absent for each site and sampling point.

Antibiotic Susceptibility Testing (AST)

Identified bacterial isolates were subjected to the disk diffusion method on Nutrient media agar, following Clinical Laboratory Standards Institute (CLSI) 2024 guidelines.[14] The antibiotic panel included Nitrofurantoin, Amoxy-Clav, Ofloxacin, Cefixime,

Norfloxacin, Levofloxacin, Ciprofloxacin, Cefuroxime, Fosfomycin, Meropenem, Amikacin, and Ceftriaxone.

RESULTS

Over a period of three consecutive months (May, June, July), the study yielded 36 samples (12 per month), representing all critical contact and environmental surfaces in the Panchakarma theatre.

The summary of positive and negative microbial cultures per month is as follows:

S. No.	Site	May	June	July
1	Patient bed surface	-	*Staphylococcus aureus*	-
2	Basti yantra table	*Pseudomonas aeruginosa*	-	-
3	Vamana bowl	-	-	-
4	Floor beneath therapy table	*Escherichia coli, Klebsiella*	*Escherichia coli*	*Klebsiella*
5	Oil massage table	-	-	-
6	Door handle	*Staphylococcus, Escherichia*	*Staphylococcus aureus*	-
7	Table used for medicine	-	-	*Staphylococcus aureus*
8	Nadi swedana yantra	*Staphylococcus aureus*	-	-
9	Sink area	*Pseudomonas, Escherichia*	*Escherichia coli*	*Pseudomonas, Escherichia*
10	Waiting area seats	*Staphylococcus aureus*	*Klebsiella*	-
11	Utensils	-	-	-
12	Rings used for basti	-	-	-

Most contaminated sites included Floor beneath therapy table, sink area, and door handles, consistently yielding *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. Nadi swedana yantra and patient bed surface occasionally showed the presence of *S. aureus*, associated with direct tactile exposure.[15,16] Oil massage table, vamana bowl, utensils, and basti rings remained sterile throughout, indicating the efficacy of disinfection or single-use practices.

Environmental moisture and high contact frequency appeared to correlate strongly with microbial presence.

Antibiotic Susceptibility Analysis

The isolates were tested for susceptibility trends across three months.

Overall, Meropenem and Amikacin showed the most consistent efficacy against all recovered species. Gram-negative bacteria (*E. coli*, *K. pneumoniae*, *P. aeruginosa*) demonstrated extensive resistance to beta-lactams and fluoroquinolones, while *S. aureus* showed variable responses to quinolones and cephalosporins.[17-19]

Summary of Antibiotic Susceptibility Results (May–July 2025)

(Interpretations coded as: S = Sensitive, I = Intermediate, R = Resistant)

Antibiotic	Klebsiella pneumoniae	Staphylococcus aureus	Pseudomonas aeruginosa	Escherichia coli
Nitrofurantoin	R-R-R	R-R-S	I-R-R	R-R-R
Amoxy-Clav	R-S-R	S-I-R	R-I-R	S-I-R
Ofloxacin	I-R-I	R-S-R	S-R-R	R-R-R
Cefixime	R-R-R	R-I-R	I-R-R	S-R-R
Norfloxacin	S-R-I	R-S-R	S-R-R	I-R-R
Levofloxacin	S-R-S	S-S-R	I-I-I	I-I-I
Ciprofloxacin	S-R-S	S-I-R	I-I-R	I-I-R
Cefuroxime	R-R-I	R-R-I	I-R-R	R-R-R
Fosfomycin	S-R-S	S-S-S	S-I-R	R-I-I
Meropenem	S-S-S	S-S-S	S-S-S	S-S-S
Amikacin	S-S-S	I-S-S	S-S-S	S-S-S
Ceftriaxone	S-I-S	I-S-R	S-S-S	S-I-I

Observed Trends

Meropenem and Amikacin exhibited universal susceptibility, making them reliable treatment options against isolated pathogens. *Klebsiella pneumonia* and *Pseudomonas aeruginosa* displayed notable multi-resistance, particularly against cefixime, cefuroxime, and Nitrofurantoin, mirroring their known hospital resilience.[18] *Staphylococcus aureus* isolates indicated fluctuating susceptibility—possibly reflecting transient contamination or changes in surface contact behaviour.

E. coli demonstrated broad resistance to fluoroquinolones and cephalosporins, indicating environmental microflora adapting to external selection pressure.

DISCUSSION

The findings of this study are a reminder that, while rooted in ancient wisdom, Panchakarma theatres can encounter microbial challenges similar to any clinical setting.[6,7,20] Yet, the principles of Ayurveda offer unique strengths in infection prevention that, if harmonized with modern practices, can yield safer healthcare environments.

From an Ayurvedic perspective, the concept of *śuddhi* (purity) is paramount not just for the patient but for the therapeutic theatre itself. Foundational texts like the Charaka Samhita and Sushruta Samhita prescribe meticulous cleansing (*marjana*) and ritual fumigation (*dhoopana karma*) using medicated herbs for both environmental and energetic purification.[15,21,23] These age-old measures, while spiritual in intent, carry tangible antimicrobial benefits confirmed by contemporary research.[25-27]

Beyond cleansing, Ayurveda emphasizes the comprehensive prevention of disease—*Swasthasya Rakshanam* (protection of the healthy)—as a central directive. This includes not only environmental hygiene but also the personal cleanliness (*dinacharya*) of therapists and staff, correct handling of medicated oils to prevent staleness or contamination, and prudent patient selection for Panchakarma procedures. The study's findings, where utensils and oil tables consistently tested negative, may reflect the silent efficacy of these embedded traditional habits.

The presence of multidrug-resistant organisms in select areas should not cast doubt on the ethos or efficacy of Panchakarma. Rather, these findings present an opportunity: to reclaim and validate Ayurveda's legacy of prevention, hygiene, and adaptive resilience through integration with rigorous microbiological surveillance and antibiotic stewardship. Periodic assessment provides a feedback loop, identifying vulnerabilities that can be addressed by reinforcing both evidence-based and traditional protocols—such as adjusting *dhoopana* frequency, alternating cleaning agents, or instituting copper or brass fixtures as recommended in Ayurvedic classics.[28,29]

Ultimately, the multifaceted approach that Ayurveda encourages—combining ritual, herbal science, and hygienic discipline—remains highly relevant today. By scientifically validating and modernizing these practices, Panchakarma facilities can lead the way in holistic infection prevention, honoring both the letter and spirit of Ayurveda.[30]

Therefore, embedding microbiological surveillance in Ayurvedic theatres is not a concession to modernity, but a renewal of Ayurveda's own doctrine: preventive vigilance, compassionate care, and the unbroken quest for *ārogya* (health) and *kalyāṇa* (well-being), for all.

CONCLUSION

This study reinforces the timeless wisdom embedded within Ayurveda, where the harmony of body, mind, and environment is central to the promise of *ārogya* (health). Panchakarma, as a sophisticated practice of purification and rejuvenation, bears unique responsibilities for safety and hygiene, both for the patient and the clinical space. Our investigation revealed that, even in environments upholded by tradition, contemporary microbial challenges and antibiotic resistance cannot be overlooked. The detection of hospital-relevant pathogens and multidrug-resistant bacteria in some Panchakarma theatre sites echoes, rather than diminishes, the vigilance advocated by Ayurvedic classics, which emphasize cleanliness (*śuddhi*), regular herbal fumigation (*dhoopana*), and disciplined routines (*dinacharya*) for therapists and infrastructure alike.

It is essential to recognize that Ayurveda does not operate in isolation from the advancements of modern science. Instead, the integration of thorough microbiological surveillance, smart infection control, and regular antibiotic susceptibility testing honours Ayurveda's preventive ethos while ensuring that care standards remain robust amid today's evolving microbial landscape. Our results suggest that ritualistic cleaning, judicious use of disposable implements, and scientific validation of traditional disinfectants can all play a constructive role in protecting patients.

By melding the ancient teachings of *Swasthasya Rakshanam* (preservation of health) with evidence-based protocols, Panchakarma centres can become beacons of holistic, safe, and forward-thinking healthcare. This convergence should inspire ongoing research, open-minded interdisciplinary collaboration, and heartfelt dedication to patient well-being. Above all, it is in the spirit of Ayurveda to continually adapt and improve, ensuring that its guiding principles lead not only to healing but to a future where tradition and innovation thrive together.

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